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MIL-HDBK-704-1
9 April 2004

DEPARTMENT OF DEFENSE HANDBOOK

GUIDANCE FOR TEST PROCEDURES FOR DEMONSTRATION OF UTILIZATION EQUIPMENT COMPLIANCE TO AIRCRAFT ELECTRICAL POWER CHARACTERISTICS (PART 1 OF 8 PARTS)

Notations and comments made in this document are not official and are for reference only.

This Handbook is for guidance only.
Do not cite this document as a requirement.

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FOREWORD

1. This handbook is approved for use by all Departments and Agencies of the Department of Defense.

2. This handbook provides guidance on test procedures for demonstration of utilization equipment to determine compliance with the aircraft electrical power characteristics of MIL-STD-704.

3. MIL-HDBK-704-1 is Part 1 in a series of 8 Parts. Part 1 provides general guidance information on compliance tests, power groups, aircraft electrical operating conditions, and utilization equipment specifications. Parts 2 through Part 8 provide guidance on application of compliance tests for utilization equipment in specific power groups. These series of handbooks and MIL-STD-704 are companion documents.

4. Comments, suggestions, or questions on this document should be addressed to Commander, Naval Air Systems Command, Code 4.1.4, Highway 547, Lakehurst, NJ 08733-5100 or email to thomas.omara@navy.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil/

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1. SCOPE

1.1 Scope. This handbook provides guidance on test procedures for demonstration of utilization equipment to determine compliance with the aircraft electrical power characteristics of MIL-STD-704. This handbook is for guidance only and cannot be cited as a requirement.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed below are not necessarily all of the documents referenced herein, but are those needed to understand the information provided by this handbook.

2.2 Government documents.

2.2.1 Specifications, standards and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-704	DoD Interface Standard for Aircraft Electric Power Characteristics

(Copies of these documents are available at http://assist.daps.dla.mil/quicksearch/ or www.dodssp.daps.mil/or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

3. DEFINITIONS

3.1 Acronyms and definitions. The acronyms and definitions of MIL-STD-704 are applicable to this handbook.

4. GENERAL INFORMATION

4.1 Utilization equipment compliance testing. MIL-STD-704 states that equipment testing is required to demonstrate that utilization equipment is compatible with the electric power characteristics as defined in MIL-STD-704. MIL-STD-704 is the interface document that defines the aircraft electrical power characteristics at the input terminals to utilization equipment. The aircraft electrical system must provide power in accordance with MIL-STD-704 and the utilization equipment must perform as specified when provided input power in accordance with MIL-STD-704. MIL-HDBK-704-1 through MIL-HDBK-704-8 provide detail test methods for demonstrating compliance to MIL-STD-704. All previous editions of MIL-STD-704, which have been cited in aircraft platform or subsystem contracts, remain in effect. The applicable edition of MIL-STD-704 for utilization equipment compliance is the edition that is applicable to the aircraft platform or platform(s) in which the utilization equipment will be installed.

4.2 Compliance tests. Compliance tests are intended to give a reasonable assurance that the utilization equipment will perform as specified when installed in aircraft that are designed and built to the applicable edition of MIL-STD-704 without unduly burdening the development of utilization equipment. The compliance tests simulate the range of power characteristics that utilization equipment may experience during its life. The compliance test procedures cannot simulate exactly every power condition that may be experienced by the utilization equipment. The designer/manufacturer of utilization equipment must design and build the utilization equipment to be compatible with the power characteristics defined in the applicable edition(s) of MIL-STD-704 and should not design equipment solely based on the test procedures herein.

4.3 Utilization equipment power groups. There are seven utilization input power types defined by the different editions of MIL-STD-704. The MIL-STD-704 compliance tests are organized into power groups based on input electrical power type to utilization equipment. The power groups are:

a. Single Phase, 400 Hz, 115 Volt (AC)
b. Three Phase, 400 Hz, 115 Volt (AC)
c. Single Phase, Variable Frequency, 115 Volt (AC)
d. Three Phase, Variable Frequency, 115 Volt (AC)
e. Single Phase, 60 Hz, 115 Volt (AC)
f. Direct Current, 28 Volt (DC)
g. Direct Current, 270 Volt (DC)

The preferable input power type for utilization equipment differs for each aircraft platform. The selection of input power type for utilization must take into consideration the aircraft power types available on the intended aircraft platform and the capacity of the electrical system on the aircraft. All power types may not be available on an aircraft platform.

4.4 Aircraft electrical operating conditions. MIL-STD-704 defines six distinct aircraft electrical system operating conditions: (1) Normal Electrical Power, (2) Power Transfers, (3) Abnormal Electrical Power, (4) Emergency Electrical Power, (5) Engine Starting, and (6) Power Failure. The equipment performance specification must explicitly define the performance requirement of the utilization equipment for the six aircraft electrical operating conditions.

4.5 Utilization equipment performance specifications. Utilization equipment specifications should include utilization equipment performance level requirements when operating with electrical input power characteristics that fall within the six aircraft electrical operating conditions. The following are given as examples only and are not intended as recommended performance levels for utilization equipment. Performance levels for utilization equipment for the six aircraft electrical operating conditions should based on the criticality to flight safety, mission requirements, cost, weight, and reliability; and are unique to each utilization equipment. Current distortion and current spectrum limits may be imposed to minimize undesirable current distortion draw of utilization equipment and reduce the likelihood of the equipment having an adverse effect on the electrical power characteristics of the aircraft. These current distortion limits should take into account the utilization equipment power draw, aircraft electrical system capacity and distribution characteristics, trade-offs with weight, volume, cost, and reliability that are specific to each type of equipment and aircraft.

4.5.1 Examples of utilization equipment performance requirements.

a. Example 1: Flight Critical Computer and Flight Displays

(1) Performance level for normal aircraft electrical operating condition - The flight critical computer and flight displays shall provide 100 percent full performance during normal aircraft electrical operation. The flight critical computer shall provide all data signals. There shall be no interruption, corruptions, or data loss. Displays shall not flicker or become distorted. The flight critical computer and flight display shall not be damaged or cause an unsafe condition. The flight critical computer and flight display shall not cause the aircraft electrical power to degrade beyond the limits of the applicable edition(s) of MIL-STD-704. Total current distortion shall be less than 12 percent for steady state normal aircraft electrical operation.

(2) Performance level for power transfer aircraft electrical operating condition - The flight critical computer and flight displays shall provide 100 percent full performance before, during, and after power transfer. The flight critical computer and flight displays shall provide the same performance level for power transfer aircraft electrical operating conditions as for normal electrical operating conditions.

(3) Performance level for abnormal aircraft electrical operating condition - The flight critical computer and flight displays shall provide 100 percent full performance during abnormal electrical operation. The flight critical computer and flight displays shall provide the same performance level for abnormal aircraft electrical operating conditions as for normal electrical operating conditions.

(4) Performance level for emergency aircraft electrical operating condition - The flight critical computer and flight displays shall provide 100 percent full performance during emergency electrical operation. The flight critical computer and flight displays shall provide the same performance level for emergency aircraft electrical operating conditions as for normal electrical operating conditions.

(5) Performance level for starting aircraft electrical operating condition - The flight critical computer and flight displays shall provide 100 percent full performance during emergency electrical operation. The flight critical computer and flight displays shall provide the same performance level for starting aircraft electrical operating conditions as for normal electrical operating conditions.

(6) Performance level for power failure aircraft electrical operating condition - The flight critical computer and flight displays are allowed to shutdown for power failures greater than 50 milliseconds. For power failure less than seven seconds, the flight critical computer and flight displays shall automatically return to 100 percent full performance within one second after power is restored. There shall be no corruption, or data loss due to the power failure. The flight critical computer and flight display shall not be damaged or cause an unsafe condition.

b. Example 2: Mission Data Storage Device and Mission Displays

(1) Performance level for normal aircraft electrical operating condition - The mission data storage device and mission displays shall provide 100 percent full performance during normal aircraft electrical operation. The mission data storage device and mission displays shall provide all data signals. There shall be no interruption, corruptions, or data loss. Displays shall not flicker or become distorted. The mission data storage device and mission displays shall not be damaged or cause an unsafe condition. The mission data storage device and mission displays shall not cause the aircraft electrical power to degrade beyond the limits of the applicable edition(s) of MIL-STD-704. Total current distortion shall be less than 12 percent for steady state normal aircraft electrical operation.

(2) Performance level for power transfer aircraft electrical operating condition - The mission data storage device and mission displays may momentarily interrupt during power transfer. The mission data storage device and mission displays shall automatically return to 100 percent full performance within 5 seconds after the power returns to within normal limits. There shall be no corruption, or data loss. The mission data storage device and mission displays shall not be damaged or cause an unsafe condition due to the power transfer. The mission data storage device and mission displays shall not cause the aircraft electrical power to degrade beyond the limits of the applicable edition(s) of MIL-STD-704.

(3) Performance level for abnormal aircraft electrical operating condition - The mission data storage device and mission displays may momentarily interrupt during abnormal aircraft electrical operation. The mission data storage device and mission displays shall automatically return to normal operation within 5 seconds after the aircraft electrical system operation returns to normal. There shall be no corruption or data loss. Displays may flicker or become distorted, but must still be readable. The mission data storage device and mission displays shall not be damaged or cause an unsafe condition.

(4) Performance level for emergency aircraft electrical operating condition - The mission data storage device shall provide 100 percent full performance and the mission displays may provide degraded performance during emergency aircraft electrical operation. The mission displays shall automatically return to normal operation within 5 seconds when the aircraft electrical system operation returns to normal. There shall be no corruption or data loss. Displays may flicker or become distorted but must still be readable. The mission data storage device and mission displays shall not be damaged or cause an unsafe condition.

(5) Performance level for starting aircraft electrical operating condition - The mission data storage device and mission displays may momentarily interrupt during starting. The mission data storage device and mission displays shall automatically return to 100 percent full performance within 5 seconds after the power returns to within normal limits. There shall be no corruption, or data loss. The mission data storage device and mission displays shall not be damaged or cause an unsafe condition due to the starting operation.

(6) Performance level for power failure aircraft electrical operating condition - The mission data storage device and mission displays are allowed to shutdown for power failures

greater than 50 milliseconds. For power failure less than seven seconds, the mission data storage device and mission displays shall automatically reboot within 5 seconds and return to 100 percent full performance within 2 minutes after power is restored. There shall be no corruption, but data loss may occur due to the power failure. The mission data storage device and mission displays shall not be damaged or cause an unsafe condition.

c. Example 3: Circulation Fan

(1) Performance level for normal aircraft electrical operating condition - The circulation fan shall provide continuous operation during normal aircraft electrical operation. The circulation fan shall maintain airflow between the minimum and maximum limits during normal aircraft electrical operation. The circulation fan shall not be damaged or cause an unsafe condition.

(2) Performance level for power transfer aircraft electrical operating condition - The circulation fan may shut off during power transfer. The circulation fan shall automatically resume operation within 30 seconds after the transfer is complete and power is restored. The circulation fan shall not be damaged or cause an unsafe condition.

(3) Performance level for abnormal aircraft electrical operating condition - The circulation fan shall provide continuous operation during abnormal aircraft electrical operation. The circulation fan shall maintain airflow between 50 percent below normal minimum limits and 50 percent above the normal maximum limits during abnormal aircraft electrical operation. The circulation fan shall not be damaged or cause an unsafe condition.

(4) Performance level for emergency aircraft electrical operating condition - The circulation fan shall provide continuous operation during emergency aircraft electrical operation. The circulation fan shall maintain airflow between 50 percent below normal minimum limits and 50 percent above the normal maximum limits during emergency aircraft electrical operation. The circulation fan shall not be damaged or cause an unsafe condition.

(5) Performance level for starting aircraft electrical operating condition - The circulation fan may shut off during starting aircraft electrical operations. The circulation fan shall automatically resume operation within 30 seconds after the power reaches normal limits. The circulation fan shall not be damaged or cause an unsafe condition.

(6) Performance level for power failure aircraft electrical operating condition - The circulation fan is allowed to shutdown for power failures greater than 50 milliseconds. For power failure less than seven seconds, the circulation fan shall automatically resume operation within 30 seconds after the power is restored. The circulation fan shall not be damaged or cause an unsafe condition.

d. Example 4: Coffeepot

(1) Performance level for normal aircraft electrical operating condition - The coffeepot shall provide 100 percent performance during normal electrical operating conditions.

The coffeepot shall not be damaged or cause an unsafe condition. The coffeepot shall not cause the aircraft electrical power to degrade beyond the limits of the applicable edition(s) of MIL-STD-704. The current drawn by the coffeepot shall not have a total current distortion greater than 12 percent for steady state normal aircraft electrical operation.

(2) Performance level for power transfer aircraft electrical operating condition - The coffeepot may shut off during power transfer. The coffeepot is not required to automatically reset after the power transfer is complete. The coffeepot shall not be damaged or cause an unsafe condition.

(3) Performance level for abnormal aircraft electrical operating condition - The coffeepot may shutdown for abnormal aircraft electrical operating conditions. The coffeepot is not required to return to normal operation automatically when normal power is restored. The coffeepot shall not be damaged or cause an unsafe condition.

(4) Performance level for emergency aircraft electrical operating condition - The coffeepot may shutdown for emergency aircraft electrical operating conditions. The coffeepot is not required to return to normal operation automatically when normal power is restored. The coffeepot shall not be damaged or cause an unsafe condition

(5) Performance level for starting aircraft electrical operating condition - The coffeepot may shutdown for starting aircraft electrical operating conditions. The coffeepot is not required to return to normal operation automatically when normal power is restored.

(6) Performance level for power failure aircraft electrical operating condition - The coffeepot may shutdown for power failures. The coffeepot is not required to return to normal operation automatically when normal power is restored. The coffeepot shall not be damaged or cause an unsafe condition

4.6 Dual source utilization equipment. Special consideration must be taken when utilization equipment is dual sourced, especially for flight critical equipment. Fault conditions may momentarily disturb the electrical power of a battery bus until the battery bus can be isolated from the other systems. Ideally, the tests for compliance to MIL-STD-704 should involve the disconnecting of the backup system to perform testing on the primary system. The tests should then be repeated with the primary system disconnected with only the backup system connected. In cases where this is not possible or not permitted by the design of the equipment, the backup system for MIL-STD-704 test compliance should be representative of the aircraft electrical system performance. If, for example, the unit under test were connected to a transformer rectifier for its backup power, the DC backup power would experience some variation of power quality during AC input disturbances. The test setup should therefore simulate the simultaneous disturbance on both the AC and DC as it would be on the aircraft. Failure to tie the backup power to the dynamic system during testing would not reveal an accurate representation of the backup power during aircraft operations. Circumventing a systems approach to the test may not reflect the unit under test's true performance on actual aircraft.

4.7 Transformer rectifiers units. Transformer rectifiers units fall into a unique category that is both utilization equipment and source equipment. The transformer rectifier must provide DC output power that is in accordance with the appropriate edition of MIL-STD-704 when provided AC input power according to the applicable edition of MIL-STD-704. For example, allowing the coupling of AC input transients to the DC output that result in DC power outside of the applicable edition of MIL-STD-704 for a power group would be evaluated as a failure. The transformer rectifier unit should be supplying full rated load during MIL-STD-704 compliance testing.

4.8 Inverters. Inverters fall into a unique category that is both utilization equipment and source equipment. The inverter must provide AC output power that is in accordance with the appropriate edition of MIL-STD-704 when provided DC input power according to the applicable edition of MIL-STD-704. For example, allowing the coupling of DC input transients to the AC output that result in AC power outside of the applicable edition of MIL-STD-704 for a power group would be evaluated as a failure. The Inverter should be supplying full rated load during MIL-STD-704 compliance testing.

4.9 Compliance to aircraft electrical power characteristics demonstration test methods of MIL-HDBK-704-2 through -8. The MIL-HDBK-704-1 through -8 test methods are grouped by power type defined in the applicable editions of MIL-STD-704 and as listed in table I. For each power type, the test methods are further divided into the six aircraft electrical operating conditions as listed in table II. Utilization equipment performance levels may differ for each of the six aircraft electrical operating conditions and must be defined in the utilization equipment performance specification. The nomenclature for individual test method labeling is shown in table III. The Unit Under Test (UUT) must be subjected to all test methods for UUT's applicable power group as shown in tables IV through X. The UUT test method limits are defined by the applicable edition(s) of MIL-STD-704.

4.10 Stimulation and monitoring equipment. Demonstration test stimulation and monitoring equipment is required to confirm utilization equipment performance for the compliance to aircraft electrical power characteristics. Together the stimulation and monitoring equipment should definitively determine if the utilization equipment is performing to specified levels when the utilization equipment is provided with input power in accordance with the applicable edition(s) of MIL-STD-704 testing. This includes input power for the six aircraft electrical operating conditions of both steady state characteristics and transient characteristics.

4.10.1 Stimulation equipment. The stimulation equipment is unique to each utilization equipment and aircraft. Stimulation equipment is the equipment that will simulate all aircraft inputs and outputs other than the electrical input power. These may be analog signals, digital signals, relays, hydraulics, pneumatics, sensors, test patterns, test data, etc. The intent is to closely reproduce the inputs from other systems in the aircraft and the outputs to other systems in the aircraft. Care must be taken to ensure that the stimulation equipment will accurately reproduce the aircraft environment for the MIL-STD-704 compliance testing to be valid. This is especially important during transient testing where the power can deviate from normal power characteristics for only a few milliseconds.

4.10.2 Monitoring equipment. Monitoring equipment is unique to each utilization equipment and aircraft. Monitoring equipment is the equipment that determines that utilization equipment is performing at the specified levels during the compliance testing. Monitoring equipment may include means to monitor, measure and/or record sample data exchanges, display test patterns, mechanical outputs, etc. Care must be taken to ensure that the monitoring equipment can accurately measure the performance of the utilization equipment for all the test methods. This is especially important during transient testing were the power can deviate from normal power characteristics for only a few milliseconds.

5. NOTES

5.1 Intended use. This handbook should be used as guidance when establishing test requirements, for inclusion in performance specifications developed for the procurement of utilization equipment, and to ensure compliance with the aircraft electrical power characteristics as specified by MIL-STD-704.

5.2 Single phase test numbers. There are no tests required for SAC103, SAC602, SVF103, SVF602, and SXF103. The numbering has been specified so the Single Phase test numbers coincide with the corresponding Three Phase test numbers.

5.3 Subject term (keyword) listing.

Aircraft, electrical power
Aircraft, electrical test
Electrical operating conditions
Equipment, utilization
Power groups
Specification, utilization equipment

TABLE I. Power groups.

Power Group	Acronym
Single Phase, 400 Hz, 115 V	SAC
Three Phase, 400 Hz, 115 V	TAC
Single Phase, Variable Frequency, 115 V	SVF
Three Phase, Variable Frequency, 115V	TVF
Single Phase, 60 Hz, 115 V	SXF
Low Voltage DC (28 VDC)	LDC
High Voltage DC (270 VDC)	HDC

TABLE II. Aircraft electrical power systems operating conditions.

Aircraft Electrical Operating Condition	
Normal	1
Transfer	2
Abnormal	3
Emergency	4
Starting	5
Power Failure	6

TABLE III. Test numbering nomenclature example SAC303A.

Power Group	Aircraft Electrical Operating Condition	Test number	Revision letter of test when applicable
SAC	3	03	A
Single Phase, 400 Hz, 115 V	Abnormal	Test 3	Revision A

TABLE IV. Single phase, 400 Hz, 115 V utilization equipment compliance tests.

Normal, Aircraft Electrical Operation	
SAC101	Load and Current Harmonic Measurements
SAC102	Steady State Limits for Voltage and Frequency
SAC103	No Test See Note #1
SAC104	Voltage Modulation
SAC105	Frequency Modulation
SAC106	Voltage Distortion Spectrum
SAC107	Total Voltage Distortion
SAC108	DC Voltage Component
SAC109	Normal Voltage Transients
SAC110	Normal Frequency Transients
Transfer, Aircraft Electrical Operation	
SAC201	Power Interrupt
Abnormal, Aircraft Electrical Operation	
SAC301	Abnormal Limits for Voltage and Frequency
SAC302	Abnormal Voltage Transients (Overvoltage/Undervoltage)
SAC303	Abnormal Frequency Transients (Overfrequency/Underfrequency)
Emergency, Aircraft Electrical Operation	
SAC401	Emergency Limits for Voltage and Frequency
Starting, Aircraft Electrical Operation	
SAC501	See Note #2
Power Failure, Aircraft Electrical Operation	
SAC601	Power Failure (Single Phase)
SAC602	No Test See Note #1
SAC603	Phase Reversal

Note 1: There are no tests required for SAC103 and SAC602. The numbering has been arranged so that the single phase test numbers coincide with the three phase test numbers.
Note 2: Starting operation conditions are usually not applicable to AC utilization equipment. No test is required for SAC501 unless specified by the equipment performance specification.

TABLE V. Three phase, 400 Hz, 115 V utilization equipment compliance tests.

Normal, Aircraft Electrical Operation	
TAC101	Three Phase Load and Current Harmonic Measurements
TAC102	Steady State Limits for Voltage (Including Unbalance) and Frequency
TAC103	Voltage Phase Difference
TAC104	Voltage Modulation
TAC105	Frequency Modulation
TAC106	Voltage Distortion Spectrum
TAC107	Total Voltage Distortion
TAC108	DC Voltage Component
TAC109	Normal Voltage Transients
TAC110	Normal Frequency Transients
Transfer, Aircraft Electrical Operation	
TAC201	Power Interrupt
Abnormal, Aircraft Electrical Operation	
TAC301	Abnormal Limits for Voltage and Frequency
TAC302	Abnormal Voltage Transients (Overvoltage/Undervoltage)
TAC303	Abnormal Frequency Transients (Overfrequency/Underfrequency)
Emergency, Aircraft Electrical Operation	
TAC401	Emergency Limits for Voltage and Frequency
Starting, Aircraft Electrical Operation	
TAC501	See Note #1
Power Failure, Aircraft Electrical Operation	
TAC601	Power Failure (Three Phase)
TAC602	One Phase and Two Phase Power Failures
TAC603	Phase Reversal

Note 1: Starting operation conditions are usually not applicable to AC utilization equipment. No test is required for TAC501 unless specified by the equipment performance specification.

TABLE VI. Single phase, variable frequency, 115 V utilization equipment compliance tests.

Normal, Aircraft Electrical Operation	
SVF101	Load and Current Harmonic Measurements
SVF102	Steady State Limits for Voltage and Frequency
SVF103	No Test, See Note #1
SVF104	Voltage Modulation
SVF105	Frequency Modulation
SVF106	Voltage Distortion Spectrum
SVF107	Total Voltage Distortion
SVF108	DC Voltage Component
SVF109	Normal Voltage Transients
SVF110	Normal Frequency Transients
Transfer, Aircraft Electrical Operation	
SVF201	Transfer Interrupt
Abnormal, Aircraft Electrical Operation	
SVF301	Abnormal Limits for Voltage and Frequency
SVF302	Abnormal Voltage Transients (Overvoltage/Undervoltage)
SVF303	Abnormal Frequency Transients (Overfrequency/Underfrequency)
Emergency, Aircraft Electrical Operation	
SVF401	Emergency Limits for Voltage and Frequency
Starting, Aircraft Electrical Operation	
SVF501	See Note #2
Power Failure, Aircraft Electrical Operation	
SVF601	Power Failure
SVF602	No Test See Note #1
SVF603	Phase Reversal

Note 1: There are no tests required for SVF103 and SVF602. This is done so that the single phase test numbers coincide with the three phase test numbers.
Note 2: Starting operation conditions are usually not applicable to AC utilization equipment. No test is required for SVF501 unless specified by the equipment performance specification.

TABLE VII. Three phase, variable frequency, 115 V utilization equipment compliance tests.

Normal, Aircraft Electrical Operation	
TVF101	Three Phase Load and Current Harmonic Measurements
TVF102	Steady State Limits for Voltage (Including Unbalance) and Frequency
TVF103	Voltage Phase Difference
TVF104	Voltage Modulation
TVF105	Frequency Modulation
TVF106	Voltage Distortion Spectrum
TVF107	Total Voltage Distortion
TVF108	DC Voltage Component
TVF109	Normal Voltage Transients
TVF110	Normal Frequency Transients
Transfer, Aircraft Electrical Operation	
TVF201	Power Interrupt
Abnormal, Aircraft Electrical Operation	
TVF301	Abnormal Limits for Voltage and Frequency
TVF302	Abnormal Voltage Transients (Overvoltage/Undervoltage)
TVF303	Abnormal Frequency Transients (Overfrequency/Underfrequency)
Emergency, Aircraft Electrical Operation	
TVF401	Emergency Limits for Voltage and Frequency
Starting, Aircraft Electrical Operation	
TVF501	See Note#1
Power Failure, Aircraft Electrical Operation	
TVF601	Power Failure (Three Phase)
TVF602	One Phase and Two Phase Power Failures
TVF603	Phase Reversal

Note 1: Starting operation conditions are usually not applicable to AC utilization equipment. No test is required for TVF501 unless specified by the equipment performance specification.

TABLE VIII. Single phase, 60 Hz, 115 V utilization equipment compliance tests.

Normal, Aircraft Electrical Operation	
SXF101	Load and Current Harmonic Measurements
SXF102	Steady State Limits for Voltage and Frequency
SXF103	No Test, See Note #1
SXF104	Voltage Modulation
SXF105	Frequency Modulation
SXF106	Voltage Distortion Spectrum
SXF107	Total Voltage Distortion
SXF108	DC Voltage Component
SXF109	Normal Voltage Transients
SXF110	Normal Frequency Transients
Transfer, Aircraft Electrical Operation	
SXF201	Transfer Interrupt
Abnormal, Aircraft Electrical Operation	
SXF301	Abnormal Limits for Voltage and Frequency
SXF302	Abnormal Voltage Transients (Overvoltage/Undervoltage)
SXF303	Abnormal Frequency Transients (Overfrequency/Underfrequency)
Emergency, Aircraft Electrical Operation	
SXF401	Emergency Limits for Voltage and Frequency
Starting, Aircraft Electrical Operation	
SXF501	See Note #2
Power Failure, Aircraft Electrical Operation	
SXF601	Power Failure
SXF602	No Test, See Note #1
SXF603	Phase Reversal

Note 1: There are no tests required for SXF103 and SXF602. The numbering has been arranged so that the single phase test numbers coincide with the three phase test numbers.
Note 2: Starting operation conditions are usually not applicable to AC utilization equipment. No test is required for SXF501 unless specified by the equipment performance specification.

TABLE IX. 28 VDC utilization equipment compliance tests.

Normal, Aircraft Electrical Operation	
LDC101	Load Measurements
LDC102	Steady State Limits for Voltage
LDC103	Voltage Distortion Spectrum
LDC104	Total Ripple
LDC105	Normal Voltage Transients
Transfer, Aircraft Electrical Operation	
LDC201	Power Interrupt
Abnormal, Aircraft Electrical Operation	
LDC301	Abnormal Steady State Limits for Voltage
LDC302	Abnormal Voltage Transients (Overvoltage/Undervoltage)
Emergency, Aircraft Electrical Operation	
LDC401	Emergency Limits for Voltage
Starting, Aircraft Electrical Operation	
LDC501	Starting Voltage Transients
Power Failure, Aircraft Electrical Operation	
LDC601	Power Failure
LDC602	Polarity Reversal

TABLE X. 270 VDC utilization equipment compliance tests.

Normal, Aircraft Electrical Operation	
HDC101	Load Measurements
HDC102	Steady State Limits for Voltage
HDC103	Voltage Distortion Spectrum
HDC104	Total Ripple
HDC105	Normal Voltage Transients
Transfer, Aircraft Electrical Operation	
HDC201	Power Interrupt
Abnormal, Aircraft Electrical Operation	
HDC301	Abnormal Steady State Limits for Voltage
HDC302	Abnormal Voltage Transients (Overvoltage/Undervoltage)
Emergency, Aircraft Electrical Operation	
HDC401	Emergency Limits for Voltage
Starting, Aircraft Electrical Operation	
HDC501	Starting Voltage Transients
Power Failure, Aircraft Electrical Operation	
HDC601	Power Failure
HDC602	Polarity Reversal

CONCLUDING MATERIAL

Custodians:
Army - AV
Navy - AS
Air Force - 11

Preparing Activity:
Navy - AS

(Project No. SESS-0047)

Review Activities:
Army - CR, MI, TE
Navy - EC, MC, SA, SH, YD

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at www.dodssp.daps.mil.

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MIL-HDBK-704-2
9 April 2004

DEPARTMENT OF DEFENSE
HANDBOOK

GUIDANCE FOR
TEST PROCEDURES FOR DEMONSTRATION OF UTILIZATION EQUIPMENT COMPLIANCE TO AIRCRAFT ELECTRICAL POWER CHARACTERISTICS SINGLE PHASE, 400 Hz, 115 VOLT
(PART 2 OF 8 PARTS)

This Handbook is for guidance only.
Do not cite this document as a requirement.

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FOREWORD

1. This handbook is approved for use by all Departments and Agencies of the Department of Defense.

2. This handbook provides guidance on test procedures for demonstration of single phase, 400 Hz, 115 volt utilization equipment to determine compliance with the applicable edition of MIL-STD-704.

3. MIL-HDBK-704-2 is Part 2 in a series of 8 Parts. Part 2 describes the test methods and procedures to demonstrate that single phase, 400 Hz, 115 volt utilization equipment is compatible with the electric power characteristics of MIL-STD-704. These series of handbooks and MIL-STD-704 are companion documents.

4. Comments, suggestions, or questions on this document should be addressed to Commander, Naval Air Systems Command, Code 4.1.4, Highway 547, Lakehurst, NJ 08733-5100 or email to thomas.omara@navy.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil/.

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1. SCOPE

1.1 Scope. This handbook provides, as guidance, test methods used to demonstrate that single phase, 400 Hz, 115 volt utilization equipment is compatible with the electric power characteristics of the applicable edition(s) of MIL-STD-704. This handbook is for guidance only and cannot be cited as a requirement.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed below are not necessarily all of the documents referenced herein, but are those needed to understand the information provided by this handbook.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-704	DoD Interface Standard for Aircraft Electric Power Characteristics

(Copies of these documents are available online at http://assist. daps.dla.mil/quicksearch or http://www.dodssp.daps.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

3. DEFINITIONS

3.1 Acronyms and definitions. The acronyms and definitions of MIL-STD-704 are applicable to this handbook.

4. TEST METHODS INFORMATION

4.1 Demonstration of compatibility. This section contains the test methods which will ensure that single phase, 400 Hz, 115 volt utilization equipment is compatible with the electric power characteristics of the applicable edition(s) of MIL-STD-704, by testing the Unit Under Test (UUT) in accordance with the test procedures as described in test methods SAC 101 through SAC 603.

4.1.1 Recording performance. In table SAC-I, record the UUT information, the edition(s) of MIL-STD-704 that defined the aircraft electric power characteristics used for testing, the dates of the testing, and the performance of the UUT for each of the test methods.

4.2 Calibration of test equipment. Test equipment and accessories required for measurement in accordance with this handbook should be calibrated in accordance with an approved calibration program traceable to the National Institute for Standards and Technology.

The serial numbers, model, and calibration date of all test equipment should be included with the test data.

4.3 Test methods. The test methods listed in table SAC-I are provided in section 5 of this handbook.

TABLE SAC-I. Summary of single phase, 400 Hz, 115 volt utilization equipment MIL-STD-704 compliance tests.

UUT:			
Compliance to MIL-STD-704 Edition(s):			
Test Dates:			
Test Method	Description	Performance (Pass/Fail)	Comments
Normal, Aircraft Electrical Operation			
SAC101	Load and Current Harmonic Measurements		
SAC102	Steady State Limits for Voltage and Frequency		
SAC103	No Test, See Note #1	N/A	N/A
SAC104	Voltage Modulation		
SAC105	Frequency Modulation		
SAC106	Voltage Distortion Spectrum		
SAC107	Total Voltage Distortion		
SAC108	DC Voltage Component		
SAC109	Normal Voltage Transients		
SAC110	Normal Frequency Transients		
Transfer, Aircraft Electrical Operation			
SAC201	Power Interrupt		
Abnormal, Aircraft Electrical Operation			
SAC301	Abnormal Limits for Voltage and Frequency		
SAC302	Abnormal Voltage Transients (Overvoltage/Undervoltage)		
SAC303	Abnormal Frequency Transients (Overfrequency/Underfrequency)		
Emergency, Aircraft Electrical Operation			
SAC401	Emergency Limits for Voltage and Frequency		
Starting, Aircraft Electrical Operation			
SAC501	See Note #2	N/A	N/A
Power Failure, Aircraft Electrical Operation			
SAC601	Power Failure (Single Phase)		
SAC602	No Test, See Note #1	N/A	N/A
SAC603	Phase Reversal		

Note 1: There are no tests required for SAC103 and SAC602. The numbering has been arranged so that the single phase test numbers coincide with the three phase test numbers.
Note 2: Starting operation conditions are usually not applicable to AC utilization equipment. No test is required for SAC501 unless specified by the equipment performance specification.

5. TEST METHODS

METHOD SAC101
Load Measurements

POWER GROUP: Single Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Load Measurements

1. Scope.

1.1 Purpose. This test procedure is intended to verify that single phase, 115 Volt, 400 Hz power utilization equipment utilizes only 115 Volt line-to-neutral power, does not require more power than allowed, maintains power factor within limits, and does not use half-wave rectification for the applicable edition(s) of MIL-STD-704. Additionally, when the utilization equipment performance specification document imposes current waveform requirements, this test procedure is used to verify that the utilization equipment current waveform is within total current distortion and current spectrum (current distortion vs. frequency) limits defined in the utilization equipment performance specification document.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment requires less than or equal to the power limit for single phase equipment, is within the power factor limits, and does not use half-wave rectification for the applicable edition(s) of MIL-STD-704 and as noted in table SAC101-I. If required by the utilization equipment performance specification document, the utilization equipment current waveform must be within the total current distortion and current spectrum limits defined in the utilization equipment performance specification document. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SAC101-I. MIL-STD-704 limits for single phase power, power factor, rectification restriction, current distortion, and current spectrum for single phase 400 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Single Phase kVA	0.5 kVA	0.5 kVA	0.5 kVA	0.5 kVA	0.5 kVA	0.5 kVA
Power Factor	Figure12 MIL-STD-704A	N/A	N/A	N/A	N/A	No Leading Power Factor for >100 VA
Rectification Restriction	N/A 1/	N/A 1/	N/A 1/	N/A 1/	No Half-Wave Rectification	No Half-Wave Rectification
Current Distortion	See Note 2/	See Note 2/	See Note 2/	See Note 2/	See Note 2/	See Note 2/
Current Spectrum	See Note 2/	See Note 2/	See Note 2/	See Note 2/	See Note 2/	See Note 2/

1/ It is highly recommended that equipment built to MIL-STD-704 edition(s) A, B, C, or D should not use half-wave rectification.
2/ The utilization equipment performance specification document should include requirements that reduce the likelihood of the equipment having an adverse effect on the electrical power characteristics of the aircraft. Current distortion and current spectrum limits may be imposed to minimize undesirable effects to the electrical power characteristics. These limits should take into account the utilization equipment power draw, aircraft electrical system capacity and distribution characteristics, trade-offs with weight, volume, cost, and reliability that are specific to each type of equipment and aircraft.

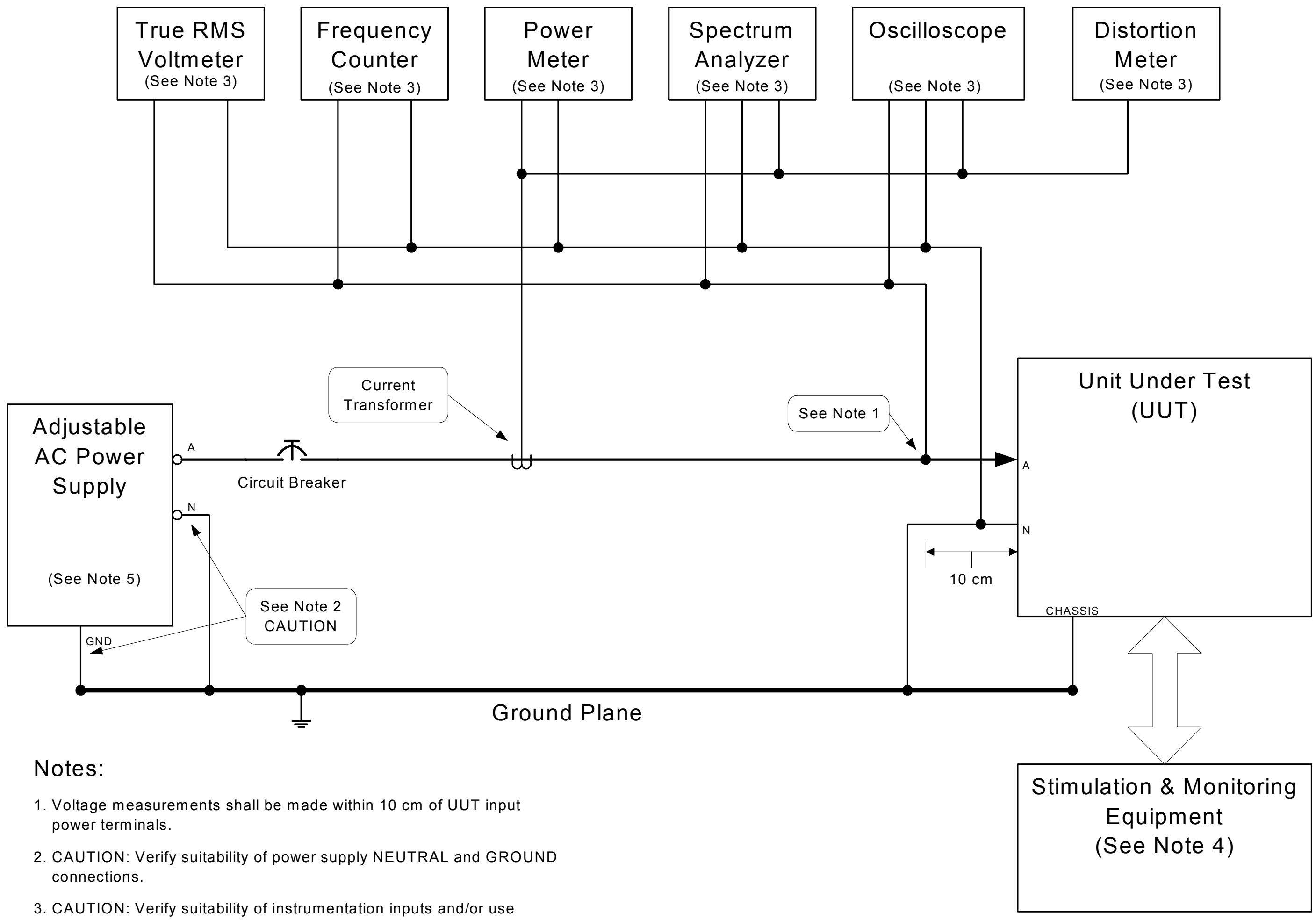
3. Apparatus. The test equipment should be as follows:

a. Adjustable AC power supply (rotating AC source for current waveform limits)
b. True RMS voltmeter
c. Frequency counter
d. Power meter
e. Spectrum analyzer
f. Distortion meter
g. Current transformer
h. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SAC101-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT. Current measurements must be taken from the 115 Volt conductor. If the utilization equipment performance specification document imposes current waveform limits, the AC power source should be a rotating machine.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SAC101-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz.

Close the circuit breaker, energizing the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltage, frequency, kVA, and power factor in table SAC101-II. Confirm that the utilization equipment does not use half-wave rectification and record in table SAC101-II. Compare the kVA, power factor, and rectification with the required limits/restriction of the applicable edition(s) of MIL-STD-704. If the utilization equipment performance specification imposes current waveform limits, record the total current distortion and current spectrum in the data sheet shown in table SAC101-II and compare to the limits defined in the utilization equipment performance specification document. Repeat for each mode of operation of the UUT.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)
5. If current waveform limits are imposed by the detailed performance specification, the AC power source shall be a rotating machine.

FIGURE SAC101-1. Load measurement.

TABLE SAC101-II. Sample data sheet for load measurements.

Parameter	Measurement	Unit	Performance Pass/Fail
Voltage		V_{rms}	N/A
Frequency		Hz	N/A
KVA		kVA	
Power Factor		pf	
No Half-Wave Rectification		N/A	
Current		A_{rms}	
Total Current Distortion		% Current Distortion	
Current Spectrum	Attach Spectrum Plot	Amplitude vs. Frequency	

METHOD SAC102
Steady State Limits for Voltage and Frequency

POWER GROUP: Single Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Steady State Limits for Voltage and Frequency

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Normal Low Steady State (NLSS) limits and the Normal High Steady State (NHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power of voltage and frequency at the specified normal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table SAC102-I. The utilization equipment should maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be, not less than thirty (30) minutes for each of the test conditions. The utilization equipment should demonstrate re-start at the steady state voltage and frequency limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: If the utilization has exactly the same full performance requirements for abnormal steady state limits and emergency steady state limits as required for the normal aircraft electrical conditions, then performance of test methods SAC301 and SAC401 will constitute performance of SAC102.

TABLE SAC102-I. MIL-STD-704 normal limits for steady state voltage and frequency.

Normal Limit	704A	704B	704C	704D	704E	704F
Voltage NLSS	108 V	108 V	108 V	108 V	108 V	108 V
Voltage NHSS	118 V	118 V	118 V	118 V	118 V	118 V
Frequency NLSS	380 Hz	395 Hz (380 Hz) 1/	393 Hz	393 Hz	393 Hz	393 Hz
Frequency NHSS	420 Hz	405 Hz (420 Hz) 1/	407 Hz	407 Hz	407 Hz	407 Hz

1/ Normal steady state frequency limits for MIL-STD-704B for helicopters is 400 ±20 Hz.

3. Apparatus. The test equipment should be as follows:

a. Adjustable AC power supply
b. True RMS voltmeter
c. Frequency counter

4. Test Setup. Configure the test setup as shown in figure SAC102-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

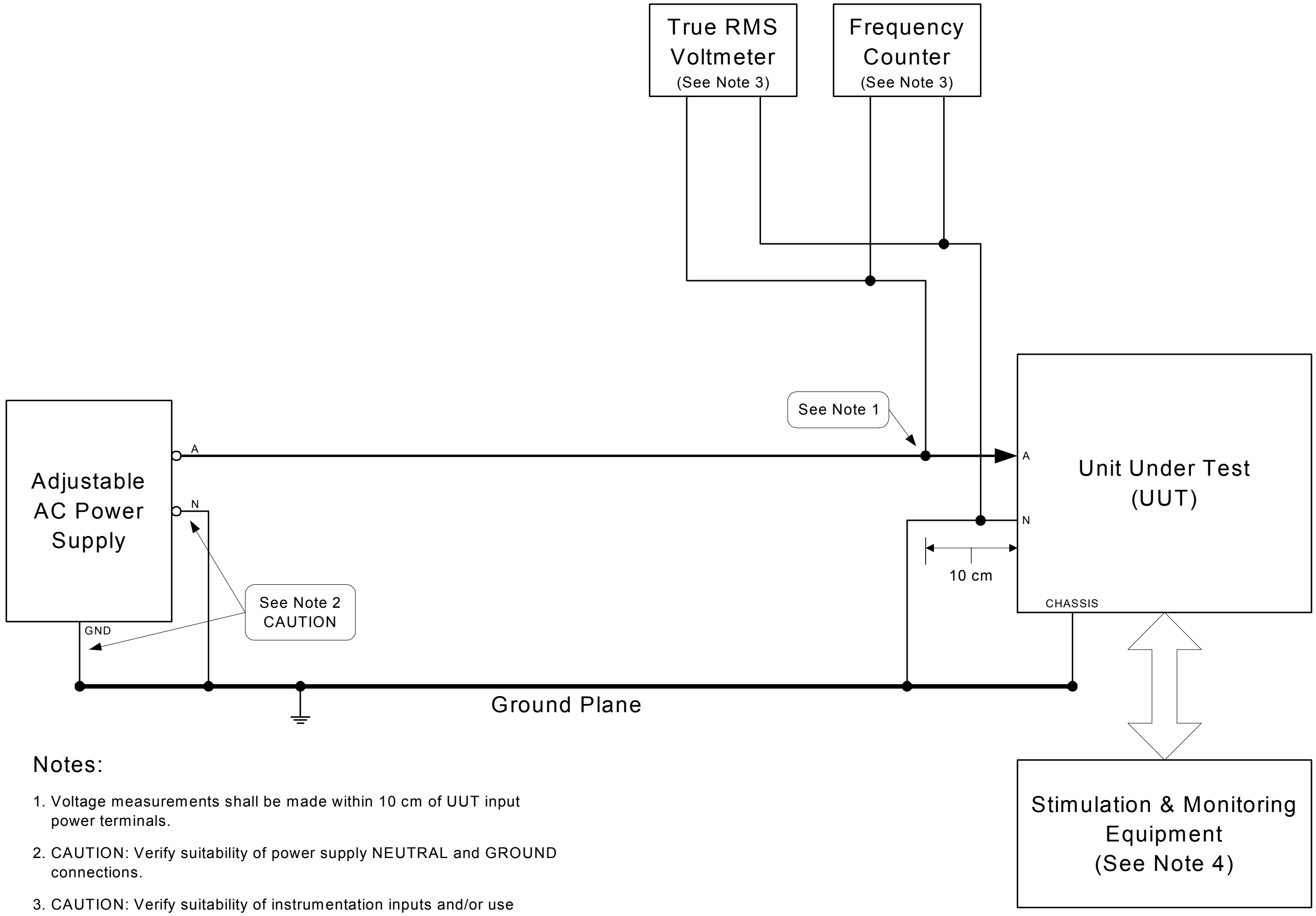
5. Compliance Test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SAC102-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through I noted in table SAC102-II, the UUT must remain for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be, not less than thirty (30) minutes. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. For each test condition shutdown the UUT and verify that the UUT can be re-started. After re-start conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltage, frequency, time duration at test condition, successful/unsuccessful re-start and the performance of the UUT for each test condition in the data sheet shown in table SAC102-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SAC102-II. Test conditions for steady state limits for voltage and frequency.

Test Condition	Voltage	Frequency
A	Nominal Voltage	Nominal Frequency
B	Nominal Voltage	NLSS Frequency
C	Nominal Voltage	NHSS Frequency
D	NLSS Voltage	Nominal Frequency
E	NLSS Voltage	NLSS Frequency
F	NLSS Voltage	NHSS Frequency
G	NHSS Voltage	Nominal Frequency
H	NHSS Voltage	NLSS Frequency
I	NHSS Voltage	NHSS Frequency



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SAC102-1. Steady state limits for voltage and frequency.

TABLE SAC102-III. Sample data sheet for SAC102 steady state limits for voltage and frequency.

Test Condition	Parameters								Performance Pass/Fail
	Voltage		Frequency		Time Duration at Condition		Re-Start (Yes/No)		
A		V_{rms}		Hz		min			
B		V_{rms}		Hz		min			
C		V_{rms}		Hz		min			
D		V_{rms}		Hz		min			
E		V_{rms}		Hz		min			
F		V_{rms}		Hz		min			
G		V_{rms}		Hz		min			
H		V_{rms}		Hz		min			
I		V_{rms}		Hz		min			

METHOD SAC103
(No Test Required)

POWER GROUP:	Single Phase, 400 Hz, 115 V
AIRCRAFT ELECTRICAL OPERATING CONDITION:	Normal
PARAMETER:	No Test Required. Test number SAC103 is not used so that the single phase, 400 Hz, 115V (SAC) test numbers coincide with the three phase, 400 Hz, 115 V (TAC) test sequence numbers.

METHOD SAC104
Voltage Modulation

POWER GROUP: Single Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Voltage Modulation

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to voltage modulation as specified in the application edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having voltage modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table SAC104-I. The utilization equipment should maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage modulation. The utilization equipment should not suffer damage or cause an unsafe condition.

TABLE SAC104-I. MIL-STD-704 limits for voltage modulation.

Limit	704A	704B 1/	704C 1/	704D 1/	704E	704F
Voltage Modulation	3.5 V Peak-to-Valley Figure 1 MIL-STD-704A	Sideband 0.62 Vrms over the range 400 ± 60 Hz	N/A	N/A	2.5 Vrms max	2.5 Vrms max

1/ For utilization equipment being tested to MIL-STD-704 editions B, C, and D, use MIL-STD-704E limits.

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SAC104-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SAC104-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through G noted in table SAC104-II, set the voltage modulation amplitude and frequency of voltage modulation. The UUT should remain at the test condition for a length of time that confirms the utilization equipment can continuously operate, and should be at least ten (10) minutes at an average steady state voltage of 115 Vrms, at least ten (10) minutes at an average steady state voltage of 109.25 Vrms, and at least ten (10) minutes at an average steady state voltage of 116.75 Vrms. During the test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record average voltage, frequency, amplitude of voltage modulation, frequency of voltage modulation, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table SAC104-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SAC104-II. Test conditions for voltage modulation.

Test Condition	Frequency of Voltage Modulation	MIL-STD-704A Amplitude of Voltage Modulation Voltage Peak-to-Valley	MIL-STD-704E & F 1/ Amplitude of Voltage Modulation Vrms
A	1.0 Hz	0.5 Vp-v	0.375 Vrms
B	1.7 Hz	0.5 Vp-v	0.375 Vrms
C	10 Hz	3.5 Vp-v	2.5 Vrms
D	25 Hz	3.5 Vp-v	2.5 Vrms
E	70 Hz	0.5 Vp-v	0.375 Vrms
F	100 Hz	0.5 Vp-v	0.375 Vrms
G	200 Hz	0.5 Vp-v	0.375 Vrms

1/ For utilization equipment being tested to MIL-STD-704 editions B, C, and D, use MIL-STD-704E limits.

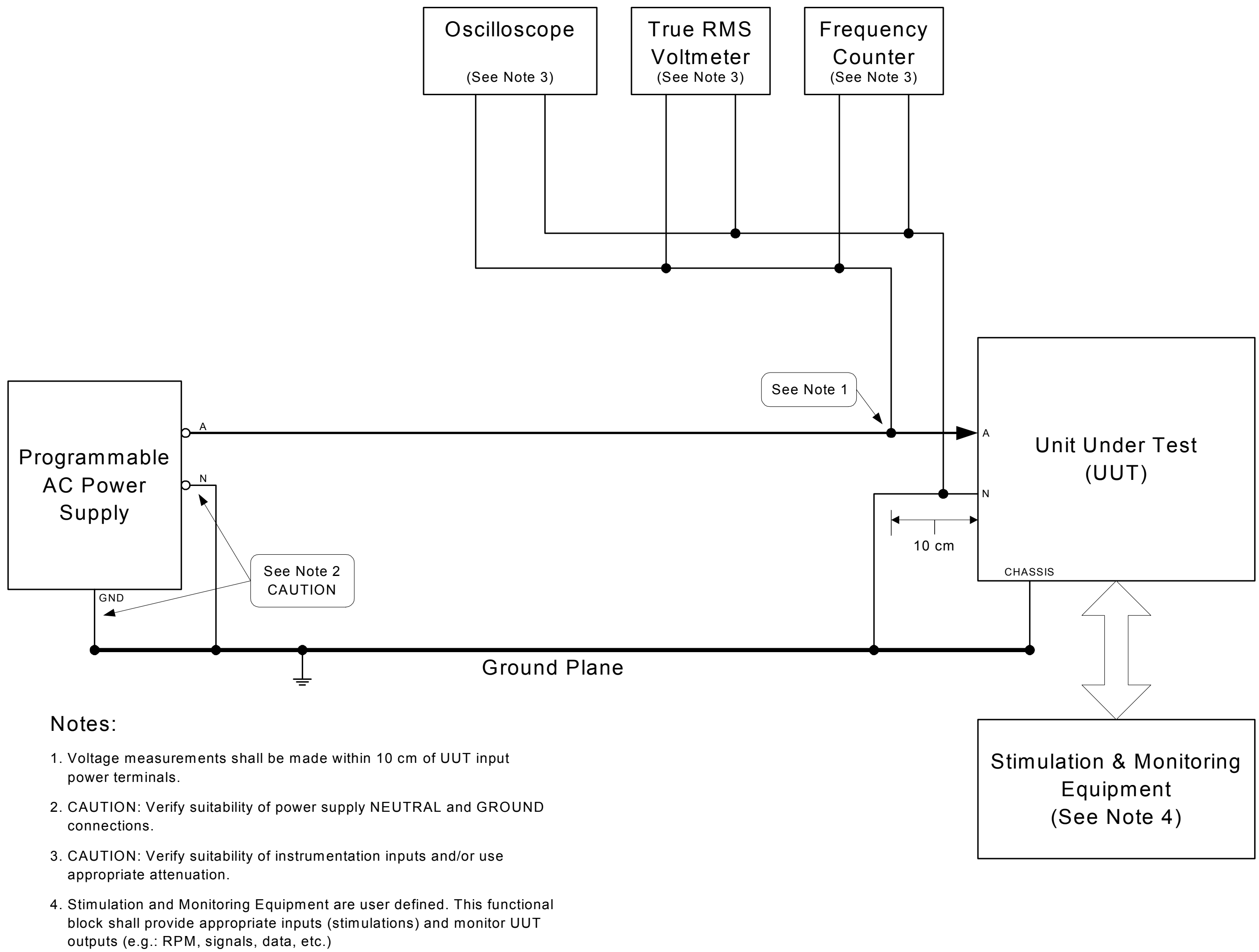


FIGURE SAC104-1. Voltage modulation.

TABLE SAC104-III. Sample data sheet for SAC104 voltage modulation

Test	Parameters										Performance
Condition	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Condition		Pass/Fail
A		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
B		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
C		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
D		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
E		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
F		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
G		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	

METHOD SAC105
Frequency Modulation

POWER GROUP: Single Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Frequency Modulation

1. Scope.

1.1. Purpose. This test procedure is used to verify that single phase, 115 volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to frequency modulation as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having frequency modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table SAC105-I. The utilization equipment should maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having frequency modulation. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SAC105-I. MIL-STD-704 limits for frequency modulation.

Limit	704A	704B	704C	704D	704E	704F
Frequency Modulation	± 4 Hz	± 5 Hz Figure 3 MIL-STD-704B	± 5 Hz Figure 4 MIL-STD-704C	± 5 Hz Figure 4 MIL-STD-704D	4 Hz	4 Hz

3. Apparatus: The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SAC105-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SAC105-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient

time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

5.1 Compliance test for MIL-STD-704A. For each test condition A through D noted in table SAC105-II, set the amplitude of frequency modulation and rate of change for frequency modulation. The UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate, and should be at least ten (10) minutes at an average steady state frequency of 400 Hz, at least ten (10) minutes at an average steady state frequency of 384 Hz, and at least ten (10) minutes at an average steady state frequency of 416 Hz. During the test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record voltage, average frequency, amplitude of frequency modulation, rate of change for frequency modulation, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table SAC105-III. Repeat for each mode of operation of the UUT

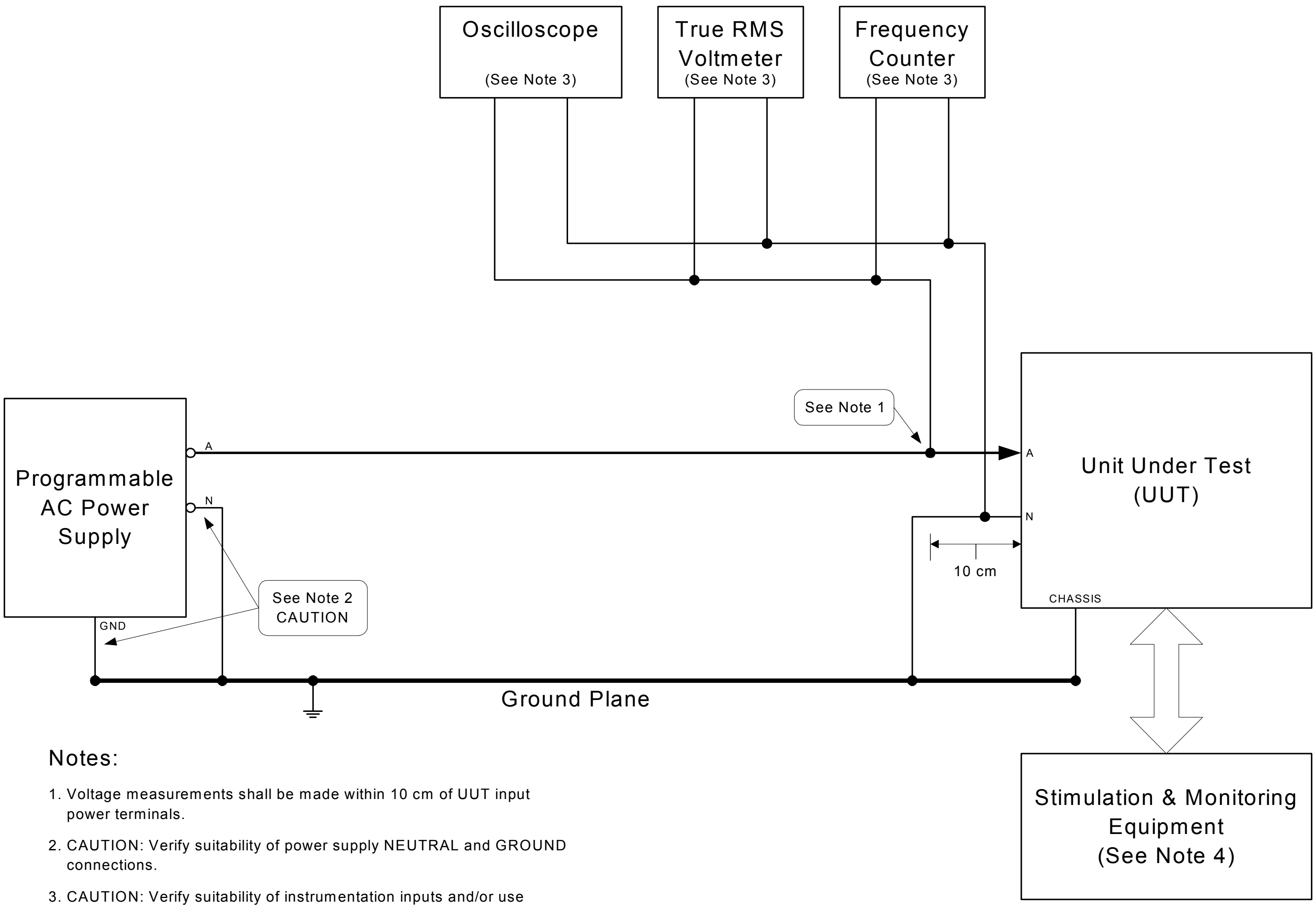
5.2 Compliance test for MIL-STD-704B, C & D. For each test condition A through E noted in table SAC105-II, set the amplitude of frequency modulation and rate of change for frequency modulation. The UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate. For test condition A, the UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate, and should be at an average steady state frequency of 400 Hz for at least thirty (30) minutes. For test condition B through E, the UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate and should be at least ten (10) minutes at an average steady state frequency of 400 Hz, at least ten (10) minutes at an average steady state frequency of 395 Hz, and at least ten (10) minutes at an average steady state frequency of 405 Hz. At each test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record voltage, average frequency, amplitude of frequency modulation, rate of change for frequency modulation, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table SAC105-III. Repeat for each mode of operation of the UUT.

5.3 Compliance test for MIL-STD-704E & F. For each test condition A through E noted in table SAC105-II, set the amplitude of frequency modulation and rate of change for frequency modulation. The UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate, and should be at least ten (10) minutes at an average steady state frequency of 400 Hz, at least ten (10) minutes at an average steady state frequency of 395 Hz, and at least ten (10) minutes at an average steady state frequency of 405 Hz. During the test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record voltage, average frequency, amplitude of frequency modulation, rate of change for frequency modulation, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table SAC105-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SAC105-II. Test conditions for frequency modulation.

Test Condition	Rate of change for frequency modulation	MIL-STD-704 A Amplitude of Frequency Modulation	MIL-STD-704 B, C, & D Amplitude of Frequency Modulation	MIL-STD-704 E &F Amplitude of Frequency Modulation
A	1 Hz/sec	± 4 Hz	± 5.00 Hz	4 Hz (± 2 Hz)
B	5 Hz/sec	± 4 Hz	± 1.75 Hz	4 Hz (± 2 Hz)
C	10 Hz/sec	± 4 Hz	± 1.20 Hz	4 Hz (± 2 Hz)
D	25 Hz/sec	± 4 Hz	± 0.85 Hz	4 Hz (± 2 Hz)
E	100 Hz/sec	N/A	± 0.58 Hz	4 Hz (± 2 Hz)



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SAC105-1. Frequency modulation.

TABLE SAC105-III. Sample data sheet for SAC105 frequency modulation.

Test Condition	Parameters										Performance
	Voltage		Average Frequency		Amplitude of Frequency Modulation		Rate of change for frequency modulation		Time Duration at Condition		Pass/Fail
A		V_{rms}		Hz		± Hz		Hz/sec		min	
		V_{rms}		Hz		± Hz		Hz/sec		min	
		V_{rms}		Hz		± Hz		Hz/sec		min	
B		V_{rms}		Hz		± Hz		Hz/sec		min	
		V_{rms}		Hz		± Hz		Hz/sec		min	
		V_{rms}		Hz		± Hz		Hz/sec		min	
C		V_{rms}		Hz		± Hz		Hz/sec		min	
		V_{rms}		Hz		± Hz		Hz/sec		min	
		V_{rms}		Hz		± Hz		Hz/sec		min	
D		V_{rms}		Hz		± Hz		Hz/sec		min	
		V_{rms}		Hz		± Hz		Hz/sec		min	
		V_{rms}		Hz		± Hz		Hz/sec		min	
E		V_{rms}		Hz		± Hz		Hz/sec		min	
		V_{rms}		Hz		± Hz		Hz/sec		min	
		V_{rms}		Hz		± Hz		Hz/sec		min	

METHOD SAC106
Voltage Distortion Spectrum

POWER GROUP: Single Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: Voltage Distortion Spectrum

1. Scope.

1.1 Purpose: This test procedure is used to verify that single phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to voltage distortion of frequencies and amplitudes as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage distortions as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704 and as noted in table SAC106-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage distortion. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: This test method subjects the UUT to voltage distortion having frequencies components from 50 Hz to 10 kHz. These voltage distortions simulate voltage distortions within aircraft due to the cumulative effects of generators, electrical distribution systems equipments, and aircraft loads. MIL-STD-461, (Requirements For The Control of Electromagnetic Interference Characteristics of Subsystems and Equipment), Test Method CS101, (Conducted Susceptibility, Power Leads, 30 Hz to 150 kHz) is a complimentary test. Power levels of the voltage distortions differ for the two test methods. Performance of Test Method SAC106 of this handbook does not relinquish the requirement to perform Test Method CS101 of MIL-STD-461, and performance of Method CS101 of MIL-STD-461 does not relinquish the requirement to perform Test Method SAC 106 of this handbook.

TABLE SAC106-I. MIL-STD-704 limits for voltage distortion spectrum.

Limit	704A 1/	704B	704C	704D	704E	704F
Voltage Distortion Spectrum	Individual Harmonic < 5%	Figure 2 MIL-STD-704B	Figure 3 MIL-STD-704C	Figure 3 MIL-STD-704D	Figure 3 MIL-STD-704E	Figure 7 MIL-STD-704F

1/ For utilization equipment being tested to MIL-STD-704 edition A, use MIL-STD-704B limits.

3. Apparatus. The test equipment should be as follows:

a. Adjustable AC power supply
b. Variable frequency power source
c. Coupling transformer
d. True RMS voltmeter
e. Frequency counter
f. Spectrum analyzer
g. (2) Inductors, 50 μH
h. Capacitor, 10 μF
i. Resistor, calibrated load

4. Test setup. Configure the test setup as shown in figure SAC106-1. Measurements, except current, should be made within 10 cm of the input power terminals of the UUT.

4.1 Calibration. Install a calibrated resistive load in the test setup shown in figure SAC106-1 in place of the UUT. The calibrated resistive load should be sized to draw the same current as the UUT. Turn on the adjustable AC power supply and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Set the variable frequency power source to output a sine wave and adjust the frequency and amplitude so that the voltage distortion measured at the input to the calibrated resistive load conforms to each test condition A through H in table SAC106-II of the applicable edition(s) of MIL-STD-704. Record the settings of the variable frequency power source for each test condition.

5. Compliance test. With the adjustable AC power supply off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SAC106-1. Turn on the adjustable AC power supply and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

Set the variable frequency power source to the settings recorded for test condition A of the calibration procedure. For each test condition, remain for a length of time that confirms the utilization equipment can continuously operate with the voltage distortion and should be, not less than five (5) minutes. At each test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. After each test condition, monitor the voltage distortion frequency and amplitude while slowly increasing the variable frequency power source frequency and adjusting the amplitude until the next test condition is reached. Do not exceed the voltage distortion spectrum limits. Repeat for each test condition A through H noted in table SAC106-II. For each test condition, record voltage, frequency, frequency of voltage distortion, amplitude of voltage distortion, time duration at test condition, and the performance of the UUT in the data sheet shown in table SAC106-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, turn the adjustable AC power supply off and remove the coupling transformer from the circuit. Turn on the adjustable AC power supply. Adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SAC106-II. Test conditions for voltage distortion spectrum.

Test Condition	Frequency of Voltage Distortion	MIL-STD-704B C, D, E & F 1/ Amplitude of Voltage Distortion Voltage rms
A	50 Hz	0.316 Vrms
B	100 Hz	0.316 Vrms
C	500 Hz	1.580 Vrms
D	1 kHz	3.160 Vrms
E	2 kHz	3.160 Vrms
F	3 kHz	3.160 Vrms
G	5 kHz	1.900 Vrms
H	10 kHz	0.950 Vrms

1/ For utilization equipment being tested to MIL-STD-704 edition A, use MIL-STD-704B limits.

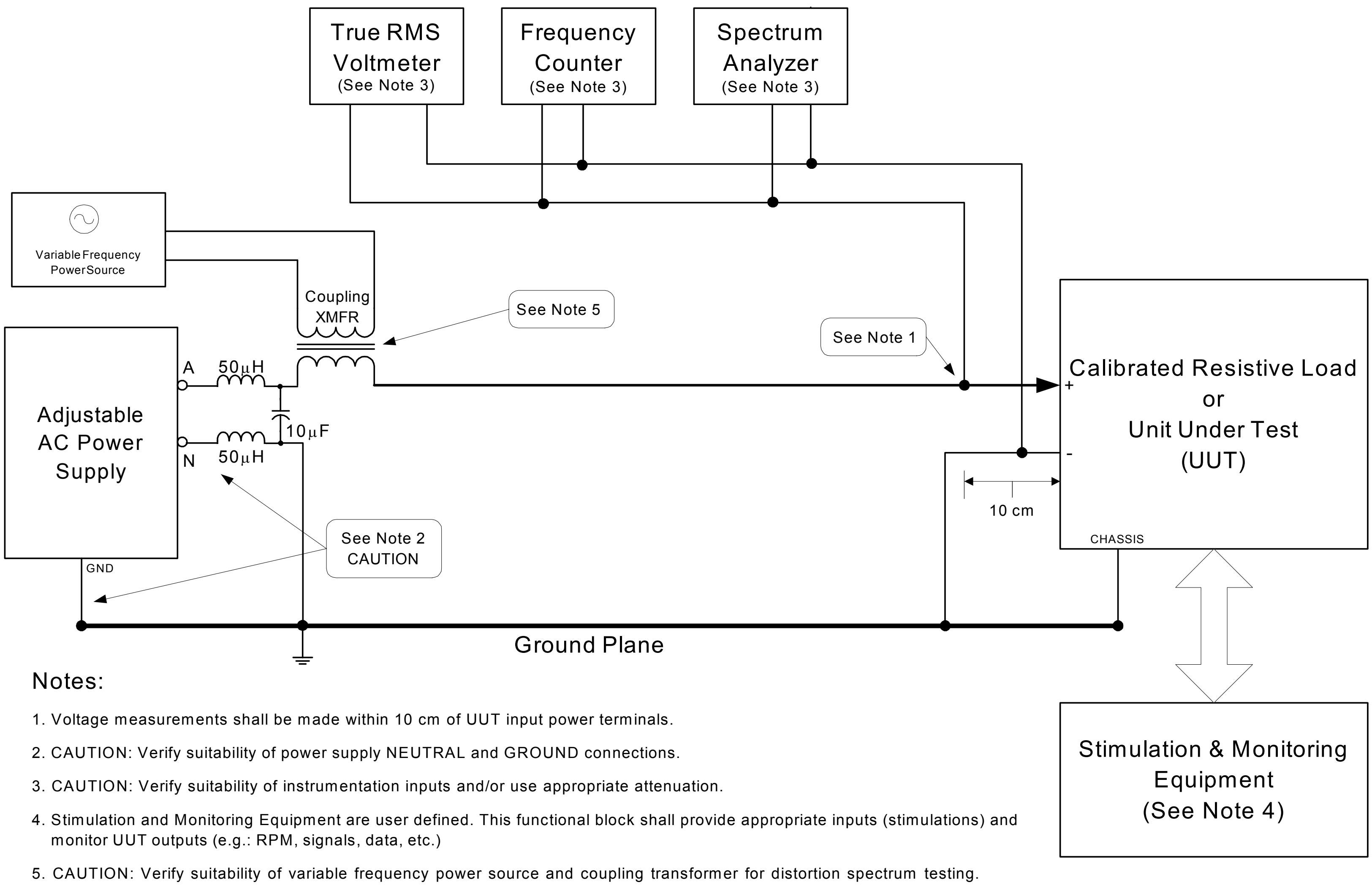


FIGURE SAC106-1. Normal operation - voltage distortion spectrum.

TABLE SAC106-III. Sample data sheet for SAC106 voltage distortion spectrum.

Test Condition	Parameters										Performance
	Voltage		Frequency		Frequency of Voltage Distortion		Amplitude of Voltage Distortion		Time Duration at Condition		Pass/Fail
A		V_{rms}		Hz		Hz		V_{rms}		min	
B		V_{rms}		Hz		Hz		V_{rms}		min	
C		V_{rms}		Hz		Hz		V_{rms}		min	
D		V_{rms}		Hz		kHz		V_{rms}		min	
E		V_{rms}		Hz		kHz		V_{rms}		min	
F		V_{rms}		Hz		kHz		V_{rms}		min	
G		V_{rms}		Hz		kHz		V_{rms}		min	
H		V_{rms}		Hz		kHz		V_{rms}		min	

METHOD SAC107
Total Voltage Distortion

POWER GROUP: Single Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Total Voltage Distortion

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to a voltage waveform having a distortion factor as specified by the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to a voltage waveform having a distortion factor as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SAC107-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to a distorted voltage waveform and should be, not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SAC107-I. MIL-STD-704 limits for total voltage distortion.

Limit	704A	704B	704C	704D	704E	704F
Voltage Distortion Factor	0.08	0.05	0.05	0.05	0.05	0.05

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Spectrum analyzer
e. Distortion meter

4. Test setup. Configure the test setup as shown in figure SAC107-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

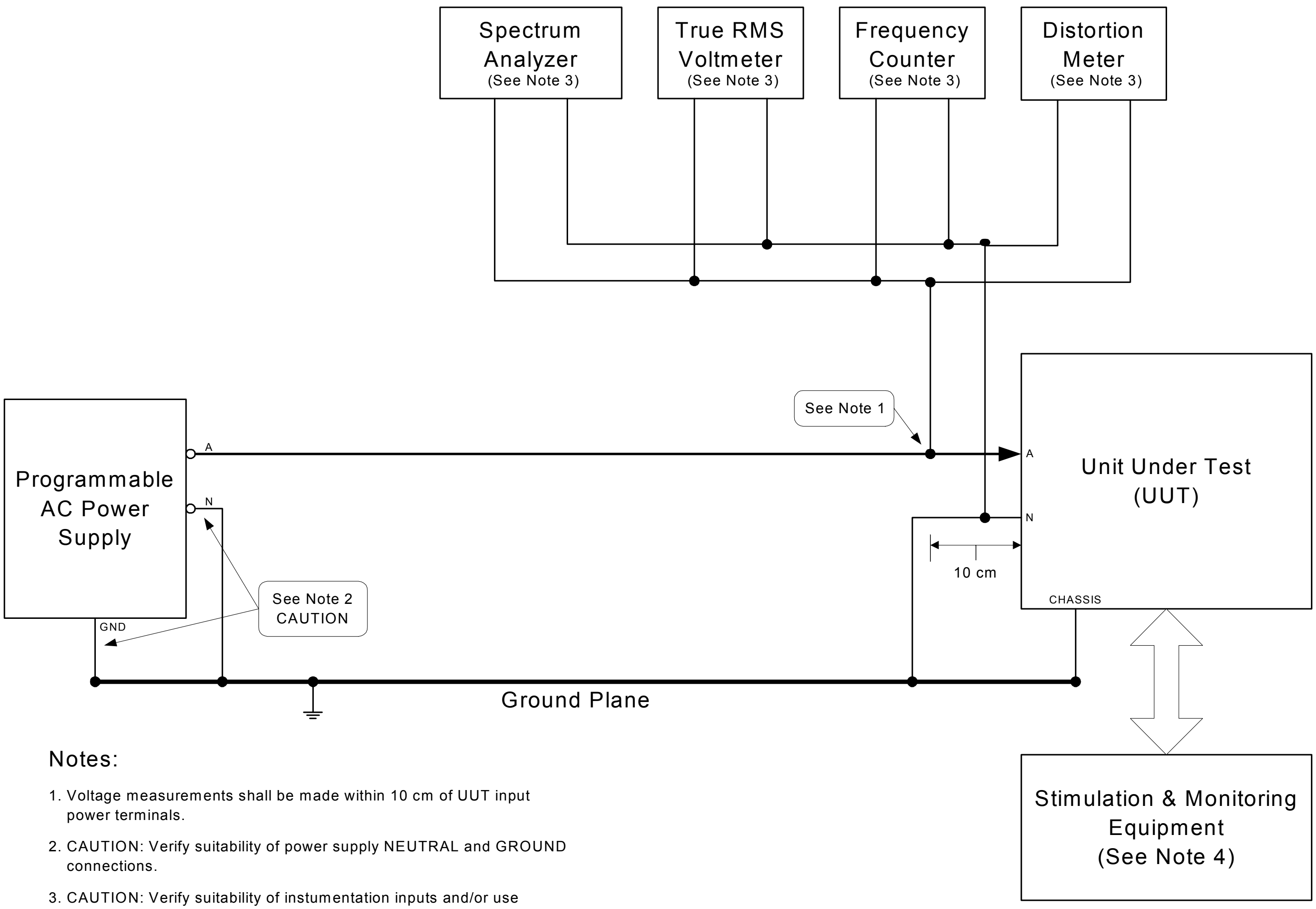
4.1 Calibration. Install a resistive load in the test setup shown in figure SAC107-1 in place of the UUT. The resistive load should be sized to draw the same current as the UUT. Set the programmable power supply to produce a voltage waveform having harmonic contents listed in table SAC107-II. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Confirm that the programmable power supply is producing a voltage waveform having harmonic content listed in table SAC107-II. Record the settings of the programmable power supply.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SAC107-1. Set the programmable power supply to the settings recorded during the calibration procedure. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. The UUT must remain for a length of time that confirms the utilization equipment can continuously operate with the total voltage distortion and should be, not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltage, frequency, voltage distortion factor, voltage harmonics, time duration at test condition, and the performance of the UUT in the data sheet shown in table SAC107-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, set the programmable power supply to produce a sine wave. Adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SAC107-II. Voltage harmonics as percent of fundamental for total voltage distortion test.

Harmonic	MIL-STD-704A Percent of Fundamental	MIL-STD-704B, C, D, E, & F Percent of Fundamental
Fundamental	100%	100%
2nd	0%	0%
3rd	5.00%	2.75%
4th	0%	0%
5th	4.12%	2.75%
6th	0%	0%
7th	2.94%	1.97%
8th	0%	0%
9th	2.29%	1.53%
10th	0%	0%
11th	1.87%	1.25%
12th	0%	0%
13th	1.58%	1.06%
14th	0%	0%
15th	1.37%	0.92%



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SAC107-1. Total voltage distortion.

TABLE SAC107-III. Sample data sheet for SAC107 total voltage distortion.

<table>
<tr><th colspan="8">Parameters</th><th>Performance</th></tr>
<tr><th colspan="2">Voltage</th><th colspan="2">Frequency</th><th colspan="2">Voltage Distortion Factor</th><th colspan="2">Time Duration at Condition</th><th>Pass/Fail</th></tr>
<tr><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>No Units</td><td></td><td>min</td><td></td></tr>
</table>

Voltage Harmonics		
Fund		%
2nd		%
3rd		%
4th		%
5th		%
6th		%
7th		%
8th		%
9th		%
10th		%
11th		%
12th		%
13th		%
14th		%
15th		%

METHOD SAC108
DC Voltage Component

POWER GROUP: Single Phase, 400 Hz 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: DC Voltage Component

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SAC108-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to a direct current component of AC voltage and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SAC108-I. MIL-STD-704 limits for direct current component of AC voltage.

Limit	704A	704B	704C	704D	704E	704F
DC Voltage Component of the AC Voltage	± 0.10 V	± 0.10 V	± 0.10 V	± 0.10 V	± 0.10 V	± 0.10 V

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter (with capability to measure DC component of AC waveform)
c. Frequency counter

4. Test setup. Configure the test setup as shown in figure SAC108-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SAC108-1. Set the programmable power supply to produce a voltage waveform having a DC component for test condition A as noted in

table SAC108-II. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. The UUT should remain for a length of time that confirms the utilization equipment can continuously operate with the direct current component of the AC voltage and should be not less than thirty (30) minutes. Repeat the test for test condition B as noted in table SAC108-II. Record the voltage, frequency, DC voltage component, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table SAC108-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, set the programmable power supply to produce a voltage sine wave without a DC component. Adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SAC108-II. Test conditions for direct current component of AC voltage.

Test Condition	MIL-STD-704A, B C, D, E & F Direct Current Component of AC Voltage
A	+ 0.10V
B	− 0.10 V

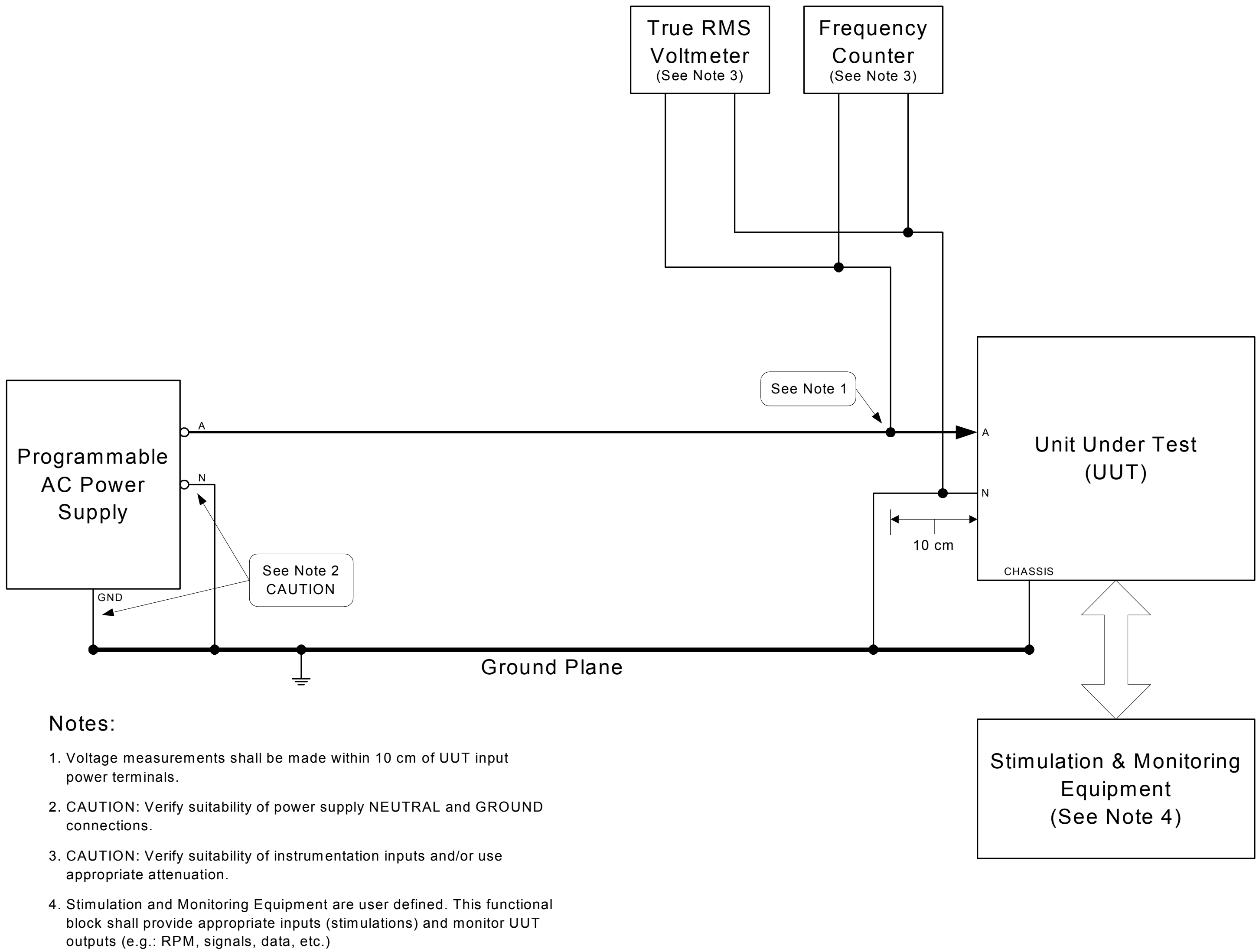


FIGURE SAC108-1. DC voltage component.

TABLE SAC108-III. Sample data sheet for SAC108 DC voltage component.

Test Condition	Parameters								Performance
	Voltage		Frequency		DC Voltage Component		Time Duration at Condition		Pass/Fail
A		V_{rms}		Hz		V_{dc}		min	
B		V_{rms}		Hz		V_{dc}		min	

METHOD SAC109
Normal Voltage Transients

POWER GROUP: Single Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: Normal Voltage Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to normal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SAC109-I. The utilization equipment must maintain specified performance during and after the voltage transients. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SAC109-I. MIL-STD-704 limits for normal voltage transients.

Limit	704A	704B	704C	704D	704E	704F
Normal Voltage Transients	Figure 3 MIL-STD-704A Locus of Equivalent Step Function Curves 2 and 3	Figure 4 MIL-STD-704B	Figure 5 MIL-STD-704C	Figure 5 MIL-STD-704D	Figure 4 MIL-STD-704E	Figure 3 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SAC109-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SAC109-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions

5.1 Compliance test for MIL-STD-704A. The UUT must be subjected to the voltage transients for each test condition A through O noted in table SAC109-II. The voltage must increase or decrease from steady state voltage to the voltage transient level within ½ cycle (1.25 milliseconds). The voltage must remain at the voltage transient level for the duration noted in table SAC109-II. The voltage should return to steady state over the time duration noted in table SAC109-II. For test condition G, three over-voltage transients of 160 Vrms for 25 milliseconds are performed, separated by 0.5 seconds. For test condition N, three under-voltage transients of 58 Vrms for 25 milliseconds are performed, separated by 0.5 seconds. For test condition O, an under-voltage transient of 58 Vrms for 25 milliseconds is immediately followed by an overvoltage transient of 160 Vrms for 25 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal steady state limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltage, steady state frequency, voltage transient level, time duration at voltage transient, oscilloscope trace, and the performance of the UUT for each test condition in the data sheet shown in table SAC109-IV. Repeat for each mode of operation of the UUT. In addition, for MIL-STD-704A test compliance perform the repetitive normal voltage transient test described in 5.3.

5.2 Compliance test for MIL-STD-704B, C, D, E, & F. The UUT must be subjected to the voltage transients for each test condition AA through MM noted in table SAC109-III. The voltage must increase or decrease from steady state voltage to the voltage transient level within ½ cycle (1.25 milliseconds). The voltage must remain at the voltage transient level for the duration noted in table SAC109-III. The voltage must return to steady state over the time duration noted in table SAC109-III. For test condition GG, three overvoltage transients of 180 Vrms for 10 milliseconds are performed, separated by 0.5 seconds. For test condition LL, three undervoltage transients of 80 Vrms for 10 milliseconds are performed, separated by 0.5 seconds. For test condition MM, an undervoltage transient of 80 Vrms for 10 milliseconds is immediately followed by an overvoltage transient of 180 Vrms for 10 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal steady state limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltage, steady state frequency, voltage transient level, time duration at voltage transient, oscilloscope trace, and the performance of the UUT for each test condition in the data sheet shown in table SAC109-V. Repeat for each mode of operation of the UUT. In addition, for MIL-STD-704B, C, D, E, & F test compliance perform the repetitive normal voltage transient test described in 5.3.

5.3 Repetitive normal voltage transients test. Program the power supply to provide a continually repeating voltage transient that decreases from 115 Vrms to 90 Vrms in 2.5 msec, then increases to 140 Vrms over 50 msec, then decreases to 115 Vrms over 5.0 msec. The voltage transient is repeated every 0.5 seconds, see figure SAC109-2. The UUT must be subjected to the repetitive voltage transient for a length of time that confirms the utilization equipment can continuously operate and should be, not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltage, steady state frequency, high voltage transient level, low voltage transient level, oscilloscope trace, time duration at test condition, and the performance of the UUT in the data sheet shown in table SAC109-IV or table SAC109-V. Repeat for each mode of operation of the UUT.

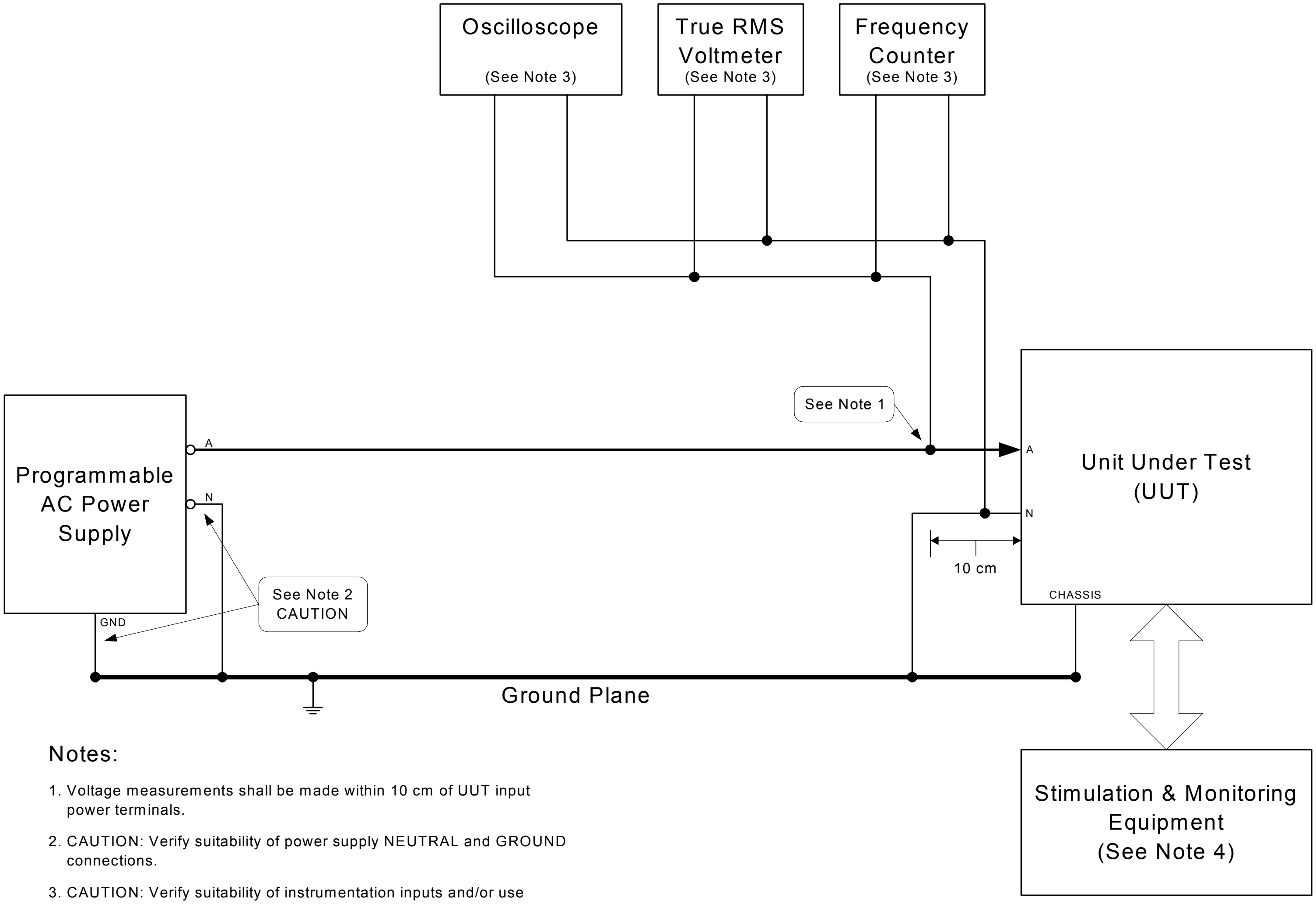
After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SAC109-II. Test conditions for MIL-STD-704A normal voltage transients.

Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage milliseconds
Overvoltage Transients				
A	< 1.25 msec	135 Vrms	210 msec	< 1.25 msec
B	< 1.25 msec	135 Vrms	145 msec	130 msec
C	< 1.25 msec	145 Vrms	130 msec	< 1.25 msec
D	< 1.25 msec	145 Vrms	90 msec	80 msec
E	< 1.25 msec	160 Vrms	48 msec	< 1.25 msec
F	< 1.25 msec	160 Vrms	30 msec	40 msec
G	< 1.25 msec	160 Vrms (3 times)	25 msec every 0.5 sec	< 1.25 msec
Undervoltage Transients				
H	< 1.25 msec	90 Vrms	300 msec	< 1.25 msec
I	< 1.25 msec	90 Vrms	210 msec	180 msec
J	< 1.25 msec	70 Vrms	140 msec	< 1.25 msec
K	< 1.25 msec	70 Vrms	95 msec	85 msec
L	< 1.25 msec	58 Vrms	48 msec	< 1.25 msec
M	< 1.25 msec	58 Vrms	30 msec	40 msec
N	< 1.25 msec	58 Vrms (3 times)	25 msec every 0.5 sec	< 1.25 msec
Combined Transient				
O	< 1.25 msec then < 1.25 msec	58 Vrms 160 Vrms	25 msec 25 msec	< 1.25 msec 50 msec

TABLE SAC109-III. Test conditions for MIL-STD-704B, C, D, E and F normal voltage.

Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage milliseconds
Overvoltage Transients				
AA	< 1.25 msec	140 Vrms	60 msec	< 1.25 msec
BB	< 1.25 msec	140 Vrms	60 msec	25 msec
CC	< 1.25 msec	160 Vrms	34 msec	< 1.25 msec
DD	< 1.25 msec	160 Vrms	34 msec	52 msec
EE	< 1.25 msec	180 Vrms	10 msec	< 1.25 msec
FF	< 1.25 msec	180 Vrms	10 msec	77 msec
GG	< 1.25 msec	180 Vrms (3 times)	10 msec every 0.5 sec	< 1.25 msec
Undervoltage Transients				
HH	< 1.25 msec	90 Vrms	35 msec	< 1.25 msec
II	< 1.25 msec	90 Vrms	35 msec	45 msec
JJ	< 1.25 msec	80 Vrms	10 msec	< 1.25 msec
KK	< 1.25 msec	80 Vrms	10 msec	70 msec
LL	< 1.25 msec	80 Vrms (3 times)	10 msec every 0.5 sec	< 1.25 msec
Combined Transient				
MM	< 1.25 msec then < 1.25 msec	80 Vrms 180 Vrms	10 msec 10 msec	< 1.25 msec 77 msec



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SAC109-1. Normal voltage transients.

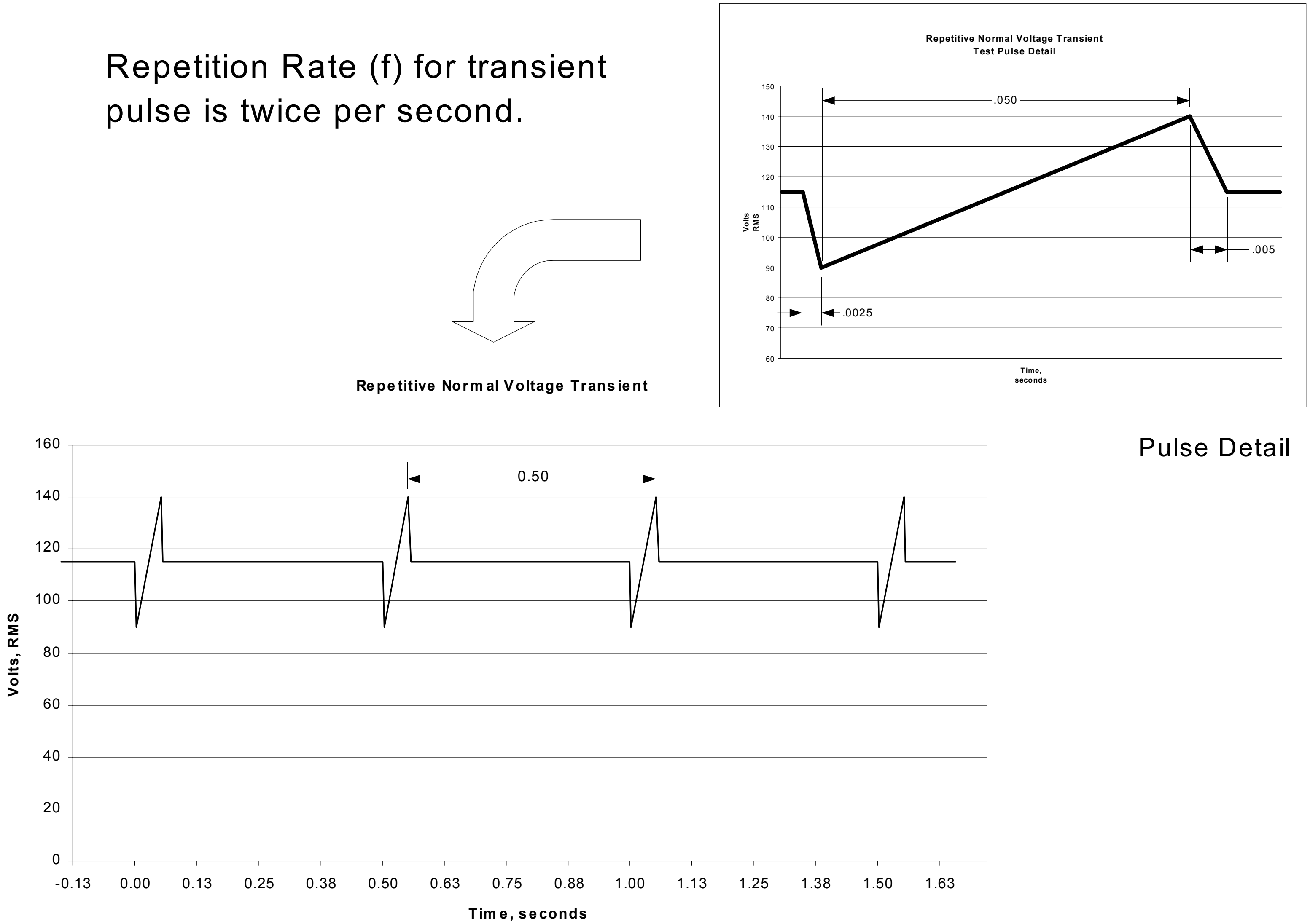


FIGURE SAC109-2. Repetitive normal voltage transient.

TABLE SAC109-IV. Sample data sheet for SAC109 normal voltage transients for MIL-STD-704A.

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
B		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
C		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
D		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
E		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
F		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
G		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
H		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
I		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
J		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
K		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
L		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
M		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
N		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
O		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
						V_{rms}		msec			
Repetitive Normal Voltage Transient											
Repetitive Transient	Steady State Voltage		Steady State Frequency		High Voltage Transient		Low Voltage Transient		Oscilloscope Trace		
		V_{rms}		Hz		V_{rms}		V_{rms}	Attach Trace	V_{rms} vs. Time	
	Time Duration at Test Condition										
		minutes									

TABLE SAC109-V. Sample data sheet for SAC109 normal voltage transients for MIL-STD-704B, C, D, E, & F.

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
AA		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
BB		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
CC		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
DD		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
EE		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
FF		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
GG		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
HH		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
II		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
JJ		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
KK		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
LL		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
MM		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
						V_{rms}		msec			
Repetitive Normal Voltage Transient											
Repetitive Transient	Steady State Voltage		Steady State Frequency		High Voltage Transient		Low Voltage Transient		Oscilloscope Trace		
		V_{rms}		Hz		V_{rms}		V_{rms}	Attach Trace	V_{rms} vs. Time	
	Time Duration at Test Condition										
		minutes									

METHOD SAC110
Normal Frequency Transients

POWER GROUP: Single Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Normal Frequency Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to normal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to frequency transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SAC110-I. The utilization equipment must maintain specified performance during and after the frequency transients. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SAC110-I. MIL-STD-704 limits for normal frequency transients.

Limit	704A	704B	704C	704D	704E	704F
Normal Frequency Transients	Figure 5 MIL-STD-704A Locus of Equivalent Step Function Curves 2 and 3	¶ 5.1.3 MIL-STD-704B	Figure 6 MIL-STD-704C	Figure 6 MIL-STD-704D	Figure 5 MIL-STD-704E	Figure 5 MIL-STD-704F
Normal Maximum Rate of Change of Frequency	250 Hz/sec	N/A	N/A	N/A	N/A	N/A

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SAC110-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SAC110-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

5.1 Compliance test for MIL-STD-704A. The UUT should be subjected to the frequency transients for each test condition A through I noted in table SAC110-II. The frequency must increase or decrease from steady state frequency to the frequency transient level over the duration noted; the frequency must remain at the frequency transient level for the duration noted; and the frequency should return from the frequency transient level over the duration noted. For test condition I, an underfrequency transient of 350 Hz is immediately followed by an overfrequency transient of 450 Hz. For each test condition, monitoring the performance of the UUT during the frequency transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal steady state limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltage, steady state frequency, frequency transient level, time at frequency transient, oscilloscope trace (Hz vs. time), and the performance of the UUT for each test condition in the data sheet shown in table SAC110-IV. Repeat for each mode of operation of the UUT.

5.2 Compliance test for MIL-STD-704B, C, D, E, & F. The UUT must be subjected to the frequency transients for each test condition AA through II noted in table SAC110-III. The frequency should increase or decrease from steady state frequency to the frequency transient level over the duration noted; the frequency must remain at the frequency transient level for the duration noted; and the frequency must return from the frequency transient level over the duration noted. For test condition II, an underfrequency transient of 375 Hz is immediately followed by an overfrequency transient of 425 Hz. For each test condition, monitoring the performance of the UUT during the frequency transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal steady state limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltage, steady state frequency, frequency transient level, time at frequency transient, oscilloscope trace (Hz vs. time), and the performance of the UUT for each test condition in the data sheet shown in table SAC110-V. Repeat for each mode of operation of the UUT.

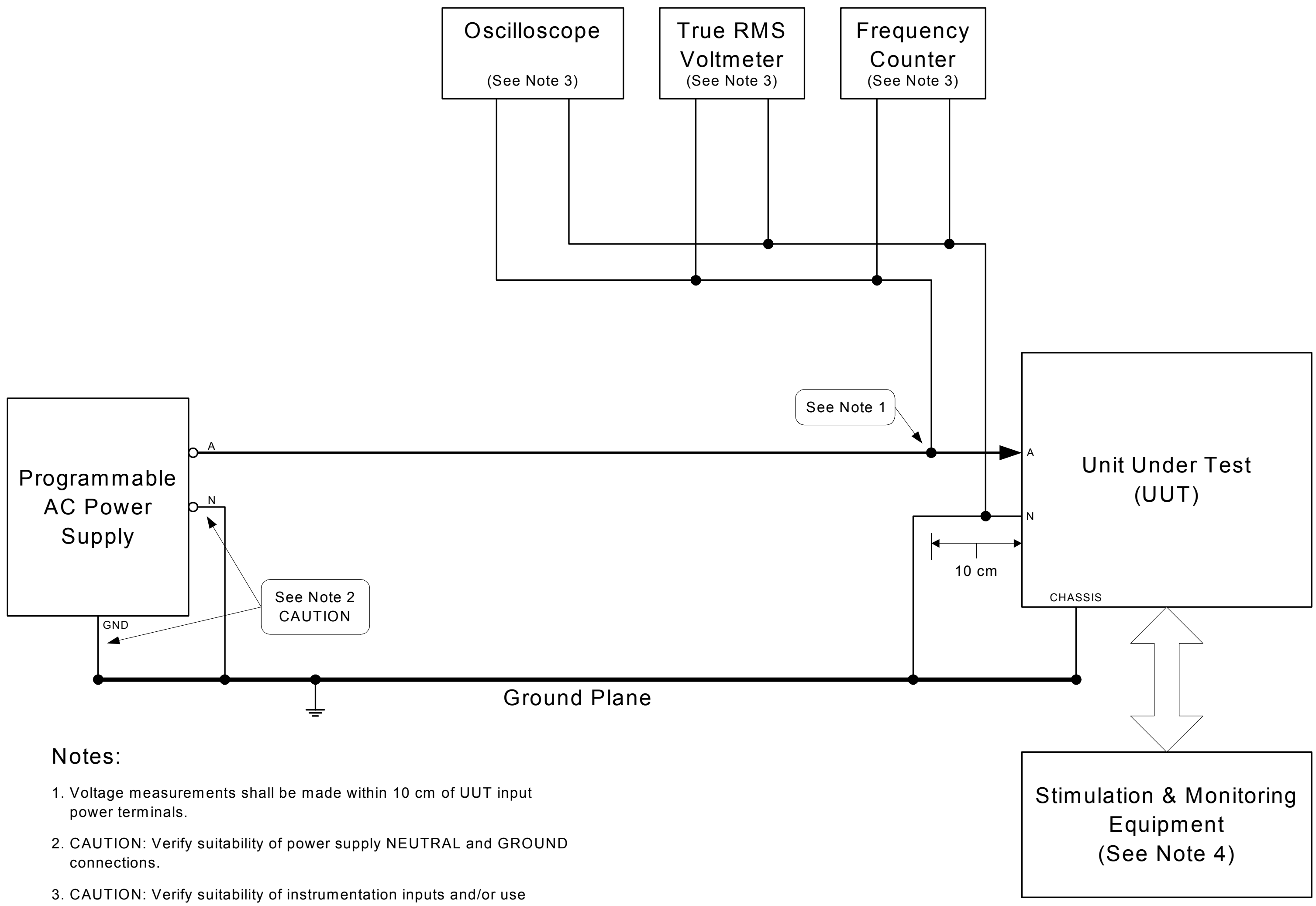
After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SAC110-II. Test conditions for MIL-STD-704A normal frequency transients.

Test Condition	Time From Steady State Frequency to Frequency Transient Level milliseconds	Frequency Transient Level Hz	Duration at Frequency Transient Level	Time From Frequency Transient Level to Steady State Frequency
Overfrequency Transients				
A	120 msec	430 Hz	½ cycle	120 msec
B	300 msec	430 Hz	½ cycle	1.2 seconds
C	200 msec	450 Hz	½ cycle	200 msec
D	250 msec	450 Hz	½ cycle	3 seconds
Underfrequency Transients				
E	120 msec	370 Hz	½ cycle	120 msec
F	300 msec	370 Hz	½ cycle	1.2 seconds
G	200 msec	350 Hz	½ cycle	200 msec
H	250 msec	350 Hz	½ cycle	3 seconds
Combined Transient				
I	200 msec then 200 msec	350 Hz 450 Hz	½ cycle ½ cycle	200 msec 200 msec

TABLE SAC110-III. Test conditions for MIL-STD-704B, C, D, E, and F normal frequency transients.

Test Condition	Time From Steady State Frequency to Frequency Transient Level milliseconds	Frequency Transient Level Hz	Duration at Frequency Transient Level	Time From Frequency Transient Level to Steady State Frequency milliseconds
Overfrequency Transients				
AA	40 msec	410 Hz	10 seconds	40 msec
BB	80 msec	420 Hz	5 seconds	80 msec
CC	100 msec	425 Hz	1 seconds	100 msec
DD	100 msec then 10 msec then 20 msec	425 Hz 420 Hz 410 Hz	1 seconds 4 seconds 5 seconds	10 msec 20 msec 40 msec
Underfrequency Transients				
EE	40 msec	390 Hz	10 seconds	40 msec
FF	80 msec	380 Hz	5 seconds	80 msec
GG	100 msec	375 Hz	1 seconds	100 msec
HH	100 msec then 10 msec then 20 msec	375 Hz 380 Hz 390 Hz	1 seconds 4 seconds 5 seconds	10 msec 20 msec 40 msec
Combined Transient				
II	100 msec then 100 msec	375 Hz 425 Hz	1 seconds 1 seconds	100 msec 100 msec



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SAC110-1. Normal frequency transients.

TABLE SAC110-IV. Sample data sheet for SAC110 normal frequency transients for MIL-STD-704A.

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace		Pass/Fail
A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
B		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
C		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
D		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
E		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
F		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
G		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
H		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
I		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
						Hz		msec			

TABLE SAC110-V. Sample data sheet for SAC110 normal frequency transients for MIL-STD-704B, C, D, E, & F.

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace		Pass/Fail
AA		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
BB		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
CC		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
DD		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
						Hz		sec			
						Hz		sec			
EE		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
FF		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
GG		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
HH		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
						Hz		sec			
						Hz		sec			
II		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
						Hz		sec			

METHOD SAC201
Power Interrupt

POWER GROUP: **Single Phase, 400 Hz, 115 V**

AIRCRAFT ELECTRICAL OPERATING CONDITION: Transfer Interrupt

PARAMETER: Power Interrupt

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to power interrupts as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for transfer aircraft electrical conditions when subjected to power interrupts as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SAC201-I. The utilization equipment must maintain the specified performance during power interrupts. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SAC201-I. MIL-STD-704 power transfer limits.

Limit	704A	704B	704C	704D	704E	704F
Power Interrupt	50 msec	50 msec	50 msec	50 msec	50 msec	50 msec
Voltage NLSS	108 V	108 V	108 V	108 V	108 V	108 V
Voltage NHSS	118 V	118 V	118 V	118 V	118 V	118 V

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope
e. Resistive dummy load

4. Test setup. Configure the test setup as shown in figure SAC201-1. The dummy resistive load placed in parallel to the UUT should be sized to draw three times the steady state current of the UUT. Note: This is done to ensure that the UUT test does not lose stored energy to other aircraft

loads during power interrupts. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

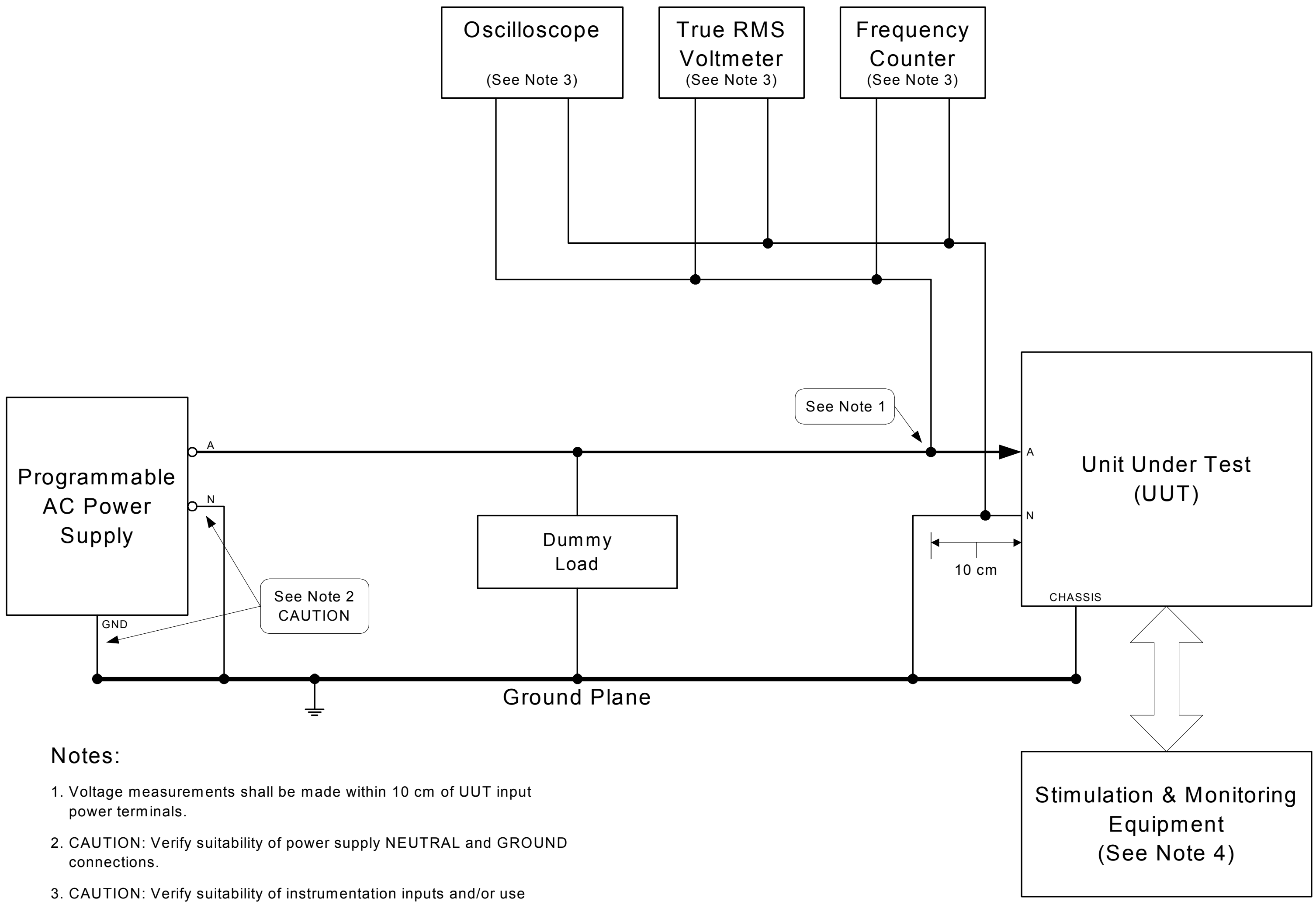
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SAC201-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through K noted in table SAC201-II, adjust the voltage to the steady state voltage listed. Perform a power interrupt (0 V) of the duration listed. The voltage should decrease from the steady state voltage to 0 Volts within ½ cycle (1.25 milliseconds), remain at 0 Volts for the duration listed for the test condition, and return form 0 Volts to the Steady State voltage within ½ cycle (1.25 milliseconds). For test condition J, three 50 millisecond power interrupts are performed, separated by 0.5 seconds. For test condition K a normal overvoltage transient follows the power interrupt. The normal voltage transient is 160 Vrms for 30 milliseconds and returns to nominal voltage over the next 40 milliseconds. For test condition L a normal undervoltage transient follows the power interrupt. The normal voltage transient is 70 Vrms for 30 milliseconds and returns to nominal voltage over the next 40 milliseconds. For each test condition, monitoring the performance of the UUT according to the utilization equipment performance test procedures for power transfer operation to verify that the UUT is providing specified performance for transfer aircraft electrical conditions. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing the performance specified for normal aircraft electrical conditions (if the UUT is allowed degraded performance during power interrupts, verify the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage). Record the steady state voltage, steady state frequency, time duration of power interrupts, and the performance of the UUT for each test condition in the data sheet shown in table SAC201-III. Repeat each test condition 5 times. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SAC201-II. Test conditions for transfer interrupt.

Test Condition	Steady State Voltage	Duration of Interrupt
A	Nominal Voltage	50 msec
B	NLSS Voltage	50 msec
C	NHSS Voltage	50 msec
D	Nominal Voltage	30 msec
E	NLSS Voltage	30 msec
F	NHSS Voltage	30 msec
G	Nominal Voltage	10 msec
H	NLSS Voltage	10 msec
I	NHSS Voltage	10 msec
J	Nominal Voltage	50 msec (repeated 3 times, separated by 0.5 sec)
K	Nominal Voltage	50 msec (followed by a normal voltage transient of 160 Vrms for 30 msec and return to steady state voltage in 40 msec)
L	Nominal Voltage	50 msec (followed by a normal voltage transient of 70 Vrms for 30 msec and return to steady state voltage in 40 msec)



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SAC201-1. Power interrupt.

TABLE SAC201-III. Sample data sheet for SAC201 power interrupt.

<table>
<tr><th rowspan="2">Test Condition</th><th colspan="6">Parameters</th><th>Performance</th></tr>
<tr><th colspan="2">Voltage</th><th colspan="2">Frequency</th><th colspan="2">Time Duration of Power Interrupt</th><th>Pass/Fail</th></tr>
<tr><td>A</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>B</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>C</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>D</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>E</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>F</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>G</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>H</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>I</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>J</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td rowspan="4">K</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td rowspan="4"></td></tr>
<tr><td colspan="6">Overvoltage Transient</td></tr>
<tr><td colspan="3">Voltage Transient</td><td colspan="3">Time at Voltage Transient Level</td></tr>
<tr><td colspan="2"></td><td>V_{rms}</td><td colspan="2"></td><td>msec</td></tr>
<tr><td rowspan="4">L</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td rowspan="4"></td></tr>
<tr><td colspan="6">Undervoltage Transient</td></tr>
<tr><td colspan="3">Voltage Transient</td><td colspan="3">Time at Voltage Transient Level</td></tr>
<tr><td colspan="2"></td><td>V_{rms}</td><td colspan="2"></td><td>msec</td></tr>
</table>

METHOD SAC301
Abnormal Steady State Limits for
Voltage and Frequency

POWER GROUP: Single Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Abnormal

PARAMETER: Abnormal Steady State Limits for Voltage and Frequency

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Abnormal Low Steady State (ALSS) limits and the Abnormal High Steady State (AHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when supplied input power of voltage and frequency at the specified abnormal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table SAC301-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the abnormal steady state voltage and frequency limits and should be, not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the abnormal steady state voltage and frequency limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SAC301-I. MIL-STD-704 abnormal limits for steady state voltage and frequency.

Abnormal Limit	704A	704B	704C	704D	704E	704F
Voltage ALSS	102 V	100 V	100 V	100 V	100 V	100 V
Voltage AHSS	124 V	125 V	125 V	125 V	125 V	125 V
Frequency ALSS	370 Hz	375 Hz	380 Hz	375 Hz	380 Hz	380 Hz
Frequency AHSS	430 Hz	425 Hz	420 Hz	425 Hz	420 Hz	420 Hz

3. Apparatus. The test equipment should be as follows:

a. Adjustable AC power supply
b. True RMS voltmeter
c. Frequency counter

4. Test setup. Configure the test setup as shown in figure SAC301-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

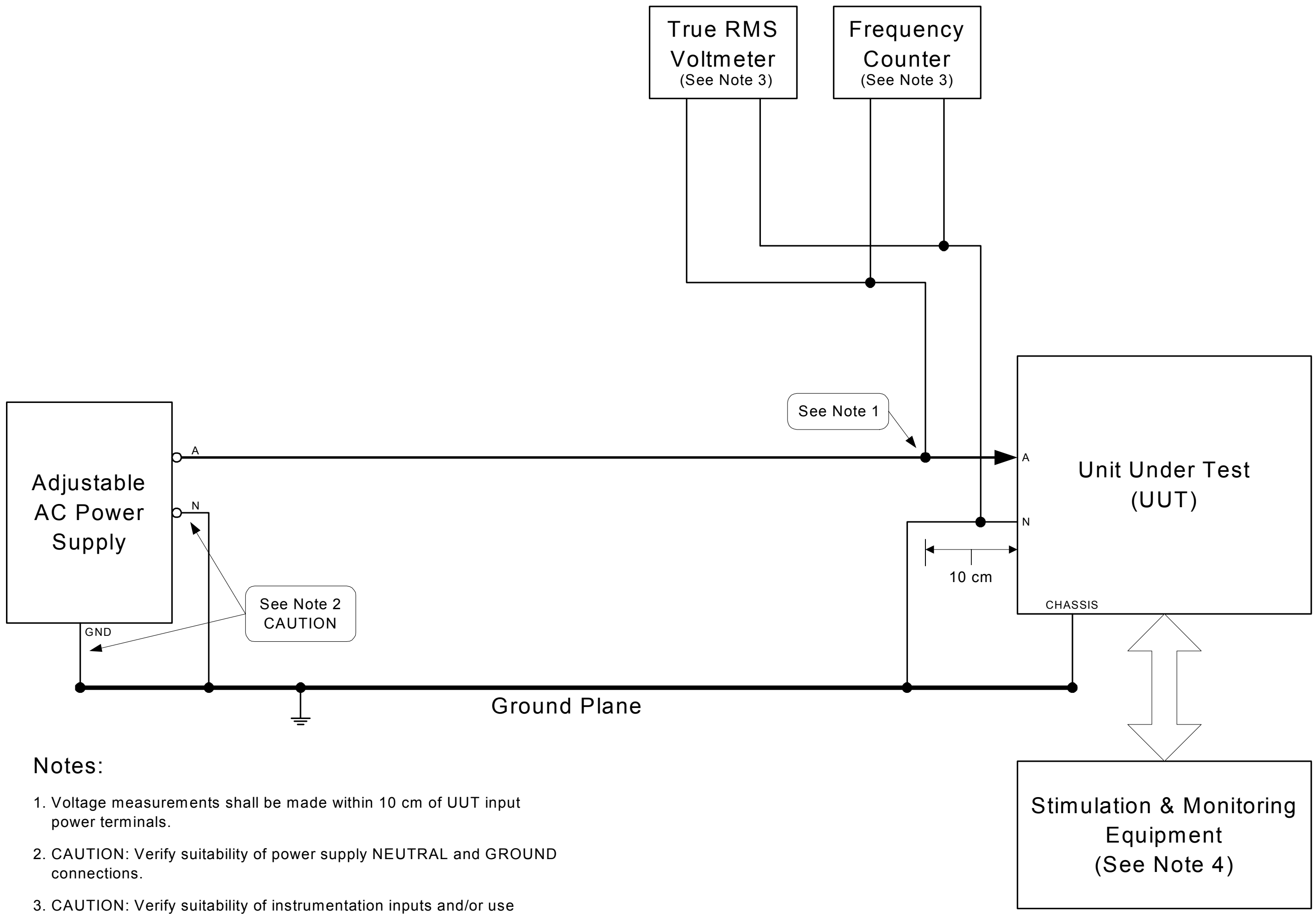
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SAC301-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through H noted in table SAC301-II, the UUT must remain for a length of time that confirms the utilization equipment can perform as specified at the abnormal steady state voltage and frequency limits and should be, not less than thirty (30) minutes. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. For each test condition shutdown the UUT and verify that the UUT can be re-started. After re-start conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Adjust the voltage to the nominal steady state voltage of 115 Vrms and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the voltage, frequency, time duration at test condition, successful/unsuccessful re-start and the performance of the UUT for each test condition in the data sheet shown in table SAC301-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SAC301-II. Test conditions for abnormal steady state limits for voltage and frequency.

Test Condition	Voltage	Frequency
A	Nominal Voltage	ALSS Frequency
B	Nominal Voltage	AHSS Frequency
C	ALSS Voltage	Nominal Frequency
D	ALSS Voltage	ALSS Frequency
E	ALSS Voltage	AHSS Frequency
F	AHSS Voltage	Nominal Frequency
G	AHSS Voltage	ALSS Frequency
H	AHSS Voltage	AHSS Frequency



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SAC301-1. Abnormal steady state limits for voltage and frequency.

TABLE SAC301-III. Sample data sheet for SAC301 abnormal steady state limits for voltage and frequency.

Test Condition	Parameters							Performance
	Voltage		Frequency		Time Duration at Condition		Re-Start (Yes/No)	Pass/Fail
A		V_{rms}		Hz		min		
B		V_{rms}		Hz		min		
C		V_{rms}		Hz		min		
D		V_{rms}		Hz		min		
E		V_{rms}		Hz		min		
F		V_{rms}		Hz		min		
G		V_{rms}		Hz		min		
H		V_{rms}		Hz		min		

METHOD SAC302
Abnormal Voltage Transients

POWER GROUP: Single Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Abnormal

PARAMETER: Abnormal Voltage Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to abnormal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to voltage transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SAC302-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SAC302-I. MIL-STD-704 limits for abnormal voltage transients.

Limit	704A	704B	704C	704D	704E	704F
Abnormal Voltage Transients	Figure 3 MIL-STD-704A Locus of Equivalent Step Function Curves 1 and 4	Figure 5 MIL-STD-704B	Figure 7 MIL-STD-704C	Figure 7 MIL-STD-704D	Figure 6 MIL-STD-704E	Figure 4 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SAC301-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SAC301-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

5.1 Compliance test for MIL-STD-704A. The UUT must be subjected to the voltage transients for each test condition A through O noted in table SAC302-II. The voltage should increase or decrease from steady state voltage to the voltage transient level within ½ cycle (1.25 milliseconds). The voltage must remain at the voltage transient level for the duration noted in table SAC302-II. The voltage must return to steady state over the time duration noted in table SAC302-II For test condition G, three over-voltage transients of 180 Vrms for 20 milliseconds are performed, separated by 0.5 seconds. For test condition N, three under-voltage transients of 45 Vrms for 20 milliseconds are performed, separated by 0.5 seconds. For test condition O, an under-voltage transient of 45 Vrms for 20 milliseconds is immediately followed by an overvoltage transient of 180 Vrms for 75 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits, and has not suffered damage. Record the steady state voltage, steady state frequency, voltage transient level, time duration at voltage transient, oscilloscope trace, and the performance of the UUT for each test condition in the data sheet shown in table SAC302-IV. Repeat for each mode of operation of the UUT.

5.2. Compliance test for MIL-STD-704B, C, D, E, & F. The UUT must be subjected to the voltage transients for each test condition AA through OO noted in table SAC302-III. The voltage must increase or decrease from steady state voltage to the voltage transient level within ½ cycle (1.25 milliseconds). The voltage must remain at the voltage transient level for the duration noted in table SAC302-III. The voltage should return to steady state over the time duration noted in table SAC302-III. For test condition GG, three over-voltage transients of 180 Vrms for 20 milliseconds are performed, separated by 0.5 seconds. For test condition NN, three under-voltage transients of 45 Vrms for 20 milliseconds are performed, separated by 0.5 seconds. For test condition OO, an under-voltage transient of 45 Vrms for 20 milliseconds is immediately followed by an overvoltage transient of 180 Vrms for 50 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits, and has not suffered damage. Record the steady state voltage, steady state frequency, voltage transient level, time duration at voltage transient, oscilloscope trace, and the performance of the UUT for each test condition in the data sheet shown in table SAC302-V. Repeat for each mode of operation of the UUT.

TABLE SAC302-II. Test conditions for MIL-STD-704 abnormal voltage transients.

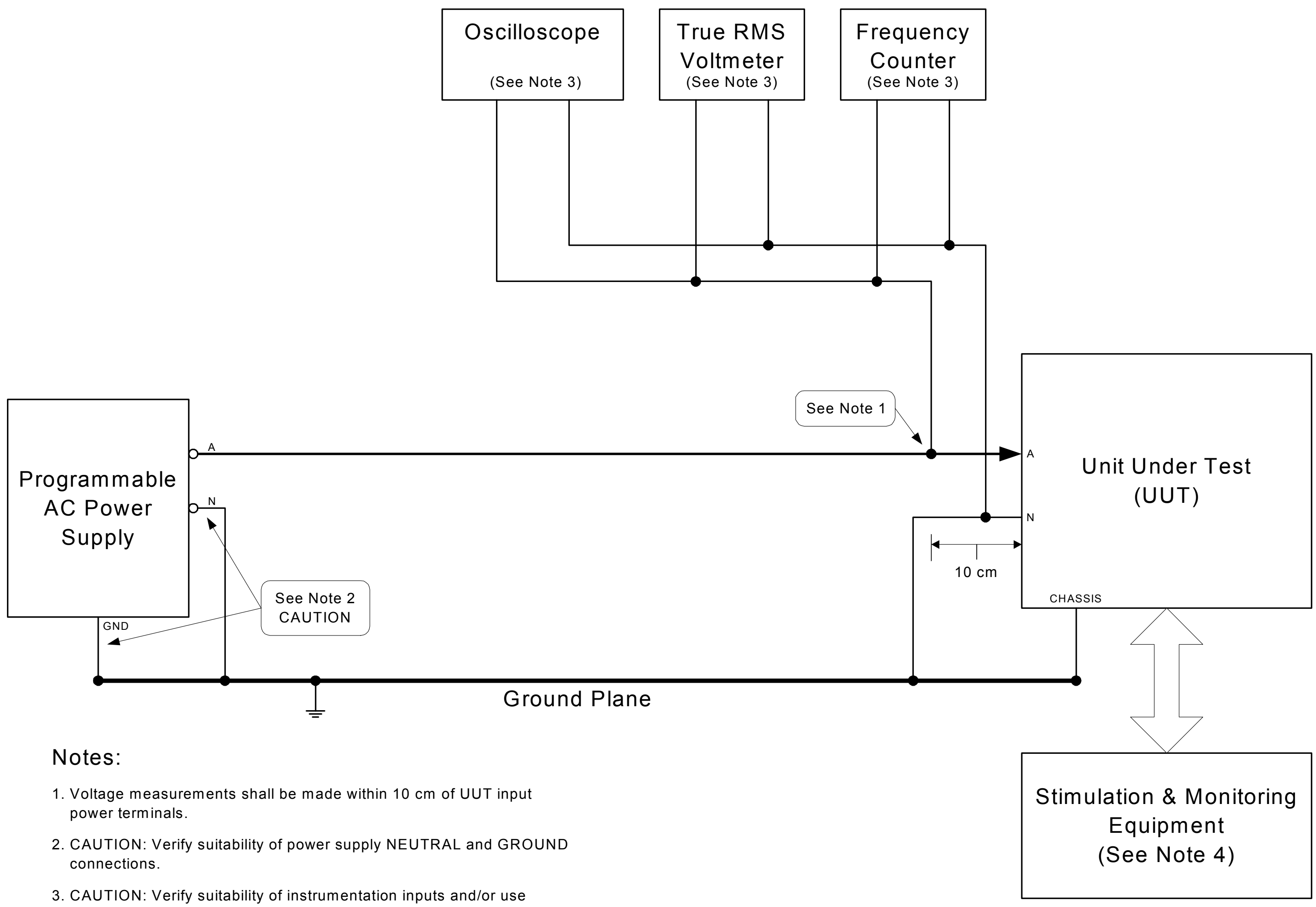
Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage milliseconds
Overvoltage Transients				
A	< 1.25 msec	140 Vrms	1450 msec	< 1.25 msec
B	< 1.25 msec	140 Vrms	1025 msec	850 msec
C	< 1.25 msec	160 Vrms	520 msec	< 1.25 msec
D	< 1.25 msec	160 Vrms	390 msec	250 msec
E	< 1.25 msec	180 Vrms	98 msec	< 1.25 msec
F	< 1.25 msec	180 Vrms	75 msec	50 msec
G	< 1.25 msec	180 Vrms (3 times)	20 msec every 0.5 sec	< 1.25 msec
Undervoltage Transients				
H	< 1.25 msec	85 Vrms	1450 msec	< 1.25 msec
I	< 1.25 msec	85 Vrms	1025 msec	850 msec
J	< 1.25 msec	75 Vrms	520 msec	< 1.25 msec
K	< 1.25 msec	75 Vrms	390 msec	250 msec
L	< 1.25 msec	45 Vrms	98 msec	< 1.25 msec
M	< 1.25 msec	45 Vrms	75 msec	50 msec
N	< 1.25 msec	45 Vrms (3 times)	20 msec every 0.5 sec	< 1.25 msec
Combined Transient				
O	< 1.25 msec then < 1.25 msec	45 Vrms 180 Vrms	20 msec 75 msec	< 1.25 msec 50 msec

TABLE SAC302-III. Test conditions for MIL-STD-704B, C, D, E, and F abnormal voltage transients.

Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Overvoltage Transients				
AA	< 1.25 msec	140 Vrms	180 msec	< 1.25 msec
BB	< 1.25 msec	140 Vrms	180 msec	87 msec
	then	135 Vrms	Decreasing	253 msec
	then	130 Vrms	Decreasing	6.41 sec
	then	125 Vrms	Decreasing	>10 sec
		115 Vrms		
CC	< 1.25 msec	160 Vrms	78 msec	< 1.25 msec
DD	< 1.25 msec	160 Vrms	78 msec	31 msec
	then	150 Vrms	Decreasing	71 msec
	then	140 Vrms	Decreasing	87 msec
	then	135 Vrms	Decreasing	253 msec
	then	130 Vrms	Decreasing	6.41 sec
	then	125 Vrms	Decreasing	>10 sec
		115 Vrms		
EE	< 1.25 msec	180 Vrms	50 msec	< 1.25 msec
FF	< 1.25 msec	180 Vrms	50 msec	11 msec
	then	170 Vrms	Decreasing	17 msec
	then	160 Vrms	Decreasing	31 msec
	then	150 Vrms	Decreasing	71 msec
	then	140 Vrms	Decreasing	87 msec
	then	135 Vrms	Decreasing	253 msec
	then	130 Vrms	Decreasing	6.41 sec
	then	125 Vrms	Decreasing	>10 sec
		115 Vrms		
GG	< 1.25 msec	180 Vrms (3 times)	20 msec every 0.5 sec	< 1.25 msec

TABLE SAC302-III. Test conditions for MIL-STD-704B, C, D, E, and F abnormal voltage transients - Continued

Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Undervoltage Transients				
HH	< 1.25 msec	85 Vrms	180 msec	< 1.25 msec
II	< 1.25 msec	85 Vrms	180 msec	87 msec
	then	90 Vrms	Increasing	253 msec
	then	95 Vrms	Increasing	6.41 sec
	then	100 Vrms	Increasing	>10 sec
		115 Vrms		
JJ	< 1.25 msec	66 Vrms	78 msec	< 1.25 msec
KK	< 1.25 msec	65 Vrms	78 msec	31 msec
	then	75 Vrms	Increasing	71 msec
	then	85 Vrms	Increasing	87 msec
	then	90 Vrms	Increasing	253 msec
	then	95 Vrms	Increasing	6.41 sec
	then	100 Vrms	Increasing	>10 sec
		115 Vrms		
LL	< 1.25 msec	45 Vrms	50 msec	< 1.25 msec
MM	< 1.25 msec	45 Vrms	50 msec	11 msec
	then	55 Vrms	Increasing	17 msec
	then	65 Vrms	Increasing	31 msec
	then	75 Vrms	Increasing	71 msec
	then	85 Vrms	Increasing	87 msec
	then	90 Vrms	Increasing	253 msec
	then	95 Vrms	Increasing	6.41 sec
	then	100 Vrms	Increasing	>10 sec
		115 Vrms		
NN	< 1.25 msec	45 Vrms (3 times)	20 msec every 0.5 sec	< 1.25 msec
Combined Transient				
OO	< 1.25 msec	45 Vrms	20 msec	< 1.25 msec
	< 1.25 msec	then 180 Vrms	50 msec	11 msec
	then	170 Vrms	Decreasing	17 msec
	then	160 Vrms	Decreasing	31 msec
	then	150 Vrms	Decreasing	71 msec
	then	140 Vrms	Decreasing	87 msec
	then	135 Vrms	Decreasing	253 msec
	then	130 Vrms	Decreasing	6.41 sec
	then	125 Vrms	Decreasing	>10 sec
		115 Vrms		



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SAC302-1. Abnormal voltage transients.

TABLE SAC302-IV. Sample data sheet for SAC302 abnormal voltage transients for MIL-STD-704A.

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
B		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
C		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
D		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
E		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
F		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
G		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
H		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
I		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
J		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
K		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
L		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
M		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
N		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
O		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
						V_{rms}		msec			

TABLE SAC302-V. Sample data sheet for SAC302 abnormal voltage transients for MIL-STD-704B, C, D, E, and F.

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
AA		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
BB		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
CC		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
DD		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
EE		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
FF		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
GG		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
HH		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
II		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
JJ		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
KK		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
LL		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
MM		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
NN		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
OO		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
						V_{rms}		msec			

METHOD SAC303
Abnormal Frequency Transients

POWER GROUP: Single Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Abnormal

PARAMETER: Abnormal Frequency Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to abnormal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to frequency transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SAC303-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SAC303-I. MIL-STD-704 limits for abnormal frequency transients.

Limit	704A	704B	704C	704D	704E	704F
Abnormal Frequency Transients	Figure 5 MIL-STD-704A Locus of Equivalent Step Function Curves 1 and 4	¶ 5.1.5 MIL-STD-704B	Figure 8 MIL-STD-704C	Figure 8 MIL-STD-704D	Figure 7 MIL-STD-704E	Figure 6 MIL-STD-704F
Abnormal Maximum Rate of Change of Frequency	500 Hz/sec	500 Hz/sec	500 Hz/sec	N/A	N/A	N/A

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter

d. Oscilloscope

4. <u>Test setup</u>. Configure the test setup as shown in figure SAC303-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. <u>Compliance test</u>. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SAC303-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions.

5.1 <u>Compliance test for MIL-STD-704A</u>. The UUT must be subjected to the frequency transients for each test condition A through E noted in table SAC303-II. The frequency should increase or decrease from steady state frequency to the frequency transient level over the duration noted; the frequency must remain at the frequency transient level for the duration noted; and the frequency must return from the frequency transient level over the duration noted. For test condition E, an underfrequency transient of 320 Hz is immediately followed by an overfrequency transient of 480 Hz. For each test condition, monitor the performance of the UUT during the frequency transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions, and has not suffered damage. Record the steady state voltage, steady state frequency, frequency transient level, time at frequency transient, oscilloscope trace (Hz vs. time), and the performance of the UUT for each test condition in the data sheet shown in table SAC303-IV. Repeat for each mode of operation of the UUT.

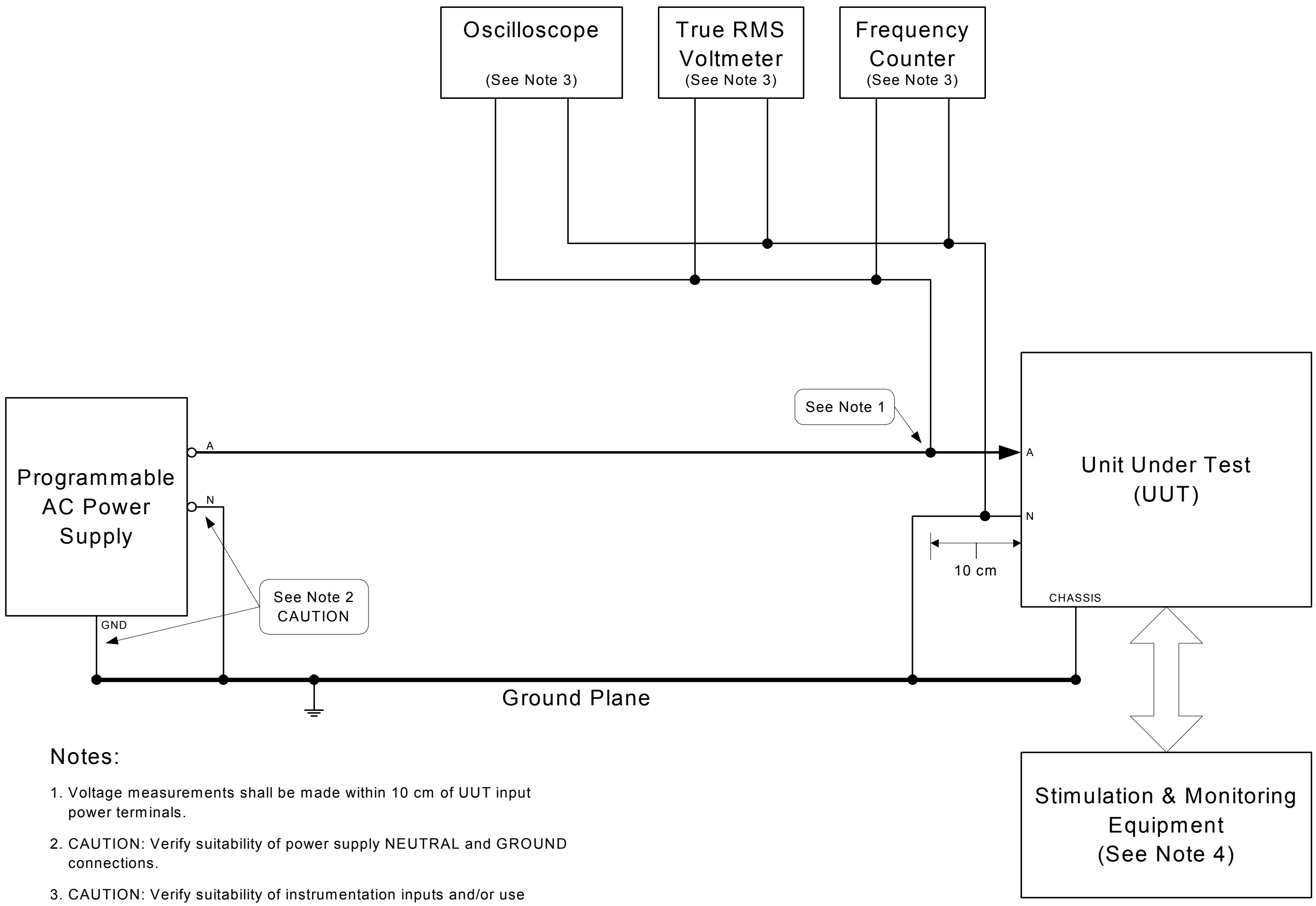
5.2 <u>Compliance test for MIL-STD-704B, C, D, E, & F</u>. The UUT must be subjected to the frequency transients for each test condition AA through EE noted in table SAC303-III. The frequency should increase or decrease from steady state frequency to the frequency transient level over the duration noted; the frequency must remain at the frequency transient level for the duration noted; and the frequency must return from the frequency transient level over the duration noted. For test condition EE, an underfrequency transient of 320 Hz is immediately followed by an overfrequency transient of 480 Hz. For each test condition, monitor the performance of the UUT during the frequency transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions, and has not suffered damage. Record the steady state voltage, steady state frequency, frequency transient level, time at frequency transient, oscilloscope trace (Hz vs. time), and the performance of the UUT for each test condition in the data sheet shown in table SAC303-V. Repeat for each mode of operation of the UUT.

TABLE SAC303-II. Test conditions for MIL-STD-704A abnormal frequency transients.

Test Condition	Time From Steady State Frequency to Frequency Transient Level milliseconds	Frequency Transient Level Hz	Duration at Frequency Transient Level	Time From Frequency Transient Level to Steady State Frequency milliseconds
Overfrequency Transients				
A	333 msec	480 Hz	½ cycle	60 msec
B	333 msec	480 Hz	6.69 seconds	60 msec
Underfrequency Transients				
C	333 msec	320 Hz	½ cycle	60 msec
D	333 msec	320 Hz	6.69 seconds	60 msec
Combined Transient				
E	333 msec 333 msec	320 Hz then 480 Hz	½ cycle ½ cycle	333 msec 333 msec

TABLE SAC303-III. Test conditions for MIL-STD-704B, C, D, E, and F abnormal frequency transients.

Test Condition	Time From Steady State Frequency to Frequency Transient Level milliseconds	Frequency Transient Level Hz	Duration at Frequency Transient Level	Time From Frequency Transient Level to Steady State Frequency milliseconds
Overfrequency Transients				
AA	160 msec	480 Hz	½ cycle	160 msec
BB	160 msec	480 Hz	4.78 seconds	160 msec
Underfrequency Transients				
CC	160 msec	320 Hz	½ cycle	160 msec
DD	160 msec	320 Hz	4.78 seconds	160 msec
Combined Transient				
EE	160 msec 160 msec	320 Hz then 480 Hz	½ cycle ½ cycle	160 msec 160 msec



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SAC303-1. Abnormal frequency transients.

TABLE SAC303-IV. Sample data sheet for SAC303 abnormal frequency transients for MIL-STD-704A.

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace		Pass/Fail
A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
B		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
C		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
D		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
E		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
						Hz		msec			

TABLE SAC303-V. Sample data sheet for SAC303 abnormal frequency transients for MIL-STD-704B, C, D, E, & F.

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace		Pass/Fail
AA		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
BB		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
CC		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
DD		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
EE		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
						Hz		msec			

METHOD SAC401
Emergency Steady State Limits
for Voltage and Frequency

POWER GROUP:	Single Phase, 400 Hz, 115 V
AIRCRAFT ELECTRICAL OPERATING CONDITION:	Emergency
PARAMETER:	Emergency Steady State Limits for Voltage and Frequency

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Emergency Low Steady State (ELSS) limits and the Emergency High Steady State (EHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for emergency aircraft electrical conditions when supplied input power of voltage and frequency at the specified emergency steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table SAC401-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the emergency steady state voltage and frequency limits and should be, not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the emergency steady state voltage and frequency limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SAC401-I. MIL-STD-704 emergency limits for steady state voltage and frequency.

Emergency Limit	704A	704B	704C	704D	704E[1/]	704F[1/]
Voltage ELSS	104 V	102 V	104 V	104 V	108 V	108 V
Voltage EHSS	122 V	124 V	122 V	122 V	118 V	118 V
Frequency ELSS	360 Hz	360 Hz	360 Hz	360 Hz	393 Hz	393 Hz
Frequency EHSS	440 Hz	440 Hz	440 Hz	440 Hz	407 Hz	407 Hz

[1/] For MIL-STD-704E and F, performance of test method SAC102 will constitute performance of test method SAC401.

3. Apparatus. The test equipment should be as follows:

a. Adjustable AC power supply
b. True RMS voltmeter
c. Frequency counter

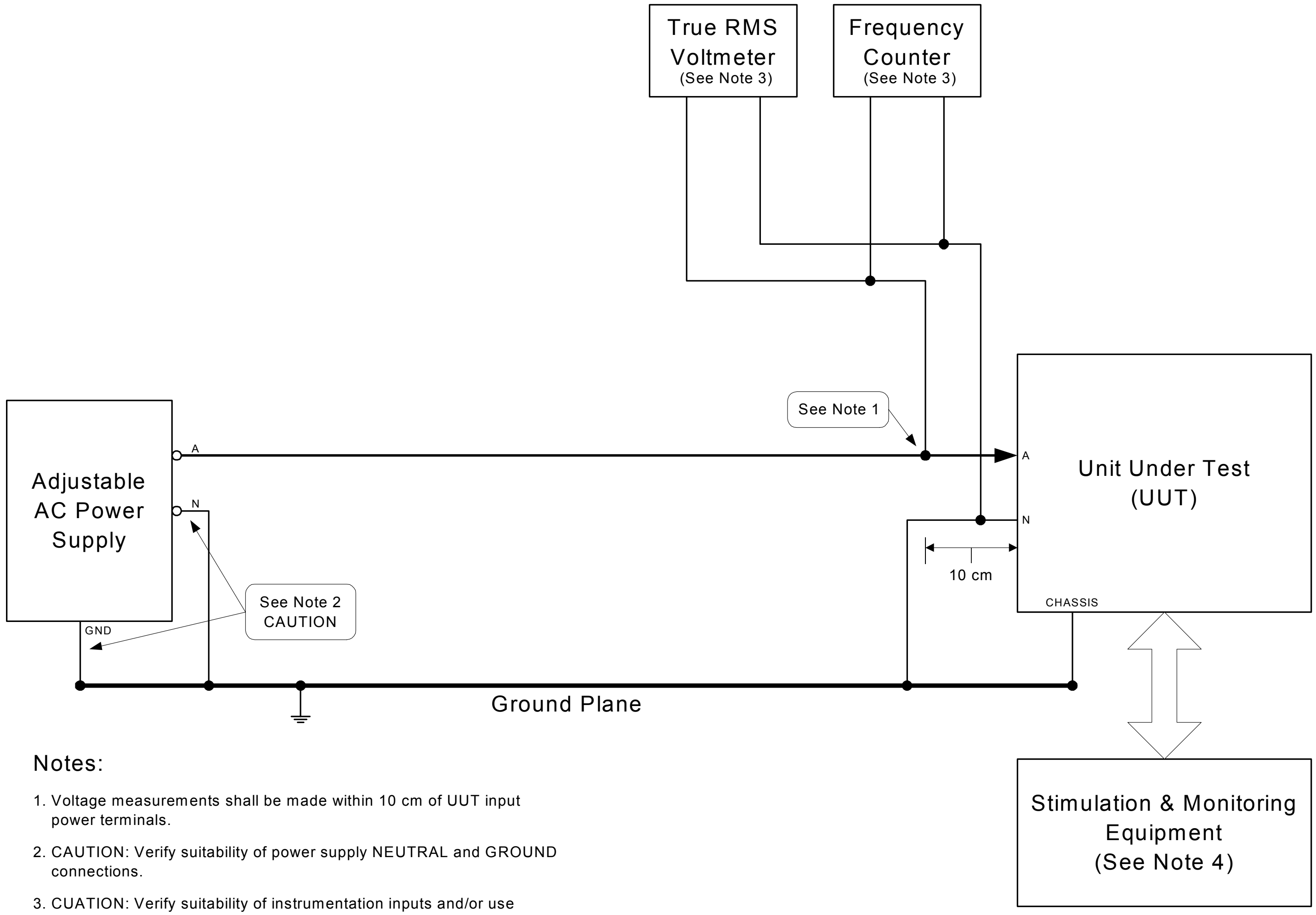
4. Test setup. Configure the test setup as shown in figure SAC401-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SAC401-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through H noted in table SAC401-II, the UUT must remain for a length of time that confirms the utilization equipment can perform as specified at the emergency steady state voltage and frequency limits and should be, not less than thirty (30) minutes. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for emergency aircraft electrical conditions. For each test condition shutdown the UUT and verify that the UUT can be re-started. After re-start conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for emergency aircraft electrical conditions. Adjust the voltage to the nominal steady state voltage of 115 Vrms and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the voltage, frequency, time duration at test condition, successful/unsuccessful re-start and the performance of the UUT for each test condition in the data sheet shown in table SAC401-III. Repeat for each mode of operation of the UUT.

TABLE SAC401-II. Test conditions for emergency steady state limits for voltage and frequency.

Test Condition	Voltage	Frequency
A	Nominal Voltage	ELSS Frequency
B	Nominal Voltage	EHSS Frequency
C	ELSS Voltage	Nominal Frequency
D	ELSS Voltage	ELSS Frequency
E	ELSS Voltage	EHSS Frequency
F	EHSS Voltage	Nominal Frequency
G	EHSS Voltage	ELSS Frequency
H	EHSS Voltage	EHSS Frequency



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CUATION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SAC401-1. Emergency steady state limits for voltage and frequency.

TABLE SAC401-III. Sample data sheet for SAC401 emergency steady state limits for voltage and frequency.

Test Condition	Parameters							Performance
	Voltage		Frequency		Time Duration at Condition		Re-Start (Yes/No)	Pass/Fail
A		V_{rms}		Hz		min		
B		V_{rms}		Hz		min		
C		V_{rms}		Hz		min		
D		V_{rms}		Hz		min		
E		V_{rms}		Hz		min		
F		V_{rms}		Hz		min		
G		V_{rms}		Hz		min		
H		V_{rms}		Hz		min		

METHOD SAC501
(No Test Required)

POWER GROUP: Single Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Starting

PARAMETER: No Tests

Starting operations are usually not applicable to AC utilization equipment.

METHOD SAC601
Power Failure (Single Phase)

POWER GROUP: Single Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Power Failure

PARAMETER: Power Failure (Single Phase)

1. Scope

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to power failures as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to power failures as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SAC601-I. The utilization equipment must maintain the specified performance during the power failures. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SAC601-I. MIL-STD-704 power failure limits.

Limit	704A	704B	704C	704D	704E	704F
Power Failure	7 sec Figure 3 Curve 4 MIL-STD-704B	7 sec Figure 5 MIL-STD-704B	7 sec Figure 7 MIL-STD-704C	7 sec Figure 7 MIL-STD-704D	7 sec Figure 6 MIL-STD-704E	7 sec Figure 4 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SAC106-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

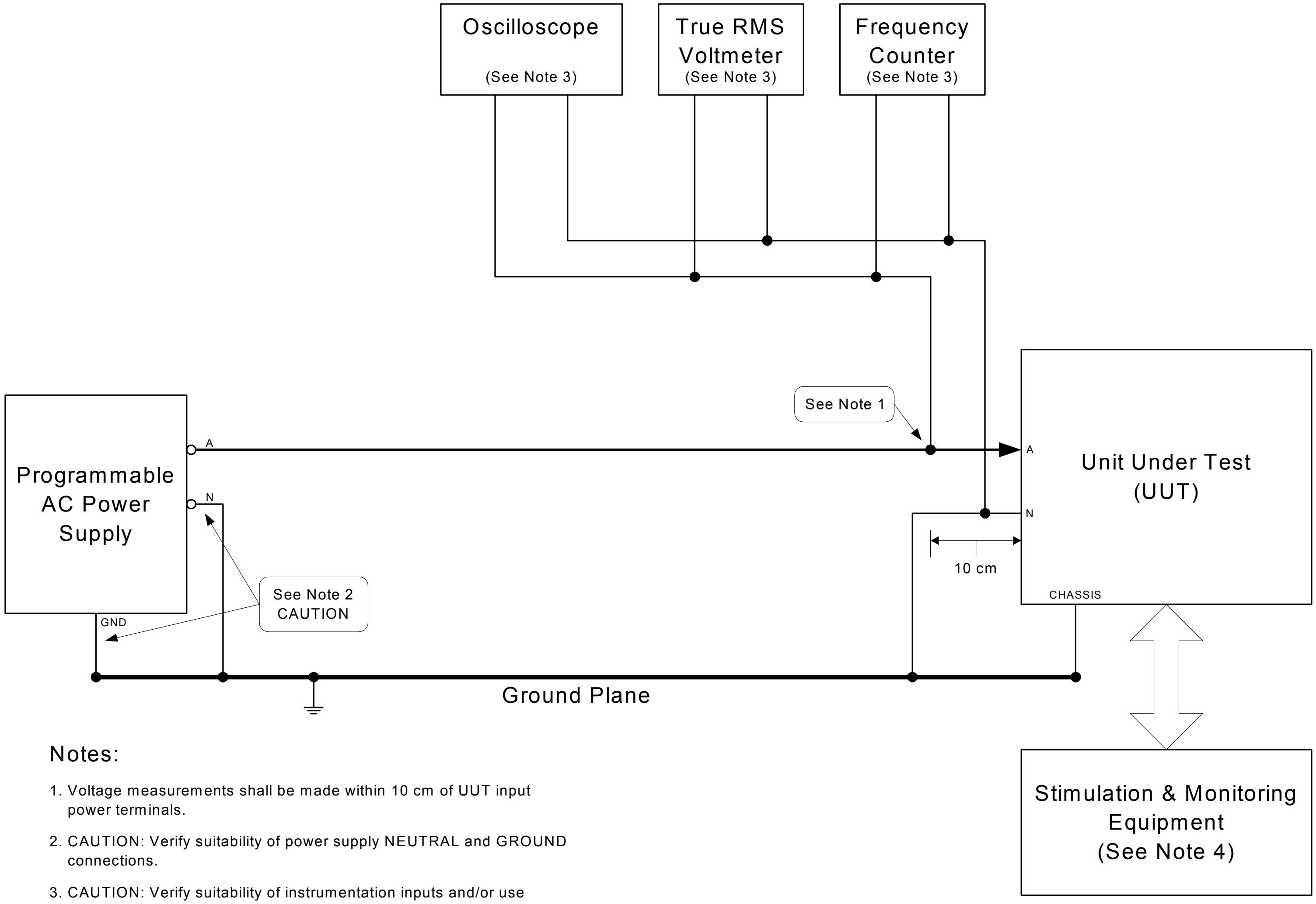
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SAC601-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through D noted in table SAC601-II, perform a power failure (0 V) of the duration listed. The voltage should decrease from the steady state voltage to 0 Volts within ½ cycle (1.25 milliseconds), remain at 0 Volts for the duration listed for the test condition, and return form 0 Volts to the steady state voltage within ½ cycle (1.25 milliseconds). For each test condition, monitor the performance of the UUT according to the utilization equipment performance test procedures for power failure operation to verify that the UUT is providing specified performance for power failure aircraft electrical conditions. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the steady state voltage, steady state frequency, time duration of power failure, and the performance of the UUT for each test condition in the data sheet shown in table SAC601-III. Repeat each test condition 5 times. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SAC601-II. Test conditions for single phase power failures.

Test Condition	Duration of Power Failure
A	100 msec
B	500 msec
C	3 seconds
D	7 seconds



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SAC601-1. Power failure.

TABLE SAC601-III. Sample data sheet for SAC601 power failure (single phase).

Test Condition	Parameters						Performance
	Voltage		Frequency		Time Duration of Power Failure		Pass/Fail
A		V_{rms}		Hz		msec	
B		V_{rms}		Hz		msec	
C		V_{rms}		Hz		sec	
D		V_{rms}		Hz		sec	

METHOD SAC602
(No Test Required)

POWER GROUP:	Single Phase, 400 Hz, 115 V
AIRCRAFT ELECTRICAL OPERATING CONDITION:	Power Failure
PARAMETER:	No Test Required. Test number SAC602 is not used so that the single phase, 400 Hz, 115 V (SAC) test numbers coincide with the three phase, 400 Hz, 115 V (TAC) test sequence numbers.

METHOD SAC603
Phase Reversal (Single Phase)

POWER GROUP: Single Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Power Failure

PARAMETER: Phase Reversal (Single Phase)

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, 400 Hz power utilization equipment is not damaged by phase reversal or a positive physical means is employed to prevent phase reversal.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment is not damaged and does not cause an unsafe condition when the line and neutral connection are reversed for the applicable edition(s) of MIL-STD-704 and as noted in table SAC603-I. A positive physical means to prevent phase reversal may be used to fulfill this requirement.

TABLE SAC603-I. MIL-STD-704 phase reversal requirement.

Limit	704A	704B	704C	704D	704E	704F
Phase Reversal	N/A	N/A	N/A	N/A	N/A	Phase Reversal Does not Cause Damage

3. Apparatus. The test equipment should be as follows:

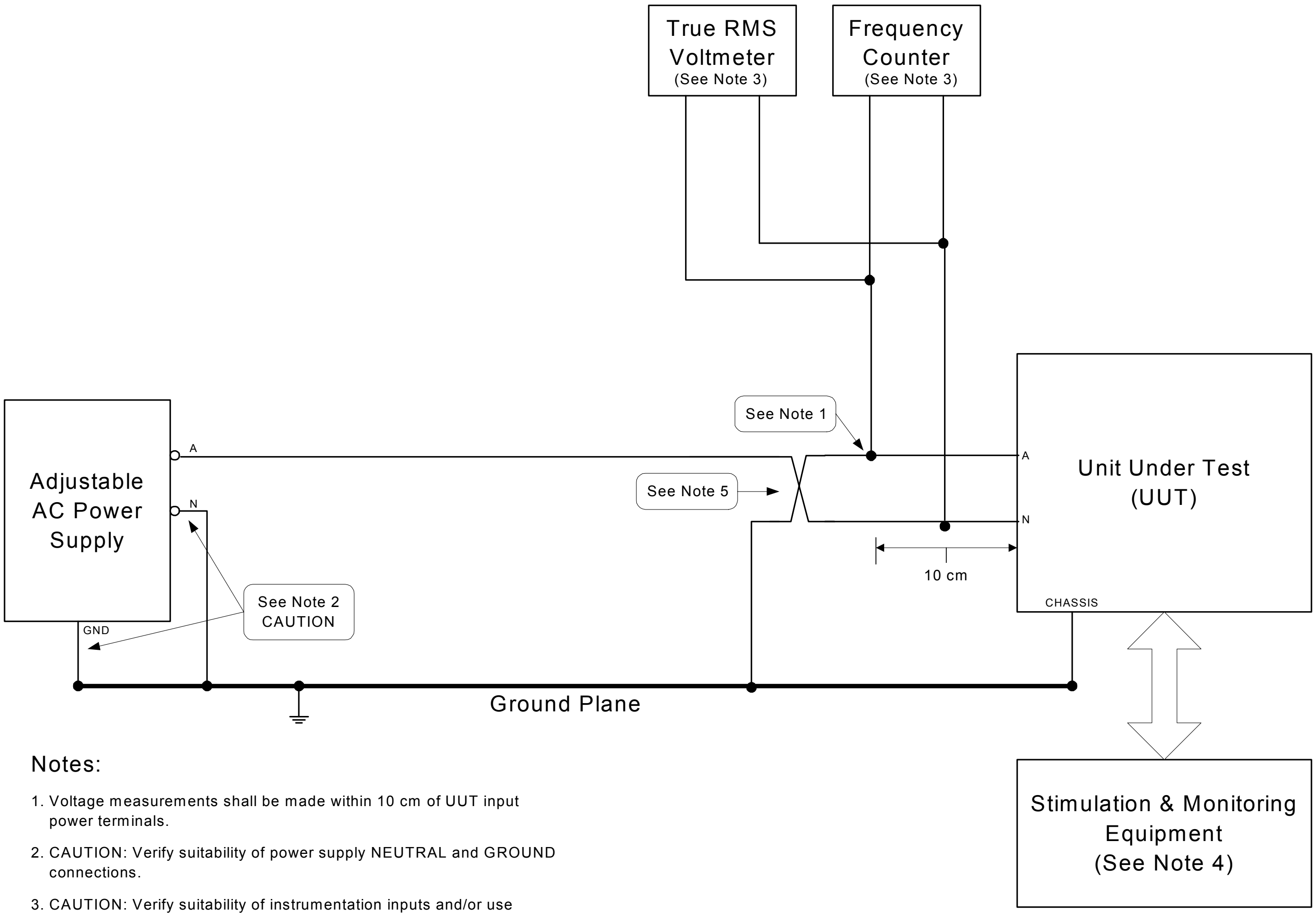
a. Adjustable AC power supply
b. True RMS voltmeter
c. Frequency counter

4. Test setup. Configure the test setup as shown in figure SAC603-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. If a positive physical means is employed to prevent phase reversal, confirm that the line and neutral conductor cannot be reversed.

If the line and neutral conductor can be reversed, with the power source off, install the UUT and the stimulation and monitoring rquipment into the test setup of figure SAC603-1 (line and neutral conductors reversed). Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. The UUT must remain for a length of time that confirms the utilization equipment is not damaged and does not cause an unsafe condition due to phase reversal and should be not less than thirty (30) minutes. Record the steady state voltage, steady state frequency, time duration at phase reversal test condition, and the performance of the UUT in the data sheet shown in table SAC603-II. Repeat for each mode of operation of the UUT.

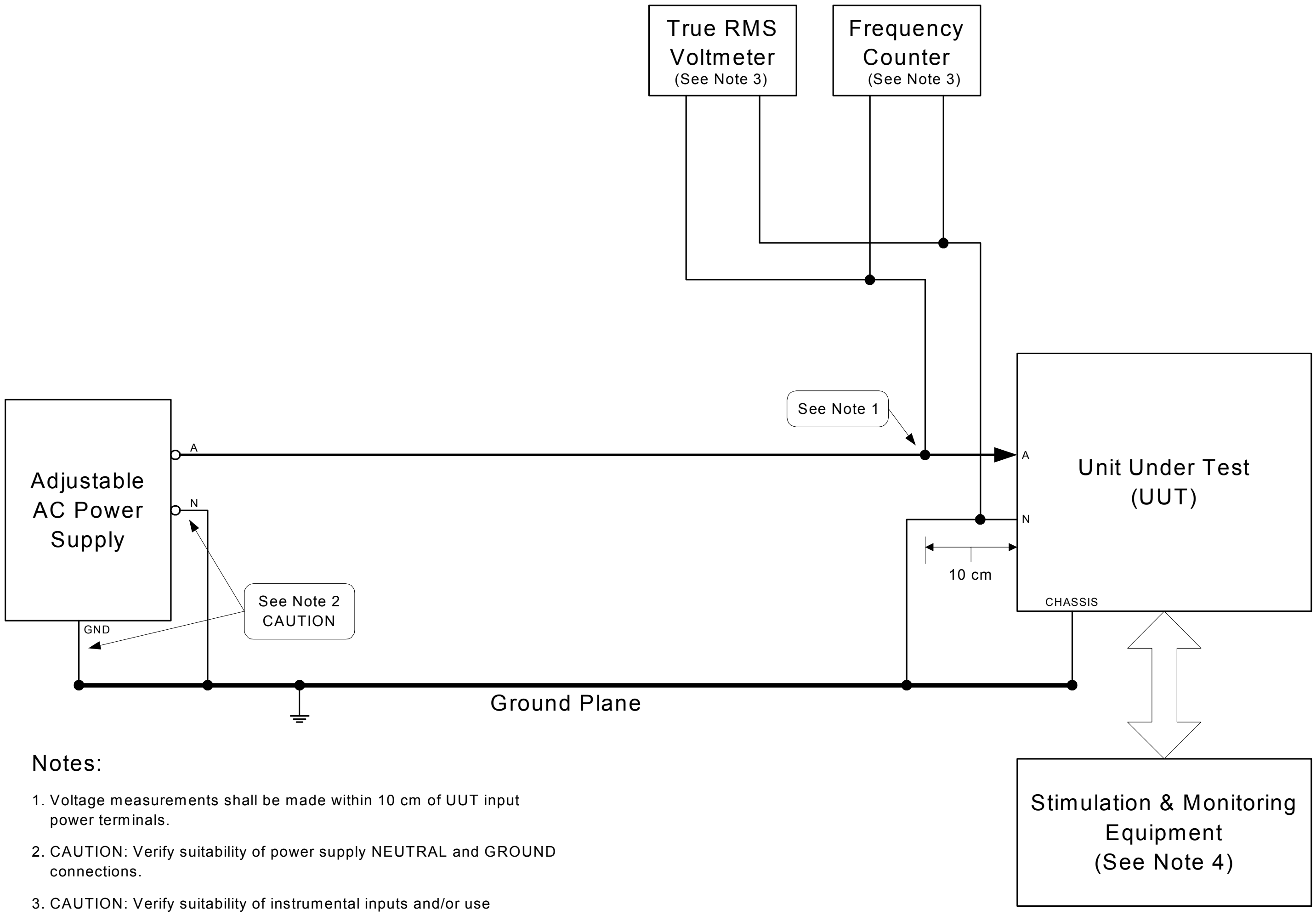
With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SAC603-II (line and neutral conductors connected properly). Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. The UUT must remain for a length of time that confirms the utilization equipment was not damaged and does not cause an unsafe condition after the phase reversal and should be not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has returned to the performance specified for normal aircraft electrical conditions and has not suffered damage. Record the steady state voltage, steady state frequency, time duration at test condition, and the performance of the UUT in the data sheet shown in table SAC603-II. Repeat for each mode of operation of the UUT.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)
5. Phase Polarity is reversed.

FIGURE SAC603-1. Phase reversal.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumental inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SAC603-2. Correct phase connection.

TABLE SAC603-II. Sample data sheet for SAC603 phase reversal.

<table>
<tr><td rowspan="2">Test Condition</td><td colspan="6" rowspan="2">Parameters</td><td>Performance</td></tr>
<tr><td>Yes/No</td></tr>
<tr><td colspan="7">Phase Reversal Prevented by Positive Physical Means</td><td></td></tr>
<tr><td colspan="8">If No</td></tr>
<tr><td></td><td colspan="2">Voltage</td><td colspan="2">Frequency</td><td colspan="2">Time Duration at Condition</td><td>Pass/Fail</td></tr>
<tr><td>Phase Reversal</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>min</td><td></td></tr>
<tr><td>Correct Phase Connection</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>min</td><td></td></tr>
</table>

6. NOTES

6.1 Intended use. This handbook should be used as guidance when establishing test requirements, for inclusion in performance specifications developed for the procurement of utilization equipment, to ensure compliance with the aircraft electrical power characteristics as specified by MIL-STD-704.

6.2 Single phase test numbers. There are no tests required for SAC103 and SAC602. This is done so that the single phase test numbers coincide with the three phase test numbers.

6.3 Subject term (keyword) listing.

Aircraft, electrical power
Aircraft, electrical test
Electrical operating areas
Equipment, utilization
Power groups
Specification, utilization equipment

CONCLUDING MATERIAL

Custodians:
Army - AV
Navy - AS
Air Force - 11

Preparing Activity:
Navy - AS

(Project No. SESS-0048)

Review Activities:
Army - CR, MI, TE
Navy - EC, MC, SA, SH, YD

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities change, you should verify the currency of the information above using the ASSIST Online database at www.dodssp.daps.mil.

NOT MEASUREMENT
SENSITIVE

MIL-HDBK-704-3
9 April 2004

DEPARTMENT OF DEFENSE
HANDBOOK

GUIDANCE FOR
TEST PROCEDURES FOR DEMONSTRATION OF UTILIZATION EQUIPMENT COMPLIANCE TO AIRCRAFT ELECTRICAL POWER CHARACTERISTICS THREE PHASE, 400 Hz, 115 VOLT
(PART 3 OF 8 PARTS)

This Handbook is for guidance only.
Do not cite this document as a requirement.

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FOREWORD

1. This handbook is approved for use by all Departments and Agencies of the Department of Defense.

2. This handbook provides guidance on test procedures for demonstration of three phase, 400 Hz, 115 volt utilization equipment to determine compliance with the applicable edition of MIL-STD-704.

3. MIL-HDBK-704-3 is Part 3 in a series of 8 Parts. Part 3 describes the test methods and procedures to demonstrate that three phase, 400 Hz, 115 volt utilization equipment is compatible with the electric power characteristics of MIL-STD-704. These series of handbooks and MIL-STD-704 are companion documents.

4. Comments, suggestions, or questions on this document should be addressed to Commander, Naval Air Systems Command, 4.1.4, Highway 547, Lakehurst, NJ 08733-5100 or email to thomas.omara@navy.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at http://www.dodssp.daps.mil/.

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1. SCOPE

1.1 Scope. This handbook provides, as guidance, test methods used to demonstrate that three phase, 400 Hz, 115 volt utilization equipment is compatible with the electric power characteristics of the applicable edition(s) of MIL-STD-704. This handbook is for guidance only and cannot be cited as a required.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed below are not necessarily all of the documents referenced herein, but are those needed to understand the information provided by this handbook.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-704	DoD Interface Standard for Aircraft Electric Power Characteristics

(Copies of these documents are available online at http://assist. daps.dla.mil/quicksearch or http://www.dodssp.daps.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

3. DEFINITIONS

3.1 Acronyms and definitions. The acronyms and definitions of MIL-STD-704 are applicable to this handbook.

4. TEST METHODS INFORMATION

4.1 Demonstration of compatibility. This section contains the test methods which will ensure that three phase, 400 Hz, 115 volt utilization equipment is compatible with the electric power characteristics of the applicable edition(s) of MIL-STD-704, by testing the Unit Under Test (UUT) in accordance with the test procedures as described in test methods TA101 through TAC603.

4.1.1 Recording performance. In table TAC-I, record the edition(s) of MIL-STD-704 that defined the aircraft electric power characteristics used for testing and the performance of the UUT for each of the test methods.

4.2 Calibration of test equipment. Test equipment and accessories required for measurement in accordance with this handbook should be calibrated in accordance with an approved calibration program traceable to the National Institute for Standards and Technology.

The serial numbers, model, and calibration date of all test equipment should be included with the test data.

4.3 Test methods. The test methods listed in table TAC-I are provided in section 5 of this handbook.

TABLE TAC-I. Summary of Three Phase, 400 Hz, 115 volt utilization equipment MIL-STD-704 compliance tests.

UUT:			
Compliance to MIL-STD-704 Edition(s):			
Test Dates:			
Test Method	Description	Performance (Pass/Fail)	Comments
Normal, Aircraft Electrical Operation			
TAC101	Three Phase Load and Current Harmonic Measurements		
TAC102	Steady State Limits for Voltage (Including Unbalance) and Frequency		
TAC103	Voltage Phase Difference		
TAC104	Voltage Modulation		
TAC105	Frequency Modulation		
TAC106	Voltage Distortion Spectrum		
TAC107	Total Voltage Distortion		
TAC108	DC Voltage Component		
TAC109	Normal Voltage Transients		
TAC110	Normal Frequency Transients		
Transfer, Aircraft Electrical Operation			
TAC201	Power Interrupt		
Abnormal, Aircraft Electrical Operation			
TAC301	Abnormal Limits for Voltage and Frequency		
TAC302	Abnormal Voltage Transients (Overvoltage/Undervoltage)		
TAC303	Abnormal Frequency Transients (Overfrequency/Underfrequency)		
Emergency, Aircraft Electrical Operation			
TAC401	Emergency Limits for Voltage and Frequency		
Starting, Aircraft Electrical Operation			
TAC501	See Note #1		
Power Failure, Aircraft Electrical Operation			
TAC601	Power Failure (Three Phase)		
TAC602	One Phase and Two Phase Power Failures		
TAC603	Phase Reversal		

Note 1: Starting operation conditions are usually not applicable to AC utilization equipment. No test is required for TAC501 unless specified by the equipment performance specification.

5. TEST METHODS

METHOD TAC101
Load Measurements

POWER GROUP:	Three Phase, 400 Hz, 115 V
AIRCRAFT ELECTRICAL OPERATING CONDITION:	Normal
PARAMETER:	Load Measurements

1. Scope.

1.1 Purpose. This test is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment utilizes only 115 Volt line-to-neutral power, current inrush is within limits, has balanced power, the power factor is within limits, and does not use half-wave rectification for the applicable edition(s) of MIL-STD-704. Additionally, when the utilization equipment performance specification document imposes current waveform requirements, this test procedure is used to verify that the utilization equipment current waveform is within total current distortion and current spectrum (current distortion vs. frequency) limits defined in the utilization equipment performance specification document.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment utilize only 115 Volt line-to-neutral power, is within current inrush limits, is within the balanced load limits, is within the power factor limits, and does not use half-wave rectification for the applicable edition(s) of MIL-STD-704 and as noted in table TAC101-I. If required by the utilization equipment performance specification document, the utilization equipment current waveform must be within the total current distortion and current spectrum limits defined in the utilization equipment performance specification document. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TAC101-I. MIL-STD-704 limits for inrush current, balanced load, power factor, rectification restriction, current distortion, and current spectrum for three phase, 400 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Inrush Current	N/A	N/A	N/A	N/A	N/A	300 Percent for Loads >3 kVA
Percent Unbalanced Load	Figure 11 MIL-STD-704A	N/A 1/	Figure 1 MIL-STD-704C	Figure 1 MIL-STD-704D	Figure 1 MIL-STD-704E or 3.33% for Loads >30 kVA	Figure 1 MIL-STD-704F or 3.33% for Loads >30 kVA
Power Factor	Figure 12 MIL-STD-704A	N/A	N/A	N/A	N/A	0.85 Lagging to Unity for Loads >500 VA and No Leading Power Factor for > 100VA
Rectification Restriction	N/A 2/	N/A 2/	N/A 2/	N/A 2/	No Half-Wave Rectification	No Half-Wave Rectification
Current Distortion	See Note 3/	See Note 3/	See Note 3/	See Note 3/	See Note 3/	See Note 3/
Current Spectrum	See Note 3/	See Note 3/	See Note 3/	See Note 3/	See Note 3/	See Note 3/

1/ For utilization equipment being tested to MIL-STD-704 edition B use the unbalanced load limits of MIL-STD-704C.
2/ It is highly recommended that equipment built to MIL-STD-704 editions A, B, C, or D should not use half-wave rectification.
3/ Utilization equipment specification should include requirements that reduce the likelihood of the equipment having an adverse effect on the electrical power characteristics of the aircraft. Current distortion and current spectrum limits may be imposed to minimize the undesirable effects to the electrical power characteristics. These limits should take into account the utilization equipment power draw, aircraft electrical system capacity and distribution characteristics, trade-offs with weight, volume, cost, and reliability that are specific to each type of equipment and aircraft.

3. Apparatus. The test equipment should be as follows:

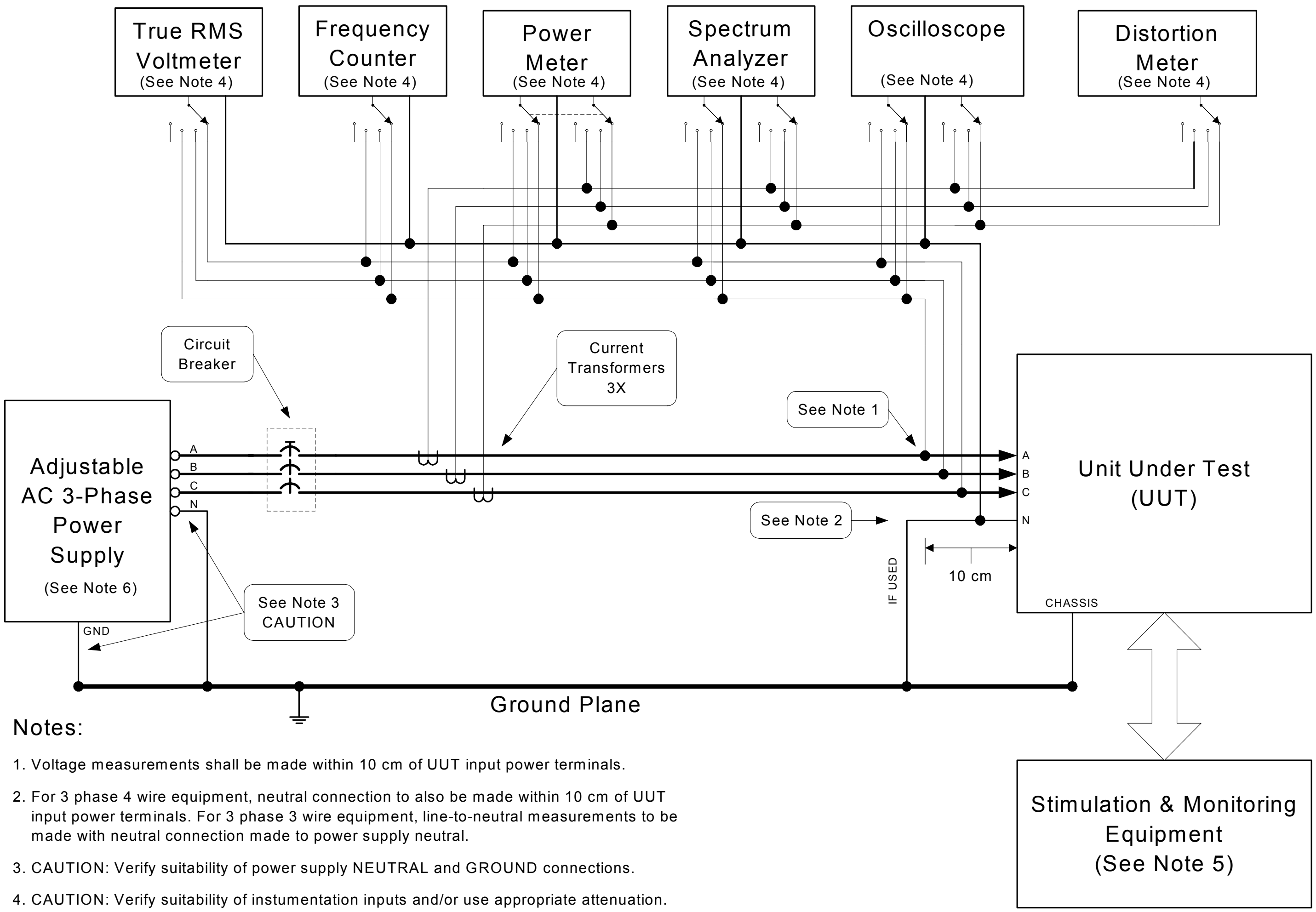
a. Adjustable AC power supply (rotating AC source for current waveform limits)
b. True RMS voltmeter
c. Frequency counter
d. Power meter
e. Spectrum analyzer
f. Distortion meter
g. Current transformer
h. Oscilloscope

4. Test setup. Configure the test setup as shown in figure TAC101-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT. Current measurements must be taken from the 115 Volt conductors. If the utilization equipment performance specification document imposes current waveform limits, the AC power source must be a rotating machine.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC101-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz.

Close the circuit breaker, energizing the UUT. Record the inrush currents (oscilloscope traces) and record the maximum rms current of each phase in the data sheet shown in table TAC101-II. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the frequency in table TAC101-II. For each phase, record the voltage, VA, and power factor in the data sheet shown in table TAC101-II. Compare the calculated percent inrush current, the load unbalance, and power factor with the limits of the applicable edition(s) of MIL-STD-704. Repeat for each mode of operation of the UUT.

Confirm the UUT does not use half-wave rectification and record in the data sheet shown in table TAC101-II. If the utilization equipment performance specification document imposes current waveform limits, for each phase record the total current distortion and current spectrum in the data sheet shown in table TAC101-II and compare to the limits defined in the utilization equipment performance specification document. Repeat for each mode of operation of the UUT.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)
6. If current waveform limits are imposed by the detail performance specification, the AC power source shall be a rotating machine.

FIGURE TAC101-1. Load measurement.

TABLE TAC101-II. Sample data sheet for TAC101 load measurement.

<table>
<tr><th colspan="11">Parameters</th></tr>
<tr><th colspan="11">Inrush Current</th></tr>
<tr><th>Phase</th><th colspan="2">Inrush Current</th><th colspan="2">Percent of Rated Current</th><th colspan="4">Oscilloscope Trace</th><th>Pass/Fail</th><th>Comments</th></tr>
<tr><td>A</td><td></td><td>A_{rms}</td><td></td><td>%</td><td colspan="2">Attach Trace</td><td colspan="2">A_{rms} vs. Time</td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td>B</td><td></td><td>A_{rms}</td><td></td><td>%</td><td colspan="2">Attach Trace</td><td colspan="2">A_{rms} vs. Time</td></tr>
<tr><td>C</td><td></td><td>A_{rms}</td><td></td><td>%</td><td colspan="2">Attach Trace</td><td colspan="2">A_{rms} vs. Time</td></tr>
<tr><th colspan="11">Balanced Load and Power Factor</th></tr>
<tr><th>Phase</th><th colspan="2">Voltage</th><th colspan="2">Frequency</th><th colspan="2">Volt-Amp</th><th colspan="2">Power Factor</th><th>Pass/Fail</th><th>Comments</th></tr>
<tr><td>A</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>VA</td><td></td><td>pf</td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td>B</td><td></td><td>V_{rms}</td><td colspan="2" rowspan="2"></td><td></td><td>VA</td><td></td><td>pf</td></tr>
<tr><td>C</td><td></td><td>V_{rms}</td><td></td><td>VA</td><td></td><td>pf</td></tr>
<tr><td colspan="5">Total VA</td><td></td><td>VA</td><td colspan="2" rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td colspan="5">Maximum Unbalance (difference between highest and lowest phase load)</td><td></td><td>VA</td></tr>
<tr><th colspan="11">Rectification Type</th></tr>
<tr><td colspan="9"></td><th>Pass/Fail</th><th>Comments</th></tr>
<tr><td colspan="9">Does not use half-wave rectification.</td><td></td><td></td></tr>
<tr><th colspan="11">Current Waveform Measurements</th></tr>
<tr><th>Phase</th><th colspan="4">Total Current Distortion</th><th colspan="4">Current Spectrum</th><th>Pass/Fail</th><th>Comments</th></tr>
<tr><td>A</td><td colspan="2"></td><td colspan="2">% Distortion</td><td colspan="2">Attach Spectrum Plot</td><td colspan="2">Amplitude Vs. Frequency</td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td>B</td><td colspan="2"></td><td colspan="2">% Distortion</td><td colspan="2">Attach Spectrum Plot</td><td colspan="2">Amplitude Vs. Frequency</td></tr>
<tr><td>C</td><td colspan="2"></td><td colspan="2">% Distortion</td><td colspan="2">Attach Spectrum Plot</td><td colspan="2">Amplitude Vs. Frequency</td></tr>
</table>

METHOD TAC102
Steady State Limits for Voltage, Including Unbalance, and Frequency

POWER GROUP:	Three Phase, 400 Hz, 115 V
AIRCRAFT ELECTRICAL OPERATING CONDITION:	Normal
PARAMETER:	Steady State Limits for Voltage, Including Unbalance, and Frequency

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Normal Low Steady State (NLSS) limits and the Normal High Steady State (NHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power of voltage and frequency at the specified normal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC102-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be, not less than thirty (30) minutes for each of the test conditions. The utilization equipment must demonstrate re-start at the steady state voltage and frequency limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: If the utilization has exactly the same full performance requirements for abnormal steady state limits and emergency steady state limits as required for the normal aircraft electrical conditions, then performance of test methods TAC301 and TAC401 will constitute performance of test conditions A through I of TAC102.

TABLE TAC102-I. MIL-STD-704 normal limits for steady state voltage, voltage unbalance, and frequency.

Normal Limit	704A	704B	704C	704D	704E	704F
Voltage NLSS	108 V	108 V	108 V	108 V	108 V	108 V
Voltage NHSS	118 V	118 V	118 V	118 V	118 V	118 V
Voltage Unbalance	3.0V	3.0V	3.0V	3.0V	3.0V	3.0V
Frequency NLSS	380 Hz	395 Hz (380 Hz)[1/]	393 Hz	393 Hz	393 Hz	393 Hz
Frequency NHSS	420 Hz	405 Hz (420 Hz)[1/]	407 Hz	407 Hz	407 Hz	407 Hz

1/ Normal steady state frequency limits for MIL-STD-704B for helicopters is 400 ±20 Hz.

3. Apparatus. The test equipment should be as follows:

a. Adjustable AC power supply
b. True RMS voltmeter
c. Frequency counter

4. Test setup. Configure the test setup as shown in figure TAC102-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

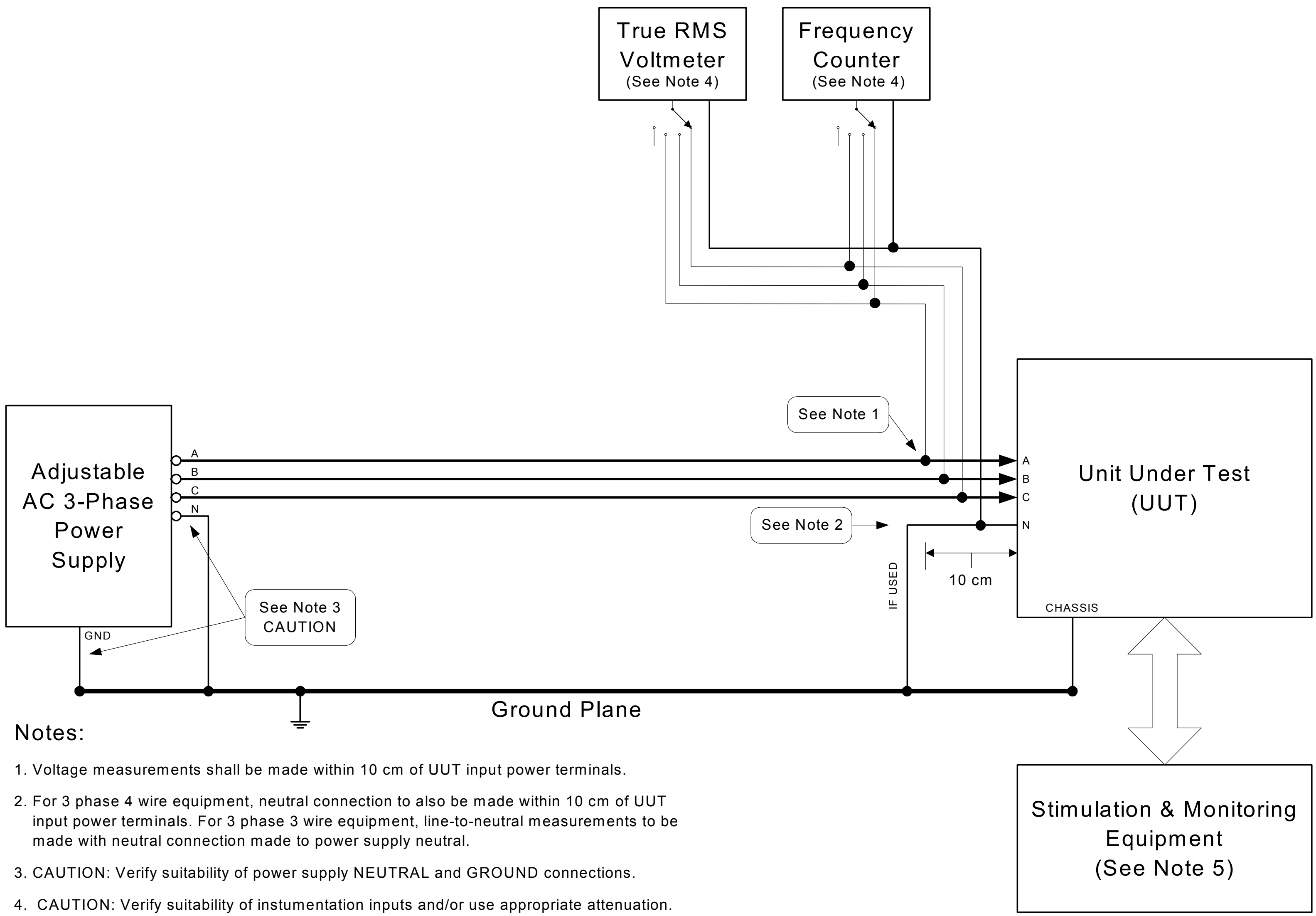
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC102-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through K noted in table TAC102-II, the UUT must remain for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be not less than thirty (30) minutes. Test conditions A through I are three phase balanced voltages. Test conditions J and K are unbalanced voltage conditions. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. For each test condition shutdown the UUT and verify that the UUT can be re-started. After re-start conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltages, frequency, time duration at test condition, successful/unsuccessful re-start and the performance of the UUT for each test condition in the data sheet shown in table TAC102-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TAC102-II. Test conditions for steady state limits for voltage and frequency.

Test Condition	Voltage	Frequency
Balanced Voltages		
A	Nominal Voltage	Nominal Frequency
B	Nominal Voltage	NLSS Frequency
C	Nominal Voltage	NHSS Frequency
D	NLSS Voltage	Nominal Frequency
E	NLSS Voltage	NLSS Frequency
F	NLSS Voltage	NHSS Frequency
G	NHSS Voltage	Nominal Frequency
H	NHSS Voltage	NLSS Frequency
I	NHSS Voltage	NHSS Frequency
Unbalanced Voltages		
J	Van NLSS Voltage Vbn NLSS Voltage+3.0V Vcn NLSS Voltage+3.0V	Nominal Frequency
K	Van NHSS Voltage Vbn NHSS Voltage-3.0V Vcn NHSS Voltage-3.0V	Nominal Frequency



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC102-1. Steady state limits for voltage including unbalance.

TABLE TAC102-III. Sample data sheet for TAC102 steady state limits for voltage and frequency.

Test Condition	Parameters								Performance
	Phase	Voltage		Frequency		Time Duration at Test Condition		Re-Start (Yes/No)	Pass/Fail
A	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
B	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
C	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
D	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
E	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
F	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
G	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						

TABLE TAC102-III. Sample data sheet for TAC102 steady state limits for voltage and frequency. - Continued

Test Condition	Parameters								Performance
	Phase	Voltage		Frequency		Time Duration at Test Condition		Re-Start (Yes/No)	Pass/Fail
H	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
I	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
J	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
K	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						

METHOD TAC103
Voltage Phase Difference

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Voltage Phase Difference

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when provided voltages having phase angles within the limits specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when provided voltages having phase angles at the limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC103-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate and should be not less than thirty (30) minutes for each of the test conditions. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TAC103-I. MIL-STD-704 limits for voltage phase difference.

Limit	704A	704B	704C	704D	704E	704F
Voltage Phase Difference	116^o to 124^o	116^o to 124^o	116^o to 124^o	116^o to 124^o	116^o to 124^o	116^o to 124^o

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Phase angle meter

4. Test setup. Configure the test setup as shown in figure TAC103-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC103-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient

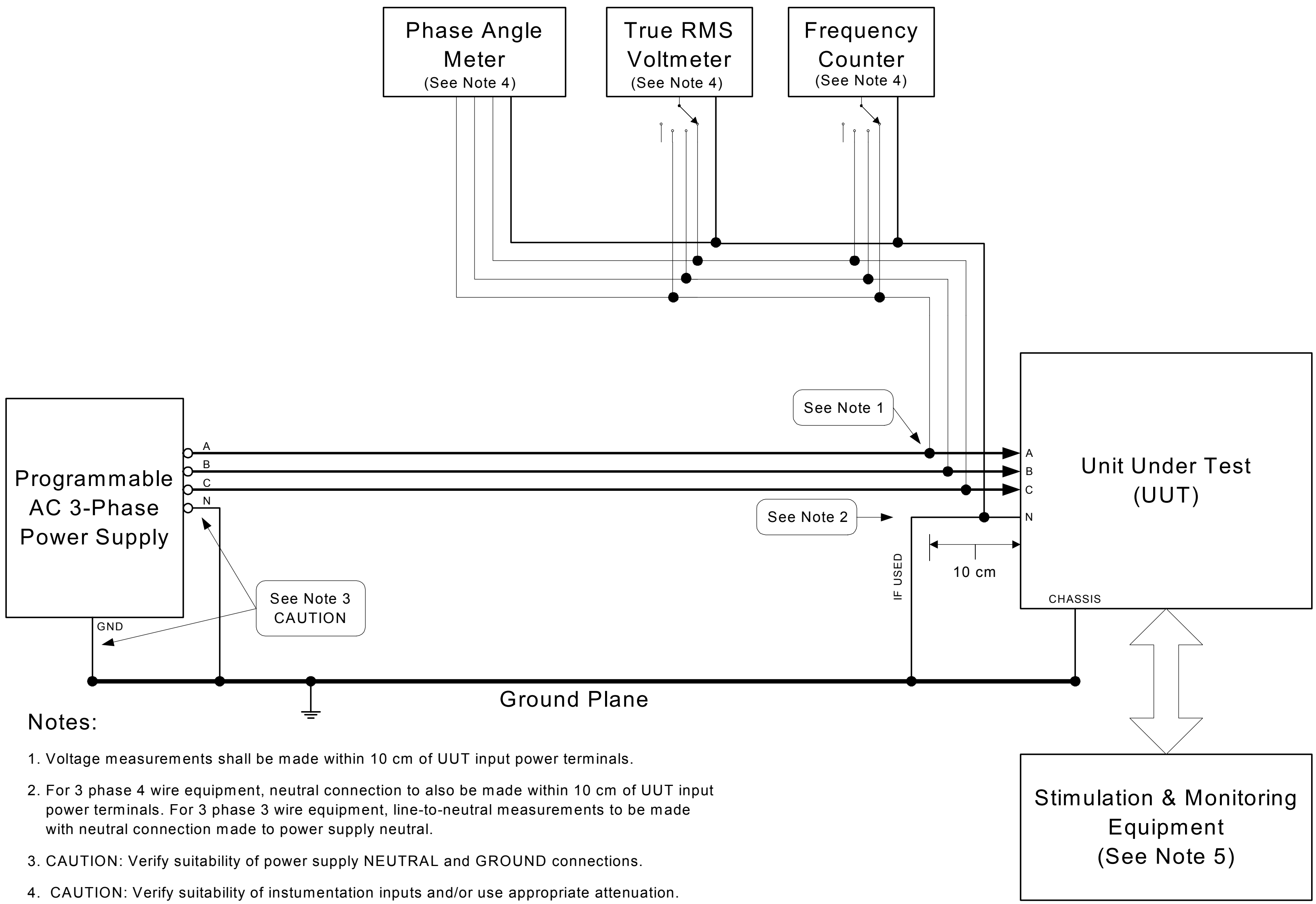
time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A and B noted in table TAC103-II, the UUT must remain for a length of time that confirms the utilization equipment can continuously operate with voltage phase differences and should be, not less than thirty (30) minutes. The phase angles are referenced to Van. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltages, frequency, phase angles, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table TAC103-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Adjust the phase angles to Van 0^o, Vbn 120^o, and Vcn 240^o. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TAC103-II. Test conditions for voltage phase difference.

Test Condition	Voltage Phase Angle Van	Voltage Phase Angle Vbn	Voltage Phase Angle Vcn
A	0^o	116^o	240^o
B	0^o	124^o	240^o



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC103-1. Voltage phase difference.

TABLE TAC103-III. Sample data sheet for TAC103 voltage phase difference.

Test Condition	Parameters										Performance
	Phase	Voltage		Frequency		Phase Angle			Time Duration at Test Condition		Pass/Fail
A	A		V_{rms}		Hz	Van		$^{\circ}$		min	
	B		V_{rms}			Vbn		$^{\circ}$			
	C		V_{rms}			Vcn		$^{\circ}$			
B	A		V_{rms}		Hz	Van		$^{\circ}$		min	
	B		V_{rms}			Vbn		$^{\circ}$			
	C		V_{rms}			Vcn		$^{\circ}$			

METHOD TAC104
Voltage Modulation

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: Voltage Modulation

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to voltage modulation as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having voltage modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table TAC104-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage modulation. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TAC104-I. MIL-STD-704 limits for voltage modulation.

Limit	704A	704B 1/	704C 1/	704D 1/	704E	704F
Voltage Modulation	3.5 V Peak-to-Valley Figure 1 MIL-STD-704A	sideband 0.62 Vrms over the range 400 ± 60 Hz	N/A	N/A	2.5 Vrms max	2.5 Vrms max

1/ For utilization equipment being tested to MIL-STD-704 edition B, C, and D, use MIL-STD-704E limits.

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure TAC104-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC104-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions

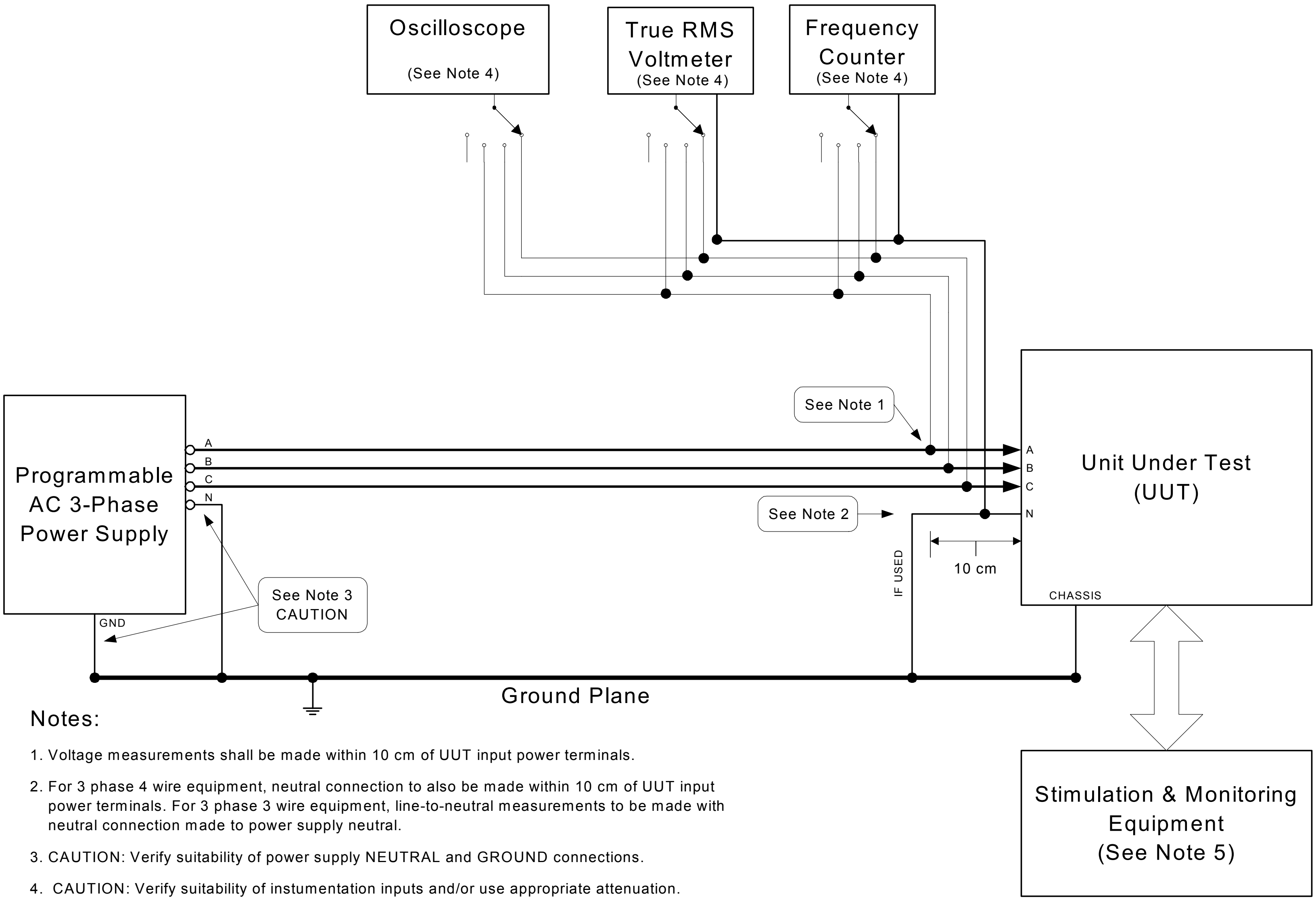
For each test condition A through G noted in table TAC104-II, set the voltage modulation amplitude and frequency of voltage modulation. The UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate, and should be at least ten (10) minutes at an average steady state voltage of 115 Vrms, at least ten (10) minutes at an average steady state voltage of 109.25 Vrms, and at least ten (10) minutes at an average steady state voltage of 116.75 Vrms. During the test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record average voltage, frequency, amplitude of voltage modulation, frequency of voltage modulation, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table TAC104-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TAC104-II. Test conditions for voltage modulation.

Test Condition	Frequency of Voltage Modulation	MIL-STD-704A Amplitude of Voltage Modulation Voltage Peak-to-Valley	MIL-STD-704E & F 1/ Amplitude of Voltage Modulation Vrms
A	1.0 Hz	0.5 Vp-v	0.375 Vrms
B	1.7 Hz	0.5 Vp-v	0.375 Vrms
C	10 Hz	3.5 Vp-v	2.5 Vrms
D	25 Hz	3.5 Vp-v	2.5 Vrms
E	70 Hz	0.5 Vp-v	0.375 Vrms
F	100 Hz	0.5 Vp-v	0.375 Vrms
G	200 Hz	0.5 Vp-v	0.375 Vrms

1/ For utilization equipment being tested to MIL-STD-704 edition B, C, and D, use MIL-STD-704E limits.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC104-1. Voltage modulation.

TABLE TAC104-III. Sample data sheet for TAC104 voltage modulation.

Test Condition	Parameters											Performance
	Phase	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Test Condition		Pass/Fail
A-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
A-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
A-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
B-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
B-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
B-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
C-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			

TABLE TAC104-III. Sample data sheet for TAC104 voltage modulation. - Continued

Test Condition	Parameters											Performance
	Phase	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Test Condition		Pass/Fail
C-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
C-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
D-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
D-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
D-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
E-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
E-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			

TABLE TAC104-III. Sample data sheet for TAC104 voltage modulation. - Continued

Test Condition	Parameters												Performance
	Phase	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Test Condition		Pass/Fail
E-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
F-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
F-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
F-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
G-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
G-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
G-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			

METHOD TAC105
Frequency Modulation

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Frequency Modulation

1. Scope.

1.1. Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to frequency modulation as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having frequency modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table TAC105-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having frequency modulation. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TAC105-I. MIL-STD-704 limits for frequency modulation.

Limit	704A	704B	704C	704D	704E	704F
Frequency Modulation	± 4 Hz	± 5 Hz Figure 3 MIL-STD-704B	± 5 Hz Figure 4 MIL-STD-704C	± 5 Hz Figure 4 MIL-STD-704D	4 Hz	4 Hz

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure TAC105-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC105-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient

time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

5.1 Compliance test for MIL-STD-704A. For each test condition A through D noted in table TAC105-II, set the amplitude of frequency modulation and rate of change for frequency modulation. The UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate, and should be at least ten (10) minutes at an average steady state frequency of 400 Hz, at least ten (10) minutes at an average steady state frequency of 384 Hz, and at least ten (10) minutes at an average steady state frequency of 416 Hz. During the test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record voltage, average frequency, amplitude of frequency modulation, rate of change for frequency modulation, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table TAC105-III. Repeat for each mode of operation of the UUT.

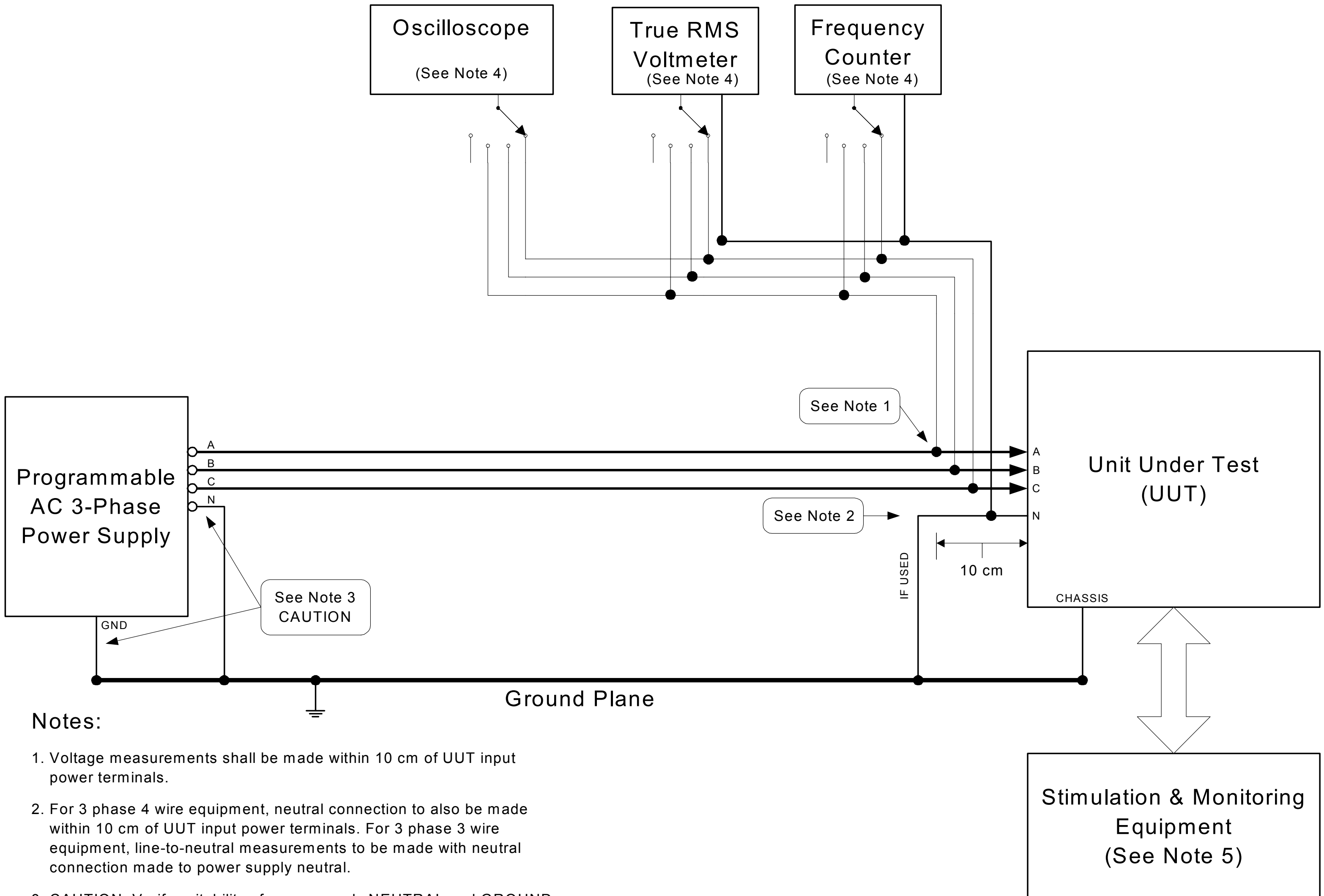
5.2 Compliance test for MIL-STD-704B, C, & D. For each test condition A through E noted in table TAC105-II, set the amplitude of frequency modulation and rate of change for frequency modulation. The UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate. For test condition A, the UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate, and should be at an average steady state frequency of 400 Hz for at least thirty (30) minutes. For test condition B through E, the UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate and should be at least ten (10) minutes at an average steady state frequency of 400 Hz, at least ten (10) minutes at an average steady state frequency of 395 Hz, and at least ten (10) minutes at an average steady state frequency of 405 Hz. At each test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record voltages, average frequency, amplitude of frequency modulation, rate of change for frequency modulation, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table TAC105-III. Repeat for each mode of operation of the UUT.

5.3 Compliance test for MIL-STD-704E & F. For each test condition A through E noted in table TAC105-II, set the amplitude of frequency modulation and rate of change for frequency modulation. The UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate, and should be at least ten (10) minutes at an average steady state frequency of 400 Hz, at least ten (10) minutes at an average steady state frequency of 395 Hz, and at least ten (10) minutes at an average steady state frequency of 405 Hz. During the test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record voltages, average frequency, amplitude of frequency modulation, rate of change for frequency modulation, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table TAC105-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TAC105-II. Test conditions for frequency modulation.

Test Condition	Rate of change for frequency modulation	MIL-STD-704 A Amplitude of Frequency Modulation	MIL-STD-704 B, C, & D Amplitude of Frequency Modulation	MIL-STD-704 E &F Amplitude of Frequency Modulation
A	1 Hz/sec	± 4 Hz	± 5.00 Hz	4 Hz (± 2 Hz)
B	5 Hz/sec	± 4 Hz	± 1.75 Hz	4 Hz (± 2 Hz)
C	10 Hz/sec	± 4 Hz	± 1.20 Hz	4 Hz (± 2 Hz)
D	25 Hz/sec	± 4 Hz	± 0.85 Hz	4 Hz (± 2 Hz)
E	100 Hz/sec	N/A	± 0.58 Hz	4 Hz (± 2 Hz)



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC105-1. Frequency modulation.

TABLE TAC105-III. Sample data sheet for TAC105 frequency modulation.

Test Condition	Parameters										Performance
	Phase	Voltage		Average Frequency		Amplitude of Frequency Modulation		Rate of change for frequency modulation		Time Duration at Test Condition		Pass/Fail
A-1	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
A-2	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
A-3	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
B-1	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
B-2	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
B-3	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									

TABLE TAC105-III. Sample data sheet for TAC105 frequency modulation. - Continued

Test Condition	Parameters										Performance
	Phase	Voltage		Average Frequency		Amplitude of Frequency Modulation		Rate of change for frequency modulation		Time Duration at Test Condition	Pass/Fail
C-1	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
C-2	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
C-3	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
D-1	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
D-2	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
D-3	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									

TABLE TAC105-III. Sample data sheet for TAC105 frequency modulation. - Continued

Test Condition	Parameters										Performance
	Phase	Voltage		Average Frequency		Amplitude of Frequency Modulation		Rate of change for frequency modulation		Time Duration at Test Condition		Pass/Fail
E-1	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
E-2	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
E-3	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									

METHOD TAC106
Voltage Distortion Spectrum

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Voltage Distortion Spectrum

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to voltage distortion of frequencies and amplitudes as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage distortions as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704 and as noted in table TAC106-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage distortion. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: This test method subjects the UUT to voltage distortion having frequencies components from 50 Hz to 10 kHz. These voltage distortions simulate voltage distortions within aircraft due to the cumulative effects of generators, electrical distribution systems equipments, and aircraft loads. MIL-STD-461, (Requirements For The Control of Electromagnetic Interference Characteristics of Subsystems and Equipment), Test Method CS101, (Conducted Susceptibility, Power Leads, 30 Hz to 150 kHz) is a complimentary test. Power levels of the voltage distortions differ for the two test methods. Performance of Test Method TAC106 of this handbook does not relinquish the requirement to perform Test Method CS101 of MIL-STD-461, and performance of Method CS101 of MIL-STD-461 does not relinquish the requirement to perform Test Method TAC106 of this handbook.

TABLE TAC106-I. MIL-STD-704 limits for voltage distortion spectrum.

Limit	704A 1/	704B	704C	704D	704E	704F
Voltage Distortion Spectrum	Individual Harmonic < 5%	Figure 2 MIL-STD-704B	Figure 3 MIL-STD-704C	Figure 3 MIL-STD-704D	Figure 3 MIL-STD-704E	Figure 7 MIL-STD-704F

1/ For utilization equipment being tested to MIL-STD-704 edition A, use MIL-STD-704B limits.

3. Apparatus. The test equipment should be as follows:

a. Adjustable AC power supply
b. Variable frequency power source
c. Coupling transformer
d. True RMS voltmeter
e. Frequency counter
f. Spectrum analyzer
g. (3) Inductors, 50 μH
h. (3) Capacitors, 10 μF
i. Resistor, calibrated load

4. Test setup. Configure the test setup as shown in figure TAC106-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

4.1 Calibration (50 Hz to 10 kHz). Install a calibrated resistive load in the test setup shown in figure TAC106-1 in place of the UUT. The calibrated resistive load should be sized to draw the same current as the UUT. Turn on the adjustable AC power supply and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Set the variable frequency power source to output a sine wave and adjust the frequency and amplitude so that the voltage distortion measured at the input to the calibrated resistive load conforms to each test condition A through H in table TAC106-II. Record the settings of the variable frequency power source for each test condition.

5. Compliance test. With the adjustable AC power supply off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC106-1. Figure TAC106-1 shows the coupling transformer installed in phase A. The test will be repeated with the coupling transformer installed in Phase B and Phase C. Turn on the adjustable AC power supply and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

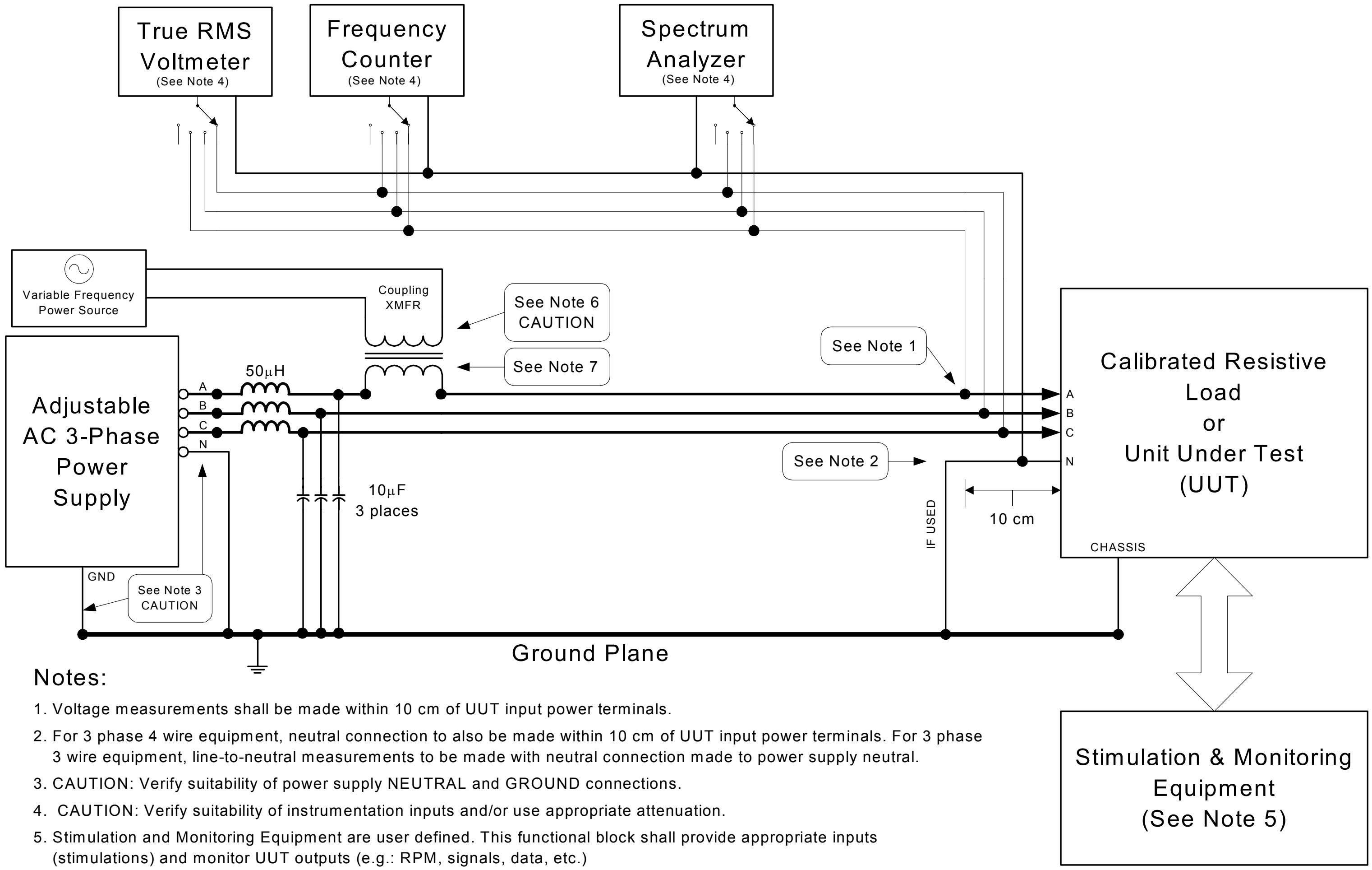
Set the variable frequency power source to the settings recorded for test condition A of the calibration procedure. For each test condition, remain for a length of time that confirms the utilization equipment can continuously operate with the voltage distortion and should be, not less than five (5) minutes. At each test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. After each test condition, monitor the voltage distortion frequency and amplitude while slowly increasing the variable frequency power source frequency and adjusting the amplitude until the next test condition is reached. Do not exceed the voltage distortion spectrum limits. Repeat for each test condition A through H noted in table TAC106-II. For each test condition, record the phase tested, voltage, frequency, frequency of voltage distortion, amplitude of voltage distortion, time duration at test condition, and the performance of the UUT in the data sheet shown in table TAC106-III. Repeat for each mode of operation of the UUT. Turn the adjustable AC power supply off, install the coupling transformer in phase B, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and the frequency to the nominal steady state frequency of 400 Hz and repeat the testing for phase B. Turn the adjustable AC power supply off, install the coupling transformer in phase C, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and the frequency to the nominal steady state frequency of 400 Hz and repeat the testing for Phase C.

After all test conditions are complete for Phase A, Phase B, and Phase C, turn the adjustable AC power supply off and remove the coupling transformer from the circuit. Turn on the adjustable AC power supply. Adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TAC106-II. Test conditions for voltage distortion spectrum.

Test Condition	Frequency of Voltage Distortion	MIL-STD-704B C, D, E & F 1/ Amplitude of Voltage Distortion Voltage rms
A	50 Hz	0.316 Vrms
B	100 Hz	0.316 Vrms
C	500 Hz	1.580 Vrms
D	1 kHz	3.160 Vrms
E	2 kHz	3.160 Vrms
F	3 kHz	3.160 Vrms
G	5 kHz	1.900 Vrms
H	10 kHz	0.950 Vrms

1/ For utilization equipment being tested to MIL-STD-704 edition A, use MIL-STD-704B limits.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)
6. CAUTION: Verify suitability of variable frequency power source and coupling transformer for distortion spectrum testing.
7. Coupling Transformer shown is connected in series on Phase A. Testing is repeated with Coupling Transformer connected in series on Phase B and Phase C.

FIGURE TAC106-1. Normal operation - voltage distortion spectrum (50 Hz to 10 kHz).

TABLE TAC106-III. Sample data sheet for TAC106 voltage distortion spectrum.

Test Condition	Parameter						Performance
	Phase	Voltage	Frequency	Frequency of Voltage Distortion	Amplitude of Voltage Distortion	Time Duration at Test Condition	Pass/Fail
	A						
A		V_{rms}	Hz	Hz	V_{rms}	min	
B		V_{rms}	Hz	Hz	V_{rms}	min	
C		V_{rms}	Hz	Hz	V_{rms}	min	
D		V_{rms}	Hz	kHz	V_{rms}	min	
E		V_{rms}	Hz	kHz	V_{rms}	min	
F		V_{rms}	Hz	kHz	V_{rms}	min	
G		V_{rms}	Hz	kHz	V_{rms}	min	
H		V_{rms}	Hz	kHz	V_{rms}	min	
	B						
A		V_{rms}	Hz	Hz	V_{rms}	min	
B		V_{rms}	Hz	Hz	V_{rms}	min	
C		V_{rms}	Hz	Hz	V_{rms}	min	
D		V_{rms}	Hz	kHz	V_{rms}	min	
E		V_{rms}	Hz	kHz	V_{rms}	min	
F		V_{rms}	Hz	kHz	V_{rms}	min	
G		V_{rms}	Hz	kHz	V_{rms}	min	
H		V_{rms}	Hz	kHz	V_{rms}	min	

TABLE TAC106-III. Sample data sheet for TAC106 voltage distortion spectrum. - Continued

Test Condition	Parameter											Performance Pass/Fail
	Phase	Voltage		Frequency		Frequency of Voltage Distortion		Amplitude of Voltage Distortion		Time Duration at Test Condition		
	C											
A			V_{rms}		Hz		Hz		V_{rms}		min	
B			V_{rms}		Hz		Hz		V_{rms}		min	
C			V_{rms}		Hz		Hz		V_{rms}		min	
D			V_{rms}		Hz		kHz		V_{rms}		min	
E			V_{rms}		Hz		kHz		V_{rms}		min	
F			V_{rms}		Hz		kHz		V_{rms}		min	
G			V_{rms}		Hz		kHz		V_{rms}		min	
H			V_{rms}		Hz		kHz		V_{rms}		min	

METHOD TAC107
Total Voltage Distortion

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Total Voltage Distortion

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to voltage waveforms having a distortion factor as specified by the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage waveforms having a distortion factor as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TAC107-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to distorted voltage waveforms and should be, not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TAC107-I. MIL-STD-704 limits for total voltage distortion.

Limit	704A	704B	704C	704D	704E	704F
Voltage Distortion Factor	0.08	0.05	0.05	0.05	0.05	0.05

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Spectrum analyzer
e. Distortion meter

4. Test setup. Configure the test setup as shown in figure TAC107-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

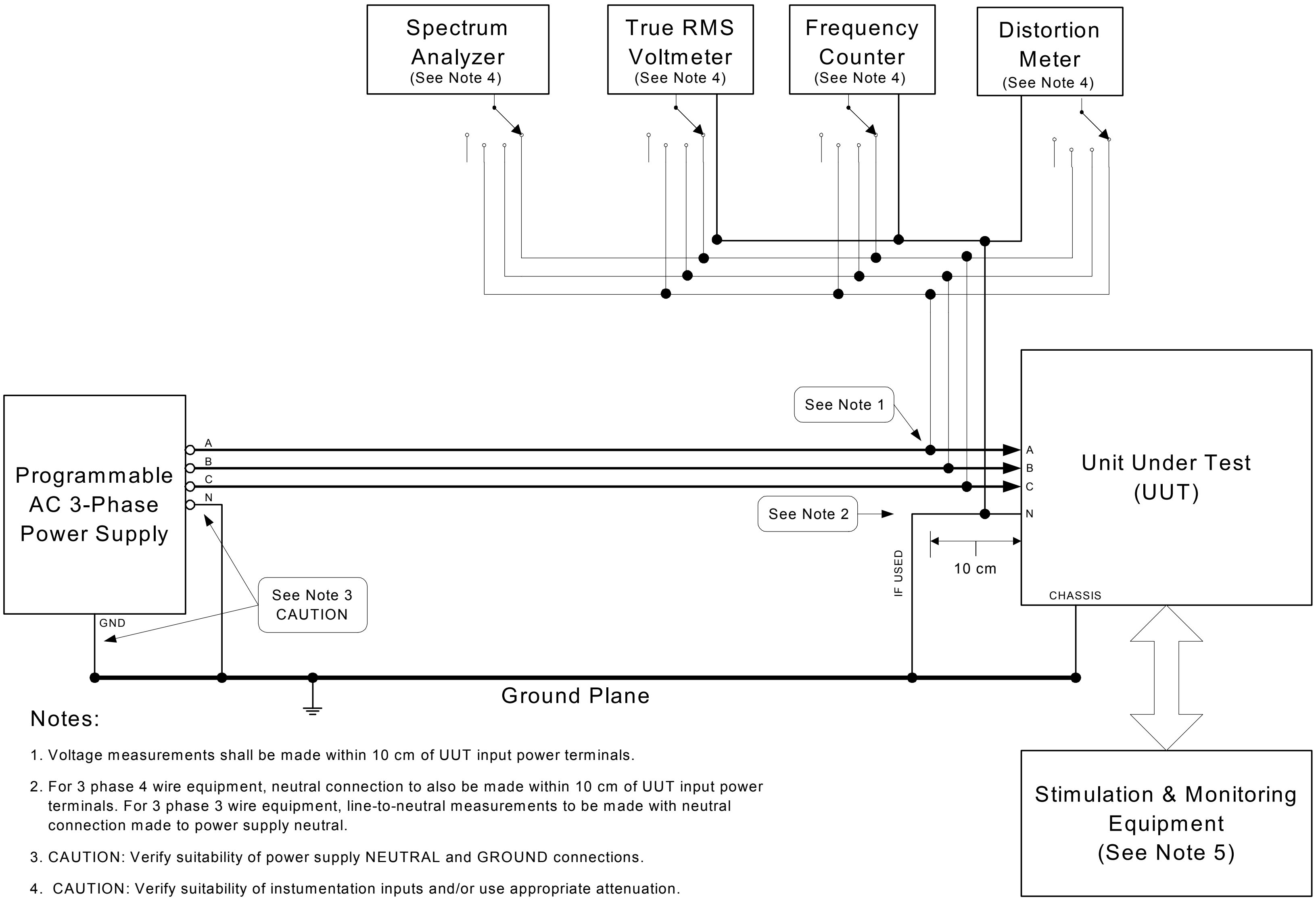
4.1 Calibration. Install a resistive load in the test setup shown in figure TAC107-1 in place of the UUT. The resistive load should be sized to draw the same current as the UUT. Set the programmable power supply to produce a voltage waveform having harmonic contents listed in table TAC107-I. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Confirm that the programmable power supply is producing a voltage waveform having harmonic content listed in table TAC107-II. Record the settings of the programmable power supply.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC107-1. Set the programmable power supply to the settings recorded during the calibration procedure. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. The UUT must remain for a length of time that confirms the utilization equipment can continuously operate with the total voltage distortion and should be, not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltage, frequency, voltage distortion factor, voltage harmonics, time duration at test condition, and the performance of the UUT in the data sheet shown in table TAC107-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, set the programmable power supply to produce sine waves for each of the three phases. Adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TAC107-II. Voltage harmonics as percent of fundamental for total voltage distortion test.

Harmonic	MIL-STD-704A Percent of Fundamental	MIL-STD-704B, C, D, E, & F Percent of Fundamental
Fundamental	100%	100%
2nd	0%	0%
3rd	5.00%	2.75%
4th	0%	0%
5th	4.12%	2.75%
6th	0%	0%
7th	2.94%	1.97%
8th	0%	0%
9th	2.29%	1.53%
10th	0%	0%
11th	1.87%	1.25%
12th	0%	0%
13th	1.58%	1.06%
14th	0%	0%
15th	1.37%	0.92%



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC107-1. Total voltage distortion.

TABLE TAC107-III. Sample data sheet for TAC107 total voltage distortion.

Parameters									Performance
Phase	Voltage		Frequency		Voltage Distortion Factor		Time Duration at Test Condition		Pass/Fail
A		V_{rms}		Hz		No units		min	
B		V_{rms}				No units			
C		V_{rms}				No units			

Voltage Harmonics Phase A			Voltage Harmonics Phase B			Voltage Harmonics Phase C		
Fund		%	Fund		%	Fund		%
2nd		%	2nd		%	2nd		%
3rd		%	3rd		%	3rd		%
4th		%	4th		%	4th		%
5th		%	5th		%	5th		%
6th		%	6th		%	6th		%
7th		%	7th		%	7th		%
8th		%	8th		%	8th		%
9th		%	9th		%	9th		%
10th		%	10th		%	10th		%
11th		%	11th		%	11th		%
12th		%	12th		%	12th		%
13th		%	13th		%	13th		%
14th		%	14th		%	14th		%
15th		%	15th		%	15th		%

METHOD TAC108
DC Voltage Component

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: DC Voltage Component

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TAC108-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to a direct current component of AC voltage and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TAC108-I. MIL-STD-704 limits for direct current component of AC voltage.

Limit	704A	704B	704C	704D	704E	704F
DC Voltage Component of the AC Voltage	± 0.10 V	± 0.10 V	± 0.10 V	± 0.10 V	± 0.10 V	± 0.10 V

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter (with capability to measure DC component of AC waveform)
c. Frequency counter

4. Test setup. Configure the test setup as shown in figure TAC108-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

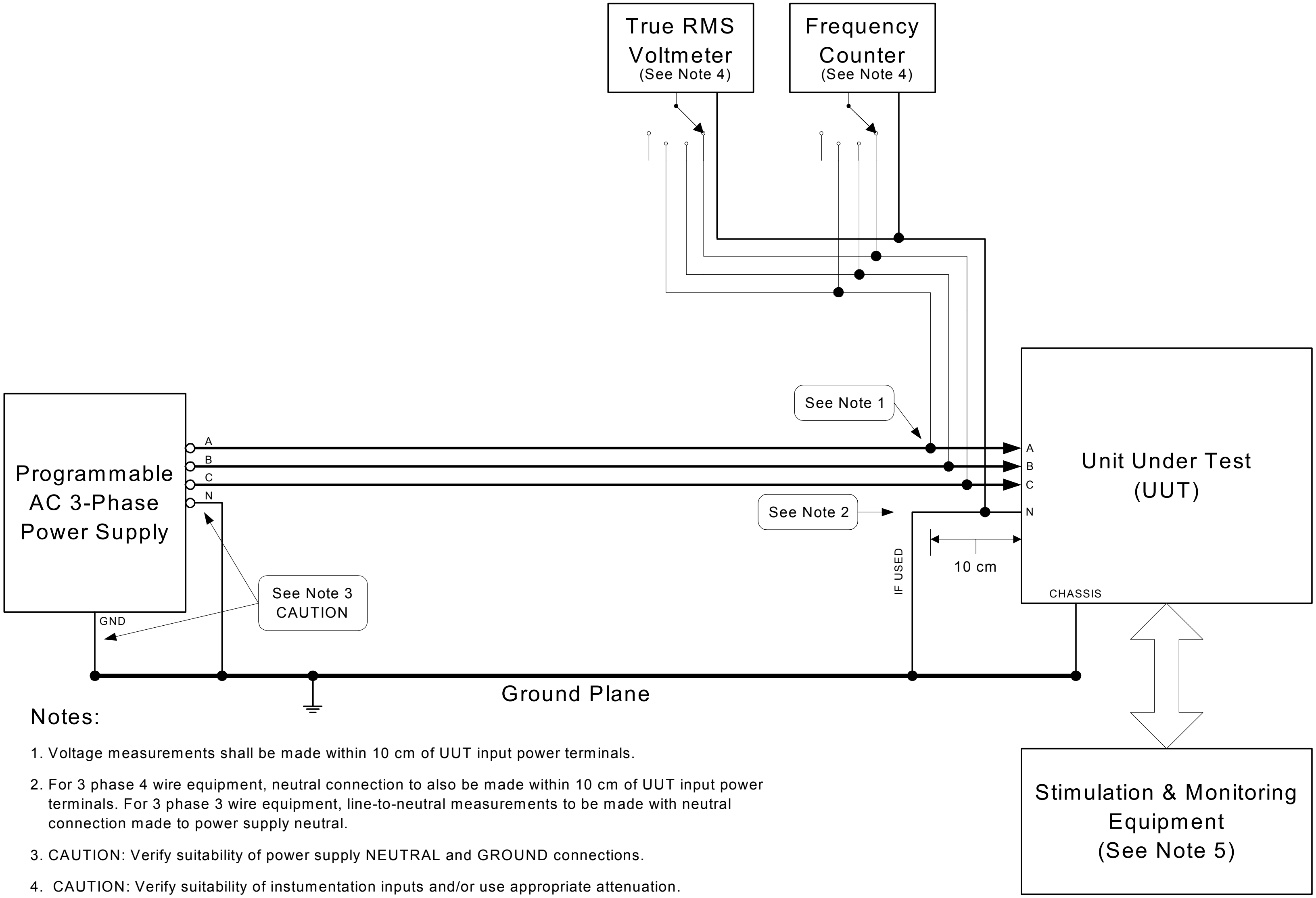
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC108-1. Set the programmable power supply to produce voltage waveforms having a DC component on each of the three phases for

test condition A as noted in table TAC108-II. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. The UUT must remain for a length of time that confirms the utilization equipment can continuously operate with the direct current component of the AC voltage and should be, not less than thirty (30) minutes. Repeat the test for test condition B as noted in table TAC108-II. Record the voltages, frequency, DC voltage component, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table TAC108-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, set the programmable power supply to produce voltage sine waves without a DC component. Adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TAC108-II. Test conditions for direct current component of AC voltage.

Test Condition	MIL-STD-704A, B C, D, E & F Direct Current Component of AC Voltage
A	+ 0.10V
B	– 0.10 V



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC108-1. DC voltage component.

TABLE TAC108-III. Sample data sheet for TAC108 DC voltage component.

Test Condition	Parameters								Performance
	Phase	Voltage		Frequency		DC Voltage Component		Time Duration at Test Condition		Pass/Fail
A	A		V_{rms}		Hz		V_{dc}		min	
	B		V_{rms}				V_{dc}			
	C		V_{rms}				V_{dc}			
B	A		V_{rms}		Hz		V_{dc}		min	
	B		V_{rms}				V_{dc}			
	C		V_{rms}				V_{dc}			

METHOD TAC109
Normal Voltage Transients

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Normal Voltage Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to normal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC109-I. The utilization equipment must maintain specified performance during and after the voltage transients. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TAC109-I. MIL-STD-704 limits for normal voltage transients.

Limit	704A	704B	704C	704D	704E	704F
Normal Voltage Transients	Figure 3 MIL-STD-704A Locus of Equivalent Step Function Curves 2 and 3	Figure 4 MIL-STD-704B	Figure 5 MIL-STD-704C	Figure 5 MIL-STD-704D	Figure 4 MIL-STD-704E	Figure 3 MIL-STD-704F

3. Apparatus: The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure TAC109-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC109-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

5.1 Compliance test for MIL-STD-704A. The UUT must be subjected to the voltage transients for each test condition A through O noted in table TAC109-II. The voltage must increase or decrease from steady state voltage to the voltage transient level within ½ cycle (1.25 milliseconds). The voltage must remain at the voltage transient level for the duration noted in table TAC109-II. The voltage must return to steady state over the time duration noted in table TAC109-II. For test condition G, three over-voltage transients of 160 Vrms for 25 milliseconds are performed, separated by 0.5 seconds. For test condition N, three under-voltage transients of 58 Vrms for 25 milliseconds are performed, separated by 0.5 seconds. For test condition O, an under-voltage transient of 58 Vrms for 25 milliseconds is immediately followed by an overvoltage transient of 160 Vrms for 25 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal steady state limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltages, steady state frequency, voltage transient level, time duration at voltage transient, oscilloscope trace, and the performance of the UUT for each test condition in the data sheet shown in table TAC109-IV. Repeat for each mode of operation of the UUT. In addition, for MIL-STD-704A test compliance perform the repetitive normal voltage transient test described later.

5.2 Compliance test for MIL-STD-704B, C, D, E, & F. The UUT must be subjected to the voltage transients for each test condition AA through MM noted in table TAC109-III. The voltage must increase or decrease from steady state voltage to the voltage transient level within ½ cycle (1.25 milliseconds). The voltage must remain at the voltage transient level for the duration noted in table TAC109-III. The voltage must return to steady state over the time duration noted in table TAC109-III. For test condition GG, three overvoltage transients of 180 Vrms for 10 milliseconds are performed, separated by 0.5 seconds. For test condition LL, three undervoltage transients of 80 Vrms for 10 milliseconds are performed, separated by 0.5 seconds. For test condition MM, an undervoltage transient of 80 Vrms for 10 milliseconds is immediately followed by an overvoltage transient of 180 Vrms for 10 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal steady state limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltages, steady state frequency, voltage transient level, time duration at voltage transient, oscilloscope trace, and the performance of the UUT for each test condition in the data sheet shown in table TAC109-V. Repeat for each mode of operation of the UUT. In addition, for MIL-STD-704B, C, D, E, & F test compliance perform the repetitive normal voltage transient test as described in 5.3.

5.3 Repetitive normal voltage transients test. Program the power supply to provide a continually repeating voltage transient that decreases from 115 Vrms to 90 Vrms in 2.5 msec, then increases to 140 Vrms over 50 msec, then decreases to 115 Vrms over 5.0 msec. The voltage transient is repeated every 0.5 seconds, see figure TAC109-2. The UUT must be subjected to the repetitive voltage transient for a length of time that confirms the utilization equipment can continuously operate and should be not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltages, steady state frequency, high voltage transient level, low voltage transient level, oscilloscope trace, time duration at test condition, and the performance of the UUT in the data sheet shown in table TAC109-IV or table TAC109-V. Repeat for each mode of operation of the UUT.

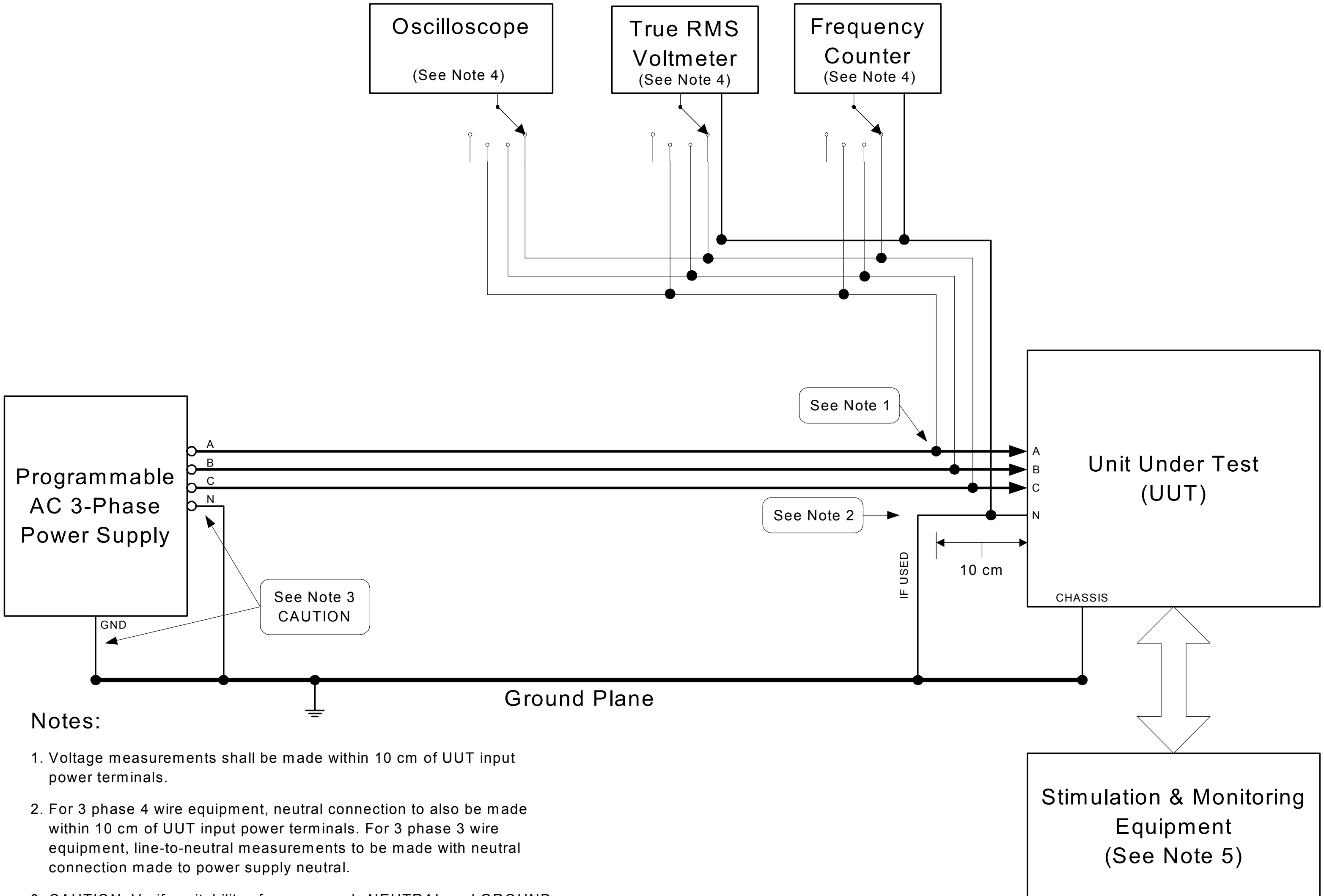
After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TAC109-II. Test conditions for MIL-STD-704A normal voltage transients.

Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage milliseconds
Overvoltage Transients				
A	< 1.25 msec	135 Vrms	210 msec	< 1.25 msec
B	< 1.25 msec	135 Vrms	145 msec	130 msec
C	< 1.25 msec	145 Vrms	130 msec	< 1.25 msec
D	< 1.25 msec	145 Vrms	90 msec	80 msec
E	< 1.25 msec	160 Vrms	48 msec	< 1.25 msec
F	< 1.25 msec	160 Vrms	30 msec	40 msec
G	< 1.25 msec	160 Vrms (3 times)	25 msec every 0.5 sec	< 1.25 msec
Undervoltage Transients				
H	< 1.25 msec	90 Vrms	300 msec	< 1.25 msec
I	< 1.25 msec	90 Vrms	210 msec	180 msec
J	< 1.25 msec	70 Vrms	140 msec	< 1.25 msec
K	< 1.25 msec	70 Vrms	95 msec	85 msec
L	< 1.25 msec	58 Vrms	48 msec	< 1.25 msec
M	< 1.25 msec	58 Vrms	30 msec	40 msec
N	< 1.25 msec	58 Vrms (3 times)	25 msec every 0.5 sec	< 1.25 msec
Combined Transient				
O	< 1.25 msec then < 1.25 msec	58 Vrms 160 Vrms	25 msec 25 msec	< 1.25 msec 50 msec

TABLE TAC109-III. Test conditions for MIL-STD-704B, C, D, E, and F normal voltage transients.

Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage milliseconds
Overvoltage Transients				
AA	< 1.25 msec	140 Vrms	60 msec	< 1.25 msec
BB	< 1.25 msec	140 Vrms	60 msec	25 msec
CC	< 1.25 msec	160 Vrms	34 msec	< 1.25 msec
DD	< 1.25 msec	160 Vrms	34 msec	52 msec
EE	< 1.25 msec	180 Vrms	10 msec	< 1.25 msec
FF	< 1.25 msec	180 Vrms	10 msec	77 msec
GG	< 1.25 msec	180 Vrms (3 times)	10 msec every 0.5 sec	< 1.25 msec
Undervoltage Transients				
HH	< 1.25 msec	90 Vrms	35 msec	< 1.25 msec
II	< 1.25 msec	90 Vrms	35 msec	45 msec
JJ	< 1.25 msec	80 Vrms	10 msec	< 1.25 msec
KK	< 1.25 msec	80 Vrms	10 msec	70 msec
LL	< 1.25 msec	80 Vrms (3 times)	10 msec every 0.5 sec	< 1.25 msec
Combined Transient				
MM	< 1.25 msec then < 1.25 msec	80 Vrms 180 Vrms	10 msec 10 msec	< 1.25 msec 77 msec



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC109-1. Normal voltage transients.

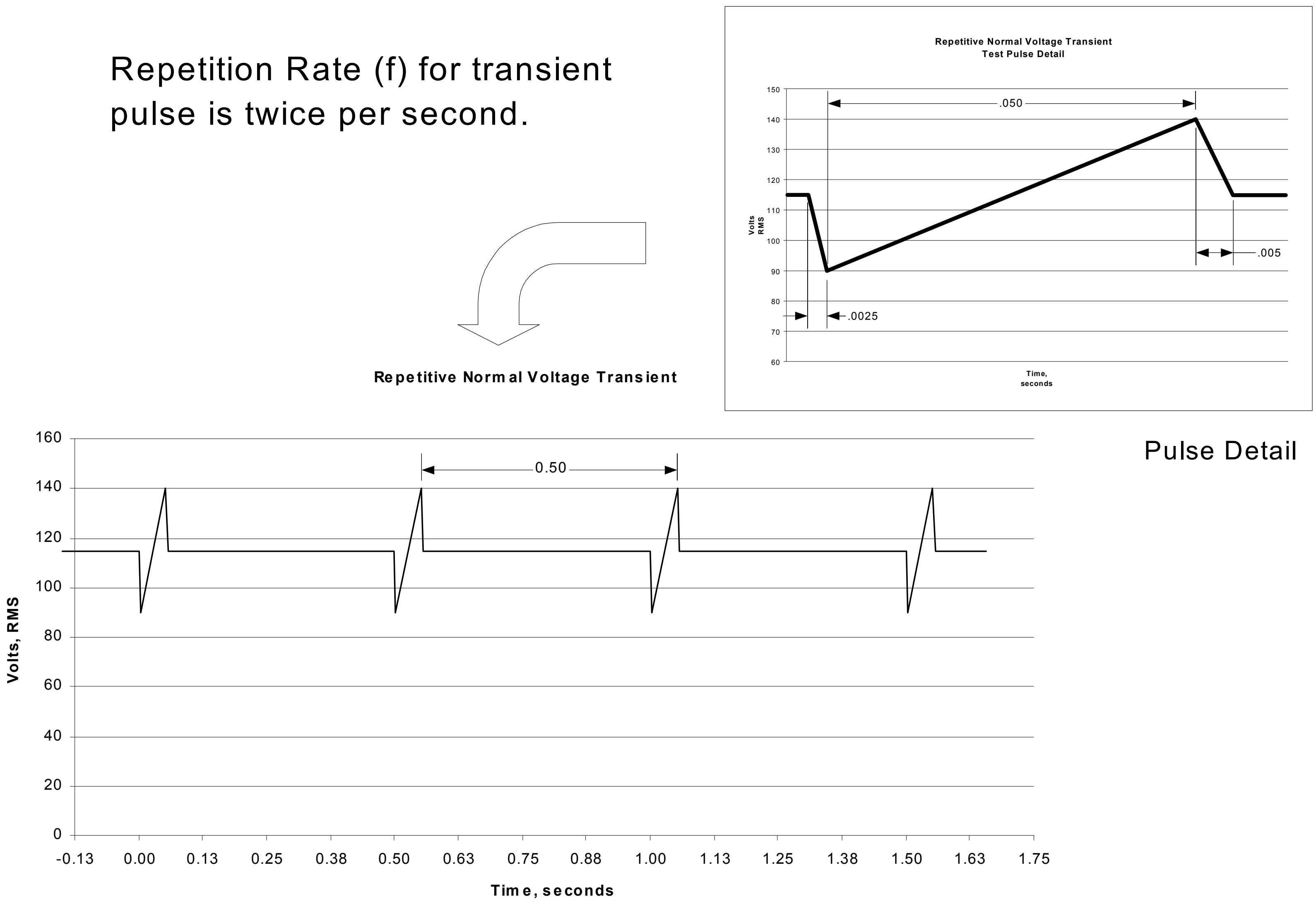


FIGURE TAC109-2. Repetitive normal voltage transients.

TABLE TAC109-IV. Sample data sheet for TAC109 normal voltage transients for MIL-STD-704A.

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
A	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
B	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
C	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
D	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
E	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
F	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
G	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			

TABLE TAC109-IV. Sample data sheet for TAC109 normal voltage transients for MIL-STD-704A. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
H	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
I	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
J	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
K	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
L	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
M	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
N	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			

TABLE TAC109-IV. Sample data sheet for TAC109 normal voltage transients for MIL-STD-704A. - Continued

Test Condition	Parameters										Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace	Pass/Fail
O	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
	A						V_{rms}		msec			
	B						V_{rms}		msec			
	C						V_{rms}		msec			
Repetitive Transient	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
	A						V_{rms}		msec			
	B						V_{rms}		msec			
	C						V_{rms}		msec			
	Time duration at test condition										min	

TABLE TAC109-V. Sample data sheet for TAC109 normal voltage transients for MIL-STD-704B, C, D, E, & F.

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
AA	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
BB	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
CC	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
DD	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
EE	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
FF	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
GG	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			

TABLE TAC109-V. Sample data sheet for TAC109 normal voltage transients for MIL-STD-704B, C, D, E, & F. - Continued

Test Condition	Parameters: Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Performance Pass/Fail
HH	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
II	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
JJ	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
KK	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
LL	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
MM	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
	A						V_{rms}		msec			
	B						V_{rms}		msec			
	C						V_{rms}		msec			

TABLE TAC109-V. Sample data sheet for TAC109 normal voltage transients for MIL-STD-704B, C, D, E, & F. - Continued

Test Condition	Parameters											Performance Pass/Fail
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		
Repetitive Transient	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
	A						V_{rms}		msec			
	B						V_{rms}		msec			
	C						V_{rms}		msec			
	Time duration at test condition										min	

METHOD TAC110
Normal Frequency Transients

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Normal Frequency Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to normal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to frequency transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC110-I. The utilization equipment must maintain specified performance during and after the frequency transients. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TAC110-I. MIL-STD-704 limits for normal frequency transients.

Limit	704A	704B	704C	704D	704E	704F
Normal Frequency Transients	Figure 5 MIL-STD-704A Locus of Equivalent Step Function Curves 2 and 3	¶ 5.1.3 MIL-STD-704B	Figure 6 MIL-STD-704C	Figure 6 MIL-STD-704D	Figure 5 MIL-STD-704E	Figure 5 MIL-STD-704F
Normal Maximum Rate of Change of Frequency	250 Hz/sec	N/A	N/A	N/A	N/A	N/A

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure TAC110-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC110-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

5.1 Compliance test for MIL-STD-704A. The UUT must be subjected to the frequency transients for each test condition A through I noted in table TAC110-II. The frequency must increase or decrease from steady state frequency to the frequency transient level over the duration noted; the frequency must remain at the frequency transient level for the duration noted; and the frequency must return from the frequency transient level over the duration noted. For test condition I, an underfrequency transient of 350 Hz is immediately followed by an overfrequency transient of 450 Hz. For each test condition, monitoring the performance of the UUT during the frequency transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal steady state limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltages, steady state frequency, frequency transient level, time at frequency transient, oscilloscope trace (Hz vs. time), and the performance of the UUT for each test condition in the data sheet shown in table TAC110-IV. Repeat for each mode of operation of the UUT.

5.2 Compliance test for MIL-STD-704B, C, D, E, & F. The UUT must be subjected to the frequency transients for each test condition AA through II noted in table TAC110-III. The frequency must increase or decrease from steady state frequency to the frequency transient level over the duration noted; the frequency must remain at the frequency transient level for the duration noted; and the frequency must return from the frequency transient level over the duration noted. For test condition II, an underfrequency transient of 375 Hz is immediately followed by an overfrequency transient of 425 Hz. For each test condition, monitoring the performance of the UUT during the frequency transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal steady state limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltages, steady state frequency, frequency transient level, time at frequency transient, oscilloscope trace (Hz vs. time), and the performance of the UUT for each test condition in the data sheet shown in table TAC110-V. Repeat for each mode of operation of the UUT.

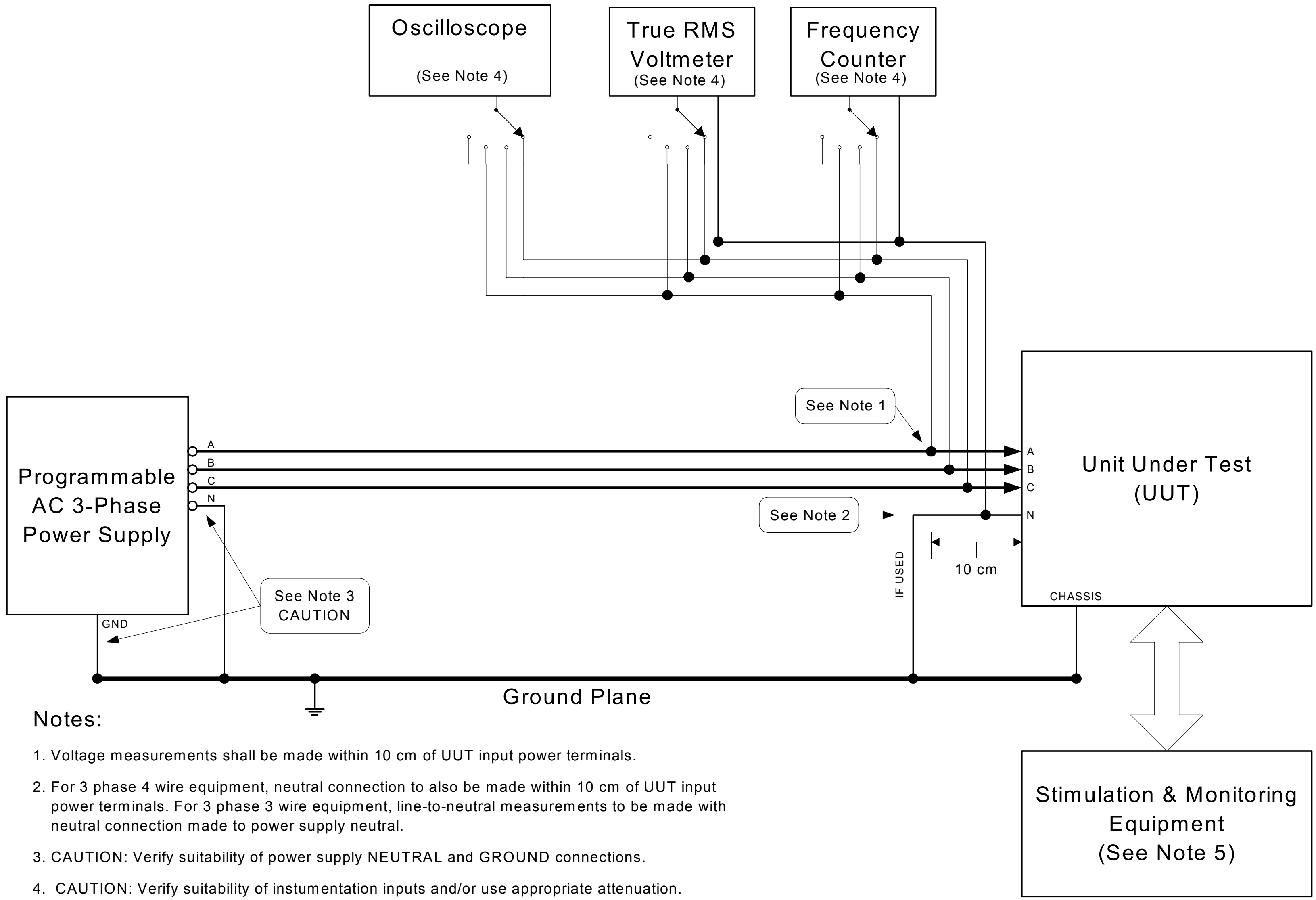
After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TAC110-II. Test conditions for MIL-STD-704A normal frequency transients.

Test Condition	Time From Steady State Frequency to Frequency Transient Level milliseconds	Frequency Transient Level Hz	Duration at Frequency Transient Level	Time From Frequency Transient Level to Steady State Frequency
Overfrequency Transients				
A	120 msec	430 Hz	½ cycle	120 msec
B	300 msec	430 Hz	½ cycle	1.2 seconds
C	200 msec	450 Hz	½ cycle	200 msec
D	250 msec	450 Hz	½ cycle	3 seconds
Underfrequency Transients				
E	120 msec	370 Hz	½ cycle	120 msec
F	300 msec	370 Hz	½ cycle	1.2 seconds
G	200 msec	350 Hz	½ cycle	200 msec
H	250 msec	350 Hz	½ cycle	3 seconds
Combined Transient				
I	200 msec then 200 msec	350 Hz 450 Hz	½ cycle ½ cycle	200 msec 200 msec

TABLE TAC110-III. Test conditions for MIL-STD-704B, C, D, E, and F normal frequency transients.

Test Condition	Time From Steady State Frequency to Frequency Transient Level milliseconds	Frequency Transient Level Hz	Duration at Frequency Transient Level	Time From Frequency Transient Level to Steady State Frequency milliseconds
Overfrequency Transients				
AA	40 msec	410 Hz	10 seconds	40 msec
BB	80 msec	420 Hz	5 seconds	80 msec
CC	100 msec	425 Hz	1 seconds	100 msec
DD	100 msec then 10 msec then 20 msec	425 Hz 420 Hz 410 Hz	1 seconds 4 seconds 5 seconds	10 msec 20 msec 40 msec
Underfrequency Transients				
EE	40 msec	390 Hz	10 seconds	40 msec
FF	80 msec	380 Hz	5 seconds	80 msec
GG	100 msec	375 Hz	1 seconds	100 msec
HH	100 msec then 10 msec then 20 msec	375 Hz 380 Hz 390 Hz	1 seconds 4 seconds 5 seconds	10 msec 20 msec 40 msec
Combined Transient				
II	100 msec then 100 msec	375 Hz 425 Hz	1 seconds 1 seconds	100 msec 100 msec



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC110-1. Normal frequency transients.

TABLE TAC110-IV. Sample data sheet for TAC110 normal frequency transients for MIL-STD-704A.

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace		Pass/Fail
A	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
B	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
C	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
D	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
E	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
F	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
G	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									

TABLE TAC110-IV. Sample data sheet for TAC110 normal frequency transients for MIL-STD-704A. - Continued

Test Condition	Parameters										Performance
	Phase	Steady State Voltage		Steady State Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace	Pass/Fail
H	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
I	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
							Hz		msec			

TABLE TAC110-V. Sample data sheet for TAC110 normal frequency transients for MIL-STD-704B, C, D, E, & F.

Test Condition	Parameters: Phase	Parameters: Voltage		Parameters: Frequency		Parameters: Frequency Transient		Parameters: Time at Frequency Transient Level		Parameters: Oscilloscope Trace		Performance Pass/Fail
AA	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
BB	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
CC	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
DD	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
EE	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
FF	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
GG	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									

TABLE TAC110-V. Sample data sheet for TAC110 normal frequency transients for MIL-STD-704B, C, D, E, & F. - Continued

<table>
<tr><th rowspan="2">Test Condition</th><th colspan="10">Parameters</th><th>Performance</th></tr>
<tr><th>Phase</th><th colspan="2">Voltage</th><th colspan="2">Frequency</th><th colspan="2">Frequency Transient</th><th colspan="2">Time at Frequency Transient Level</th><th colspan="2">Oscilloscope Trace</th><th>Pass/Fail</th></tr>
<tr><td rowspan="3">HH</td><td>A</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>Hz</td><td></td><td>sec</td><td>Attach Trace</td><td>Hz vs. Time</td><td rowspan="3"></td></tr>
<tr><td>B</td><td></td><td>V_{rms}</td><td colspan="2" rowspan="2"></td><td colspan="2" rowspan="2"></td><td colspan="2" rowspan="2"></td><td colspan="2" rowspan="2"></td></tr>
<tr><td>C</td><td></td><td>V_{rms}</td></tr>
<tr><td rowspan="4">II</td><td>A</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>Hz</td><td></td><td>sec</td><td>Attach Trace</td><td>Hz vs. Time</td><td rowspan="4"></td></tr>
<tr><td>B</td><td></td><td>V_{rms}</td><td colspan="2" rowspan="3"></td><td colspan="2" rowspan="2"></td><td colspan="2" rowspan="2"></td><td colspan="2" rowspan="3"></td></tr>
<tr><td>C</td><td></td><td>V_{rms}</td></tr>
<tr><td colspan="3"></td><td></td><td>Hz</td><td></td><td>sec</td></tr>
</table>

METHOD TAC201
Power Interrupt

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Transfer Interrupt

PARAMETER: Power Interrupt

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to power interrupts as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for transfer aircraft electrical conditions when subjected to power interrupts as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TAC201-I. The utilization equipment must maintain the specified performance during power interrupts. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TAC201-I. MIL-STD-704 power transfer limits.

Limit	704A	704B	704C	704D	704E	704F
Power Interrupt	50 msec	50 msec	50 msec	50 msec	50 msec	50 msec
Voltage NLSS	108 V	108 V	108 V	108 V	108 V	108 V
Voltage NHSS	118 V	118 V	118 V	118 V	118 V	118 V

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope
e. Resistive dummy load

4. Test setup. Configure the test setup as shown in figure TAC201-1. The dummy resistive load placed in parallel to the UUT should be sized to draw three times the steady state current of the UUT up to a maximum of 25 kW dummy load. Note: This is done to ensure that the UUT test

does not lose stored energy to other aircraft loads during power interrupts. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

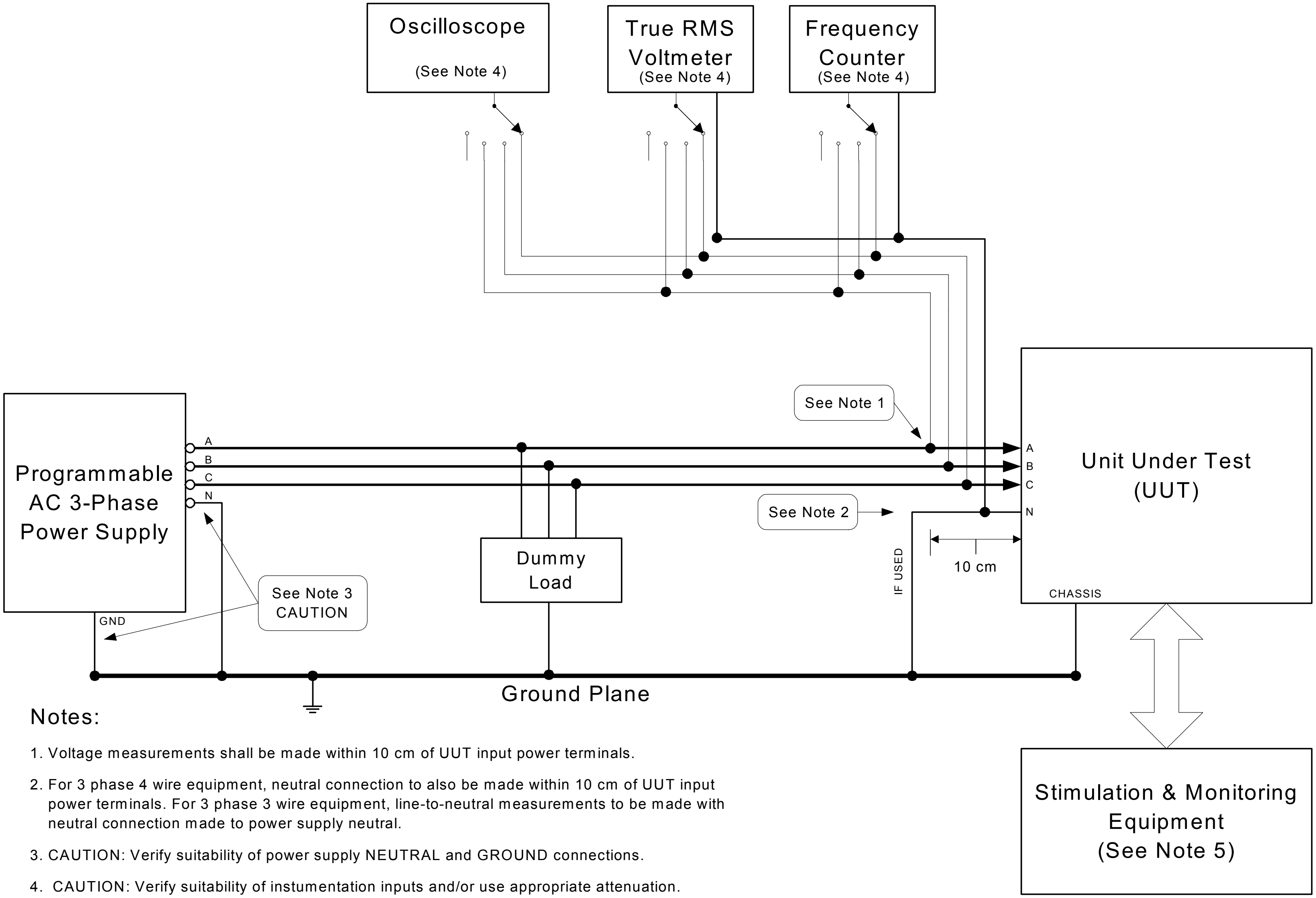
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC201-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through K noted in table TAC201-II, adjust the voltage to the steady state voltage listed. Perform a power interrupt (0 V) of the duration listed. The voltage must decrease from the steady state voltage to 0 Volts within ½ cycle (1.25 milliseconds), remain at 0 Volts for the duration listed for the test condition, and return from 0 Volts to the steady state voltage within ½ cycle (1.25 milliseconds). For test condition J, three 50 millisecond power interrupts are performed, separated by 0.5 seconds. For test condition K a normal overvoltage transient follows the power interrupt. The normal voltage transient is 160 Vrms for 30 milliseconds and returns to nominal voltage over the next 40 milliseconds. For test condition L a normal undervoltage transient follows the power interrupt. The normal voltage transient is 70 Vrms for 30 milliseconds and returns to nominal voltage over the next 40 milliseconds. For each test condition, monitor the performance of the UUT according to the utilization equipment performance test procedures for power transfer operation to verify that the UUT is providing specified performance for transfer aircraft electrical conditions. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing the performance specified for normal aircraft electrical conditions (if the UUT is allowed degraded performance during power interrupts, verify the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage). Record the steady state voltages, steady state frequency, time duration of power interrupts, and the performance of the UUT for each test condition in the data sheet shown in table TAC201-II. Repeat each test condition 5 times. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TAC201-II. Test conditions for transfer interrupt.

Test Condition	Steady State Voltage	Duration of Interrupt
A	Nominal Voltage	50 msec
B	NLSS Voltage	50 msec
C	NHSS Voltage	50 msec
D	Nominal Voltage	30 msec
E	NLSS Voltage	30 msec
F	NHSS Voltage	30 msec
G	Nominal Voltage	10 msec
H	NLSS Voltage	10 msec
I	NHSS Voltage	10 msec
J	Nominal Voltage	50 msec (repeated 3 times, separated by 0.5 sec)
K	Nominal Voltage	50 msec (followed by a normal voltage transient of 160 Vrms for 30 msec and return to steady state voltage in 40 msec)
L	Nominal Voltage	50 msec (followed by a normal voltage transient of 70 Vrms for 30 msec and return to steady state voltage in 40 msec)



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC201-1. Power interrupt.

TABLE TAC201-III. Sample data sheet for TAC201 power interrupt.

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration of Power Interrupt		Pass/Fail
A	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
B	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
C	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
D	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
E	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
F	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
G	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	

TABLE TAC201-III. Sample data sheet for TAC201 power interrupt. - Continued

Test Condition	Parameter								Performance
	Phase	Voltage		Frequency		Time Duration of Power Interrupt		Pass/Fail	
H	A		V_{rms}		Hz		msec		
	B		V_{rms}				msec		
	C		V_{rms}				msec		
I	A		V_{rms}		Hz		msec		
	B		V_{rms}				msec		
	C		V_{rms}				msec		
J	A		V_{rms}		Hz		msec		
	B		V_{rms}				msec		
	C		V_{rms}				msec		
K	A		V_{rms}		Hz		msec		
	B		V_{rms}				msec		
	C		V_{rms}				msec		
	Voltage Transient Level					Time at Voltage Transient Level			
	A		V_{rms}				msec		
	B		V_{rms}				msec		
	C		V_{rms}				msec		

TABLE TAC201-III. Sample data sheet for TAC201 power interrupt. – Continued

<table>
<tr><th>Test</th><th colspan="7">Parameter</th><th>Performance</th></tr>
<tr><th>Condition</th><th>Phase</th><th colspan="2">Voltage</th><th colspan="2">Frequency</th><th colspan="2">Time Duration of Power Interrupt</th><th>Pass/Fail</th></tr>
<tr><td rowspan="8">L</td><td>A</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td rowspan="8"></td></tr>
<tr><td>B</td><td></td><td>V_{rms}</td><td colspan="2" rowspan="2"></td><td></td><td>msec</td></tr>
<tr><td>C</td><td></td><td>V_{rms}</td><td></td><td>msec</td></tr>
<tr><td colspan="3">Voltage Transient Level</td><td colspan="2" rowspan="4"></td><td colspan="2">Time at Voltage Transient Level</td></tr>
<tr><td>A</td><td></td><td>V_{rms}</td><td></td><td>msec</td></tr>
<tr><td>B</td><td></td><td>V_{rms}</td><td></td><td>msec</td></tr>
<tr><td>C</td><td></td><td>V_{rms}</td><td></td><td>msec</td></tr>
</table>

METHOD TAC301
Abnormal Steady State Limits for Voltage and Frequency

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Abnormal

PARAMETER: Abnormal Steady State Limits for Voltage and Frequency

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Abnormal Low Steady State (ALSS) limits and the Abnormal High Steady State (AHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when supplied input power of voltage and frequency at the specified abnormal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC301-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the abnormal steady state voltage and frequency limits and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the abnormal steady state voltage and frequency limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TAC301-I. MIL-STD-704 abnormal limits for steady state voltage and frequency.

Abnormal Limit	704A	704B	704C	704D	704E	704F
Voltage ALSS	102 V	100 V	100 V	100 V	100 V	100 V
Voltage AHSS	124 V	125 V	125 V	125 V	125 V	125 V
Frequency ALSS	370 Hz	375 Hz	380 Hz	375 Hz	380 Hz	380 Hz
Frequency AHSS	430 Hz	425 Hz	420 Hz	425 Hz	420 Hz	420 Hz

3. Apparatus. The test equipment should be as follows:

a. Adjustable AC power supply
b. True RMS voltmeter
c. Frequency counter

4. Test setup. Configure the test setup as shown in figure TAC301-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

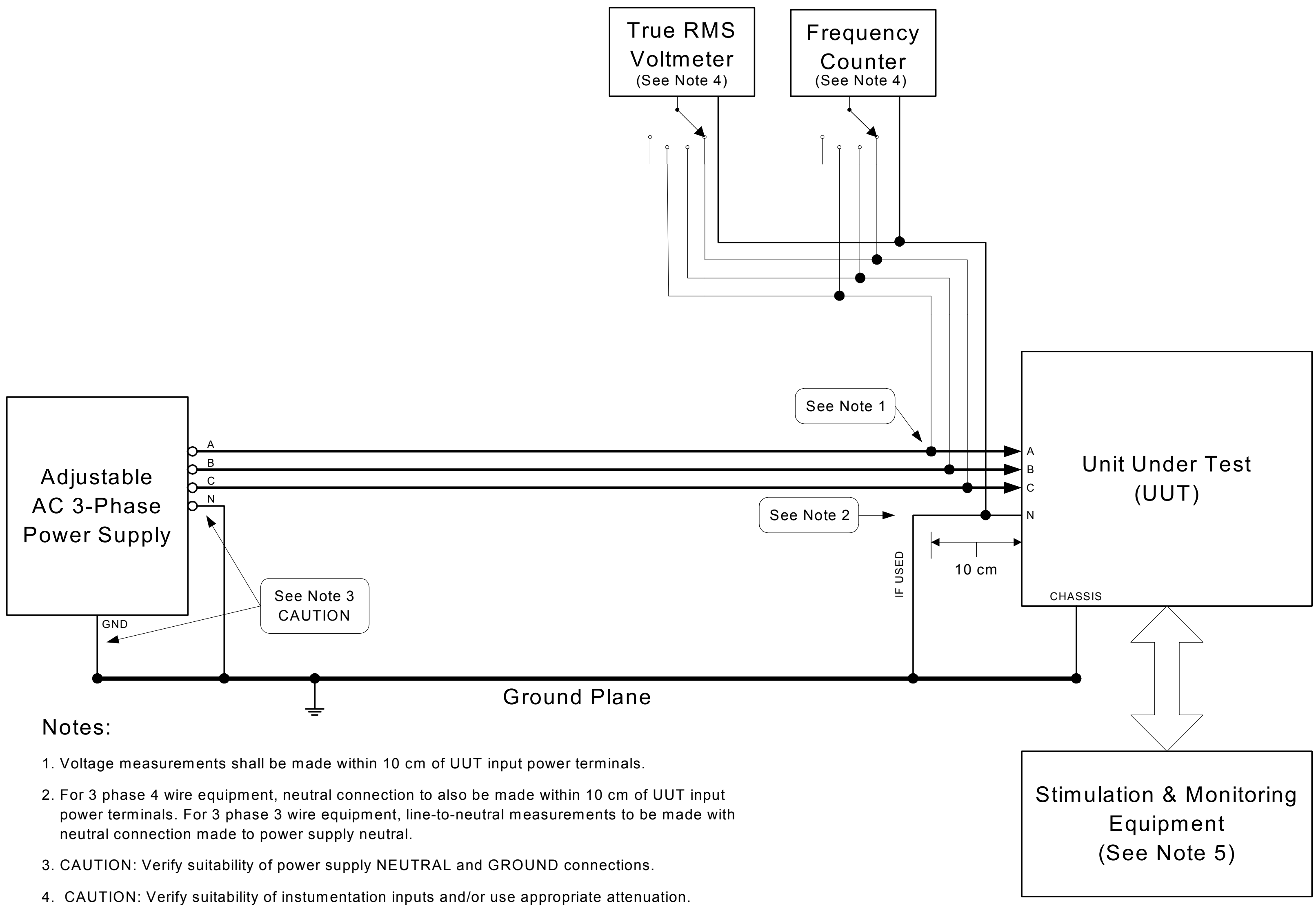
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC301-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through H noted in table TAC301-II, the UUT must remain for a length of time that confirms the utilization equipment can perform as specified at the abnormal steady state voltage and frequency limits and should be not less than thirty (30) minutes. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. For each test condition shut down the UUT and verify that the UUT can be re-started. After re-start, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Adjust the voltage to the nominal steady state voltage of 115 Vrms and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the voltages, frequency, time duration at test condition, successful/unsuccessful re-start and the performance of the UUT for each test condition in the data sheet shown in table TAC301-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TAC301-II. Test conditions for abnormal steady state limits for voltage and frequency.

Test Condition	Voltage	Frequency
A	Nominal Voltage	ALSS Frequency
B	Nominal Voltage	AHSS Frequency
C	ALSS Voltage	Nominal Frequency
D	ALSS Voltage	ALSS Frequency
E	ALSS Voltage	AHSS Frequency
F	AHSS Voltage	Nominal Frequency
G	AHSS Voltage	ALSS Frequency
H	AHSS Voltage	AHSS Frequency



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC301-1. Abnormal steady state limits for voltage and frequency.

TABLE TAC301-III. Sample data sheet for TAC301 abnormal steady state limits for voltage and frequency.

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration at Test Condition		Pass/Fail
A	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
B	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
C	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
D	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
E	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
F	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					

TABLE TAC301-III. Sample data sheet for TAC301 abnormal steady state limits for voltage and frequency. - Continued

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration at Test Condition		Pass/Fail
G	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
H	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					

METHOD TAC302
Abnormal Voltage Transients

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Abnormal

PARAMETER: Abnormal Voltage Transients

1. Scope.

1.1. Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to abnormal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to voltage transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC302-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TAC302-I. MIL-STD-704 limits for abnormal voltage transients.

Limit	704A	704B	704C	704D	704E	704F
Abnormal Voltage Transients	Figure 3 MIL-STD-704A Locus of Equivalent Step Function Curves 1 and 4	Figure 5 MIL-STD-704B	Figure 7 MIL-STD-704C	Figure 7 MIL-STD-704D	Figure 6 MIL-STD-704E	Figure 4 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure TAC302-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC302-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

5.1 Compliance test for MIL-STD-704A. The UUT must be subjected to the voltage transients for each test condition A through O noted in table TAC302-II. The voltage must increase or decrease from steady state voltage to the voltage transient level within ½ cycle (1.25 milliseconds). The voltage must remain at the voltage transient level for the duration noted in table TAC302-II. The voltage must return to steady state over the time duration noted in table TAC302-II. For test condition G, three over-voltage transients of 180 Vrms for 20 milliseconds are performed, separated by 0.5 seconds. For test condition N, three under-voltage transients of 45 Vrms for 20 milliseconds are performed, separated by 0.5 seconds. For test condition O, an under-voltage transient of 45 Vrms for 20 milliseconds is immediately followed by an overvoltage transient of 180 Vrms for 75 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits, and has not suffered damage. Record the steady state voltages, steady state frequency, voltage transient level, time duration at voltage transient, oscilloscope trace, and the performance of the UUT for each test condition in the data sheet shown in table TAC302-IV. Repeat for each mode of operation of the UUT.

5.2 Compliance test for MIL-STD-704B, C, D, E, & F. The UUT must be subjected to the voltage transients for each test condition AA through OO noted in table TAC302-III. The voltage must increase or decrease from steady state voltage to the voltage transient level within ½ cycle (1.25 milliseconds). The voltage must remain at the voltage transient level for the duration noted in table TAC302-III. The voltage must return to steady state over the time duration noted in table TAC303-III. For test condition GG, three over-voltage transients of 180 Vrms for 20 milliseconds are performed, separated by 0.5 seconds. For test condition NN, three under-voltage transients of 45 Vrms for 20 milliseconds are performed, separated by 0.5 seconds. For test condition OO, an under-voltage transient of 45 Vrms for 20 milliseconds is immediately followed by an overvoltage transient of 180 Vrms for 50 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits, and has not suffered damage. Record the steady state voltages, steady state frequency, voltage transient level, time duration at voltage transient, oscilloscope trace, and the performance of the UUT for each test condition in the data sheet shown in table TAC302-V. Repeat for each mode of operation of the UUT.

TABLE TAC302-II. Test conditions for MIL-STD-704A abnormal voltage transients.

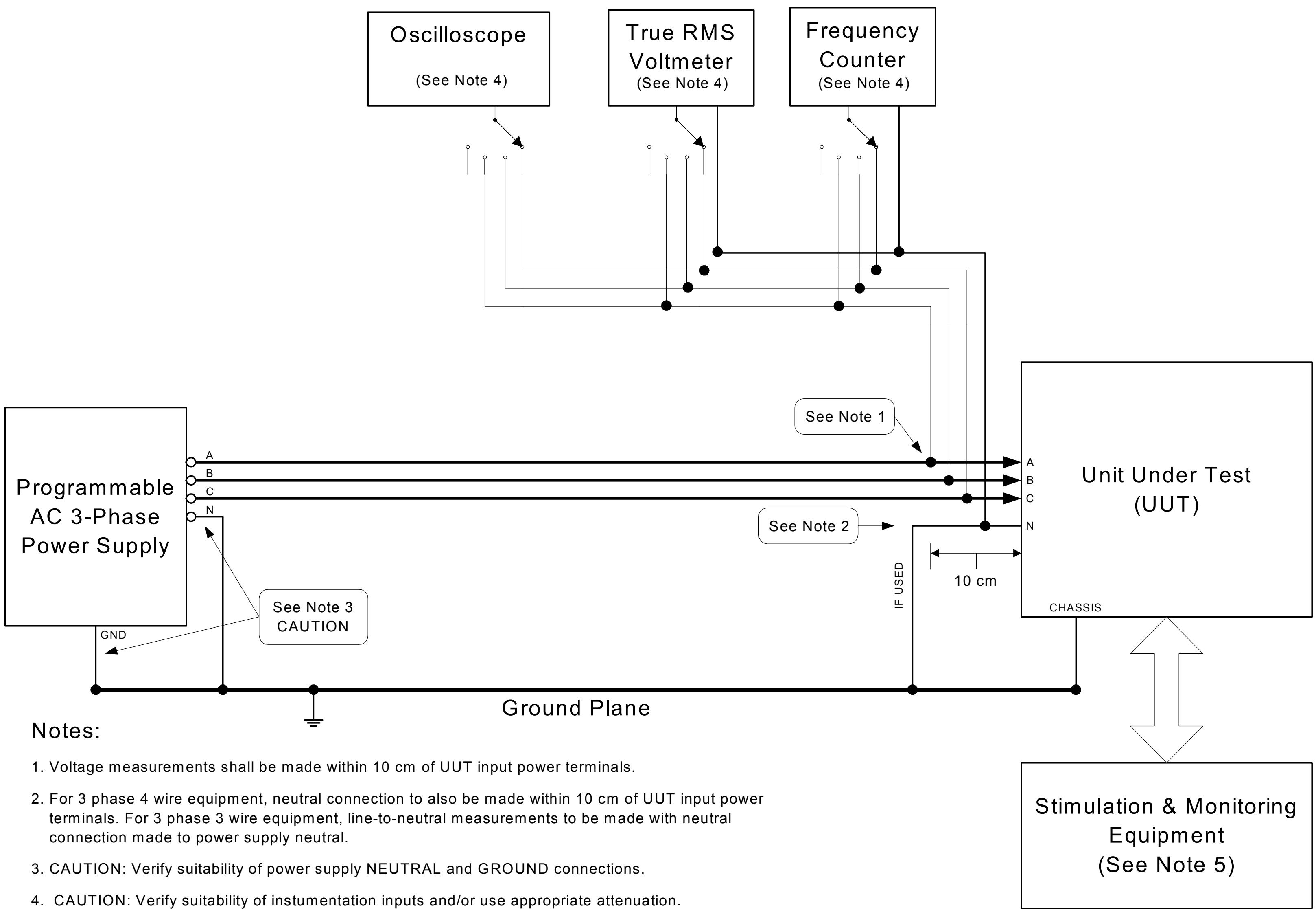
Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage milliseconds
Overvoltage Transients				
A	< 1.25 msec	140 Vrms	1450 msec	< 1.25 msec
B	< 1.25 msec	140 Vrms	1025 msec	850 msec
C	< 1.25 msec	160 Vrms	520 msec	< 1.25 msec
D	< 1.25 msec	160 Vrms	390 msec	250 msec
E	< 1.25 msec	180 Vrms	98 msec	< 1.25 msec
F	< 1.25 msec	180 Vrms	75 msec	50 msec
G	< 1.25 msec	180 Vrms (3 times)	20 msec every 0.5 sec	< 1.25 msec
Undervoltage Transients				
H	< 1.25 msec	85 Vrms	1450 msec	< 1.25 msec
I	< 1.25 msec	85 Vrms	1025 msec	850 msec
J	< 1.25 msec	75 Vrms	520 msec	< 1.25 msec
K	< 1.25 msec	75 Vrms	390 msec	250 msec
L	< 1.25 msec	45 Vrms	98 msec	< 1.25 msec
M	< 1.25 msec	45 Vrms	75 msec	50 msec
N	< 1.25 msec	45 Vrms (3 times)	20 msec every 0.5 sec	< 1.25 msec
Combined Transient				
O	< 1.25 msec then < 1.25 msec	45 Vrms 180 Vrms	20 msec 75 msec	< 1.25 msec 50 msec

TABLE TAC302-III. Test conditions for MIL-STD-704B, C, D, E, and F abnormal voltage transients.

Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Overvoltage Transients				
AA	< 1.25 msec	140 Vrms	180 msec	< 1.25 msec
BB	< 1.25 msec	140 Vrms	180 msec	87 msec
	then	135 Vrms	decreasing	253 msec
	then	130 Vrms	decreasing	6.41 sec
	then	125 Vrms	decreasing	>10 sec
		115 Vrms		
CC	< 1.25 msec	160 Vrms	78 msec	< 1.25 msec
DD	< 1.25 msec	160 Vrms	78 msec	31 msec
	then	150 Vrms	decreasing	71 msec
	then	140 Vrms	decreasing	87 msec
	then	135 Vrms	decreasing	253 msec
	then	130 Vrms	decreasing	6.41 sec
	then	125 Vrms	decreasing	>10 sec
		115 Vrms		
EE	< 1.25 msec	180 Vrms	50 msec	< 1.25 msec
FF	< 1.25 msec	180 Vrms	50 msec	11 msec
	then	170 Vrms	decreasing	17 msec
	then	160 Vrms	decreasing	31 msec
	then	150 Vrms	decreasing	71 msec
	then	140 Vrms	decreasing	87 msec
	then	135 Vrms	decreasing	253 msec
	then	130 Vrms	decreasing	6.41 sec
	then	125 Vrms	decreasing	>10 sec
		115 Vrms		
GG	< 1.25 msec	180 Vrms (3 times)	20 msec every 0.5 sec	< 1.25 msec

TABLE TAC302-III. Test conditions for MIL-STD-704B, C, D, E, and F abnormal voltage transients. - Continued

Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Undervoltage Transients				
HH	< 1.25 msec	85 Vrms	180 msec	< 1.25 msec
II	< 1.25 msec	85 Vrms	180 msec	87 msec
	then	90 Vrms	increasing	253 msec
	then	95 Vrms	increasing	6.41 sec
	then	100 Vrms	increasing	>10 sec
		115 Vrms		
JJ	< 1.25 msec	66 Vrms	78 msec	< 1.25 msec
KK	< 1.25 msec	65 Vrms	78 msec	31 msec
	then	75 Vrms	increasing	71 msec
	then	85 Vrms	increasing	87 msec
	then	90 Vrms	increasing	253 msec
	then	95 Vrms	increasing	6.41 sec
	then	100 Vrms	increasing	>10 sec
		115 Vrms		
LL	< 1.25 msec	45 Vrms	50 msec	< 1.25 msec
MM	< 1.25 msec	45 Vrms	50 msec	11 msec
	then	55 Vrms	increasing	17 msec
	then	65 Vrms	increasing	31 msec
	then	75 Vrms	increasing	71 msec
	then	85 Vrms	increasing	87 msec
	then	90 Vrms	increasing	253 msec
	then	95 Vrms	increasing	6.41 sec
	then	100 Vrms	increasing	>10 sec
		115 Vrms		
NN	< 1.25 msec	45 Vrms (3 times)	20 msec every 0.5 sec	< 1.25 msec
Combined Transient				
OO	< 1.25 msec	45 Vrms then	20 msec	< 1.25 msec
	< 1.25 msec	180 Vrms	50 msec	11 msec
	then	170 Vrms	decreasing	17 msec
	then	160 Vrms	decreasing	31 msec
	then	150 Vrms	decreasing	71 msec
	then	140 Vrms	decreasing	87 msec
	then	135 Vrms	decreasing	253 msec
	then	130 Vrms	decreasing	6.41 sec
	then	125 Vrms	decreasing	>10 sec
		115 Vrms		



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC302-1. Abnormal voltage transients.

TABLE TAC302-IV. Sample data sheet for TAC302 abnormal voltage transients for MIL-STD-704A.

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
A	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
B	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
C	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
D	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
E	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
F	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
G	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			

TABLE TAC302-IV. Sample data sheet for TAC302 abnormal voltage transients for MIL-STD-704A. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
H	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
I	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
J	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
K	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
L	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
M	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			

TABLE TAC302-IV. Sample data sheet for TAC302 abnormal voltage transients for MIL-STD-704A. - Continued

Test Condition	Parameters										Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace	Pass/Fail
N	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
O	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
	A						V_{rms}		msec			
	B						V_{rms}		msec			
	C						V_{rms}		msec			

TABLE TAC302-V. Sample data sheet for TAC302 abnormal voltage transients for MIL-STD-704B, C, D, E, & F.

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
AA	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
BB	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
CC	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
DD	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
EE	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
FF	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
GG	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			

TABLE TAC302-V. Sample data sheet for TAC302 abnormal voltage transients for MIL-STD-704B, C, D, E, & F. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
HH	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
II	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
JJ	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
KK	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
LL	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
MM	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			

TABLE TAC302-V. Sample data sheet for TAC302 abnormal voltage transients for MIL-STD-704B, C, D, E, & F. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
NN	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
OO	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
	A						V_{rms}		msec			
	B						V_{rms}		msec			
	C						V_{rms}		msec			

METHOD TAC303
Abnormal Frequency Transients

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Abnormal

PARAMETER: Abnormal Frequency Transients

1. Scope.

1.1. Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to abnormal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to frequency transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC303-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TAC303-I. MIL-STD-704 limits for abnormal frequency transients.

Limit	704A	704B	704C	704D	704E	704F
Abnormal Frequency Transients	Figure 5 MIL-STD-704A Locus of Equivalent Step Function Curves 1 and 4	¶ 5.1.5 MIL-STD-704B	Figure 8 MIL-STD-704C	Figure 8 MIL-STD-704D	Figure 7 MIL-STD-704E	Figure 6 MIL-STD-704F
Abnormal Maximum Rate of Change of Frequency	500 Hz/sec	500 Hz/sec	500 Hz/sec	N/A	N/A	N/A

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure TAC303-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC303-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions.

5.1 Compliance test for MIL-STD-704A. The UUT must be subjected to the frequency transients for each test condition A through E noted in table TAC303-II. The frequency must increase or decrease from steady state frequency to the frequency transient level over the duration noted; the frequency must remain at the frequency transient level for the duration noted; and the frequency must return from the frequency transient level over the duration noted. For test condition E, an underfrequency transient of 320 Hz is immediately followed by an overfrequency transient of 480 Hz. For each test condition, monitor the performance of the UUT during the frequency transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions, and has not suffered damage. Record the steady state voltages, steady state frequency, frequency transient level, time at frequency transient, oscilloscope trace (Hz vs. time), and the performance of the UUT for each test condition in the data sheet shown in table TAC302-IV. Repeat for each mode of operation of the UUT.

5.2 Compliance test for MIL-STD-704B, C, D, E, & F. The UUT must be subjected to the frequency transients for each test condition AA through EE noted in table TAC302-III. The frequency must increase or decrease from steady state frequency to the frequency transient level over the duration noted; the frequency must remain at the frequency transient level for the duration noted; and the frequency must return from the frequency transient level over the duration noted. For test condition EE, an underfrequency transient of 320 Hz is immediately followed by an overfrequency transient of 480 Hz. For each test condition, monitor the performance of the UUT during the frequency transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions, and has not suffered damage. Record the steady state voltages, steady state frequency, frequency transient level, time at frequency transient, oscilloscope trace (Hz vs. time), and the performance of the UUT for each test condition in the data sheet shown in table TAC303-V. Repeat for each mode of operation of the UUT.

TABLE TAC303-II. Test conditions for MIL-STD-704A abnormal frequency transients.

Test Condition	Time From Steady State Frequency to Frequency Transient Level milliseconds	Frequency Transient Level Hz	Duration at Frequency Transient Level	Time From Frequency Transient Level to Steady State Frequency milliseconds
Overfrequency Transients				
A	333 msec	480 Hz	½ cycle	60 msec
B	333 msec	480 Hz	6.69 seconds	60 msec
Underfrequency Transients				
C	333 msec	320 Hz	½ cycle	60 msec
D	333 msec	320 Hz	6.69 seconds	60 msec
Combined Transient				
E	333 msec 333 msec	320 Hz then 480 Hz	½ cycle ½ cycle	333 msec 333 msec

TABLE TAC303-III. Test conditions for MIL-STD-704B, C, D, E and F abnormal frequency transients.

Test Condition	Time From Steady State Frequency to Frequency Transient Level milliseconds	Frequency Transient Level Hz	Duration at Frequency Transient Level	Time From Frequency Transient Level to Steady State Frequency milliseconds
Overfrequency Transients				
AA	160 msec	480 Hz	½ cycle	160 msec
BB	160 msec	480 Hz	4.78 seconds	160 msec
Underfrequency Transients				
CC	160 msec	320 Hz	½ cycle	160 msec
DD	160 msec	320 Hz	4.78 seconds	160 msec
Combined Transient				
EE	160 msec 160 msec	320 Hz then 480 Hz	½ cycle ½ cycle	160 msec 160 msec

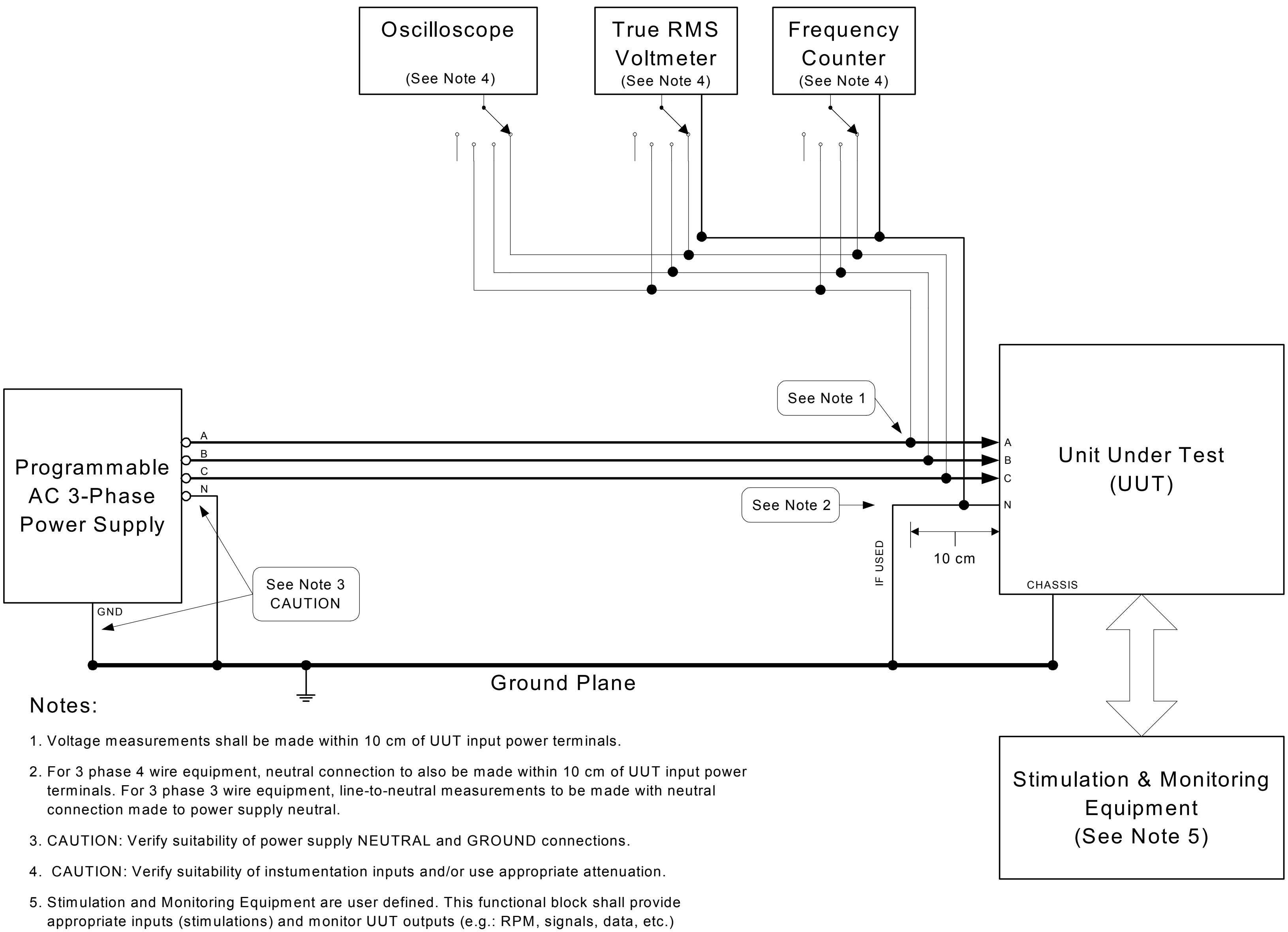


FIGURE TAC303-1. Abnormal frequency transients.

TABLE TAC303-IV. Sample data sheet for TAC303 abnormal frequency transients for MIL-STD-704A.

Test Condition	Parameters										Performance
	Phase	Steady State Voltage		Steady State Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace	Pass/Fail
A	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
B	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
C	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
D	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
E	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
							Hz		msec			

TABLE TAC303-V. Sample data sheet for TAC303 abnormal frequency transients for MIL-STD-704B, C, D, E, & F.

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace		Pass/Fail
AA	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
BB	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
CC	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
DD	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
EE	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
	B		V_{rms}									
	C		V_{rms}									
							Hz		msec			

METHOD TAC401
Emergency Steady State Limits for
Voltage and Frequency

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Emergency

PARAMETER: Emergency Steady State Limits for Voltage and Frequency

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at that the Emergency Low Steady State (ELSS) limits and the Emergency High Steady State (EHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for emergency aircraft electrical conditions when supplied input power of voltage and frequency at the specified emergency steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table TAC401-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the emergency steady state voltage and frequency limits and should be, not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the emergency steady state voltage and frequency limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TAC401-I. MIL-STD-704 emergency limits for steady state voltage and frequency.

Emergency Limit	704A	704B	704C	704D	704E 1/	704F 1/
Voltage ELSS	104 V	102 V	104 V	104 V	108 V	108 V
Voltage EHSS	122 V	124 V	122 V	122 V	118 V	118 V
Frequency ELSS	360 Hz	360 Hz	360 Hz	360 Hz	393 Hz	393 Hz
Frequency EHSS	440 Hz	440 Hz	440 Hz	440 Hz	407 Hz	407 Hz

1/ For MIL-STD-704E and F, performance of test method TAC102 will constitute performance of test method TAC401.

3. Apparatus. The test equipment should be as follows:

   a. Adjustable AC power supply
   b. True RMS voltmeter
   c. Frequency counter

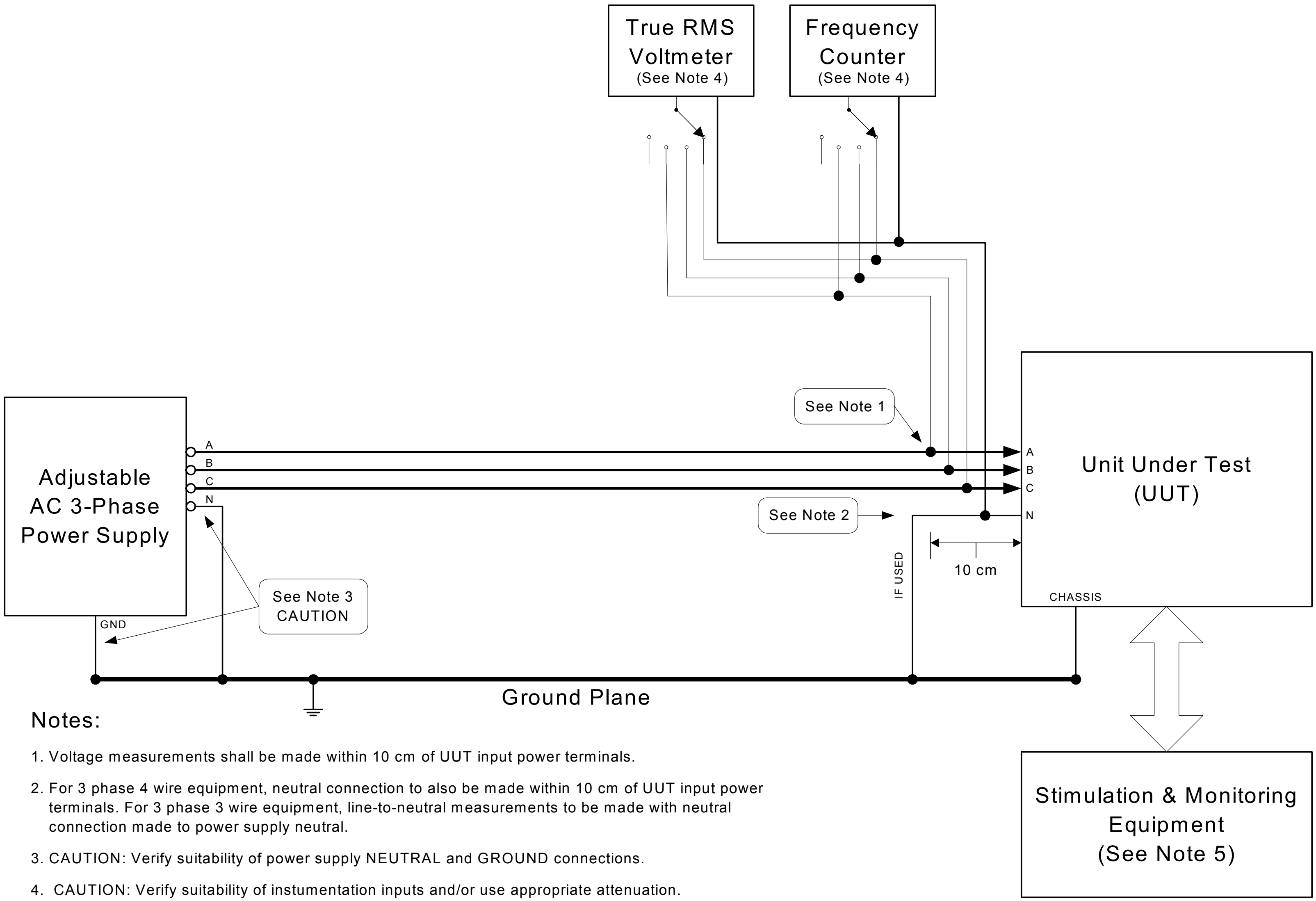
4. Test setup. Configure the test setup as shown in figure TAC401-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through H noted in table TAC401-II, the UUT must remain for a length of time that confirms the utilization equipment can perform as specified at the emergency steady state voltage and frequency limits and should be, not less than thirty (30) minutes. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for emergency aircraft electrical conditions. Adjust the voltage to the nominal steady state voltage of 115 Vrms and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the voltages, frequency, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table TAC401-III. Repeat for each mode of operation of the UUT.

TABLE TAC401-II. Test conditions for emergency steady state limits for voltage and frequency.

Test Condition	Voltage	Frequency
A	Nominal Voltage	ELSS Frequency
B	Nominal Voltage	EHSS Frequency
C	ELSS Voltage	Nominal Frequency
D	ELSS Voltage	ELSS Frequency
E	ELSS Voltage	EHSS Frequency
F	EHSS Voltage	Nominal Frequency
G	EHSS Voltage	ELSS Frequency
H	EHSS Voltage	EHSS Frequency



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC401-1. Emergency steady state limits for voltage and frequency.

TABLE TAC401-III. Sample data sheet for TAC401 emergency steady state limits for voltage and frequency.

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration at Test Condition		Pass/Fail
A	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
B	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
C	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
D	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
E	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
F	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					

TABLE TAC401-III. Sample data sheet for TAC401 emergency steady state limits for voltage and frequency. - Continued

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration at Test Condition		Pass/Fail
G	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
H	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					

METHOD TAC501
(No Test Required)

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Starting

PARAMETER: No Tests

Starting operations are usually not applicable to AC utilization equipment.

METHOD TAC601
Power Failure (Three Phase)

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Power Failure

PARAMETER: Power Failure (Three Phase)

1. Scope

1.1. Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to three phase power failures as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to three phase power failures as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TAC601-I. The utilization equipment must maintain the specified performance during the three phase power failures. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TAC601-I. MIL-STD-704 power failure limits.

Limit	704A	704B	704C	704D	704E	704F
Power Failure	7 sec Figure 3 Curve 4 MIL-STD-704A	7 sec Figure 5 MIL-STD-704B	7 sec Figure 7 MIL-STD-704C	7 sec Figure 7 MIL-STD-704D	7 sec Figure 6 MIL-STD-704E	7 sec Figure 4 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure TAC601-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

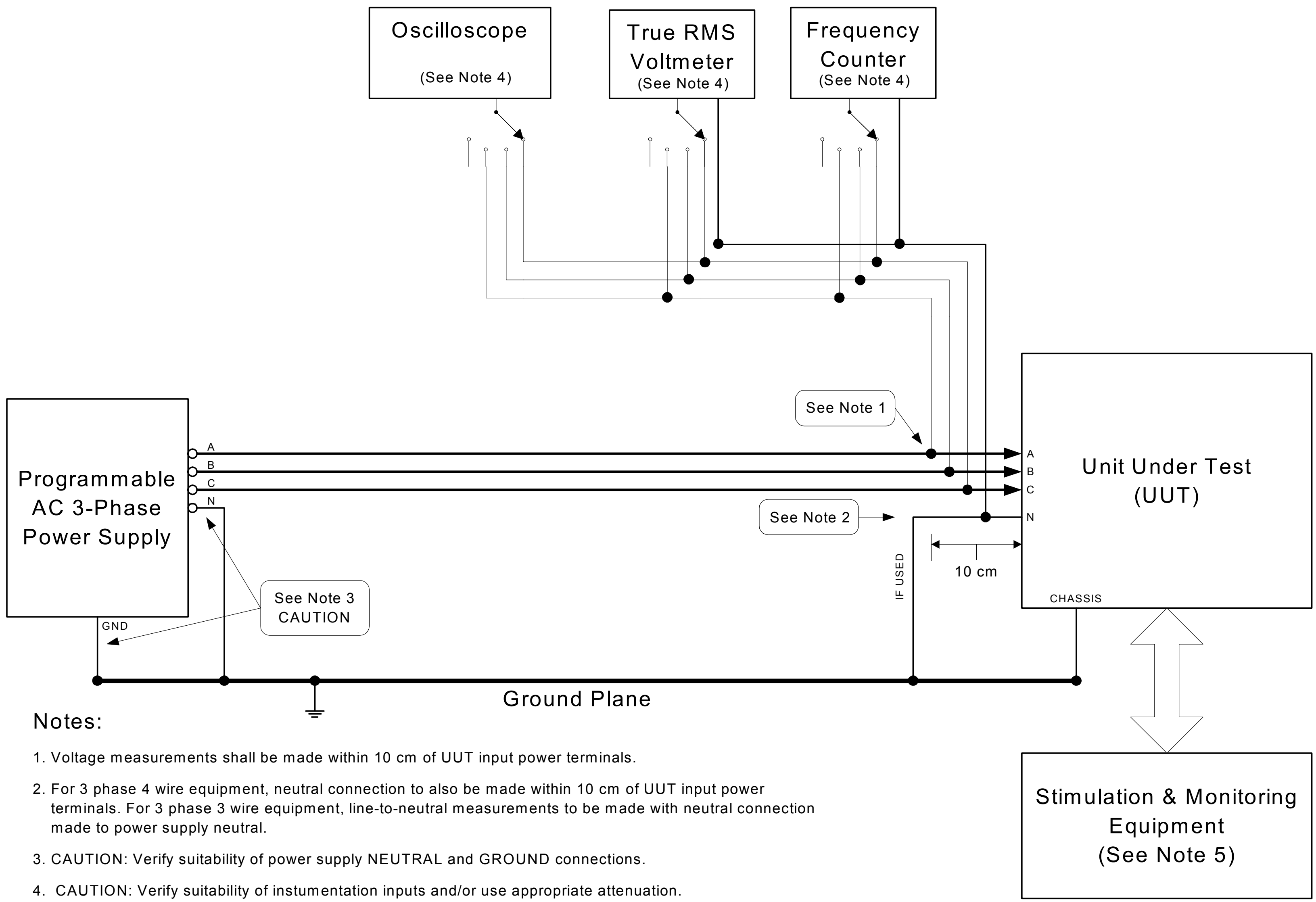
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC601-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through D noted in table TAC601-II, perform a three phase power failure (0 V) of the duration listed. The voltage must decrease from the steady state voltage to 0 Volts within ½ cycle (1.25 milliseconds), remain at 0 Volts for the duration listed for the test condition, and return from 0 Volts to the steady state voltage within ½ cycle (1.25 milliseconds). For each test condition, monitor the performance of the UUT according to the utilization equipment performance test procedures for power failure operation to verify that the UUT is providing specified performance for power failure aircraft electrical conditions. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the steady state voltages, steady state frequency, time duration of power failure, and the performance of the UUT for each test condition in the data sheet shown in table TAC601-III. Repeat each test condition 5 times. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TAC601-II. Test conditions for three phase power failures.

Test Condition	Duration of Power Failure
A	100 msec
B	500 msec
C	3 seconds
D	7 seconds



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC601-1. Power failure (three phase).

TABLE TAC601-III. Sample data sheet for TAC601 power failure (three phase).

Test Condition	Parameters									Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage during Power Failure		Time Duration of Power Failure		Pass/Fail
A	A		V_{rms}		Hz		V_{rms}		msec	
	B		V_{rms}				V_{rms}		msec	
	C		V_{rms}				V_{rms}		msec	
B	A		V_{rms}		Hz		V_{rms}		msec	
	B		V_{rms}				V_{rms}		msec	
	C		V_{rms}				V_{rms}		msec	
C	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
D	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	

METHOD TAC602
One and Two Phase Power Failures

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Power Failure

PARAMETER: One and Two Phase Power Failures

1. Scope.

1.1. Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment operates and maintains specified performance when subjected to one and two phase power failures (7 seconds and indefinitely) as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to power failures as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TAC602-I. The utilization equipment must maintain the specified performance during one and two phase power failures. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate with one and two phase power failures and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TAC602-I. MIL-STD-704 power failure limits.

Limit	704A	704B	704C	704D	704E	704F
Single Phase and Two Phase Power Failure	7 sec and indefinitely Figure 3 Curve 4 MIL-STD-704B	7 sec and indefinitely Figure 5 MIL-STD-704B	7 sec and indefinitely Figure 7 MIL-STD-704C	7 sec and indefinitely Figure 7 MIL-STD-704D	7 sec and indefinitely Figure 6 MIL-STD-704E	7 sec and indefinitely Figure 4 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure TAC602-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

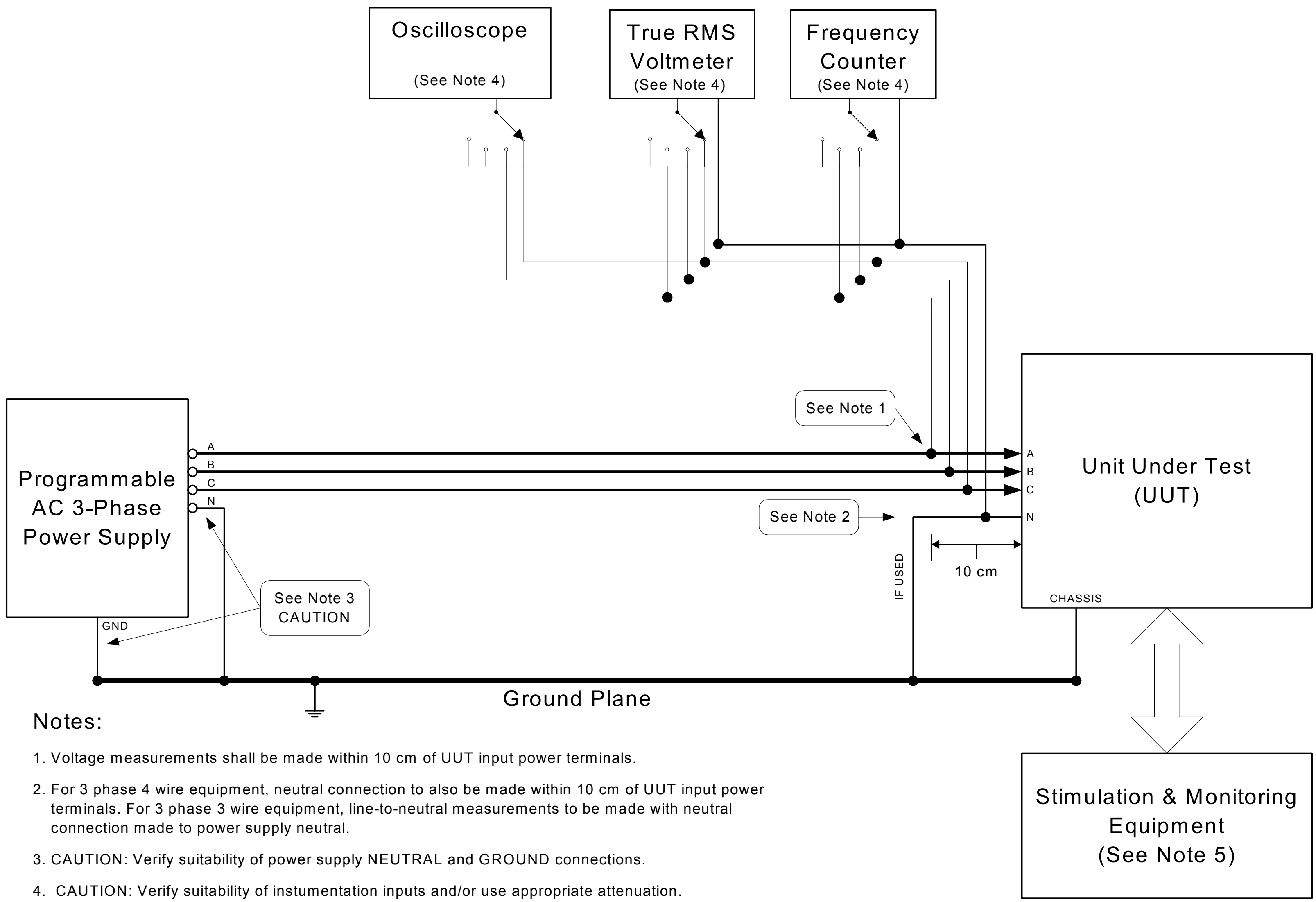
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC602-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through J noted in table TAC062-II, perform a power failure (0 V) on the phase(s) noted and of the duration listed. The voltage must decrease from the steady state voltage to 0 Volts within ½ cycle (1.25 milliseconds), remain at 0 Volts for the duration listed for the test condition, and return from 0 Volts to the steady state voltage within ½ cycle (1.25 milliseconds). For each test condition, monitor the performance of the UUT according to the utilization equipment performance test procedures for power failure operation to verify that the UUT is providing specified performance for power failure aircraft electrical conditions. For the indefinite time duration, the utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be not less than thirty (30) minutes for each of the test conditions. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the steady state voltages, steady state frequency, time duration of power failure, and the performance of the UUT for each test condition in the data sheet shown in table TAC602-III. Repeat test conditions A, B, C, G, and H 5 times. Test conditions D, E, F, I, and J are required to be performed once each. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TAC602-II. Test conditions for one and two phase power failures.

Test Condition	Phases	Duration of Power Failure
One Phase Power Failure		
A	Phase A	7 seconds
B	Phase B	7 seconds
C	Phase C	7 seconds
D	Phase A	Indefinitely
E	Phase B	Indefinitely
F	Phase C	Indefinitely
Two Phase Power Failures		
G	Phase A & B	7 seconds
H	Phase B & C	7 seconds
I	Phase A & B	Indefinitely
J	Phase B & C	Indefinitely



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC602-1. One and two phase power failures.

TABLE TAC602-III. Sample data sheet for TAC602 one and two phase power failures.

Test Condition	Parameters									Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage during Power Failure		Time Duration of Power Failure		Pass/Fail
A	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
B	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
C	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
D	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
E	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
F	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
G	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
H	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
I	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
J	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	

METHOD TAC603
Phase Reversal (Three Phase)

POWER GROUP: Three Phase, 400 Hz, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Power Failure

PARAMETER: Phase Reversal (Three Phase)

1. Scope.

1.1. Purpose. This test procedure is used to verify that three phase, 115 Volt, 400 Hz power utilization equipment is not damaged by phase reversal or a positive physical means is employed to prevent phase reversal.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment is not damaged and does not cause an unsafe condition when the input phase sequence is reversed for the applicable edition(s) of MIL-STD-704 and as noted in table TAC603-I. A positive physical means to prevent phase sequence reversal may be used to fulfill this requirement.

TABLE TAC603-I. MIL-STD-704 phase sequence reversal requirement.

Limit	704A	704B	704C	704D	704E	704F
Phase Reversal	N/A	N/A	N/A	N/A	N/A	Phase Sequence Reversal Does not Cause Damage

3. Apparatus. The test equipment should be as follows:

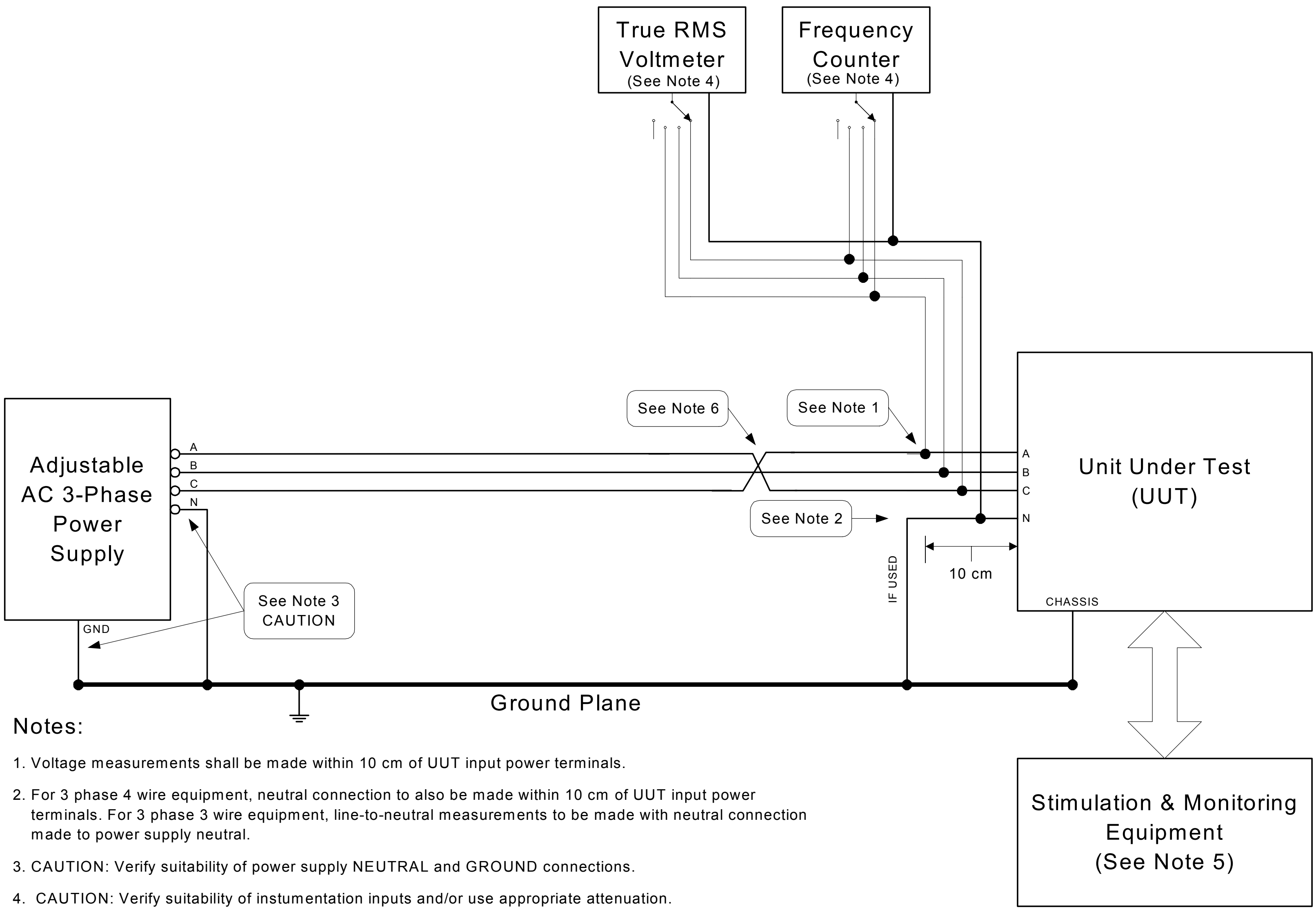
a. Adjustable AC power supply
b. True RMS voltmeter
c. Frequency counter

4. Test setup. Configure the test setup as shown in figure TAC603-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. If a positive physical means is employed to prevent phase sequence reversal, confirm that the phase conductors cannot be reversed.

If the phase sequence can be reversed, with the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC603-1 (reversed phase sequence of C-B-A). Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. The UUT must remain for a length of time that confirms the utilization equipment is not damaged and does not cause an unsafe condition due to phase sequence reversal and should be not less than thirty (30) minutes. Record the steady state voltages, steady state frequency, time duration at phase sequence reversal test condition, and the performance of the UUT in the data sheet shown in table TAC603-II.

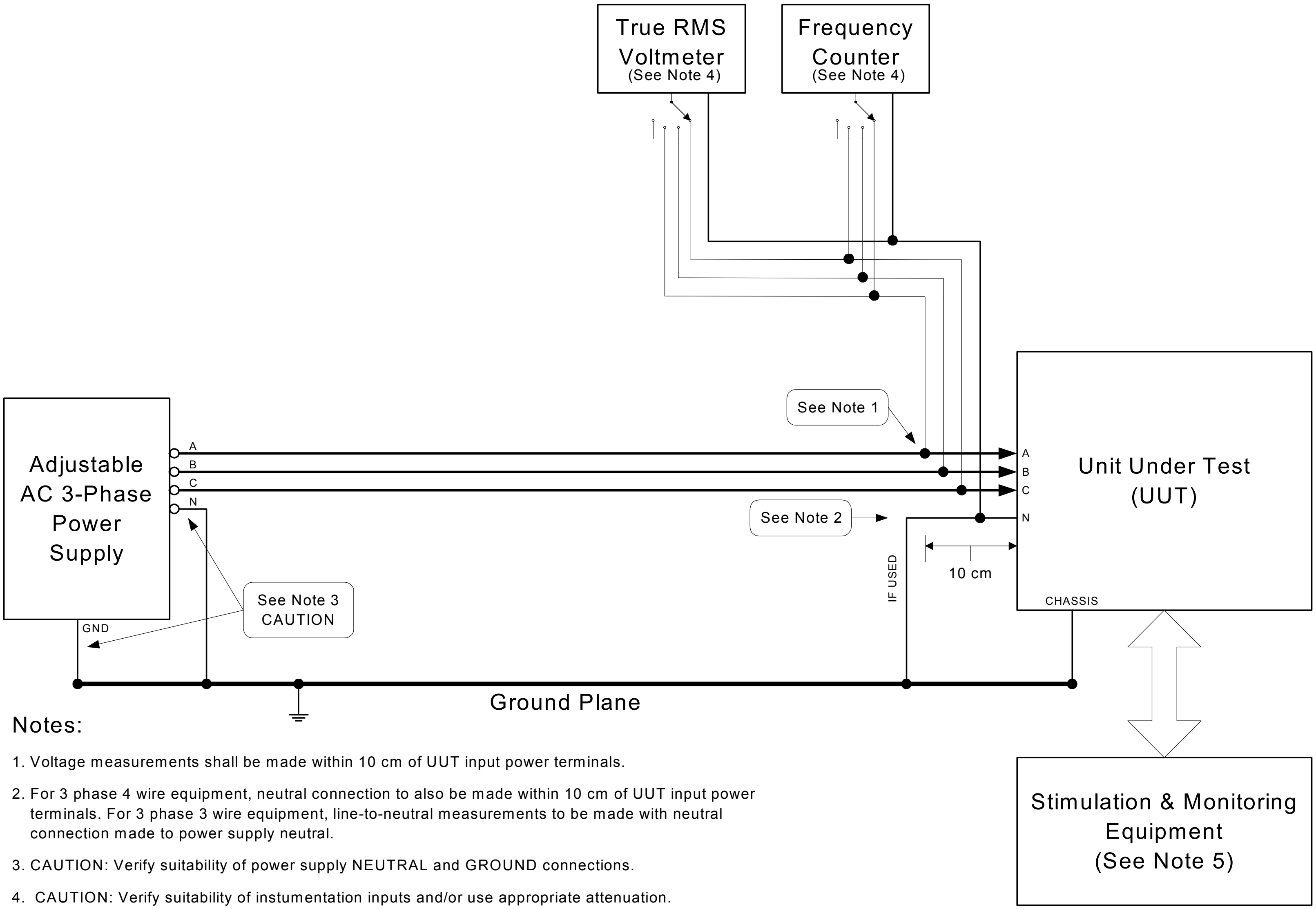
With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TAC603-2 (correct phase sequence of A-B-C). Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. The UUT must remain for a length of time that confirms the utilization equipment was not damaged and does not cause an unsafe condition after the phase sequence reversal and should be not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has returned to the performance specified for normal aircraft electrical conditions and has not suffered damage. Record the steady state voltages, steady state frequency, time duration at test condition, and the performance of the UUT in the data sheet shown in table TAC603-II. Repeat for each mode of operation of the UUT.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)
6. Phase Rotation is reversed.

FIGURE TAC603-1. Phase reversal.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TAC603-2. Correct phase connection.

TABLE TAC603-II. Sample data sheet for TAC603 phase sequence reversal.

<table>
<tr><td rowspan="2">Test Condition</td><td colspan="7" rowspan="2">Parameters</td><td>Performance</td></tr>
<tr><td>Yes/No</td></tr>
<tr><td colspan="8">Phase Sequence Reversal Prevented by Positive Physical Means</td><td></td></tr>
<tr><td colspan="9">If No</td></tr>
<tr><td></td><td>Phase</td><td colspan="2">Voltage</td><td colspan="2">Frequency</td><td colspan="2">Time Duration at Test Condition</td><td>Pass/Fail</td></tr>
<tr><td rowspan="3">Phase Sequence Reversed (C-B-A)</td><td>A</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>min</td><td rowspan="3"></td></tr>
<tr><td>B</td><td></td><td>V_{rms}</td><td colspan="2" rowspan="2"></td><td colspan="2" rowspan="2"></td></tr>
<tr><td>C</td><td></td><td>V_{rms}</td></tr>
<tr><td rowspan="3">Correct Phase Sequence (A-B-C)</td><td>A</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>min</td><td rowspan="3"></td></tr>
<tr><td>B</td><td></td><td>V_{rms}</td><td colspan="2" rowspan="2"></td><td colspan="2" rowspan="2"></td></tr>
<tr><td>C</td><td></td><td>V_{rms}</td></tr>
</table>

6. NOTES

6.1 Intended use. This handbook should be used as guidance when establishing test requirements, for inclusion in performance specifications developed for the procurement of utilization equipment, to ensure compliance with the aircraft electrical power characteristics as specified by MIL-STD-704.

6.2 Subject term (keyword) listing.

Aircraft, electrical power
Aircraft, electrical test
Electrical operating areas
Equipment, utilization
Power groups
Specification, utilization equipment

CONCLUDING MATERIAL

Custodians:
Army - AV
Navy - AS
Air Force - 11

Preparing Activity:
Navy - AS

(Project No. SESS-0049)

Review Activities:
Army - CR, MI, TE
Navy - EC, MC, SA, SH, YD

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at www.dodssp.daps.mil.

NOT MEASUREMENT
SENSITIVE

MIL-HDBK-704-4
9 April 2004

DEPARTMENT OF DEFENSE
HANDBOOK

GUIDANCE FOR
TEST PROCEDURES FOR DEMONSTRATION OF UTILIZATION EQUIPMENT COMPLIANCE TO AIRCRAFT ELECTRICAL POWER CHARACTERISTICS SINGLE PHASE, VARIABLE FREQUENCY, 115 VOLT
(PART 4 OF 8 PARTS)

This Handbook is for guidance only.
Do not cite this document as a requirement.

AMSC N/A **AREA SESS**

FOREWORD

1. This handbook is approved for use by all Departments and Agencies of the Department of Defense.

2. This handbook provides guidance on test procedures for demonstration of single phase, variable frequency, 115 volt utilization equipment to determine compliance with the applicable edition of MIL-STD-704.

3. MIL-HDBK-704-4 is Part 4 in a series of 8 Parts. Part 4 describes the test methods and procedures to demonstrate that single phase, variable frequency, 115 volt utilization equipment is compatible with the electric power characteristics of MIL-STD-704. These series of handbooks and MIL-STD-704 are companion documents.

4. Comments, suggestions, or questions on this document should be addressed to Commander, Naval Air Systems Command, 4.1.4, Highway 547, Lakehurst, NJ 08733-5100 or email to thomas.omara@navy.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil.

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CONCLUDING MATERIAL 101

1. SCOPE

1.1 Scope. This handbook provides, as guidance, test methods used to demonstrate that single phase, variable frequency, 115 volt utilization equipment is compatible with the electric power characteristics of the applicable edition(s) of MIL-STD-704. This handbook is for guidance only and cannot be cited as a requirement.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed below are not necessarily all of the documents referenced herein, but are those needed to understand the information provided by this handbook.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-704	DoD Interface Standard for Aircraft Electric Power Characteristics

(A copy of this document is available online at http://assist. daps.dla.mil/quicksearch or www.dodssp.daps.mil/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

3. DEFINITIONS

3.1 Acronyms and definitions. The acronyms and definitions of MIL-STD-704 are applicable to this handbook.

4. TEST METHODS INFORMATION

4.1 Demonstration of compatibility. This section contains the test methods which will ensure that single phase, variable frequency, 115 volt utilization equipment is compatible with the electric power characteristics of the applicable edition(s) of MIL-STD-704, by testing the Unit Under Test (UUT) in accordance with the test procedures as described in test methods SVF 101 through SVF 603.

4.1.1 Recording performance. In table SVF1, record the edition(s) of MIL-STD-704 that defined the aircraft electric power characteristics used for testing and the performance of the UUT for each of the test methods.

4.2 Calibration of test equipment. . Test equipment and accessories required for measurement in accordance with this handbook should be calibrated in accordance with an approved calibration program traceable to the National Institute for Standards and Technology.

The serial numbers, model, and calibration date of all test equipment should be included with the test data.

4.3 Test methods. The test methods listed in table SVF-I are provided in section 5 of this handbook.

TABLE SVF-I. Summary of single phase, variable frequency, 115 volt utilization equipment MIL-STD-704 compliance tests.

UUT:			
Compliance to MIL-STD-704 Edition(s):			
Test Dates:			
Test Method	Description	Performance (Pass/Fail)	Comments
Normal, Aircraft Electrical Operation			
SVF101	Load and Current Harmonic Measurements		
SVF102	Steady State Limits for Voltage and Frequency		
SVF103	No Test, See Note #1	N/A	N/A
SVF104	Voltage Modulation		
SVF105	Frequency Modulation		
SVF106	Voltage Distortion Spectrum		
SVF107	Total Voltage Distortion		
SVF108	DC Voltage Component		
SVF109	Normal Voltage Transients		
SVF110	Normal Frequency Transients		
Transfer, Aircraft Electrical Operation			
SVF201	Power Interrupt		
Abnormal, Aircraft Electrical Operation			
SVF301	Abnormal Limits for Voltage and Frequency		
SVF302	Abnormal Voltage Transients (Overvoltage/Undervoltage)		
SVF303	Abnormal Frequency Transients (Overfrequency/Underfrequency)		
Emergency, Aircraft Electrical Operation			
SVF401	Emergency Limits for Voltage and Frequency		
Starting, Aircraft Electrical Operation			
SVF501	See Note #2		
Power Failure, Aircraft Electrical Operation			
SVF601	Power Failure (Single Phase)		
SVF602	No Test, See Note #1	N/A	N/A
SVF603	Phase Reversal		

Note 1: There are no tests required for SVF103 and SVF602. This is done so that the single phase test numbers coincide with the three phase test numbers.
Note 2: Starting operation conditions are usually not applicable to AC utilization equipment. No test is required for SVF501 unless specified by the equipment performance specification.

5. TEST METHODS

METHOD SVF101
Load Measurements

POWER GROUP: Single Phase, Variable Frequency, 115 V

AIRCRAFT ELECRICAL OPERATING CONDITION: Normal

PARAMETER: Load Measurements

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, variable frequency power utilization equipment utilizes only 115 Volt line-to-neutral power, does not require more power than allowed, the power factor is within limits, and does not use half-wave rectification for the applicable edition(s) of MIL-STD-704. Additionally, when the utilization equipment performance specification document imposes current waveform requirements, this test procedure is used to verify that the utilization equipment current waveform is within total current distortion and current spectrum (current distortion vs. frequency) limits defined in the utilization equipment performance specification document.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment requires less than or equal to the power limit for single phase equipment, is within the power factor limits, and does not use half-wave rectification for the applicable edition(s) of MIL-STD-704 and as noted in table SVF101-I. If required by the utilization equipment performance specification document, the utilization equipment current waveform must be within the total current distortion and current spectrum limits defined in the utilization equipment performance specification document. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SVF101-I. MIL-STD-704 limits for single phase power, power factor, rectification restriction, current distortion, and current spectrum for single phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Single Phase kVA	N/A	N/A	N/A	N/A	N/A	0.5 kVA
Power Factor	N/A	N/A	N/A	N/A	N/A	No Leading Power Factor for >100 VA
Rectification Restriction	N/A	N/A	N/A	N/A	N/A	No Half-Wave Rectification
Current Distortion	N/A	N/A	N/A	N/A	N/A	See Note 1/
Current Spectrum	N/A	N/A	N/A	N/A	N/A	See Note 1/

1/. The utilization equipment performance specification document should include requirements that reduce the likelihood of the equipment having an adverse effect on the electrical power characteristics of the aircraft. Current distortion and current spectrum limits may be imposed to minimize undesirable effects to the electrical power characteristics. These limits should take into account the utilization equipment power draw, aircraft electrical system capacity and distribution characteristics, trade-offs with weight, volume, cost, and reliability that are specific to each type of equipment and aircraft.

3. Apparatus. The test equipment should be as follows:

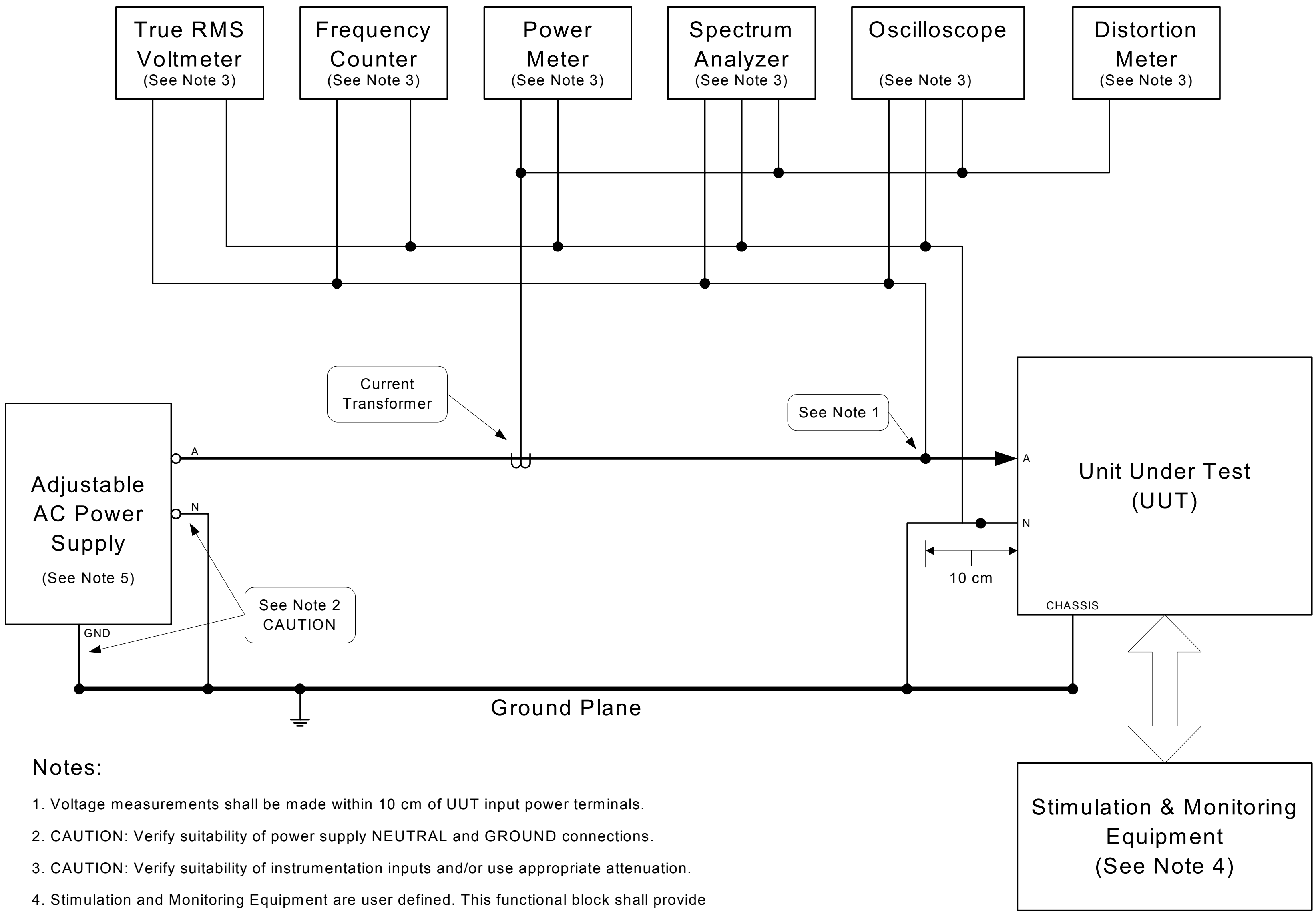
a. Adjustable AC power supply (rotating AC source for current waveform limits)
b. True RMS voltmeter
c. Frequency counter
d. Power meter
e. Spectrum Analyzer
f. Distortion meter
g. Current transformer
h. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SVF101-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT. Current measurements must be taken from the 115 Volt conductors. If the utilization equipment performance specification document imposes current waveform limits, the AC power source must be a rotating machine.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SVF101-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz.

Close the circuit breaker, energizing the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltage, frequency, kVA, and power factor in table SVF101-2. Compare the kVA, power factor, and rectification with the required limits/restriction of the applicable edition(s) of MIL-STD-704. Confirm that the utilization equipment does not use half-wave rectification and record in table SVF101-II. Repeat for each mode of operation of the UUT. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

If the utilization equipment performance specification document imposes current waveform limits, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Record the total current distortion and current spectrum in the data sheet shown in table SVF101-II and compare to the limits defined in the utilization equipment performance specification document. Repeat for each mode of operation of the UUT.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)
5. If current waveform limits are imposed by the detail performance specification, the AC power source shall be a rotating machine.

FIGURE SVF101-1. Load and current distortion measurement.

TABLE SVF101-II. Sample data sheet for SVF101 load measurement.

Test performed at **400 Hz** steady state frequency									
Load and Power Factor									
Voltage		Frequency		Volt-Amp		Power Factor		Pass/Fail	Comments
	V_{rms}		Hz		VA		pf		
Rectification Type									
								Pass/Fail	
Does not use half-wave rectification.									
Current Waveform Measurements									
Total Current Distortion				Current Spectrum				Pass/Fail	Comments
		% Distortion		Attach Spectrum Plot		Amplitude Vs. Frequency			
Test performed at **360 Hz** steady state frequency									
Load and Power Factor									
Voltage		Frequency		Volt-Amp		Power Factor		Pass/Fail	Comments
	V_{rms}		Hz		VA		pf		
Test performed at **600 Hz** steady state frequency									
Load and Power Factor									
Voltage		Frequency		Volt-Amp		Power Factor		Pass/Fail	Comments
	V_{rms}		Hz		VA		pf		
		% Distortion		Attach Spectrum Plot		Amplitude Vs. Frequency			

TABLE SVF101-II. Sample data sheet for SVF101 load measurement. - Continued

Test performed at **800 Hz** steady state frequency									
Load and Power Factor									
Voltage		Frequency		Volt-Amp		Power Factor		Pass/Fail	Comments
	V_{rms}		Hz		VA		pf		

METHOD SVF102
Steady State Limits for Voltage and Frequency

POWER GROUP: Single Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Steady State Limits for Voltage and Frequency

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Normal Low Steady State (NLSS) limits and the Normal High Steady State (NHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power of voltage and frequency at the specified normal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table SVF102-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be, not less than the time duration noted for the test conditions. The utilization equipment must demonstrate re-start at the steady state voltage and frequency limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SVF102-I. MIL-STD-704 normal limits for steady state voltage and frequency for single phase, variable frequency utilization equipment.

Normal Limit	704A	704B	704C	704D	704E	704F
Voltage NLSS	N/A	N/A	N/A	N/A	N/A	108 V
Voltage NHSS	N/A	N/A	N/A	N/A	N/A	118 V
Frequency NLSS	N/A	N/A	N/A	N/A	N/A	360 Hz
Frequency NHSS	N/A	N/A	N/A	N/A	N/A	800 Hz

3. Apparatus. The test equipment should be as follows:

a. Adjustable AC power supply
b. True RMS voltmeter
c. Frequency counter

4. Test setup. Configure the test setup as shown in figure SVF102-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SVF102-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through NN noted in table SVF102-II, the UUT must remain for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be, not less than the time duration noted. For test conditions E through NN, after each test condition slowly adjust the frequency until the next test condition is reached. This subjects the UUT to all frequency between 360 Hz and 800 Hz at the low steady state voltage limit and the high steady state voltage limit. At each test condition A through NN conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. For each test condition shutdown the UUT and verify that the UUT can be re-started. After re-start conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltage, frequency, time duration at test condition, successful/unsuccessful re-start and the performance of the UUT for each test condition in the data sheet shown in table SVF102-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SVF102-II. Test conditions for steady state limits of voltage and frequency for single phase, variable frequency utilization equipment.

Test Condition	Voltage	Frequency	Minimum Time Duration At test Condition
Nominal Voltages			
A	115 V	360 Hz	30 min
B	115 V	400 Hz	30 min
C	115 V	600 Hz	30 min
D	115 V	800 Hz	30 min
Normal Low Steady State Voltages			
E	108 V	360 Hz	30 min
F	108 V	400 Hz	30 min
G	108 V	440 Hz	5 min
H	108 V	480 Hz	5 min
I	108 V	520 Hz	5 min
J	108 V	560 Hz	5 min
K	108 V	600 Hz	30 min
L	108 V	520 Hz	5 min
M	108 V	540 Hz	5 min
N	108 V	560 Hz	5 min
O	108 V	570 Hz	5 min
P	108 V	580 Hz	5 min
Q	108 V	600 Hz	30 min
R	108 V	640 Hz	5 min
S	108 V	680 Hz	5 min
T	108 V	720 Hz	5 min
U	108 V	760 Hz	5 min
V	108 V	800 Hz	30 min
Normal High Steady State Voltages			
W	118 V	360 Hz	30 min
X	118 V	400 Hz	30 min
Y	118 V	440 Hz	5 min
Z	118 V	480 Hz	5 min
AA	118 V	520 Hz	5 min
BB	118 V	560 Hz	5 min
CC	118 V	600 Hz	30 min
DD	118 V	520 Hz	5 min
EE	118 V	540 Hz	5 min
FF	118 V	560 Hz	5 min
GG	118 V	570 Hz	5 min
HH	118 V	580 Hz	5 min
II	118 V	600 Hz	30 min
JJ	118 V	640 Hz	5 min
KK	118 V	680 Hz	5 min
LL	118 V	720 Hz	5 min
MM	118 V	760 Hz	5 min
NN	118 V	800 Hz	30 min

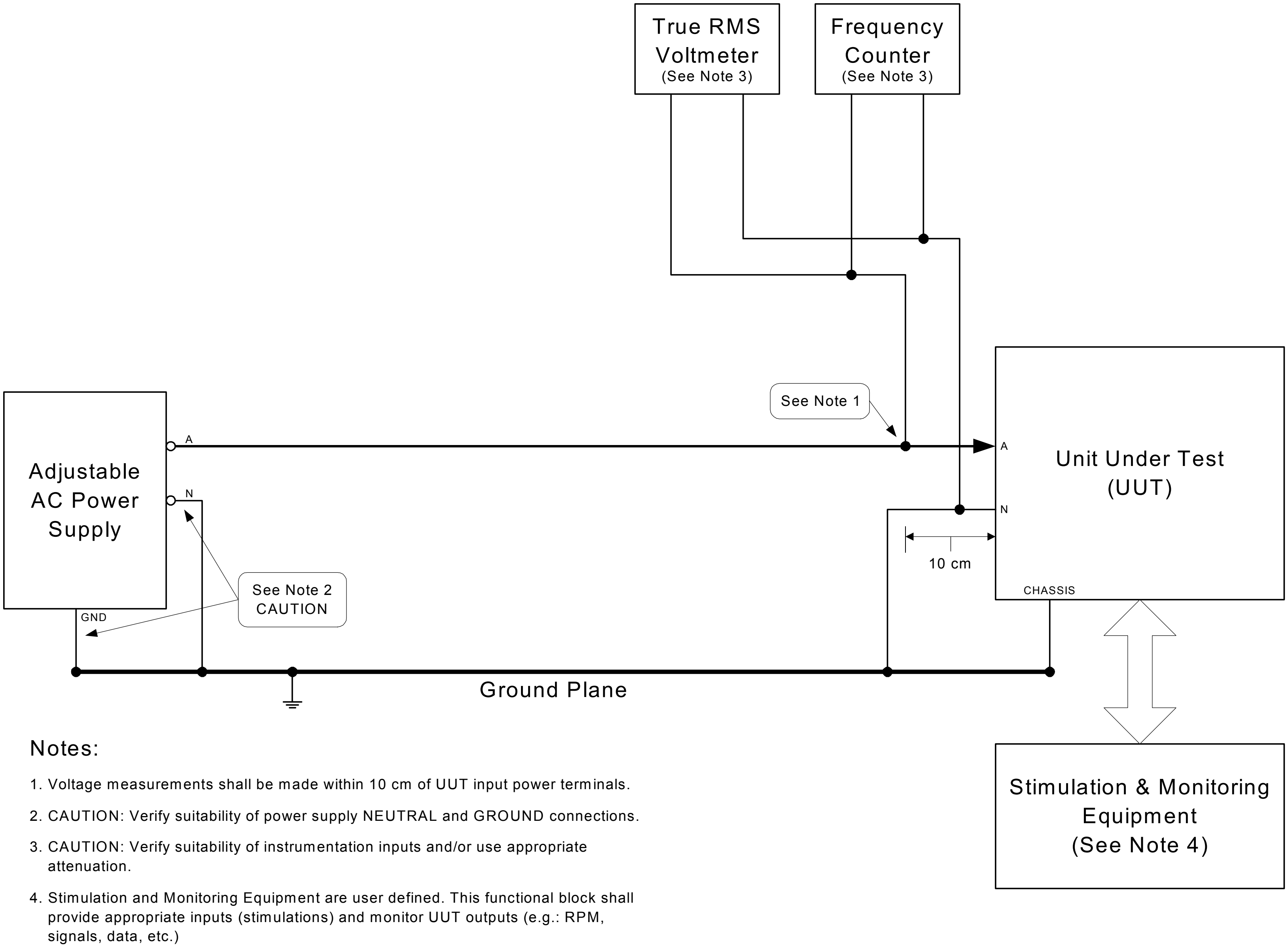


FIGURE SVF102-1. Steady state limits for voltage and frequency.

TABLE SVF102-III. Sample data sheet for SVF102 steady state limits of voltage and frequency for single phase, variable frequency utilization equipment.

Test Condition	Voltage		Frequency		Time Duration at Test Condition		Re-Start (Yes/No)	Pass/Fail
A		V_{rms}		Hz		min		
B		V_{rms}		Hz		min		
C		V_{rms}		Hz		min		
D		V_{rms}		Hz		min		
E		V_{rms}		Hz		min		
F		V_{rms}		Hz		min		
G		V_{rms}		Hz		min		
H		V_{rms}		Hz		min		
I		V_{rms}		Hz		min		
J		V_{rms}		Hz		min		
K		V_{rms}		Hz		min		
L		V_{rms}		Hz		min		
M		V_{rms}		Hz		min		
N		V_{rms}		Hz		min		
O		V_{rms}		Hz		min		
P		V_{rms}		Hz		min		
Q		V_{rms}		Hz		min		
R		V_{rms}		Hz		min		
S		V_{rms}		Hz		min		
T		V_{rms}		Hz		min		
U		V_{rms}		Hz		min		
V		V_{rms}		Hz		min		
W		V_{rms}		Hz		min		

TABLE SVF102-III. Sample data sheet for SVF102 steady state limits of voltage and frequency for single phase, variable frequency utilization equipment. - Continued

Test Condition	Voltage		Frequency		Time Duration at Test Condition		Re-Start (Yes/No)	Pass/Fail
X		V_{rms}		Hz		min		
Y		V_{rms}		Hz		min		
Z		V_{rms}		Hz		min		
AA		V_{rms}		Hz		min		
BB		V_{rms}		Hz		min		
CC		V_{rms}		Hz		min		
DD		V_{rms}		Hz		min		
EE		V_{rms}		Hz		min		
FF		V_{rms}		Hz		min		
GG		V_{rms}		Hz		min		
HH		V_{rms}		Hz		min		
II		V_{rms}		Hz		min		
JJ		V_{rms}		Hz		min		
KK		V_{rms}		Hz		min		
LL		V_{rms}		Hz		min		
MM		V_{rms}		Hz		min		
NN		V_{rms}		Hz		min		

METHOD SVF103
(No Test Required)

POWER GROUP:	Single Phase, Variable Frequency, 115 V
AIRCRAFT ELECTRICAL OPERATING CONDITION:	Normal
PARAMETER:	No test required. Test number SVF103 is not used so that the Single Phase, Variable Frequency, 115 V (SVF) test numbers coincide with the Three Phase, Variable Frequency, 115 V (TVF) test sequence numbers.

METHOD SVF104
Voltage Modulation

POWER GROUP: Single Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Voltage Modulation

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to voltage modulation as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having voltage modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table SVF104-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage modulation. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SVF104-I. MIL-STD-704 limits for voltage modulation for single phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Voltage Modulation	N/A	N/A	N/A	N/A	N/A	2.5 Vrms max

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SVF104-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SVF104-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization

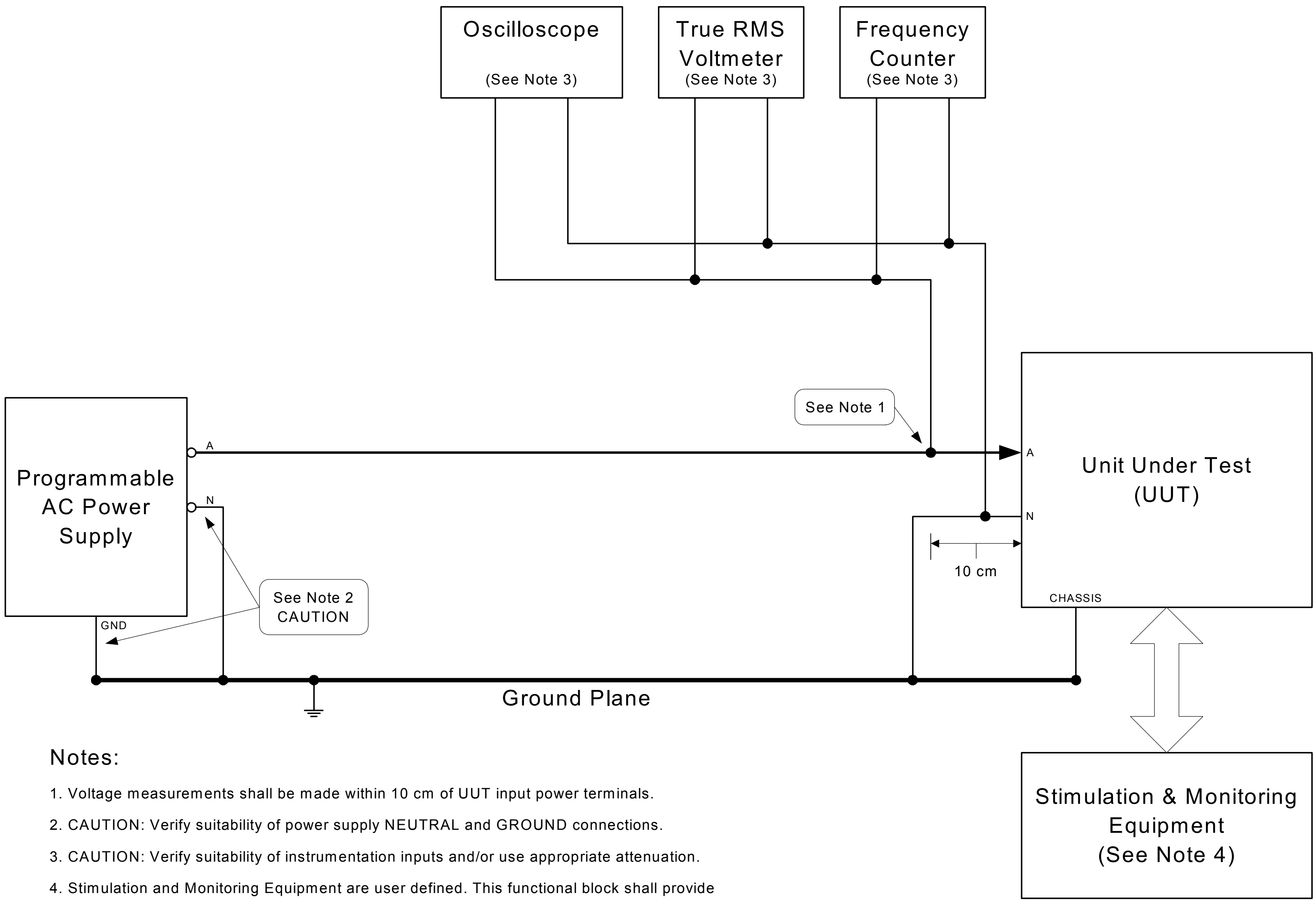
equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through G noted in table SVF104-II, set the voltage modulation amplitude and frequency of voltage modulation. The UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate, and should be at least ten (10) minutes at an average steady state voltage of 115 Vrms, at least ten (10) minutes at an average steady state voltage of 109.25 Vrms, and at least ten (10) minutes at an average steady state voltage of 116.75 Vrms. During the test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record average voltage, frequency, amplitude of voltage modulation, frequency of voltage modulation, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table SVF104-III. Repeat for each mode of operation of the UUT. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SVF104-II. Test conditions for voltage modulation for single phase, variable frequency utilization equipment.

Test Condition	Frequency of Voltage Modulation	MIL-STD-704F Amplitude of Voltage Modulation Vrms
A	1.0 Hz	0.375 Vrms
B	1.7 Hz	0.375 Vrms
C	10 Hz	2.5 Vrms
D	25 Hz	2.5 Vrms
E	70 Hz	0.375 Vrms
F	100 Hz	0.375 Vrms
G	200 Hz	0.375 Vrms



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SVF104-1. Voltage modulation.

TABLE SVF104-III. Sample data sheet for SVF104 voltage modulation for single phase, variable frequency utilization equipment.

Test Condition	Parameters										Performance
	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Test Condition		
Test performed at **400 Hz** steady state frequency											
A		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
B		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
C		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
D		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
E		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
F		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
G		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	

TABLE SVF104-III. Sample data sheet for SVF104 voltage modulation for single phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters										Performance
	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Test Condition		
Test performed at **360 Hz** steady state frequency											
A		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
B		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
C		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
D		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
E		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
F		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
G		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	

TABLE SVF104-III. Sample data sheet for SVF104 voltage modulation for single phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters										Performance
	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Test Condition		
Test performed at **600 Hz** steady state frequency											
		V_{rms}		Hz		V_{rms}		Hz		min	
A		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
B		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
C		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
D		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
E		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
F		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
G		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	

TABLE SVF104-III. Sample data sheet for SVF104 voltage modulation for single phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters					Performance
	Average Voltage	Frequency	Amplitude of Voltage Modulation	Frequency of Voltage Modulation	Time Duration at Test Condition	
Test performed at **800 Hz** steady state frequency						
A	V_{rms}	Hz	V_{rms}	Hz	min	
	V_{rms}	Hz	V_{rms}	Hz	min	
	V_{rms}	Hz	V_{rms}	Hz	min	
B	V_{rms}	Hz	V_{rms}	Hz	min	
	V_{rms}	Hz	V_{rms}	Hz	min	
	V_{rms}	Hz	V_{rms}	Hz	min	
C	V_{rms}	Hz	V_{rms}	Hz	min	
	V_{rms}	Hz	V_{rms}	Hz	min	
	V_{rms}	Hz	V_{rms}	Hz	min	
D	V_{rms}	Hz	V_{rms}	Hz	min	
	V_{rms}	Hz	V_{rms}	Hz	min	
	V_{rms}	Hz	V_{rms}	Hz	min	
E	V_{rms}	Hz	V_{rms}	Hz	min	
	V_{rms}	Hz	V_{rms}	Hz	min	
	V_{rms}	Hz	V_{rms}	Hz	min	
F	V_{rms}	Hz	V_{rms}	Hz	min	
	V_{rms}	Hz	V_{rms}	Hz	min	
	V_{rms}	Hz	V_{rms}	Hz	min	
G	V_{rms}	Hz	V_{rms}	Hz	min	
	V_{rms}	Hz	V_{rms}	Hz	min	
	V_{rms}	Hz	V_{rms}	Hz	min	

METHOD SVF105
Frequency Modulation

POWER GROUP: Single Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: Frequency Modulation

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to frequency modulation as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having frequency modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table SVF105-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having frequency modulation and should be, not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SVF105-I. MIL-STD-704 limits for frequency modulation for single phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Frequency Modulation	N/A	N/A	N/A	N/A	N/A	4 Hz

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SVF105-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SVF105-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization

equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through E noted in table SVF105-II, set the amplitude of frequency modulation and rate of change for frequency modulation. The UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate, and should be at least thirty (30) minutes. At each test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record voltages, average frequency, amplitude of frequency modulation, rate of change for frequency modulation, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table SVF105-III. Repeat for each mode of operation of the UUT. Repeat the testing at an average frequency of 362 Hz, 600 Hz, and 798 Hz.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SVF105-II. Test conditions for frequency modulation for single phase, variable frequency utilization equipment.

Test Condition	Rate of change for frequency modulation	MIL-STD-704F Amplitude of Frequency Modulation
A	1 Hz/sec	4 Hz (± 2 Hz)
B	5 Hz/sec	4 Hz (± 2 Hz)
C	10 Hz/sec	4 Hz (± 2 Hz)
D	25 Hz/sec	4 Hz (± 2 Hz)
E	100 Hz/sec	4 Hz (± 2 Hz)

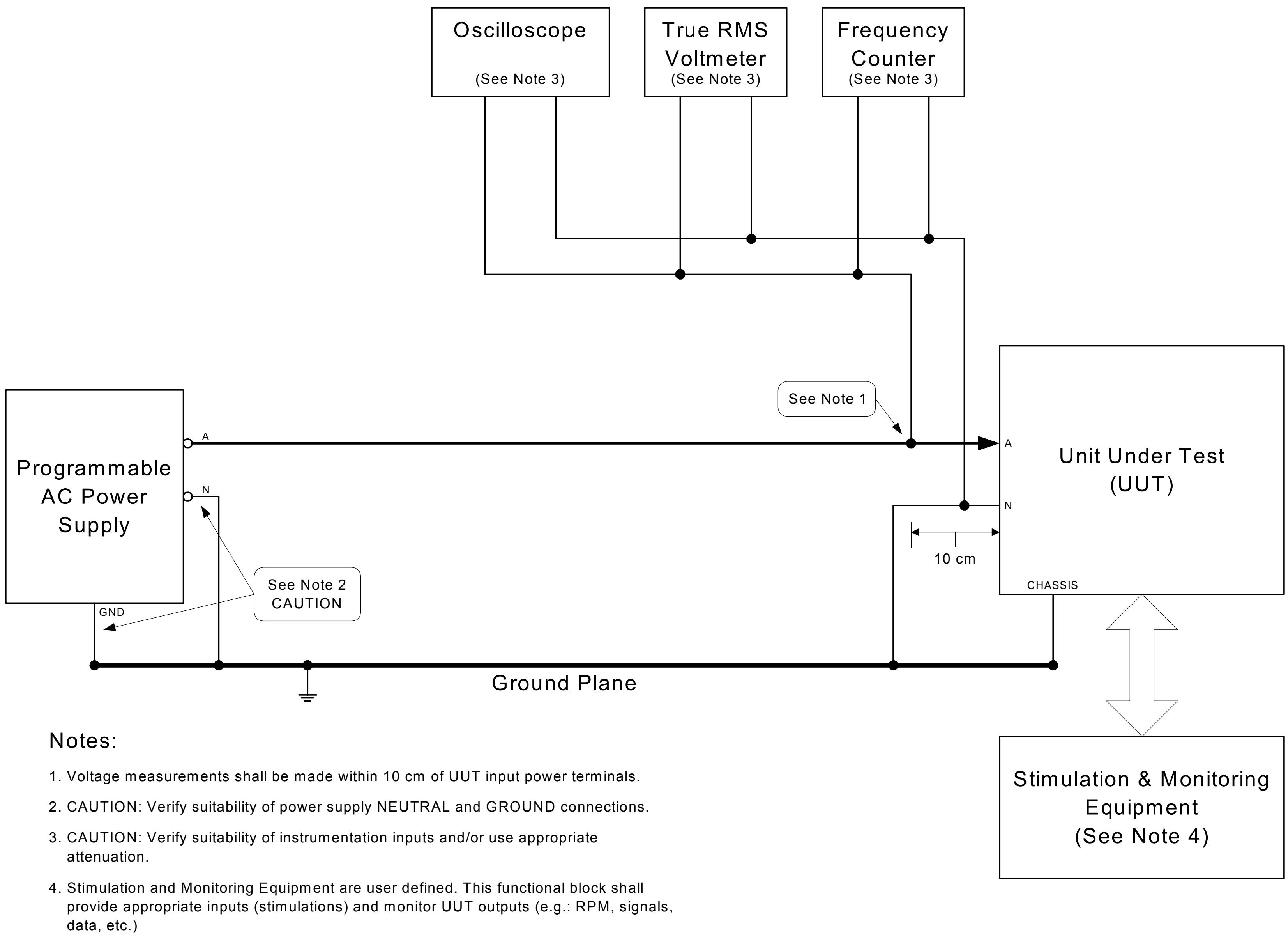


FIGURE SVF105-1. Frequency modulation.

TABLE SVF105-III. Sample data sheet for SVF105 frequency modulation for single phase, variable frequency utilization equipment.

Test Condition	Parameters					Performance
	Voltage	Average Frequency	Amplitude of Frequency Modulation	Rate of change for frequency modulation	Time Duration at Test Condition	Pass/Fail
Testing performed at an average frequency of **400 Hz**						
A	V_{rms}	Hz	± Hz	Hz/sec	min	
B	V_{rms}	Hz	± Hz	Hz/sec	min	
C	V_{rms}	Hz	± Hz	Hz/sec	min	
D	V_{rms}	Hz	± Hz	Hz/sec	min	
E	V_{rms}	Hz	± Hz	Hz/sec	min	
Testing performed at an average frequency of **362 Hz**						
A	V_{rms}	Hz	± Hz	Hz/sec	min	
B	V_{rms}	Hz	± Hz	Hz/sec	min	
C	V_{rms}	Hz	± Hz	Hz/sec	min	
D	V_{rms}	Hz	± Hz	Hz/sec	min	
E	V_{rms}	Hz	± Hz	Hz/sec	min	
Testing performed at an average frequency of **600 Hz**						
A	V_{rms}	Hz	± Hz	Hz/sec	min	
B	V_{rms}	Hz	± Hz	Hz/sec	min	
C	V_{rms}	Hz	± Hz	Hz/sec	min	
D	V_{rms}	Hz	± Hz	Hz/sec	min	
E	V_{rms}	Hz	± Hz	Hz/sec	min	

TABLE SVF105-III. Sample data sheet for SVF105 frequency modulation for single phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters					Performance
	Voltage	Average Frequency	Amplitude of Frequency Modulation	Rate of change for frequency modulation	Time Duration at Test Condition	Pass/Fail
Testing performed at an average frequency of **798 Hz**						
A	V_{rms}	Hz	± Hz	Hz/sec	min	
B	V_{rms}	Hz	± Hz	Hz/sec	min	
C	V_{rms}	Hz	± Hz	Hz/sec	min	
D	V_{rms}	Hz	± Hz	Hz/sec	min	
E	V_{rms}	Hz	± Hz	Hz/sec	min	

METHOD SVF106
Voltage Distortion Spectrum

POWER GROUP: SVF106

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Voltage Distortion Spectrum

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to voltage distortion of frequencies and amplitudes as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage distortions as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704 and as noted in table SVF106-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage distortion. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: This test method subjects the UUT to voltage distortion having frequencies components from 50 Hz to 10 kHz. These voltage distortions simulate voltage distortions within aircraft due to the cumulative effects of generators, electrical distribution systems equipments, and aircraft loads. MIL-STD-461, (Requirements For The Control of Electromagnetic Interference Characteristics of Subsystems and Equipment), Test Method CS101, (Conducted Susceptibility, Power Leads, 30 Hz to 150 kHz) is a complimentary test. Power levels of the voltage distortions differ for the two test methods. Performance of Test Method SVF106 of this handbook does not relinquish the requirement to perform test Method CS101 of MIL-STD-461, and performance of Method CS101 of MIL-STD-461 does not relinquish the requirement to perform Test Method SVF106 of this handbook.

TABLE SVF106-I. MIL-STD-704 limits for voltage distortion spectrum for single phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Voltage Distortion Spectrum	N/A	N/A	N/A	N/A	N/A	figure 7 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Adjustable AC power supply
b. Variable frequency power source
c. Coupling transformer
d. True RMS voltmeter
e. Frequency counter
f. Spectrum analyzer
g. (2) Inductors, 50 μF
h. Capacitor, 10 μF
i. Resistor, calibrated load

4. Test setup. Configure the test setup as shown in figure SVF106-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

4.1 Calibration (50 Hz to 10 kHz). Install a calibrated resistive load in the test setup shown in figure SVF106-1 in place of the UUT. The calibrated resistive load must be sized to draw the same current as the UUT. Turn on the adjustable AC power supply and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Set the variable frequency power source to output a sine wave and adjust the frequency and amplitude so that the voltage distortion measured at the input to the calibrated resistive load conforms to each test condition A through H in table SVF106-II of the applicable edition(s) of MIL-STD-704. Record the settings of the variable frequency power source for each test condition. Repeat the calibration with the adjustable AC power supply output at steady state frequencies of 360 Hz, 600 Hz, and 800 Hz.

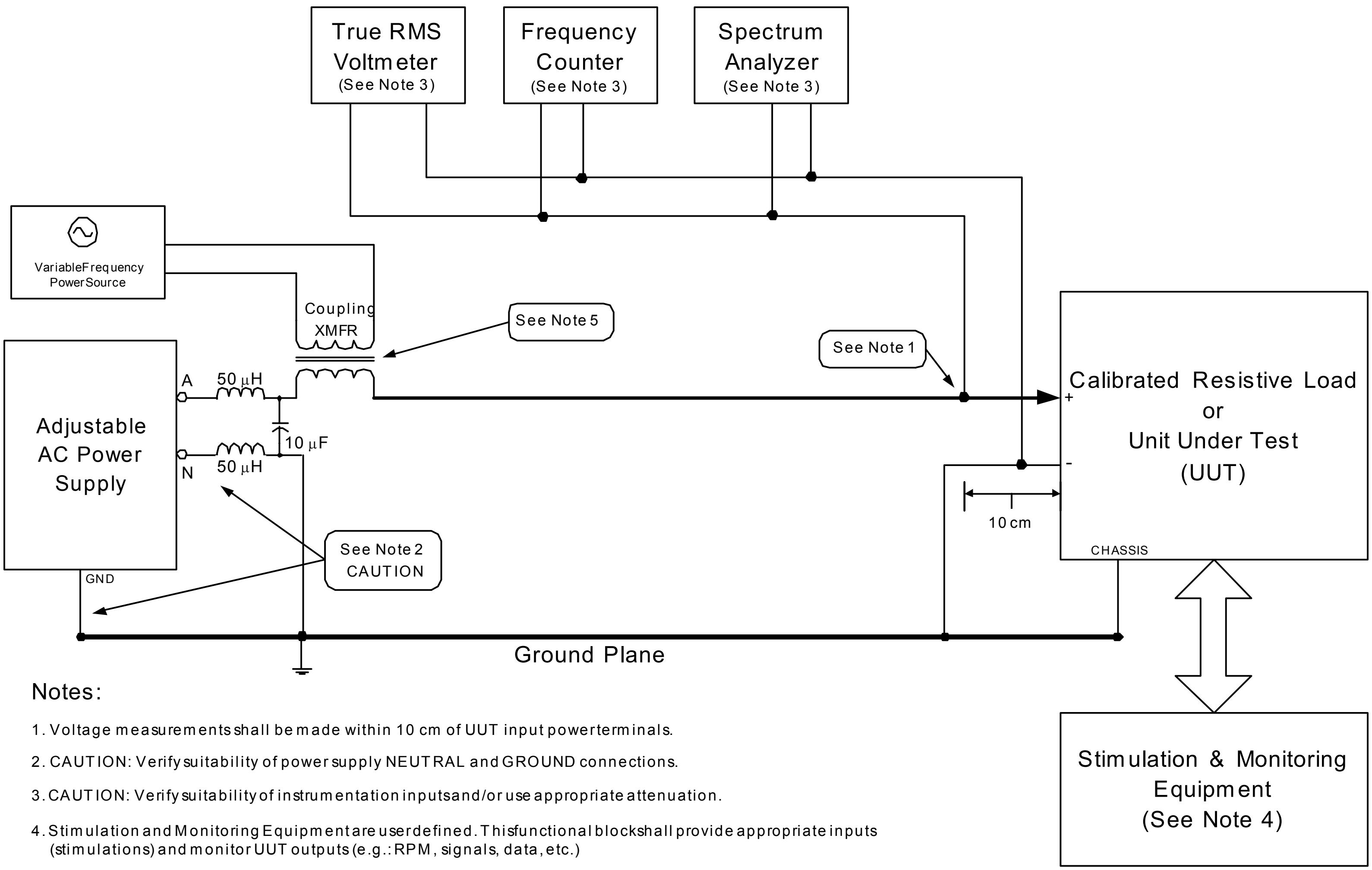
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SVF106-1. Turn on the adjustable AC power supply and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

Set the variable frequency power source to the settings recorded for test condition A of the calibration procedure. For each test condition, remain for a length of time that confirms the utilization equipment can continuously operate with the voltage distortion and should be, not less than five (5) minutes. At each test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. After each test condition, monitor the voltage distortion frequency and amplitude while slowly increasing the variable frequency power source frequency and adjusting the amplitude until the next test condition is reached. Do not exceed the voltage distortion spectrum limits. Repeat for each test condition A through H noted in table SVF106-II. For each test condition, record voltage, frequency, frequency of voltage distortion, amplitude of voltage distortion, time duration at test condition, and the performance of the UUT in the data sheet shown in table SVF106-III. Repeat for each mode of operation of the UUT. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

After all test conditions are complete, turn the adjustable AC power supply off and remove the coupling transformer from the circuit. Turn on the adjustable AC power supply. Adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SVF106-II. Test conditions for voltage distortion spectrum for single phase, variable frequency utilization equipment.

Test Condition	Frequency of Voltage Distortion	MIL-STD-704F Amplitude of Voltage Distortion Voltage rms
A	50 Hz	0.316 Vrms
B	100 Hz	0.316 Vrms
C	500 Hz	1.580 Vrms
D	1 kHz	3.160 Vrms
E	2 kHz	3.160 Vrms
F	3 kHz	3.160 Vrms
G	5 kHz	3.160 Vrms
H	10 kHz	1.900 Vrms



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)
5. CAUTION: Verify suitability of variable frequency power source and coupling transformer for distortion spectrum testing.

FIGURE SVF106-1. Normal operations - voltage distortion spectrum (50 Hz to 10 kHz).

TABLE. SVF106-III. Sample data sheet for SVF106 voltage distortion spectrum for single phase, variable frequency utilization equipment.

Test Condition	Parameter										Performance
	Voltage		Frequency		Frequency of Voltage Distortion		Amplitude of Voltage Distortion		Time Duration at Test Condition		Pass/Fail
Testing performed at **400 Hz**											
A		V_{rms}		Hz		Hz		V_{rms}		min	
B		V_{rms}		Hz		Hz		V_{rms}		min	
C		V_{rms}		Hz		Hz		V_{rms}		min	
D		V_{rms}		Hz		kHz		V_{rms}		min	
E		V_{rms}		Hz		kHz		V_{rms}		min	
F		V_{rms}		Hz		kHz		V_{rms}		min	
G		V_{rms}		Hz		kHz		V_{rms}		min	
H		V_{rms}		Hz		kHz		V_{rms}		min	

TABLE. SVF106-III. Sample data sheet for SVF106 voltage distortion spectrum for single phase, variable frequency utilization equipment.- Continued

Test Condition	Parameter										Performance
	Voltage		Frequency		Frequency of Voltage Distortion		Amplitude of Voltage Distortion		Time Duration at Test Condition		Pass/Fail
Testing performed at **360 Hz**											
A		V_{rms}		Hz		Hz		V_{rms}		min	
B		V_{rms}		Hz		Hz		V_{rms}		min	
C		V_{rms}		Hz		Hz		V_{rms}		min	
D		V_{rms}		Hz		kHz		V_{rms}		min	
E		V_{rms}		Hz		kHz		V_{rms}		min	
F		V_{rms}		Hz		kHz		V_{rms}		min	
G		V_{rms}		Hz		kHz		V_{rms}		min	
H		V_{rms}		Hz		kHz		V_{rms}		min	
I		V_{rms}		Hz		kHz		V_{rms}		min	
J		V_{rms}		Hz		kHz		V_{rms}		min	
K		V_{rms}		Hz		kHz		V_{rms}		min	

TABLE. SVF106-III. Sample data sheet for SVF106 voltage distortion spectrum for single phase, variable frequency utilization equipment.- Continued

Test Condition	Parameter										Performance
	Voltage		Frequency		Frequency of Voltage Distortion		Amplitude of Voltage Distortion		Time Duration at Test Condition		Pass/Fail
Testing performed at **600 Hz**											
A		V_{rms}		Hz		Hz		V_{rms}		min	
B		V_{rms}		Hz		Hz		V_{rms}		min	
C		V_{rms}		Hz		kHz		V_{rms}		min	
D		V_{rms}		Hz		kHz		V_{rms}		min	
E		V_{rms}		Hz		kHz		V_{rms}		min	
F		V_{rms}		Hz		kHz		V_{rms}		min	
G		V_{rms}		Hz		kHz		V_{rms}		min	
H		V_{rms}		Hz		kHz		V_{rms}		min	
I		V_{rms}		Hz		kHz		V_{rms}		min	
J		V_{rms}		Hz		kHz		V_{rms}		min	
K		V_{rms}		Hz		kHz		V_{rms}		min	

TABLE. SVF106-III. Sample data sheet for SVF106 voltage distortion spectrum for single phase, variable frequency utilization equipment.- Continued

Test Condition	Parameter										Performance
	Voltage		Frequency		Frequency of Voltage Distortion		Amplitude of Voltage Distortion		Time Duration at Test Condition		Pass/Fail
Testing performed at **800 Hz**											
A		V_{rms}		Hz		Hz		V_{rms}		min	
B		V_{rms}		Hz		Hz		V_{rms}		min	
C		V_{rms}		Hz		Hz		V_{rms}		min	
D		V_{rms}		Hz		kHz		V_{rms}		min	
E		V_{rms}		Hz		kHz		V_{rms}		min	
F		V_{rms}		Hz		kHz		V_{rms}		min	
G		V_{rms}		Hz		kHz		V_{rms}		min	
H		V_{rms}		Hz		kHz		V_{rms}		min	
I		V_{rms}		Hz		kHz		V_{rms}		min	
J		V_{rms}		Hz		kHz		V_{rms}		min	
K		V_{rms}		Hz		kHz		V_{rms}		min	

METHOD SVF107
Total Voltage Distortion

POWER GROUP: Single Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Total Voltage Distortion

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to voltage waveforms having a distortion factor as specified by the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage waveforms having a distortion factor as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SVF107-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to distorted voltage waveforms and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SVF107-I. MIL-STD-704 limits for total voltage distortion for single phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Voltage Distortion Factor	N/A	N/A	N/A	N/A	N/A	0.05

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Spectrum analyzer
e. Distortion meter

4. Test setup. Configure the test setup as shown in figure SVF107-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

4.1 Calibration. Install a resistive load in the test setup shown in figure SVF107-1 in place of the UUT. The resistive load must be sized to draw the same current as the UUT. Set the programmable power supply to produce a voltage waveform having harmonic contents listed in table SVF107-II. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Confirm that the programmable power supply is producing a voltage waveform having harmonic content listed in table SVF107-2. Record the settings of the programmable power supply.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SVF107-1. Set the programmable power supply to the settings recorded during the calibration procedure. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. The UUT must remain for a length of time that confirms the utilization equipment can continuously operate with the total voltage distortion and should be not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltage, frequency, voltage distortion factor, voltage harmonics, time duration at test condition, and the performance of the UUT in the data sheet shown in table SVF107-III. Repeat for each mode of operation of the UUT. Repeat the testing at a fundamental frequency of 360 Hz, 600 Hz, and 800 Hz.

After all test conditions are complete, set the programmable power supply to produce a sine wave for each of the three phases. Adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SVF107-II. Voltage harmonics as percent of fundamental for total voltage distortion test for single phase, variable frequency utilization equipment.

Harmonic	MIL-STD-704F Percent of Fundamental
Fundamental	100%
2nd	0%
3rd	2.75%
4th	0%
5th	2.75%
6th	0%
7th	1.97%
8th	0%
9th	1.53%
10th	0%
11th	1.25%
12th	0%
13th	1.06%
14th	0%
15th	0.92%

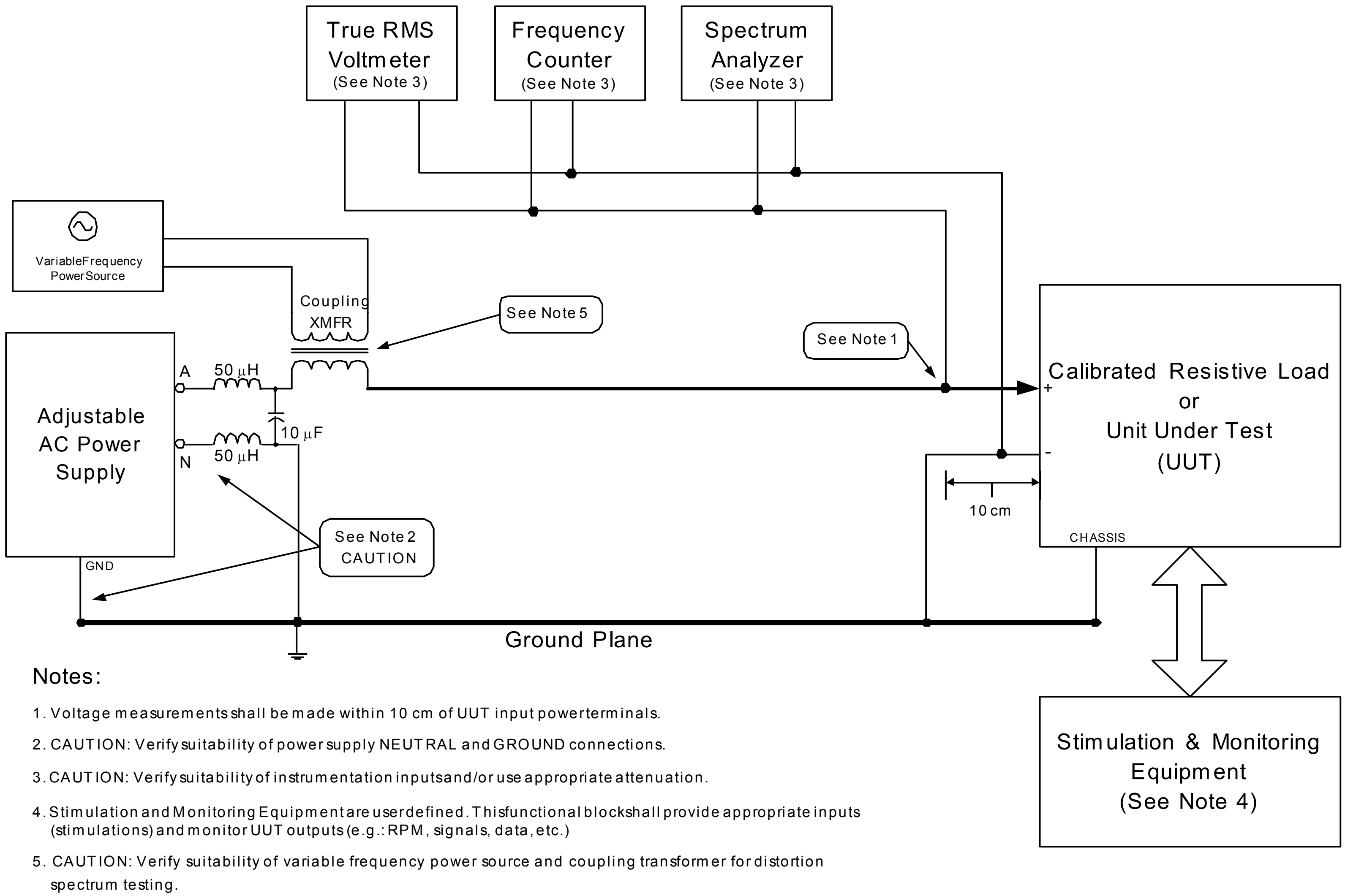


FIGURE SVF107-1. Normal operation - voltage distortion spectrum (50 Hz to 10 kHz).

TABLE SVF107-III. Sample data sheet for SVF107 total voltage distortion for single phase, variable frequency utilization equipment.

Parameters								Performance
Voltage		Frequency		Voltage Distortion Factor		Time Duration at Test Condition		Pass/Fail
Testing performed at a fundamental frequency of **400 Hz**								
	V_{rms}		Hz		No units		min	
			Voltage Harmonics					
			Fund		%			
			2nd		%			
			3rd		%			
			4th		%			
			5th		%			
			6th		%			
			7th		%			
			8th		%			
			9th		%			
			10th		%			
			11th		%			
			12th		%			
			13th		%			
			14th		%			
			15th		%			

TABLE SVF107-III. Sample data sheet for SVF107 total voltage distortion for single phase, variable frequency utilization equipment. - Continued

Parameters								Performance
Voltage		Frequency		Voltage Distortion Factor		Time Duration at Test Condition		Pass/Fail
Testing performed at a fundamental frequency of **360 Hz**								
	V_{rms}		Hz		No units		min	

Voltage Harmonics		
Fund		%
2nd		%
3rd		%
4th		%
5th		%
6th		%
7th		%
8th		%
9th		%
10th		%
11th		%
12th		%
13th		%
14th		%
15th		%

TABLE SVF107-III. Sample data sheet for SVF107 total voltage distortion for single phase, variable frequency utilization equipment. - Continued

Parameters								Performance
Voltage		Frequency		Voltage Distortion Factor		Time Duration at Test Condition		Pass/Fail
Testing performed at a fundamental frequency of **600 Hz**								
	V_{rms}		Hz		No units		min	
			Voltage Harmonics					
			Fund		%			
			2nd		%			
			3rd		%			
			4th		%			
			5th		%			
			6th		%			
			7th		%			
			8th		%			
			9th		%			
			10th		%			
			11th		%			
			12th		%			
			13th		%			
			14th		%			
			15th		%			

TABLE SVF107-III. Sample data sheet for SVF107 total voltage distortion for single phase, variable frequency utilization equipment. - Continued

Parameters				Performance
Voltage	Frequency	Voltage Distortion Factor	Time Duration at Test Condition	Pass/Fail
Testing performed at a fundamental frequency of **800 Hz**				
V_{rms}	Hz	No units	min	

Voltage Harmonics		
Fund		%
2^{nd}		%
3^{rd}		%
4^{th}		%
5^{th}		%
6^{th}		%
7^{th}		%
8^{th}		%
9^{th}		%
10^{th}		%
11^{th}		%
12^{th}		%
13^{th}		%
14^{th}		%
15^{th}		%

METHOD SVF108
DC Voltage Component

POWER GROUP: Single Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: DC Voltage Component

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SVF108-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to a direct current component of AC voltage and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SVF108-I. MIL-STD-704 limits for direct current component of AC voltage for single phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
DC Voltage Component of the AC Voltage	N/A	N/A	N/A	N/A	N/A	± 0.10 V

3. Apparatus. The test set equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter (with capability to measure DC component of AC waveform)
c. Frequency counter

4. Test setup. Configure the test setup as shown in figure SVF108-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SVF108-1. Set the programmable power

supply to produce a voltage waveform having a DC component for test condition A as noted in table SVF108-II. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. The UUT must remain for a length of time that confirms the utilization equipment can continuously operate with the direct current component of the AC voltage and should be not less than thirty (30) minutes. Repeat the test for test condition B as noted in table SVF108-II. Record the voltage, frequency, DC voltage component, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table SVF108-III. Repeat for each mode of operation of the UUT. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

After all test conditions are complete, set the programmable power supply to produce a voltage sine wave without a DC component. Adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SVF108-II. Test conditions for direct current component of the AC voltage for single phase, variable frequency utilization equipment.

Test Condition	MIL-STD-704F Direct Current Component of AC Voltage
A	+ 0.10V
B	– 0.10 V

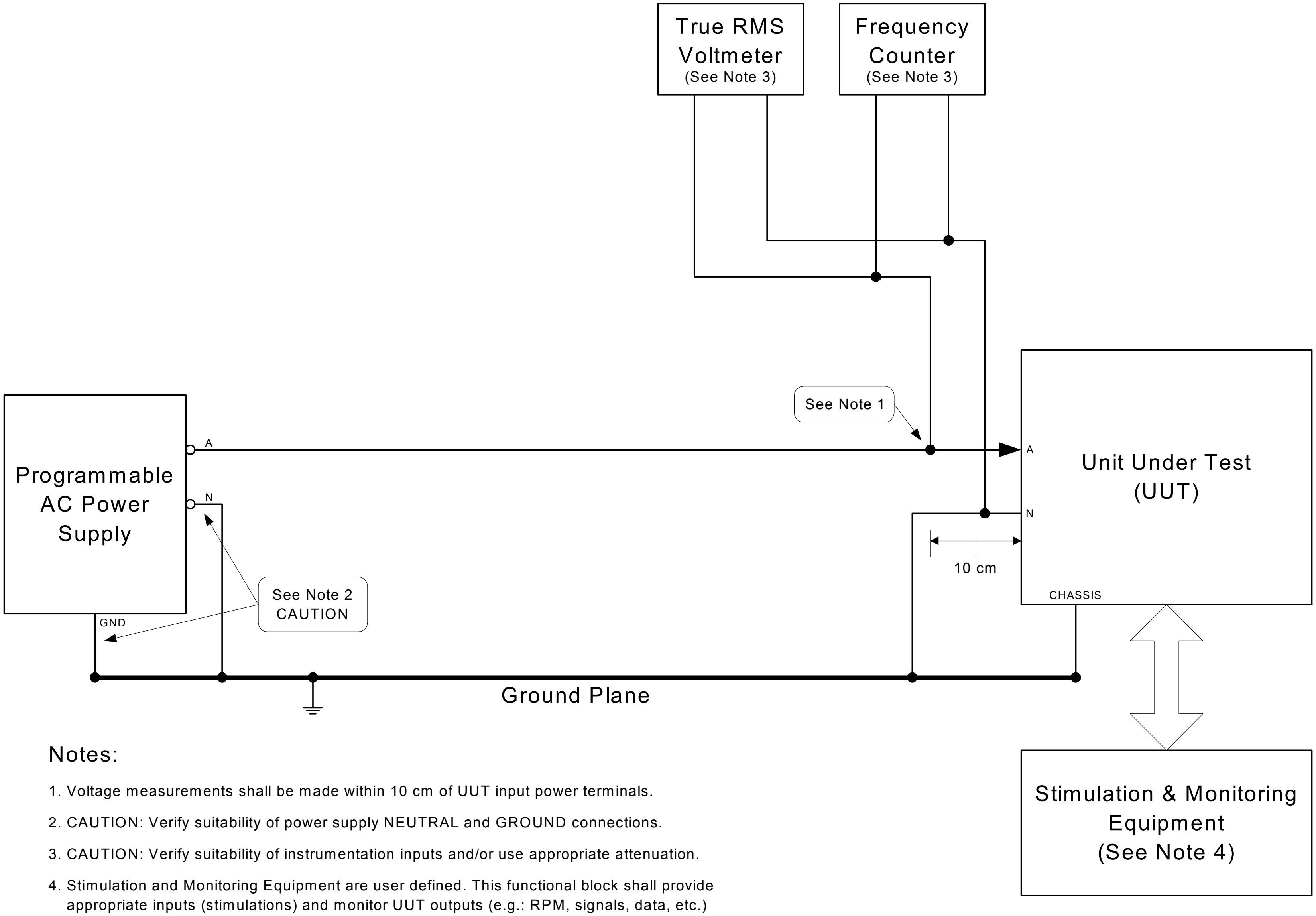


FIGURE SVF108-1. DC voltage component.

TABLE SVF108-III. Sample data sheet for SVF108 DC voltage component for single phase, variable frequency utilization equipment.

Test Condition	Parameters								Performance
	Voltage		Frequency		DC Voltage Component		Time Duration at Test Condition		Pass/Fail
Testing Performed at **400 Hz**									
A		V_{rms}		Hz		V_{dc}		min	
B		V_{rms}		Hz		V_{dc}		min	
Testing Performed at **360 Hz**									
A		V_{rms}		Hz		V_{dc}		min	
B		V_{rms}		Hz		V_{dc}		min	
Testing Performed at **600 Hz**									
A		V_{rms}		Hz		V_{dc}		min	
B		V_{rms}		Hz		V_{dc}		min	
Testing Performed at **800 Hz**									
A		V_{rms}		Hz		V_{dc}		min	
B		V_{rms}		Hz		V_{dc}		min	

METHOD SVF109
Normal Voltage Transients

POWER GROUP: Single Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Normal Voltage Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to normal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SVF109-I. The utilization equipment must maintain specified performance during and after the voltage transients. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SVF109-I. MIL-STD-704 limits for normal voltage transients for single phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Normal Voltage Transients	N/A	N/A	N/A	N/A	N/A	figure 3 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SVF109-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SVF109-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization

equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

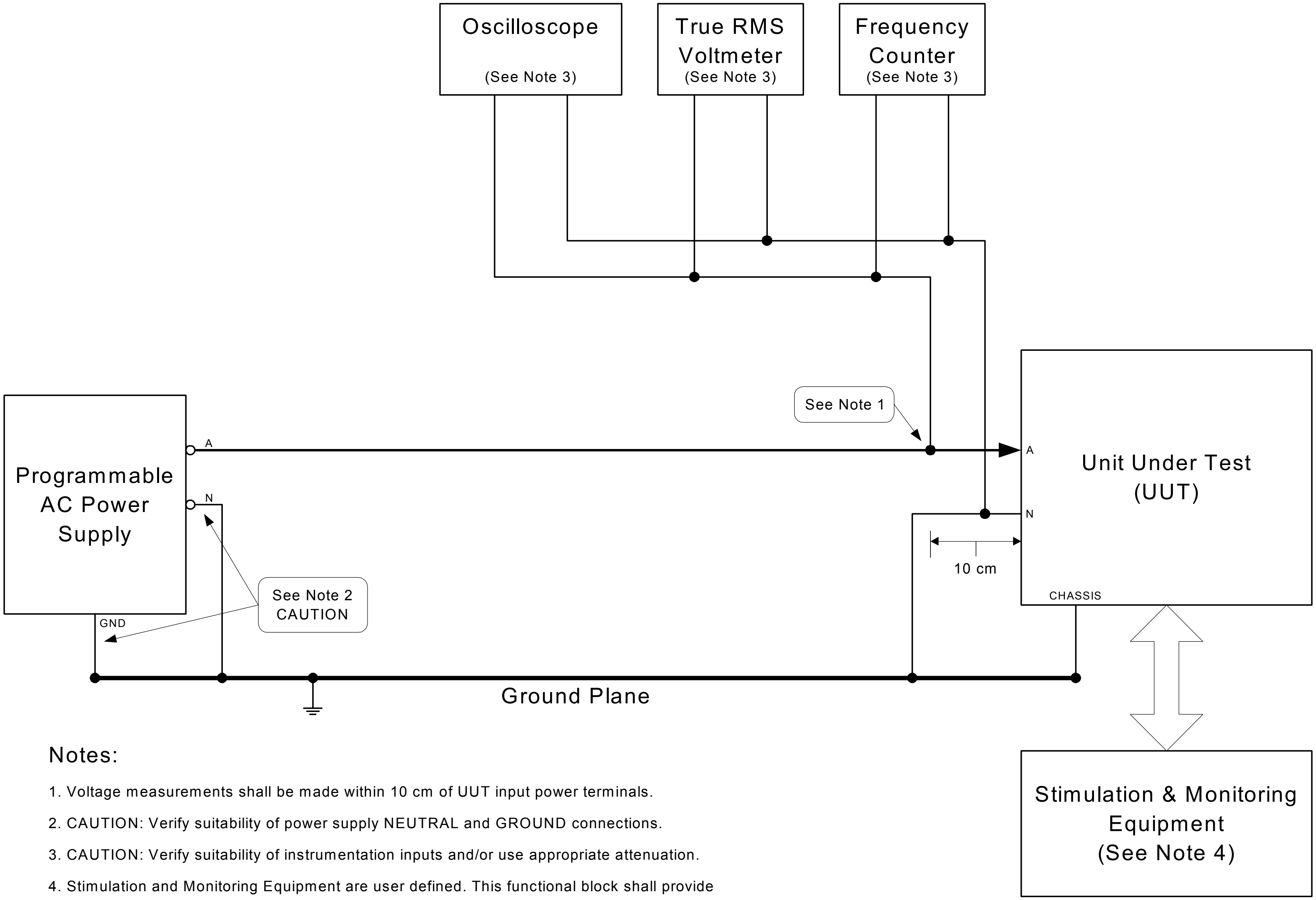
The UUT must be subjected to the voltage transients for each test condition A through M noted in table SVF109-II. The voltage must increase or decrease from steady state voltage to the voltage transient level within ½ cycle. The voltage must remain at the voltage transient level for the duration noted in table SVF109-II. The voltage must return to steady state over the time duration noted in table SVF109-II. For test condition G, three overvoltage transients of 180 Vrms for 10 milliseconds are performed, separated by 0.5 seconds. For test condition L, three undervoltage transients of 80 Vrms for 10 milliseconds are performed, separated by 0.5 seconds. For test condition M, an undervoltage transient of 80 Vrms for 10 milliseconds is immediately followed by an overvoltage transient of 180 Vrms for 10 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal steady state limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltage, steady state frequency, voltage transient level, time duration at voltage transient, oscilloscope trace, and the performance of the UUT for each test condition in the data sheet shown in table SVF109-III. Repeat for each mode of operation of the UUT. In addition perform the repetitive normal voltage transient test described below. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

5.1 Repetitive normal voltage transients test. Program the power supply to provide a continually repeating voltage transient that decreases from 115 Vrms to 90 Vrms in ½ cycle, then increases to 140 Vrms over 50 msec, then decreases to 115 Vrms over ½ cycle. The voltage transient is repeated every 0.5 seconds, see figure2. The UUT must be subjected to the repetitive voltage transient for a length of time that confirms the utilization equipment can continuously operate and should be not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltage, steady state frequency, high voltage transient level, low voltage transient level, oscilloscope trace, time duration at test condition, and the performance of the UUT in the data sheet shown in table SVF109-III. Repeat for each mode of operation of the UUT. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SVF109-II. Test conditions for normal voltage transients for single phase, variable frequency utilization equipment.

Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage milliseconds
Overvoltage Transients				
A	< ½ cycle	140 Vrms	60 msec	< ½ cycle
B	< ½ cycle	140 Vrms	60 msec	25 msec
C	< ½ cycle	160 Vrms	34 msec	< ½ cycle
D	< ½ cycle	160 Vrms	34 msec	52 msec
E	< ½ cycle	180 Vrms	10 msec	< ½ cycle
F	< ½ cycle	180 Vrms	10 msec	77 msec
G	< ½ cycle	180 Vrms (3 times)	10 msec every 0.5 sec	< ½ cycle
Undervoltage Transients				
H	< ½ cycle	90 Vrms	35 msec	< ½ cycle
I	< ½ cycle	90 Vrms	35 msec	45 msec
J	< ½ cycle	80 Vrms	10 msec	< ½ cycle
K	< ½ cycle	80 Vrms	10 msec	70 msec
L	< ½ cycle	80 Vrms (3 times)	10 msec every 0.5 sec	< ½ cycle
Combined Transient				
M	< ½ cycle then < ½ cycle	80 Vrms 180 Vrms	10 msec 10 msec	< ½ cycle 77 msec



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SVF109-1. Normal voltage transients.

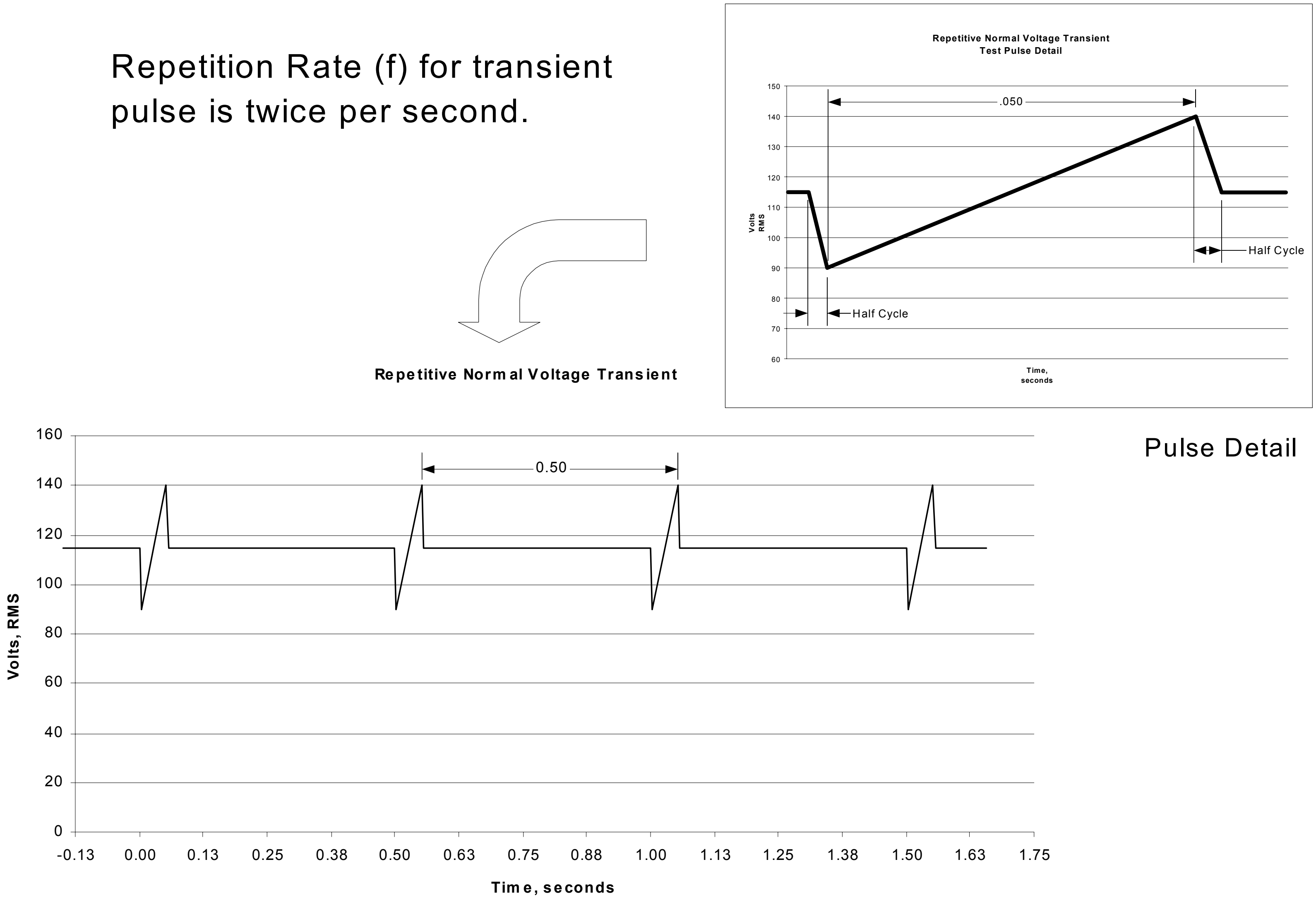


FIGURE SVF109-2. Repetitive normal voltage transient.

TABLE SVF109-III. Sample data sheet for SVF109 normal voltage transients for single phase, variable frequency utilization equipment.

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing performed at **400 Hz**											
A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
B		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
C		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
D		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
E		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
F		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
G		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
H		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
I		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
J		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
K		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
L		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
M		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
						V_{rms}		msec			
Repetitive Transient		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
						V_{rms}		msec			
	Time duration at test condition									min	

TABLE SVF109-III. Sample data sheet for SVF109 normal voltage transients for single phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing performed at **360 Hz**											
A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
B		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
C		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
D		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
E		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
F		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
G		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
H		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
I		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
J		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
K		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
L		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
M		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
						V_{rms}		msec			
Repetitive Transient		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
						V_{rms}		msec			
	Time duration at test condition									min	

TABLE SVF109-III. Sample data sheet for SVF109 normal voltage transients for single phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing performed at **600 Hz**											
A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
B		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
C		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
D		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
E		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
F		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
G		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
H		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
I		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
J		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
K		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
L		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
M		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
						V_{rms}		msec			
Repetitive Transient		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
						V_{rms}		msec			
	Time duration at test condition									min	

TABLE SVF109-III. Sample data sheet for SVF109 normal voltage transients for single phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing performed at **800 Hz**											
A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
B		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
C		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
D		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
E		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
F		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
G		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
H		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
I		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
J		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
K		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
L		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
M		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
						V_{rms}		msec			
Repetitive Transient		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
						V_{rms}		msec			
	Time duration at test condition									min	

METHOD SVF110
Normal Frequency Transients

POWER GROUP: Single Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Normal Frequency Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to normal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to frequency transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SVF110-I. The utilization equipment must maintain specified performance during and after the frequency transients. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SVF110-I. MIL-STD-704 limits for normal frequency transients for single phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Normal Frequency Transients	N/A	N/A	N/A	N/A	N/A	360 Hz to 800 Hz Maximum Rate of Change of Frequency 250 Hz/sec

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SVF110-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

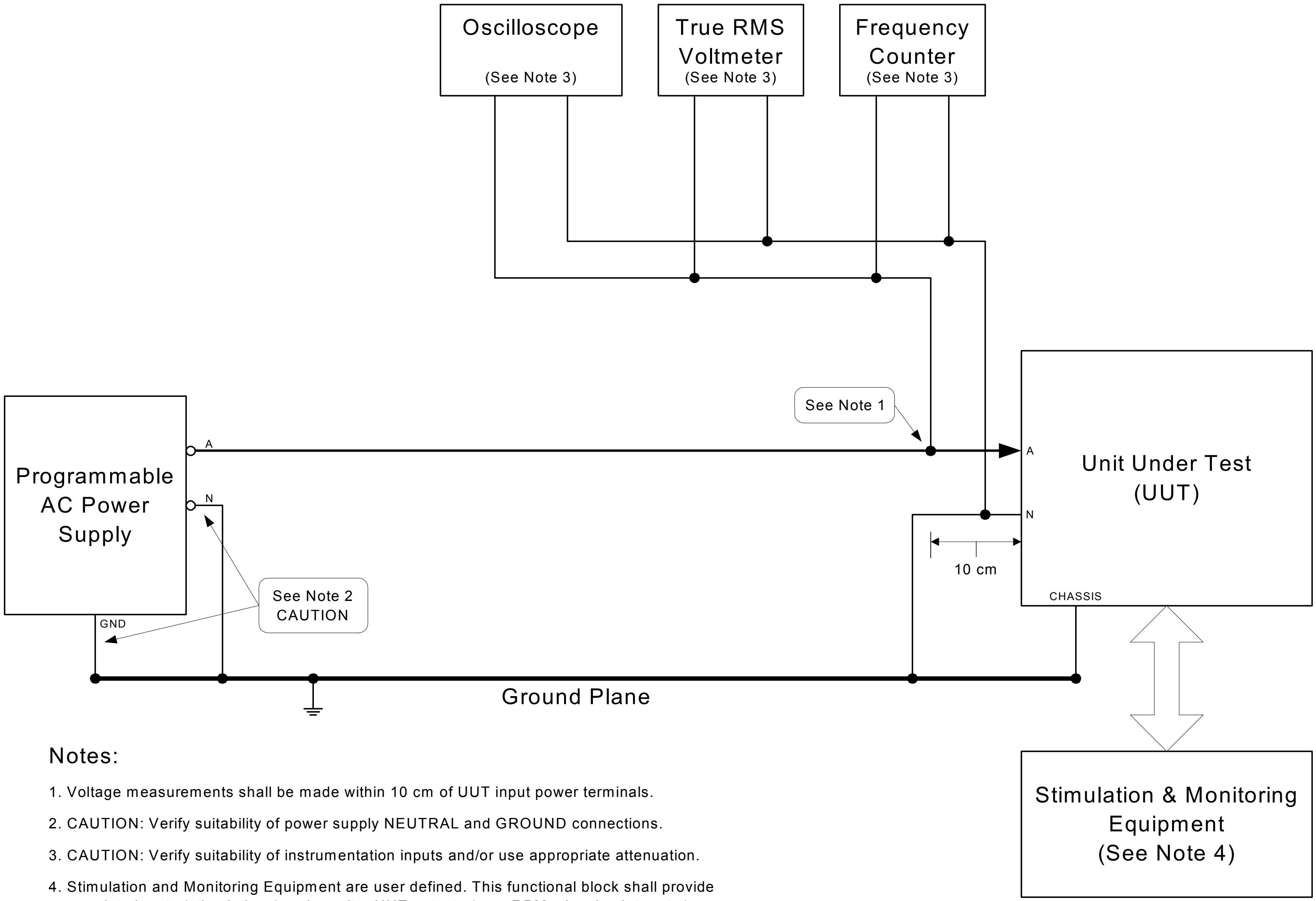
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SVF110-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

The UUT must be subjected to the frequency transients for each test condition A through I noted in table SVF110-II. The frequency must increase or decrease from the start frequency to the frequency transient level over the duration noted; the frequency must remain at the frequency transient level for the duration noted; and the frequency must return from the frequency transient level over the duration noted. For test condition I, an underfrequency transient is immediately followed by an overfrequency transient. For each test condition, monitor the performance of the UUT during the frequency transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to the start frequency, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltage, start frequency, frequency transient level, time at frequency transient, oscilloscope trace (Hz vs. time), and the performance of the UUT for each test condition in the data sheet shown in table SVF110-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SVF110-II. Test conditions for MIL-STD-704 normal frequency transients for single phase, variable frequency utilization equipment.

Test Condition	Start Frequency	Time From Start Frequency to Frequency Transient Level	Frequency Transient Level	Duration at Frequency Transient Level	Time From Frequency Transient Level to Start Frequency
Overfrequency Transients					
A	360 Hz	1.76 seconds	800 Hz	½ cycle	1.76 seconds
B	360 Hz	1.76 seconds	800 Hz	1second	1.76 seconds
C	360 Hz	0.96 seconds	600 Hz	½ cycle	0.96 seconds
D	360 Hz	0.96 seconds	600 Hz	1second	0.96 seconds
Underfrequency Transients					
E	800 Hz	1.76 seconds	360 Hz	½ cycle	1.76 seconds
F	800 Hz	1.76 seconds	360 Hz	1second	1.76 seconds
G	800 Hz	0.80 seconds	600 Hz	½ cycle	0.80 seconds
H	800 Hz	0.80 seconds	600 Hz	1second	0.80 seconds
Combined Transient					
I	600 Hz	0.96 seconds then 0.80 seconds	360 Hz 800 Hz	½ cycle ½ cycle	0.96 seconds 0.80 seconds



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SVF110-1. Normal frequency transients.

TABLE SVF110-III. Sample data sheet for SVF110 normal frequency transients for single phase, variable frequency utilization equipment.

Test Condition	Parameters										Performance
	Steady State Voltage		Start Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace		Pass/Fail
A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
B		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
C		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
D		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
E		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
F		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
G		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
H		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
I		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
						Hz		msec			

METHOD SVF201
Power Interrupt

POWER GROUP: Single Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Transfer Interrupt

PARAMETER: Power Interrupt

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to power interrupts as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for transfer aircraft electrical conditions when subjected to power interrupts as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SVF201-I. The utilization equipment must maintain the specified performance during power interrupts. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SVF201-I. MIL-STD-704 power transfer limits for single phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Power Interrupt	N/A	N/A	N/A	N/A	N/A	50 msec
Voltage NLSS	N/A	N/A	N/A	N/A	N/A	108 V
Voltage NHSS	N/A	N/A	N/A	N/A	N/A	118 V

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope
e. Resistive dummy load

4. Test setup. Configure the test setup as shown in figure SVF201-1. The dummy resistive load placed in parallel to the UUT should be sized to draw three times the steady state current of the

UUT. Note: This is done to ensure that the UUT test does not lose stored energy to other aircraft loads during power interrupts. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

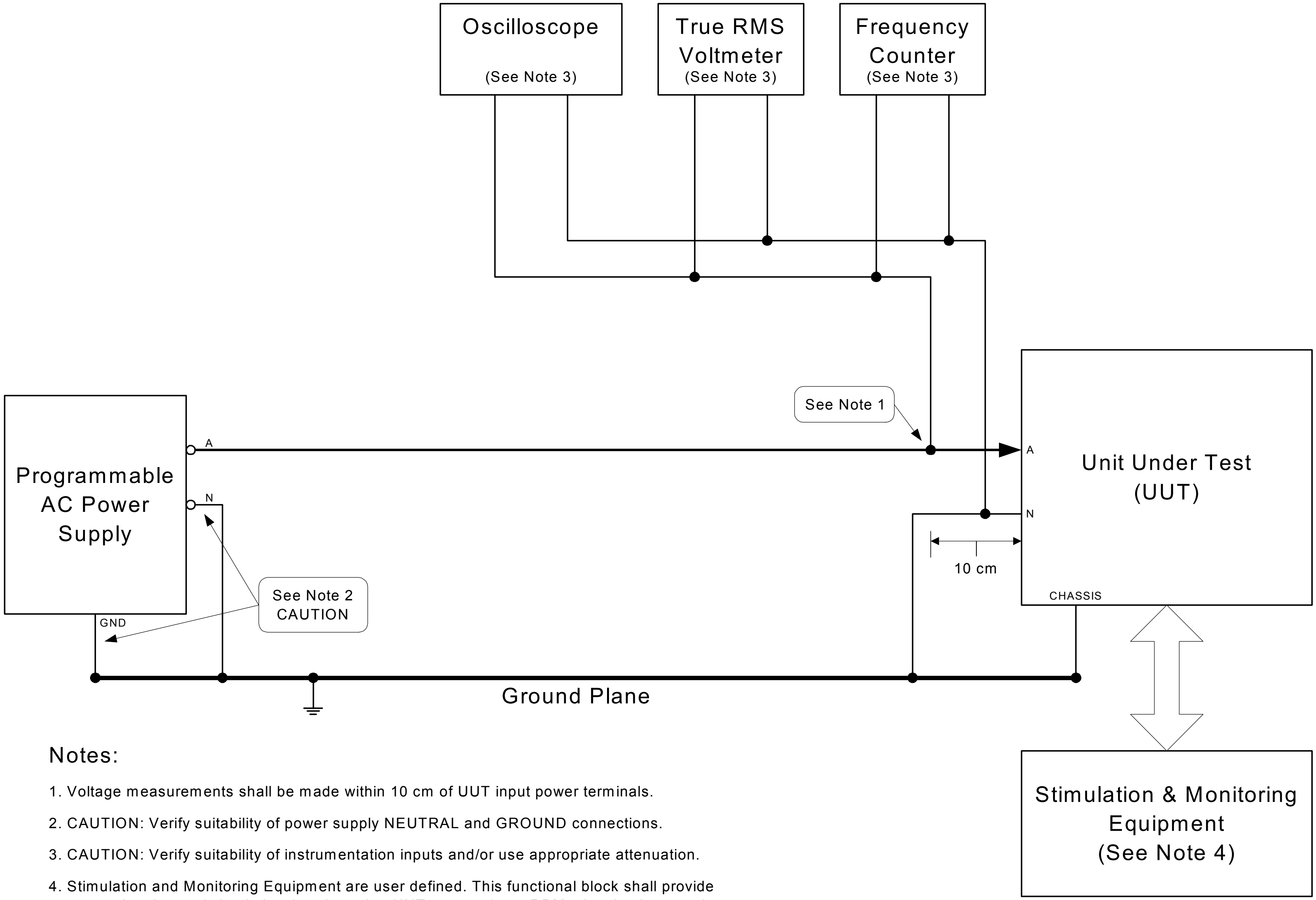
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SVF201-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through K noted in table SVF201-II, adjust the voltage to the steady state voltage listed. Perform a power interrupt (0 V) of the duration listed. The voltage must decrease from the steady state voltage to 0 Volts within ½ cycle, remain at 0 Volts for the duration listed for the test condition, and return from 0 Volts to the Steady State voltage within ½ cycle. For test condition J, three 50 milliseconds power interrupts are performed, separated by 0.5 seconds. For test condition K a normal overvoltage transient follows the power interrupt. The normal voltage transient is 160 Vrms for 30 milliseconds and returns to nominal voltage over the next 40 milliseconds. For test condition L a normal undervoltage transient follows the power interrupt. The normal voltage transient is 70 Vrms for 30 milliseconds and returns to nominal voltage over the next 40 milliseconds. For each test condition, monitoring the performance of the UUT according to the utilization equipment performance test procedures for power transfer operation to verify that the UUT is providing specified performance for transfer aircraft electrical conditions. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing the performance specified for normal aircraft electrical conditions (if the UUT is allowed degraded performance during power interrupts, verify the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage). Record the steady state voltage, steady state frequency, time duration of power interrupts, and the performance of the UUT for each test condition in the data sheet shown in table SVF201-III. Repeat each test condition 5 times. Repeat for each mode of operation of the UUT. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SVF201-II. Test conditions for transfer interrupt for single phase, variable frequency utilization equipment.

Test Condition	Steady State Voltage	Duration of Interrupt
A	Nominal Voltage	50 msec
B	NLSS Voltage	50 msec
C	NHSS Voltage	50 msec
D	Nominal Voltage	30 msec
E	NLSS Voltage	30 msec
F	NHSS Voltage	30 msec
G	Nominal Voltage	10 msec
H	NLSS Voltage	10 msec
I	NHSS Voltage	10 msec
J	Nominal Voltage	50 msec (repeated 3 times, separated by 0.5 sec)
K	Nominal Voltage	50 msec (followed by a normal voltage transient of 160 Vrms for 30 msec and return to steady state voltage in 40 msec)
L	Nominal Voltage	50 msec (followed by a normal voltage transient of 70 Vrms for 30 msec and return to steady state voltage in 40 msec)



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SVF201-1. Power interrupt.

TABLE SVF201-III. Sample data sheet for SVF201 power interrupt for single phase, variable frequency utilization equipment.

Test Condition	Parameter						Performance
	Voltage		Frequency		Time Duration of Power Interrupt		Pass/Fail
Testing performed at **400 Hz**							
A		V_{rms}		Hz		msec	
B		V_{rms}		Hz		msec	
C		V_{rms}		Hz		msec	
D		V_{rms}		Hz		msec	
E		V_{rms}		Hz		msec	
F		V_{rms}		Hz		msec	
G		V_{rms}		Hz		msec	
H		V_{rms}		Hz		msec	
I		V_{rms}		Hz		msec	
J		V_{rms}		Hz		msec	
K		V_{rms}		Hz		msec	
	Voltage Transient Level				Time at Voltage Transient Level		
		V_{rms}				msec	
L		V_{rms}		Hz		msec	
	Voltage Transient Level				Time at Voltage Transient Level		
		V_{rms}				msec	

TABLE SVF201-III. Sample data sheet for SVF201 power interrupt for single phase, variable frequency utilization equipment. - Continued

Test Condition	Parameter						Performance
	Voltage		Frequency		Time Duration of Power Interrupt		Pass/Fail
Testing performed at **360 Hz**							
A		V_{rms}		Hz		msec	
B		V_{rms}		Hz		msec	
C		V_{rms}		Hz		msec	
D		V_{rms}		Hz		msec	
E		V_{rms}		Hz		msec	
F		V_{rms}		Hz		msec	
G		V_{rms}		Hz		msec	
H		V_{rms}		Hz		msec	
I		V_{rms}		Hz		msec	
J		V_{rms}		Hz		msec	
K		V_{rms}		Hz		msec	
	Voltage Transient Level				Time at Voltage Transient Level		
		V_{rms}				msec	
L		V_{rms}		Hz		msec	
	Voltage Transient Level				Time at Voltage Transient Level		
		V_{rms}				msec	

TABLE SVF201-III. Sample data sheet for SVF201 power interrupt for single phase, variable frequency utilization equipment. - Continued

Test Condition	Parameter						Performance
	Voltage		Frequency		Time Duration of Power Interrupt		Pass/Fail
Testing performed at **600 Hz**							
A		V_{rms}		Hz		msec	
B		V_{rms}		Hz		msec	
C		V_{rms}		Hz		msec	
D		V_{rms}		Hz		msec	
E		V_{rms}		Hz		msec	
F		V_{rms}		Hz		msec	
G		V_{rms}		Hz		msec	
H		V_{rms}		Hz		msec	
I		V_{rms}		Hz		msec	
J		V_{rms}		Hz		msec	
K		V_{rms}		Hz		msec	
	Voltage Transient Level				Time at Voltage Transient Level		
		V_{rms}				msec	
L		V_{rms}		Hz		msec	
	Voltage Transient Level				Time at Voltage Transient Level		
		V_{rms}				msec	

TABLE SVF201-III. Sample data sheet for SVF201 power interrupt for single phase, variable frequency utilization equipment. - Continued

<table>
<tr><th rowspan="2">Test Condition</th><th colspan="6">Parameter</th><th>Performance</th></tr>
<tr><th colspan="2">Voltage</th><th colspan="2">Frequency</th><th colspan="2">Time Duration of Power Interrupt</th><th>Pass/Fail</th></tr>
<tr><td colspan="8">Testing performed at 800 Hz</td></tr>
<tr><td>A</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>B</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>C</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>D</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>E</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>F</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>G</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>H</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>I</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>J</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td rowspan="3">K</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td rowspan="3"></td></tr>
<tr><td colspan="2">Voltage Transient Level</td><td colspan="2" rowspan="2"></td><td colspan="2">Time at Voltage Transient Level</td></tr>
<tr><td></td><td>V_{rms}</td><td></td><td>msec</td></tr>
<tr><td rowspan="3">L</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td rowspan="3"></td></tr>
<tr><td colspan="2">Voltage Transient Level</td><td colspan="2" rowspan="2"></td><td colspan="2">Time at Voltage Transient Level</td></tr>
<tr><td></td><td>V_{rms}</td><td></td><td>msec</td></tr>
</table>

METHOD SVF301
Abnormal Steady State Limits for Voltage and Frequency

POWER GROUP: Single Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Abnormal

PARAMETER: Abnormal Steady State Limits for Voltage and Frequency

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Abnormal Low Steady State (ALSS) limits and the Abnormal High Steady State (AHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when supplied input power of voltage and frequency at the specified abnormal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table SVF301-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the abnormal steady state voltage and frequency limits and should be, not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the abnormal steady state voltage and frequency limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SVF301-I. MIL-STD-704 abnormal limits for steady state voltage and frequency for single phase, variable frequency utilization equipment.

Abnormal Limit	704A	704B	704C	704D	704E	704F
Voltage ALSS	N/A	N/A	N/A	N/A	N/A	100 V
Voltage AHSS	N/A	N/A	N/A	N/A	N/A	125 V
Frequency ALSS	N/A	N/A	N/A	N/A	N/A	360 Hz
Frequency AHSS	N/A	N/A	N/A	N/A	N/A	800 Hz

3. Apparatus. The test equipment should be as follows:

a. Adjustable AC power supply
b. True RMS voltmeter
c. Frequency counter

4. Test setup. Configure the test setup as shown in figure SVF301-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

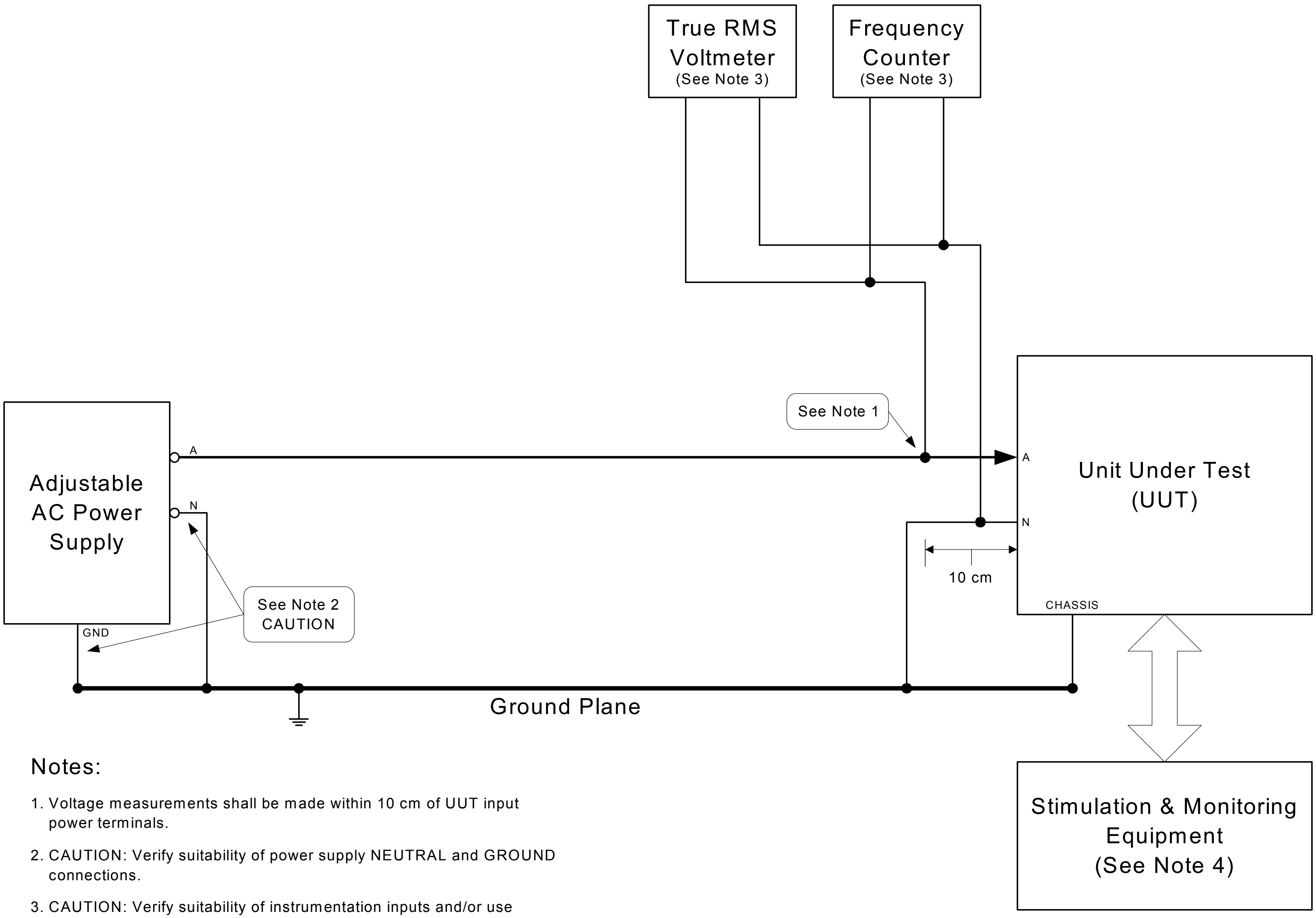
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SVF301-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through H noted in table SVF301-II, the UUT must remain for a length of time that confirms the utilization equipment can perform as specified at the abnormal steady state voltage and frequency limits and should be, not less than thirty (30) minutes. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. For each test condition shut down the UUT and verify that the UUT can be re-started. After re-start conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Adjust the voltage to the nominal steady state voltage of 115 Vrms and adjust the frequency to the steady state frequency of the test condition. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the voltage, frequency, time duration at test condition, successful/unsuccessful re-start and the performance of the UUT for each test condition in the data sheet shown in table SVF301-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SVF301-II. Test conditions for abnormal steady state limits of voltage and frequency for single phase, variable frequency utilization equipment.

Test Condition	Voltage	Frequency
Balanced Voltages		
A	100 V	400 Hz
B	100 V	360 Hz
C	100 V	600 Hz
D	100 V	800 Hz
E	125 V	400 Hz
F	125 V	360 Hz
G	125 V	600 Hz
H	125 V	800 Hz



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SVF301-1. Abnormal steady state limits for voltage and frequency.

TABLE SVF301-III. Sample data sheet for SVF301 abnormal steady state limits for voltage and frequency for single phase, variable frequency utilization equipment.

Test Condition	Parameter						Performance
	Voltage		Frequency		Time Duration at Test Condition		Pass/Fail
A		V_{rms}		Hz		min	
B		V_{rms}		Hz		min	
C		V_{rms}		Hz		min	
D		V_{rms}		Hz		min	
E		V_{rms}		Hz		min	
F		V_{rms}		Hz		min	
G		V_{rms}		Hz		min	
H		V_{rms}		Hz		min	

METHOD SVF302
Abnormal Voltage Transients

POWER GROUP: Single Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Abnormal

PARAMETER: Abnormal Voltage Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to abnormal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to voltage transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SVF302-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SVF302-I. MIL-STD-704 limits for abnormal voltage transients for single phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Abnormal Voltage Transients	N/A	N/A	N/A	N/A	N/A	figure 4 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SVF302-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SVF302-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the

frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

The UUT must be subjected to the voltage transients for each test condition A through O noted in table SVF302-II. The voltage must increase or decrease from steady state voltage to the voltage transient level within ½ cycle. The voltage must remain at the voltage transient level for the duration noted in table SVF302-II. The voltage must return to steady state over the time duration noted in table SVF302-II. For test condition G, three over-voltage transients of 180 Vrms for 20 milliseconds are performed, separated by 0.5 seconds. For test condition N, three under-voltage transients of 45 Vrms for 20 milliseconds are performed, separated by 0.5 seconds. For test condition O, an under-voltage transient of 45 Vrms for 20 milliseconds is immediately followed by an overvoltage transient of 180 Vrms for 50 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits, and has not suffered damage. Record the steady state voltage, steady state frequency, voltage transient level, time duration at voltage transient, oscilloscope trace, and the performance of the UUT for each test condition in the data sheet shown in table SVF302-III. Repeat for each mode of operation of the UUT. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

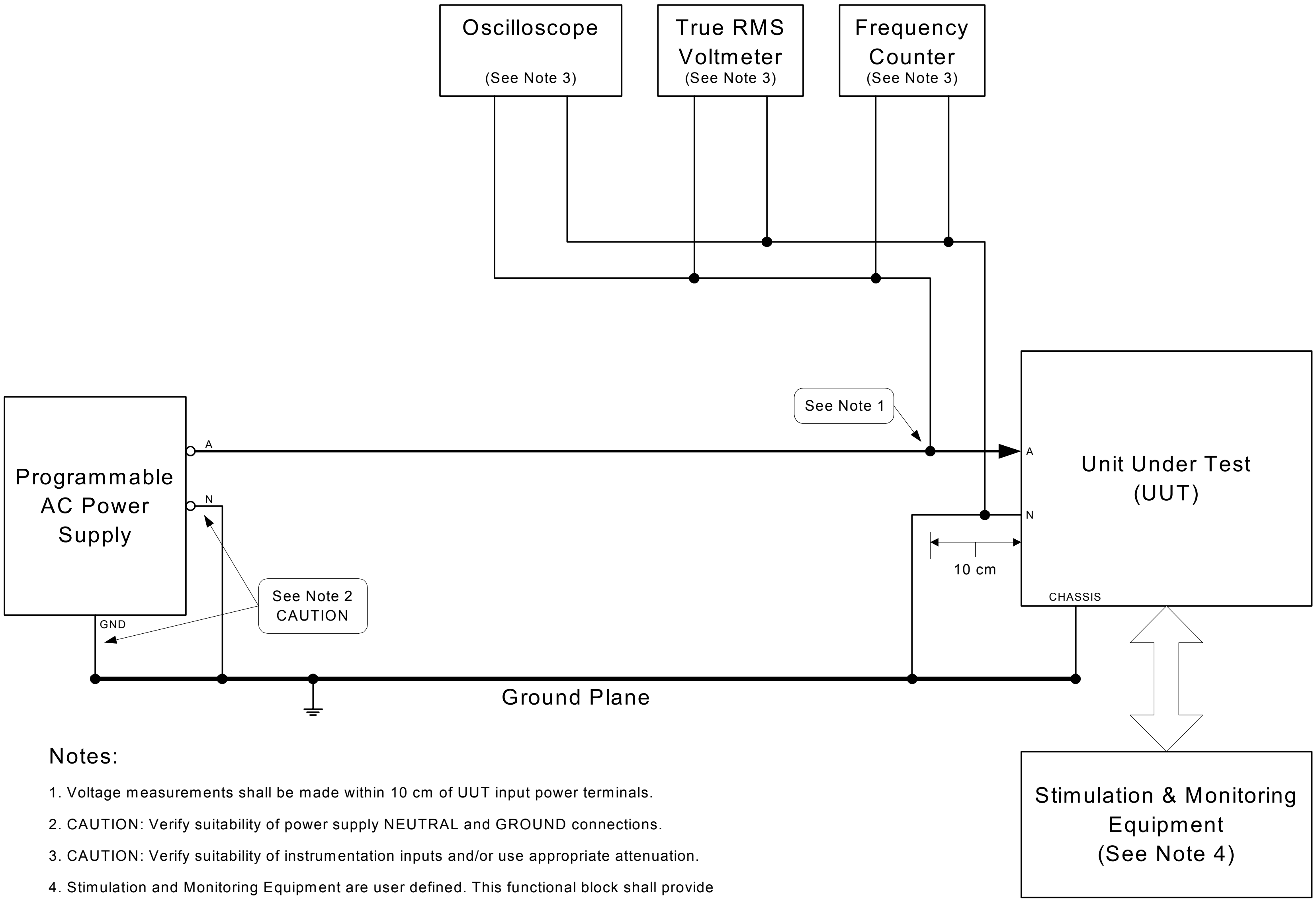
After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SVF302-II. Test conditions for abnormal voltage transients for single phase, variable frequency utilization equipment.

Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Overvoltage Transients				
A	< ½ cycle	140 Vrms	180 msec	< ½ cycle
B	< ½ cycle	140 Vrms	180 msec	87 msec
	then	135 Vrms	decreasing	253 msec
	then	130 Vrms	decreasing	6.41 sec
	then	125 Vrms	decreasing	30 sec
		115 Vrms		
C	< ½ cycle	160 Vrms	78 msec	< ½ cycle
D	< ½ cycle	160 Vrms	78 msec	31 msec
	then	150 Vrms	decreasing	71 msec
	then	140 Vrms	decreasing	87 msec
	then	135 Vrms	decreasing	253 msec
	then	130 Vrms	decreasing	6.41 sec
	then	125 Vrms	decreasing	30 sec
		115 Vrms		
E	< ½ cycle	180 Vrms	50 msec	< ½ cycle
F	< ½ cycle	180 Vrms	50 msec	11 msec
	then	170 Vrms	decreasing	17 msec
	then	160 Vrms	decreasing	31 msec
	then	150 Vrms	decreasing	71 msec
	then	140 Vrms	decreasing	87 msec
	then	135 Vrms	decreasing	253 msec
	then	130 Vrms	decreasing	6.41 sec
	then	125 Vrms	decreasing	30 sec
		115 Vrms		
G	< ½ cycle	180 Vrms (3 times)	20 msec every 0.5 sec	< ½ cycle

TABLE SVF302-II. Test conditions for abnormal voltage transients for single phase, variable frequency utilization equipment. - Continued

Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Undervoltage Transients				
H	< ½ cycle	85 Vrms	180 msec	< ½ cycle
I	< ½ cycle	85 Vrms	180 msec	87 msec
	then	90 Vrms	increasing	253 msec
	then	95 Vrms	increasing	6.41 sec
	then	100 Vrms	increasing	30 sec
		115 Vrms		
J	< ½ cycle	66 Vrms	78 msec	< ½ cycle
K	< ½ cycle	65 Vrms	78 msec	31 msec
	then	75 Vrms	increasing	71 msec
	then	85 Vrms	increasing	87 msec
	then	90 Vrms	increasing	253 msec
	then	95 Vrms	increasing	6.41 sec
	then	100 Vrms	increasing	30 sec
		115 Vrms		
L	< ½ cycle	45 Vrms	50 msec	< ½ cycle
M	< ½ cycle	45 Vrms	50 msec	11 msec
	then	55 Vrms	increasing	17 msec
	then	65 Vrms	increasing	31 msec
	then	75 Vrms	increasing	71 msec
	then	85 Vrms	increasing	87 msec
	then	90 Vrms	increasing	253 msec
	then	95 Vrms	increasing	6.41 sec
	then	100 Vrms	increasing	30 sec
		115 Vrms		
N	< ½ cycle	45 Vrms (3 times)	20 msec every 0.5 sec	< ½ cycle
Combined Transient				
O	< ½ cycle	45 Vrms then	20 msec	< ½ cycle
	< ½ cycle	180 Vrms	50 msec	11 msec
	then	170 Vrms	decreasing	17 msec
	then	160 Vrms	decreasing	31 msec
	then	150 Vrms	decreasing	71 msec
	then	140 Vrms	decreasing	87 msec
	then	135 Vrms	decreasing	253 msec
	then	130 Vrms	decreasing	6.41 sec
	then	125 Vrms	decreasing	30 sec
		115 Vrms		



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SVF302-1. Abnormal voltage transients.

TABLE SVF302-III. Sample data sheet for SVF302 abnormal voltage transients for single phase, variable frequency utilization equipment.

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing Performed at **400 Hz**											
A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
B		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
C		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
D		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
E		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
F		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
G		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
H		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
I		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
J		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
K		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
L		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
M		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
N		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
O		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
						V_{rms}		msec			

TABLE SVF302-III. Sample data sheet for SVF302 abnormal voltage transients for single phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters					Performance
	Steady State Voltage	Steady State Frequency	Voltage Transient	Time at Voltage Transient Level	Oscilloscope Trace	Pass/Fail
Testing Performed at **360 Hz**						
A	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs. Time	
B	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs. Time	
C	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs. Time	
D	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs. Time	
E	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs. Time	
F	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs. Time	
G	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs. Time	
H	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs. Time	
I	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs. Time	
J	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs. Time	
K	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs. Time	
L	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs. Time	
M	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs. Time	
N	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs. Time	
O	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs. Time	
			V_{rms}	msec		

TABLE SVF302-III. Sample data sheet for SVF302 abnormal voltage transients for single phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing Performed at **600 Hz**											
A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
B		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
C		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
D		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
E		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
F		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
G		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
H		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
I		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
J		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
K		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
L		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
M		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
N		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
O		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
						V_{rms}		msec			

TABLE SVF302-III. Sample data sheet for SVF302 abnormal voltage transients for single phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing Performed at **800 Hz**											
A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
B		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
C		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
D		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
E		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
F		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
G		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
H		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
I		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
J		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
K		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
L		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
M		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
N		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
O		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
						V_{rms}		msec			

METHOD SVF303
Abnormal Frequency Transients

POWER GROUP: Single Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Abnormal

PARAMETER: Abnormal Frequency Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to abnormal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to frequency transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SVF303-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SVF303-I. MIL-STD-704 limits for abnormal frequency transients for single phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Abnormal Frequency Transients	N/A	N/A	N/A	N/A	N/A	360 Hz to 800 Hz Maximum Rate of Change of Frequency 500 Hz/sec

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SVF303-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SVF303-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions.

The UUT must be subjected to the frequency transients for each test condition A through I noted in table SVF303-II. The frequency must increase or decrease from the start frequency to the frequency transient level over the duration noted; the frequency must remain at the frequency transient level for the duration noted; and the frequency must return from the frequency transient level over the duration noted. For test condition E, an underfrequency transient is immediately followed by an overfrequency transient. For each test condition, monitor the performance of the UUT during the frequency transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to start frequency, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions, and has not suffered damage. Record the steady state voltage, start frequency, frequency transient level, time at frequency transient, oscilloscope trace (Hz vs.. time), and the performance of the UUT for each test condition in the data sheet shown in table SVF303-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SVF303-II. Test conditions for MIL-STD-704 abnormal frequency transients for single phase, variable frequency utilization equipment.

Test Condition	Start Frequency	Time From Start Frequency to Frequency Transient Level	Frequency Transient Level	Duration at Frequency Transient Level	Time From Frequency Transient Level to Start Frequency
Overfrequency Transients					
A	360 Hz	0.88 seconds	800 Hz	½ cycle	0.88 seconds
B	360 Hz	0.88 seconds	800 Hz	1second	0.88 seconds
C	360 Hz	0.48 seconds	600 Hz	½ cycle	0.48 seconds
D	360 Hz	0.48 seconds	600 Hz	1second	0.48 seconds
Underfrequency Transients					
E	800 Hz	0.88 seconds	360 Hz	½ cycle	0.88 seconds
F	800 Hz	0.88 seconds	360 Hz	1second	0.88 seconds
G	800 Hz	0.40 seconds	600 Hz	½ cycle	0.40 seconds
H	800 Hz	0.40 seconds	600 Hz	1second	0.40 seconds
Combined Transient					
I	600 Hz	0.48 seconds then 0.40 seconds	360 Hz 800 Hz	½ cycle ½ cycle	0.48 seconds 0.40 seconds

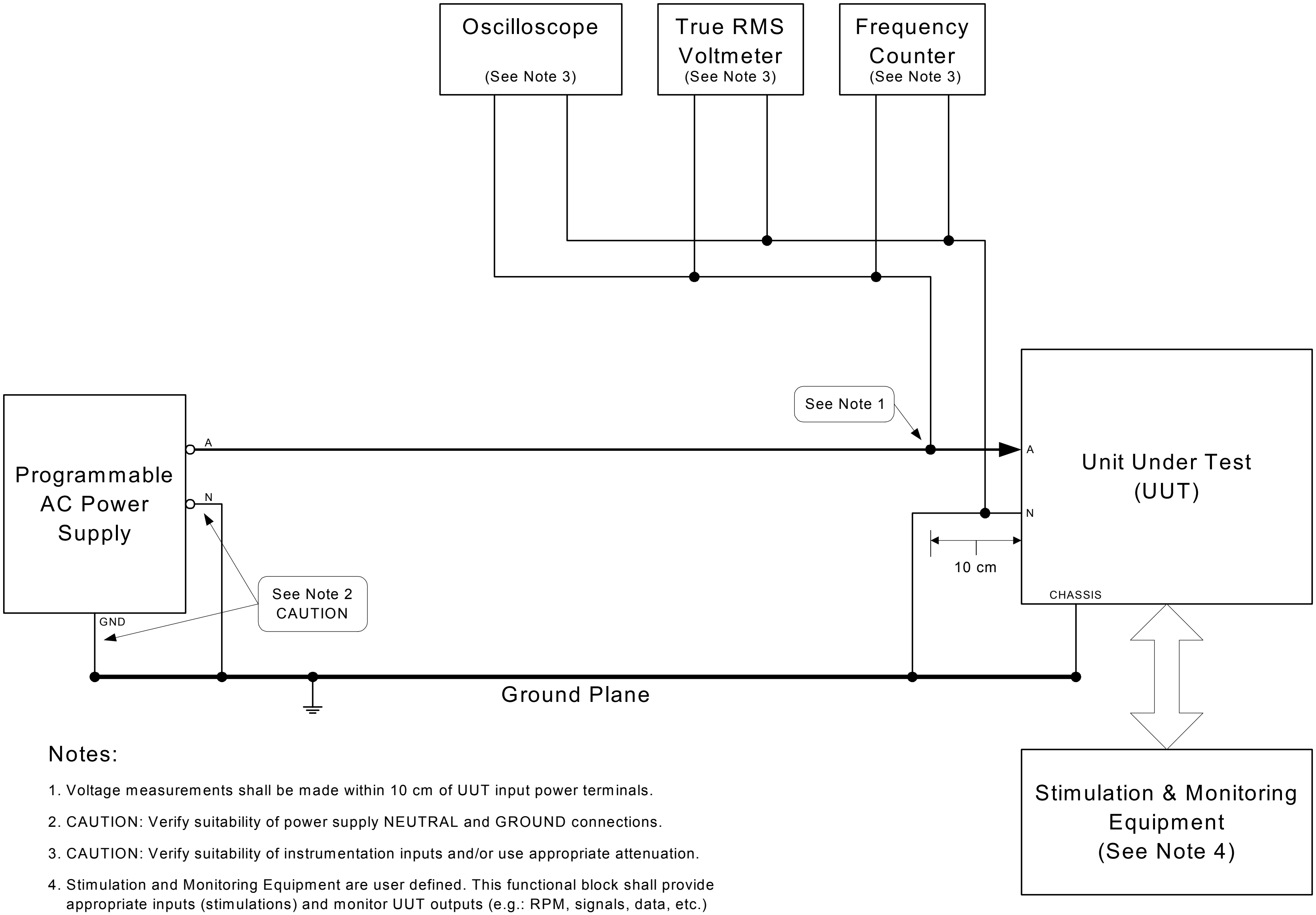


FIGURE SVF303-1. Abnormal frequency transients.

TABLE SVF303-III. Sample data sheet for SVF303 abnormal frequency transients for single phase, variable frequency utilization equipment.

Test Condition	Parameters										Performance
	Steady State Voltage		Start Frequency		Frequency Transient		Time at Frequency Transient Level		Steady State Voltage		Pass/Fail
A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
B		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
C		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
D		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
E		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
F		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
G		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
H		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
I		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
						Hz		msec			

METHOD SVF401
Emergency Steady State Limits for Voltage and Frequency

POWER GROUP: Single Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Emergency

PARAMETER: Emergency Steady State Limits for Voltage and Frequency

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at that the Emergency Low Steady State (ELSS) limits and the Emergency High Steady State (EHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. For MIL-STD-704F, the single phase, 115 Volt, variable frequency power utilization equipment normal steady state limits are the same as the emergency steady state limits. The emergency steady state limits for single phase, 115 Volt, variable frequency equipment are noted in table SVF401-I. Performance of test method SVF102 will constitute performance of test method SVF401,

TABLE SVF401-I. MIL-STD-704 emergency limits for steady state voltage and frequency for single phase, variable frequency utilization equipment.

Emergency Limit	704A	704B	704C	704D	704E	704F
Voltage ELSS	N/A	N/A	N/A	N/A	N/A	108 V
Voltage EHSS	N/A	N/A	N/A	N/A	N/A	118 V
Frequency ELSS	N/A	N/A	N/A	N/A	N/A	360 Hz
Frequency EHSS	N/A	N/A	N/A	N/A	N/A	800 Hz

METHOD SVF501
(No Tests)

POWER GROUP: Single Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Starting

PARAMETER: No Tests

Starting operations are usually not applicable to AC utilization equipment.

METHOD SVF601
Power Failure

POWER GROUP: Single Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Power Failure

PARAMETER: Power Failure

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to power failures as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to power failures as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SVF601-I. The utilization equipment must maintain the specified performance during the power failures. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SVF601-I. MIL-STD-704 power failure limits for single phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Power Failure	N/A	N/A	N/A	N/A	N/A	7 sec figure 4 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SVF601-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SVF601-1. Turn on the power source and

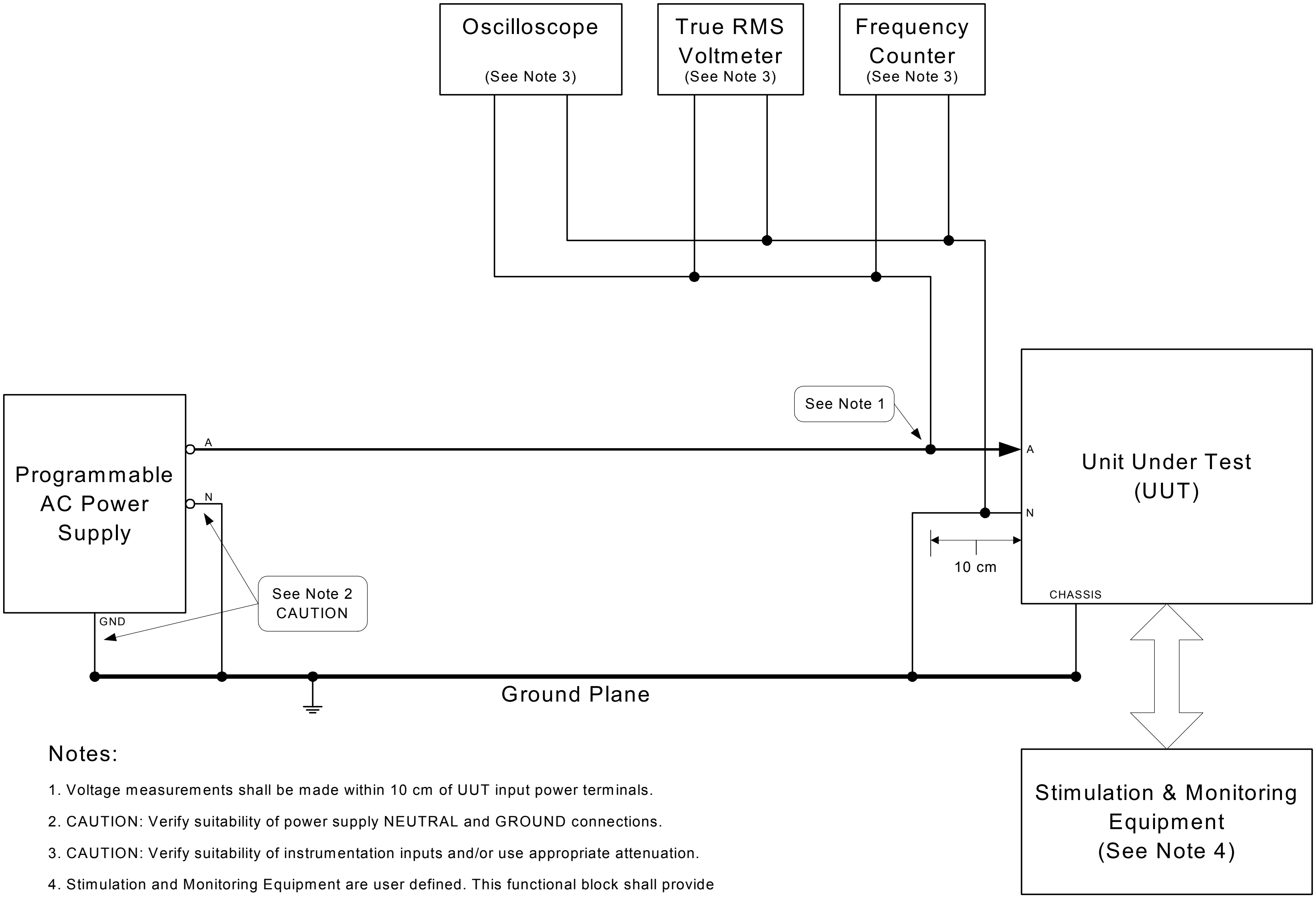
adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through D noted in table SVF601-II, perform a power failure (0 V) of the duration listed. The voltage must decrease from the steady state voltage to 0 Volts within ½ cycle, remain at 0 Volts for the duration listed for the test condition, and return form 0 Volts to the steady state voltage within ½ cycle. For each test condition, monitor the performance of the UUT according to the utilization equipment performance test procedures for power failure operation to verify that the UUT is providing specified performance for power failure aircraft electrical conditions. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the steady state voltage, steady state frequency, time duration of power failure, and the performance of the UUT for each test condition in the data sheet shown in table SVF601-III. Repeat each test condition 5 times. Repeat for each mode of operation of the UUT. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SVF601-II. Test conditions for power failures for single phase, variable frequency utilization equipment.

Test Condition	Duration of Power Failure
A	100 msec
B	500 msec
C	3 seconds
D	7 seconds



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SVF601-1. Power failure.

TABLE SVF601-III. Sample data sheet for SVF601 power failure (three phase) for single phase, variable frequency utilization equipment.

Test Condition	Parameters								Performance
	Steady State Voltage		Steady State Frequency		Voltage during Power Failure		Time Duration of Power Failure		Pass/Fail
Testing Performed at **400 Hz**									
A		V_{rms}		Hz		V_{rms}		msec	
B		V_{rms}		Hz		V_{rms}		msec	
C		V_{rms}		Hz		V_{rms}		msec	
D		V_{rms}		Hz		V_{rms}		msec	
Testing Performed at **360 Hz**									
A		V_{rms}		Hz		V_{rms}		msec	
B		V_{rms}		Hz		V_{rms}		msec	
C		V_{rms}		Hz		V_{rms}		msec	
D		V_{rms}		Hz		V_{rms}		msec	
Testing Performed at **600 Hz**									
A		V_{rms}		Hz		V_{rms}		msec	
B		V_{rms}		Hz		V_{rms}		msec	
C		V_{rms}		Hz		V_{rms}		msec	
D		V_{rms}		Hz		V_{rms}		msec	
Testing Performed at **800 Hz**									
A		V_{rms}		Hz		V_{rms}		msec	
B		V_{rms}		Hz		V_{rms}		msec	
C		V_{rms}		Hz		V_{rms}		msec	
D		V_{rms}		Hz		V_{rms}		msec	

METHOD SVF602
(No Test Required)

POWER GROUP:	Single Phase, Variable Frequency, 115 V
AIRCRAFT ELECTRICAL OPERATING CONDITION:	Power Failure
PARAMETER:	No Test Required. Test number SVF602 is not used so that the Single Phase, Variable Frequency, 115 V (SVF) test numbers coincide with the Three Phase, Variable Frequency, 115 V (TVF) test sequence numbers.

METHOD SVF603
Phase Reversal

POWER GROUP: Single Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Power Failure

PARAMETER: Phase Reversal

1. Scope.

1.1. Purpose. This test procedure is used to verify that single phase, 115 Volt, variable frequency power utilization equipment is not damaged by phase reversal or a positive physical means is employed to prevent phase reversal.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment is not damaged and does not cause an unsafe condition when the input phase sequence is reversed for the applicable edition(s) of MIL-STD-704 and as noted in table SVF603-I. A positive physical means to prevent phase sequence reversal may be used to fulfill this requirement.

TABLE SCF603-I. MIL-STD-704 phase sequence reversal requirement for single phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Phase Reversal	N/A	N/A	N/A	N/A	N/A	Phase Sequence Reversal Does not Cause Damage

3. Apparatus. The test equipment should be as follows:

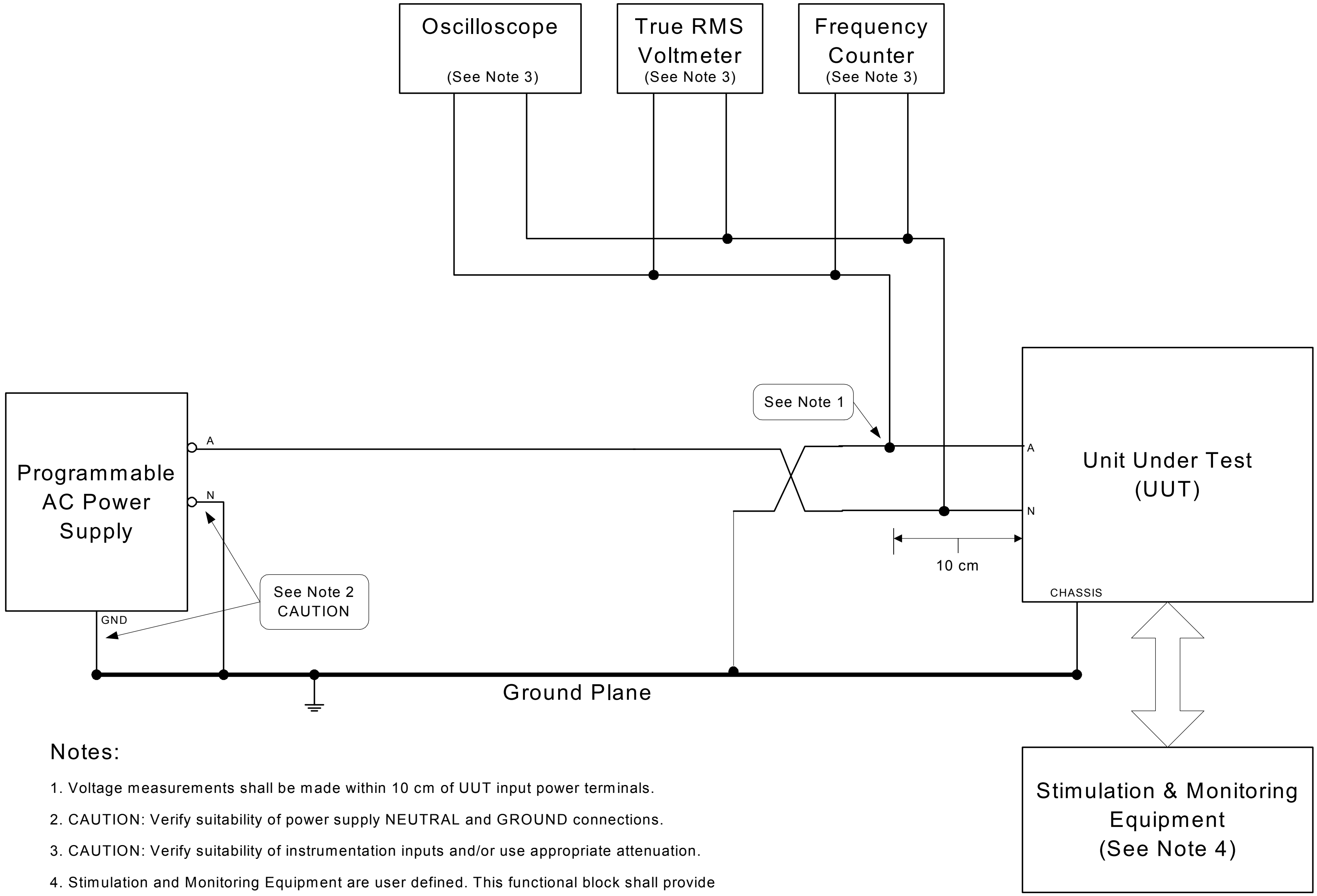
a. Adjustable AC power supply
b. True RMS voltmeter
c. Frequency counter

4. Test setup. Configure the test setup as shown in figure SVF603-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. If a positive physical means is employed to prevent phase reversal, confirm that the line and neutral conductor cannot be reversed.

If the line and neutral conductor can be reversed, with the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SVF603-1 (line and neutral conductors reversed). Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. The UUT must remain for a length of time that confirms the utilization equipment is not damaged and does not cause an unsafe condition due to phase reversal and should be, not less than thirty (30) minutes. Record the steady state voltage, steady state frequency, time duration at phase reversal test condition, and the performance of the UUT in the data sheet shown in table SVF603-II. Repeat for each mode of operation of the UUT. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

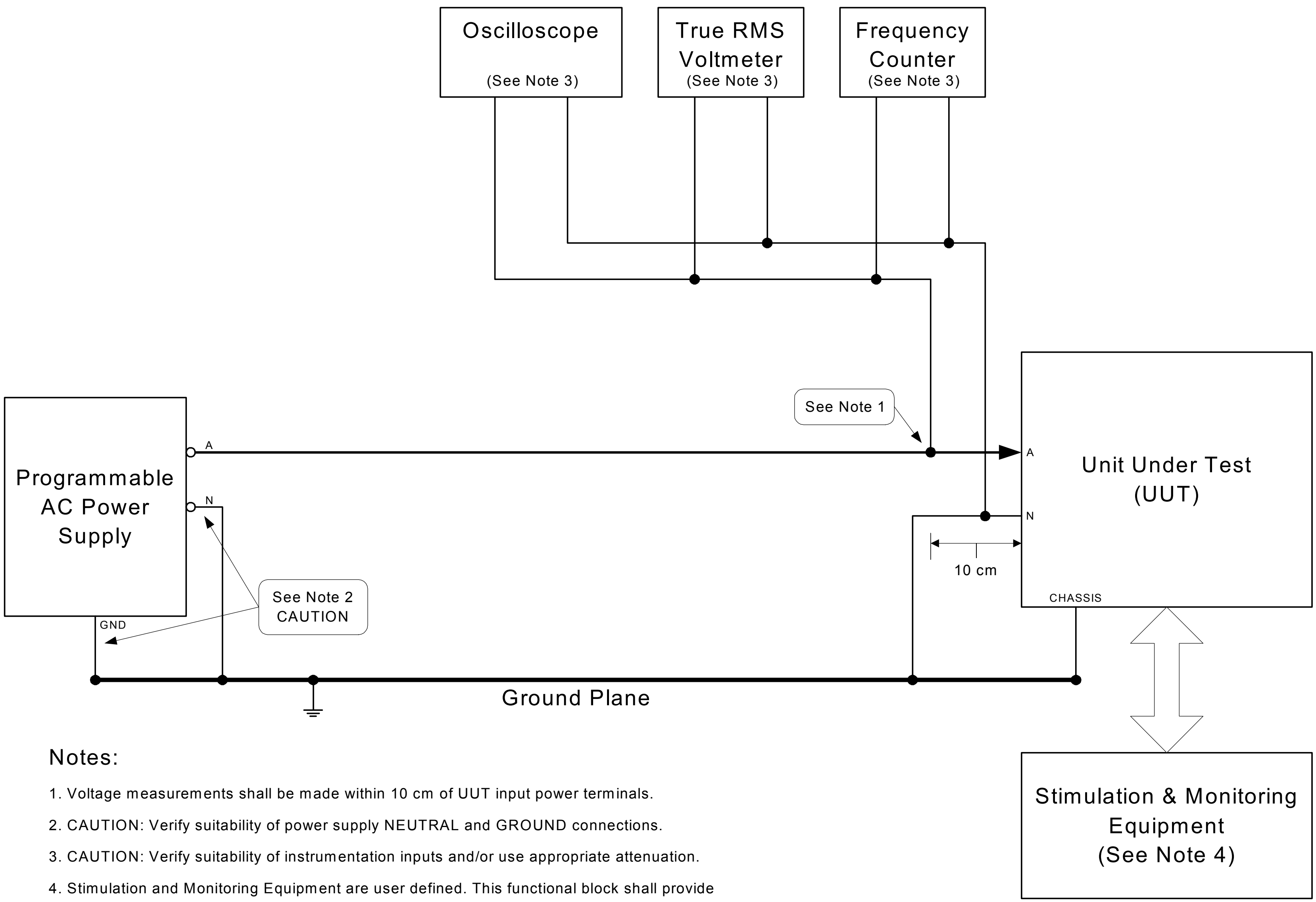
With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SVF603-2 (line and neutral conductors connected properly). Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. The UUT must remain for a length of time that confirms the utilization equipment was not damaged and does not cause an unsafe condition after the phase reversal and should be not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has returned to the performance specified for normal aircraft electrical conditions and has not suffered damage. Record the steady state voltage, steady state frequency, time duration at test condition, and the performance of the UUT in the data sheet shown in table SVF603-II. Repeat for each mode of operation of the UUT.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SVF603-1. Phase reversal.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SVF603-2. Correct phase connection.

TABLE SVF603-II. Sample data sheet for SVF603 phase sequence reversal for single phase, variable frequency utilization equipment.

Test Condition	Parameters						Performance
							Yes/No
Phase Sequence Reversal Prevented by Positive Physical Means							
If No							
	Voltage		Frequency		Time Duration at Test Condition		Pass/Fail
Testing Performed at **400 Hz**							
Phase Reversal		V_{rms}		Hz		min	
Testing Performed at **360 Hz**							
Phase Reversal		V_{rms}		Hz		min	
Testing Performed at **600 Hz**							
Phase Reversal		V_{rms}		Hz		min	
Testing Performed at **800 Hz**							
Correct Phase Connection		V_{rms}		Hz		min	

6. NOTES

6.1 Intended use. This handbook should be used as guidance when establishing test requirements, for inclusion in performance specifications developed for the procurement of utilization equipment, to ensure compliance with the aircraft electrical power characteristics as specified by MIL-STD-704.

6.2 Single phase test numbers. There are no tests required for SVF103 and SVF602. This is done so that the single phase test numbers coincide with the three phase test numbers.

6.3 Subject term (keyword) listing.

Aircraft, electrical power
Aircraft, electrical test
Electrical operating areas
Equipment, utilization
Power groups
Specification, utilization equipment

CONCLUDING MATERIAL

Custodians:
Army - AV
Navy - AS
Air Force - 11

Preparing Activity:
Navy - AS

(Project No. SESS-0050)

Review Activities:
Army - CR, MI, TE
Navy - EC, MC, SA, SH, YD

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at www.dodssp.daps.mil.

NOT MEASUREMENT
SENSITIVE

MIL-HDBK-704-5
9 April 2004

DEPARTMENT OF DEFENSE
HANDBOOK

GUIDANCE FOR
TEST PROCEDURES FOR DEMONSTRATION OF UTILIZATION EQUIPMENT COMPLIANCE TO AIRCRAFT ELECTRICAL POWER CHARACTERISTICS THREE PHASE, VARIABLE FREQUENCY, 115 VOLT
(PART 5 OF 8 PARTS)

This Handbook is for guidance only.
Do not cite this document as a requirement.

AMSC N/A

AREA SESS

FOREWORD

1. This handbook is approved for use by all Departments and Agencies of the Department of Defense.

2. This handbook provides guidance on test procedures for demonstration of three phase, variable frequency, 115 volt utilization equipment to determine compliance with the applicable edition of MIL-STD-704.

3. MIL-HDBK-704-5 is Part 5 in a series of 8 Parts. Part 5 describes the test methods and procedures to demonstrate that three phase, variable frequency, 115 volt utilization equipment is compatible with the electric power characteristics of MIL-STD-704. These series of handbooks and MIL-STD-704 are companion documents.

4. Comments, suggestions, or questions on this document should be addressed to Commander, Naval Air Systems Command, Code 4.1.4, Highway 547, Lakehurst, NJ 08733-5100 or email to thomas.omara@navy.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil.

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1. SCOPE

1.1 Scope. This handbook provides, as guidance, test methods used to demonstrate that three phase, variable frequency, 115 volt utilization equipment is compatible with the electric power characteristics of the applicable edition(s) of MIL-STD-704. This handbook is for guidance only and cannot be cited as a requirement.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed below are not necessarily all of the documents referenced herein, but are those needed to understand the information provided by this handbook.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-704	DoD Interface Standard for Aircraft Electric Power Characteristics

(Copies of these documents are available online at http://assist. daps.dla.mil/quicksearch or www.dodssp.daps.mil/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadephia, PA 19111-5094.)

3. DEFINITIONS

3.1 Acronyms and definitions. The acronyms and definitions of MIL-STD-704 are applicable to this handbook.

4. TEST METHODS INFORMATION

4.1 Demonstration of compatibility. This section contains the test methods which will ensure that three phase, variable frequency, 115 volt utilization equipment is compatible with the electric power characteristics of the applicable edition(s) of MIL-STD-704, by testing the Unit Under Test (UUT) in accordance with the test procedures as described in test methods TVF101 through TVF603.

4.1.1 Recording performance. In table TVF-I, record the edition(s) of MIL-STD-704 that defined the aircraft electric power characteristics used for testing and the performance of the UUT for each of the test methods.

4.2 Calibration of test equipment. Test equipment and accessories required for measurement in accordance with this handbook should be calibrated in accordance with an approved calibration program traceable to the National Institute for Standards and Technology.

The serial numbers, model, and calibration date of all test equipment should be included with the test data.

4.3 Test methods. The test methods listed in table TVF-1 are provided in section 5 of this handbook.

TABLE TVF-I. Summary of three phase, variable frequency,115 volt utilization equipment MIL-STD-704 compliance tests.

UUT:			
Compliance to MIL-STD-704 Edition(s):			
Test Dates:			
Test Method	Description	Performance (Pass/Fail)	Comments
Normal, Aircraft Electrical Operation			
TVF101	Three Phase Load and Current Harmonic Measurements		
TVF102	Steady State Limits for Voltage (Including Unbalance) and Frequency		
TVF103	Voltage Phase Difference		
TVF104	Voltage Modulation		
TVF105	Frequency Modulation		
TVF106	Voltage Distortion Spectrum		
TVF107	Total Voltage Distortion		
TVF108	DC Voltage Component		
TVF109	Normal Voltage Transients		
TVF110	Normal Frequency Transients		
Transfer, Aircraft Electrical Operation			
TVF201	Power Interrupt		
Abnormal, Aircraft Electrical Operation			
TVF301	Abnormal Limits for Voltage and Frequency		
TVF302	Abnormal Voltage Transients (Overvoltage/Undervoltage)		
TVF303	Abnormal Frequency Transients (Overfrequency/Underfrequency)		
Emergency, Aircraft Electrical Operation			
TVF401	Emergency Limits for Voltage and Frequency		
Starting, Aircraft Electrical Operation			
TVF501	See Note #1	N/A	N/A
Power Failure, Aircraft Electrical Operation			
TVF601	Power Failure (Single Phase)		
TVF602	One Phase and Two Phase Power Failures		
TVF603	Phase Reversal		

Note 1: Starting operation conditions are usually not applicable to AC utilization equipment. No test is required for TVF501 unless specified by the equipment performance specification.

5. TEST METHODS

METHOD TVF101
Load Measurements

POWER GROUP: Three Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Load Measurements

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, variable frequency power utilization equipment utilizes only 115 Volt line-to-neutral power, current inrush is within limits, has balanced power, the power factor is within limits, and does not use half-wave rectification for the applicable edition(s) of MIL-STD-704. Additionally, when the utilization equipment performance specification document imposes current waveform requirements, this test procedure is used to verify that the utilization equipment current waveform is within total current distortion and current spectrum (current distortion vs frequency) limits defined in the utilization equipment performance specification document.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment utilize only 115 Volt line-to-neutral power, is within current inrush limits, is within the balanced load limits, is within the power factor limits, and does not use half-wave rectification for the applicable edition(s) of MIL-STD-704 and as noted in table TVF101-I. If required by the utilization equipment performance specification document, the utilization equipment current waveform must be within the total current distortion and current spectrum limits defined in the utilization equipment performance specification document. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TVF101-I. MIL-STD-704 limits for inrush current, balanced load, power factor, rectification restriction, current distortion, and current spectrum for three phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Inrush Current	N/A	N/A	N/A	N/A	N/A	300 Percent for Loads >3 kVA
Percent Unbalanced Load	N/A	N/A	N/A	N/A	N/A	Figure 1 MIL-STD-704F or 3.33% for Loads >30 kVA
Power Factor	N/A	N/A	N/A	N/A	N/A	0.85 Lagging to Unity for Loads >500 VA and No Leading Power Factor for > 100VA
Rectification Restriction	N/A	N/A	N/A	N/A	N/A	No Half-Wave Rectification
Current Distortion	N/A	N/A	N/A	N/A	N/A	See Note 1/
Current Spectrum	N/A	N/A	N/A	N/A	N/A	See Note 1/

1/. Utilization equipment specification should include requirements that reduce the likelihood of the equipment having an adverse effect on the electrical power characteristics of the aircraft. Current distortion and current spectrum limits may be imposed to minimize undesirable effects to the electrical power characteristics. These limits should take into account the utilization equipment power draw, aircraft electrical system capacity and distribution characteristics, trade-offs with weight, volume, cost, and reliability that are specific to each type of equipment and aircraft.

3. Apparatus. The test equipment should be as follows:

a. Adjustable AC power supply (rotating AC source for current waveform limits)
b. True RMS voltmeter
c. Frequency counter
d. Power meter
e. Spectrum analyzer
f. Distortion meter
g. Current transformer
h. Oscilloscope

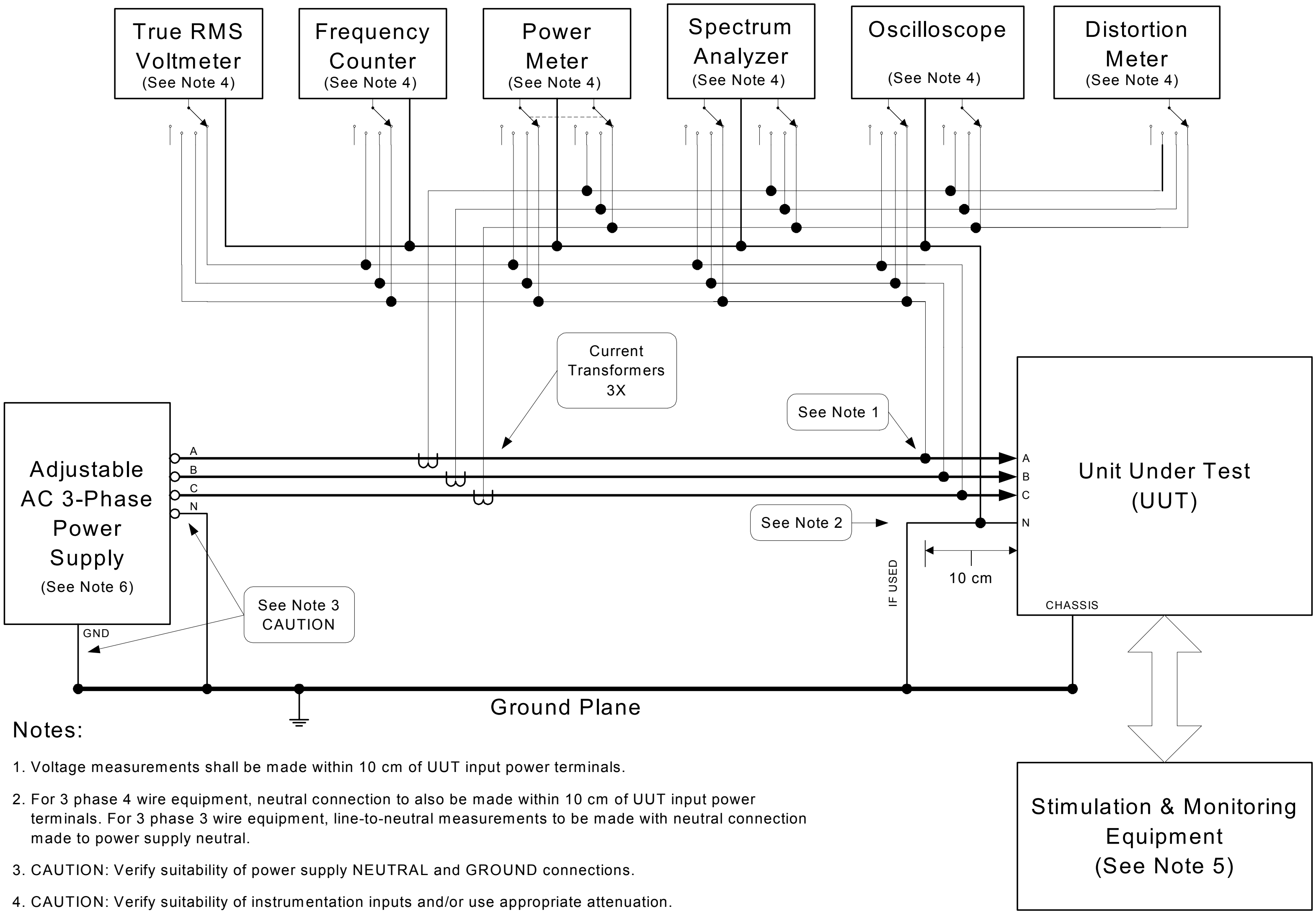
4. Test setup. Configure the test setup as shown in figure TVF101-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT. Current

measurements must be taken from the 115 Volt conductors. If the utilization equipment performance specification document imposes current waveform limits, the AC power source must be a rotating machine.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TVF101-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz.

Close the circuit breaker, energizing the UUT. Record the inrush currents (oscilloscope traces) and record the maximum rms current of each phase in the data sheet shown in table TVF101-II. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the frequency in table TVF101-II. For each phase, record the voltage, VA, and power factor in the data sheet shown in table TVF101-II. Compare the calculated percent inrush current, the load unbalance, and power factor with the limits of the applicable edition(s) of MIL-STD-704. Repeat for each mode of operation of the UUT. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

Confirm the UUT does not use half-wave rectification and record in the data sheet shown in table TVF101-II. If the utilization equipment performance specification document imposes current waveform limits, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. For each phase record the total current distortion and current spectrum in the data sheet shown in table TVF101-II and compare to the limits defined in the utilization equipment performance specification document. Repeat for each mode of operation of the UUT.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)
6. If current waveform limits are imposed by the detailed performance specification, the AC power source shall be a rotating machine.

FIGURE TVF101-1. Load measurements.

TABLE TVF101-II. Sample data sheet for TVF101 load measurement.

Parameters										
Test performed at **400 Hz** steady state frequency										
Inrush Current										
Phase	Inrush Current		Percent of Rated Current		Oscilloscope Trace				Pass/Fail	Comments
A		A_{rms}		%	Attach Trace		A_{rms} vs Time			
B		A_{rms}		%	Attach Trace		A_{rms} vs Time			
C		A_{rms}		%	Attach Trace		A_{rms} vs Time			
Balanced Load and Power Factor										
Phase	Voltage		Frequency		Volt-Amp		Power Factor		Pass/Fail	Comments
A		V_{rms}		Hz		VA		pf		
B		V_{rms}				VA		pf		
C		V_{rms}				VA		pf		
Total VA						VA				
Maximum Unbalance (difference between highest and lowest phase load)						VA				
Rectification Type										
									Pass/Fail	Comments
Does not use half-wave rectification.										
Current Waveform Measurements										
Phase	Total Current Distortion				Current Spectrum				Pass/Fail	Comments
A			% Distortion		Attach Spectrum Plot		Amplitude Vs Frequency			
B			% Distortion		Attach Spectrum Plot		Amplitude Vs Frequency			
C			% Distortion		Attach Spectrum Plot		Amplitude Vs Frequency			

TABLE TVF101-II. Sample data sheet for TVF101 load measurement. - Continued

<table>
<tr><td colspan="9">Parameters</td></tr>
<tr><td colspan="9">Test performed at 360 Hz steady state frequency</td></tr>
<tr><td colspan="9">Inrush Current</td></tr>
<tr><td>Phase</td><td colspan="2">Inrush Current</td><td colspan="2">Percent of Rated Current</td><td colspan="2">Oscilloscope Trace</td><td>Pass/Fail</td><td>Comments</td></tr>
<tr><td>A</td><td></td><td>A_{rms}</td><td></td><td>%</td><td>Attach Trace</td><td>A_{rms} vs Time</td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td>B</td><td></td><td>A_{rms}</td><td></td><td>%</td><td>Attach Trace</td><td>A_{rms} vs Time</td></tr>
<tr><td>C</td><td></td><td>A_{rms}</td><td></td><td>%</td><td>Attach Trace</td><td>A_{rms} vs Time</td></tr>
<tr><td colspan="9">Balanced Load and Power Factor</td></tr>
<tr><td>Phase</td><td colspan="2">Voltage</td><td colspan="2">Frequency</td><td>Volt-Amp</td><td>Power Factor</td><td>Pass/Fail</td><td>Comments</td></tr>
<tr><td>A</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td>VA</td><td>pf</td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td>B</td><td></td><td>V_{rms}</td><td colspan="2" rowspan="2"></td><td>VA</td><td>pf</td></tr>
<tr><td>C</td><td></td><td>V_{rms}</td><td>VA</td><td>pf</td></tr>
<tr><td colspan="5">Total VA</td><td>VA</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td colspan="5">Maximum Unbalance (difference between highest and lowest phase load)</td><td>VA</td></tr>
</table>

TABLE TVF101-II. Sample data sheet for TVF101 load measurement. - Continued

<table>
<tr><td colspan="9">Parameters</td></tr>
<tr><td colspan="9">Test performed at 360 Hz steady state frequency</td></tr>
<tr><td colspan="9">Inrush Current</td></tr>
<tr><td>Phase</td><td colspan="2">Inrush Current</td><td colspan="2">Percent of Rated Current</td><td colspan="2">Oscilloscope Trace</td><td>Pass/Fail</td><td>Comments</td></tr>
<tr><td>A</td><td></td><td>A_{rms}</td><td></td><td>%</td><td>Attach Trace</td><td>A_{rms} vs Time</td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td>B</td><td></td><td>A_{rms}</td><td></td><td>%</td><td>Attach Trace</td><td>A_{rms} vs Time</td></tr>
<tr><td>C</td><td></td><td>A_{rms}</td><td></td><td>%</td><td>Attach Trace</td><td>A_{rms} vs Time</td></tr>
<tr><td colspan="9">Balanced Load and Power Factor</td></tr>
<tr><td>Phase</td><td colspan="2">Voltage</td><td colspan="2">Frequency</td><td>Volt-Amp</td><td>Power Factor</td><td>Pass/Fail</td><td>Comments</td></tr>
<tr><td>A</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td>VA</td><td>pf</td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td>B</td><td></td><td>V_{rms}</td><td colspan="2" rowspan="2"></td><td>VA</td><td>pf</td></tr>
<tr><td>C</td><td></td><td>V_{rms}</td><td>VA</td><td>pf</td></tr>
<tr><td colspan="5">Total VA</td><td>VA</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td colspan="5">Maximum Unbalance (difference between highest and lowest phase load)</td><td>VA</td></tr>
</table>

TABLE TVF101-II. Sample data sheet for TVF101 load measurement. - Continued

<table>
<tr><td colspan="11">Parameters</td></tr>
<tr><td colspan="11">Test performed at 600 Hz steady state frequency</td></tr>
<tr><td colspan="11">Inrush Current</td></tr>
<tr><td>Phase</td><td colspan="2">Inrush Current</td><td colspan="2">Percent of Rated Current</td><td colspan="4">Oscilloscope Trace</td><td>Pass/Fail</td><td>Comments</td></tr>
<tr><td>A</td><td></td><td>A_{rms}</td><td></td><td>%</td><td colspan="2">Attach Trace</td><td colspan="2">A_{rms} vs Time</td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td>B</td><td></td><td>A_{rms}</td><td></td><td>%</td><td colspan="2">Attach Trace</td><td colspan="2">A_{rms} vs Time</td></tr>
<tr><td>C</td><td></td><td>A_{rms}</td><td></td><td>%</td><td colspan="2">Attach Trace</td><td colspan="2">A_{rms} vs Time</td></tr>
<tr><td colspan="11">Balanced Load and Power Factor</td></tr>
<tr><td>Phase</td><td colspan="2">Voltage</td><td colspan="2">Frequency</td><td colspan="2">Volt-Amp</td><td colspan="2">Power Factor</td><td>Pass/Fail</td><td>Comments</td></tr>
<tr><td>A</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>VA</td><td></td><td>pf</td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td>B</td><td></td><td>V_{rms}</td><td colspan="2" rowspan="2"></td><td></td><td>VA</td><td></td><td>pf</td></tr>
<tr><td>C</td><td></td><td>V_{rms}</td><td></td><td>VA</td><td></td><td>pf</td></tr>
<tr><td colspan="5">Total VA</td><td></td><td>VA</td><td colspan="2" rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td colspan="5">Maximum Unbalance (difference between highest and lowest phase load)</td><td></td><td>VA</td></tr>
</table>

METHOD TVF102
Steady State Limits for Voltage (Including Unbalance) and Frequency

POWER GROUP: Three Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Steady State Limits for Voltage (Including Unbalance) and Frequency

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Normal Low Steady State (NLSS) limits and the Normal High Steady State (NHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power of voltage and frequency at the specified normal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table TVF102-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be, not less than the time duration noted for the test conditions. The utilization equipment must demonstrate re-start at the steady state voltage and frequency limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TVF102-I. MIL-STD-704 normal limits for steady state voltage, voltage unbalance, and frequency for three phase variable frequency utilization equipment.

Normal Limit	704A	704B	704C	704D	704E	704F
Voltage NLSS	N/A	N/A	N/A	N/A	N/A	108 V
Voltage NHSS	N/A	N/A	N/A	N/A	N/A	118 V
Voltage Unbalance	N/A	N/A	N/A	N/A	N/A	3.0V
Frequency NLSS	N/A	N/A	N/A	N/A	N/A	360 Hz
Frequency NHSS	N/A	N/A	N/A	N/A	N/A	800 Hz

3. Apparatus. The test equipment should be as follows:

a. Adjustable AC power supply
b. True RMS voltmeter
c. Frequency counter

4. Test setup. Configure the test setup as shown in figure TVF102-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TVF102-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through RR noted in table TVF102-II, the UUT must remain for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be, not less than the time duration noted. For test conditions E through NN, after each test condition slowly adjust the frequency until the next test condition is reached. This subjects the UUT to all frequency between 360 Hz and 800 Hz at the low steady state voltage limit and the high steady state voltage limit. Test conditions A through NN are three phase balanced voltages. Test conditions OO through RR are unbalanced voltage conditions.

At each test condition A through RR conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. For each test condition shutdown the UUT and verify that the UUT can be re-started. After re-start conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltages, frequency, time duration at test condition, successful/unsuccessful re-start and the performance of the UUT for each test condition in the data sheet shown in table TVF102-III. Repeat for each mode of operation of the UUT.

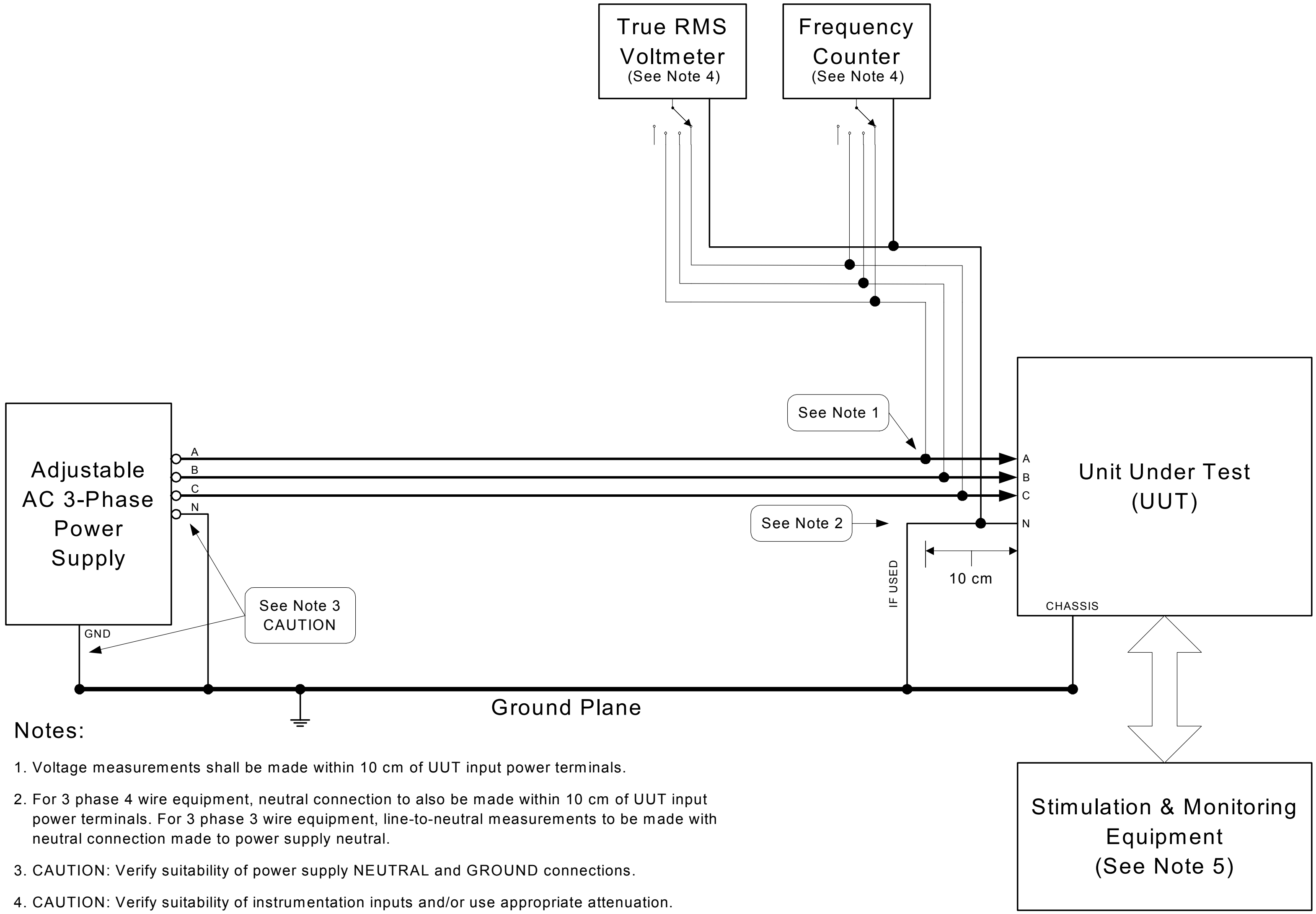
After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TVF102-II. Test conditions for steady state limits of voltage and frequency for three phase, variable frequency utilization equipment.

Test Condition	Voltage	Frequency	Minimum Time Duration At test Condition
Balanced Nominal Voltages			
A	115 V	360 Hz	30 min
B	115 V	400 Hz	30 min
C	115 V	600 Hz	30 min
D	115 V	800 Hz	30 min
Balanced Normal Low Steady State Voltages			
E	108 V	360 Hz	30 min
F	108 V	400 Hz	30 min
G	108 V	440 Hz	5 min
H	108 V	480 Hz	5 min
I	108 V	520 Hz	5 min
J	108 V	560 Hz	5 min
K	108 V	600 Hz	30 min
L	108 V	520 Hz	5 min
M	108 V	540 Hz	5 min
N	108 V	560 Hz	5 min
O	108 V	570 Hz	5 min
P	108 V	580 Hz	5 min
Q	108 V	600 Hz	30 min
R	108 V	640 Hz	5 min
S	108 V	680 Hz	5 min
T	108 V	720 Hz	5 min
U	108 V	760 Hz	5 min
V	108 V	800 Hz	30 min
Balanced Normal High Steady State Voltages			
W	118 V	360 Hz	30 min
X	118 V	400 Hz	30 min
Y	118 V	440 Hz	5 min
Z	118 V	480 Hz	5 min
AA	118 V	520 Hz	5 min
BB	118 V	560 Hz	5 min
CC	118 V	600 Hz	30 min
DD	118 V	520 Hz	5 min
EE	118 V	540 Hz	5 min
FF	118 V	560 Hz	5 min
GG	118 V	570 Hz	5 min
HH	118 V	580 Hz	5 min
II	118 V	600 Hz	30 min
JJ	118 V	640 Hz	5 min
KK	118 V	680 Hz	5 min
LL	118 V	720 Hz	5 min
MM	118 V	760 Hz	5 min
NN	118 V	800 Hz	30 min

TABLE TVF102-II. Test conditions for steady state limits of voltage and frequency for three phase, variable frequency utilization equipment. - Continued

Test Condition	Voltage	Frequency	Minimum Time Duration At test Condition
Unbalanced Voltages			
OO	Van 108 V Vbn 111 V Vcn 111 V	360 Hz	30 min
PP	Van 118 V Vbn 115 V Vcn 115 V	360 Hz	30 min
QQ	Van 108 V Vbn 111 V Vcn 111 V	800 Hz	30 min
RR	Van 118 V Vbn 115 V Vcn 115 V	800 Hz	30 min



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TVF102-1. Steady state limits for voltage (including unbalance) and frequency.

TABLE TVF102-III. Sample data sheet for TVF102 steady state limits of voltage and frequency for three phase, variable frequency utilization equipment.

Test Condition	Parameters								Performance
	Phase	Voltage		Frequency		Time Duration at Test Condition		Re-Start (Yes/No)	Pass/Fail
A	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
B	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
C	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
D	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
E	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
F	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
G	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						

TABLE TVF102-III. Sample data sheet for TVF102 steady state limits of voltage and frequency for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters								Performance
	Phase	Voltage		Frequency		Time Duration at Test Condition		Re-Start (Yes/No)	Pass/Fail
H	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
I	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
J	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
K	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
L	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
M	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
N	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
O	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						

TABLE TVF102-III. Sample data sheet for TVF102 steady state limits of voltage and frequency for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters								Performance
	Phase	Voltage		Frequency		Time Duration at Test Condition		Re-Start (Yes/No)	Pass/Fail
P	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
Q	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
R	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
S	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
T	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
U	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
V	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
W	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						

TABLE TVF102-III. Sample data sheet for TVF102 steady state limits of voltage and frequency for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters								Performance
	Phase	Voltage		Frequency		Time Duration at Test Condition		Re-Start (Yes/No)	Pass/Fail
X	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
Y	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
Z	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
AA	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
BB	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
CC	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
DD	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
EE	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						

TABLE TVF102-III. Sample data sheet for TVF102 steady state limits of voltage and frequency for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters								Performance
	Phase	Voltage		Frequency		Time Duration at Test Condition		Re-Start (Yes/No)	Pass/Fail
FF	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
GG	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
HH	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
II	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
JJ	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
KK	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
LL	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
MM	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						

TABLE TVF102-III. Sample data sheet for TVF102 steady state limits of voltage and frequency for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters								Performance
	Phase	Voltage		Frequency		Time Duration at Test Condition		Re-Start (Yes/No)	Pass/Fail
NN	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
OO	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
PP	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
QQ	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						
RR	A		V_{rms}		Hz		min		
	B		V_{rms}						
	C		V_{rms}						

METHOD TVF103
Voltage Phase Difference

POWER GROUP: Three Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Voltage Phase Difference

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when provided voltages having phase angles within the limits specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when provided voltages having phase angles at the limits of the applicable edition(s) of MIL-STD-704 and as noted in table TVF103-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate and should be, not less than thirty (30) minutes for each of the test conditions. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TVF103-I. MIL-STD-704 limits for voltage phase difference for three phase variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Voltage Phase Difference	N/A	N/A	N/A	N/A	N/A	116^o to 124^o

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Phase angle meter

4. Test setup. Configure the test setup as shown in figure TVF103-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TVF103-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the

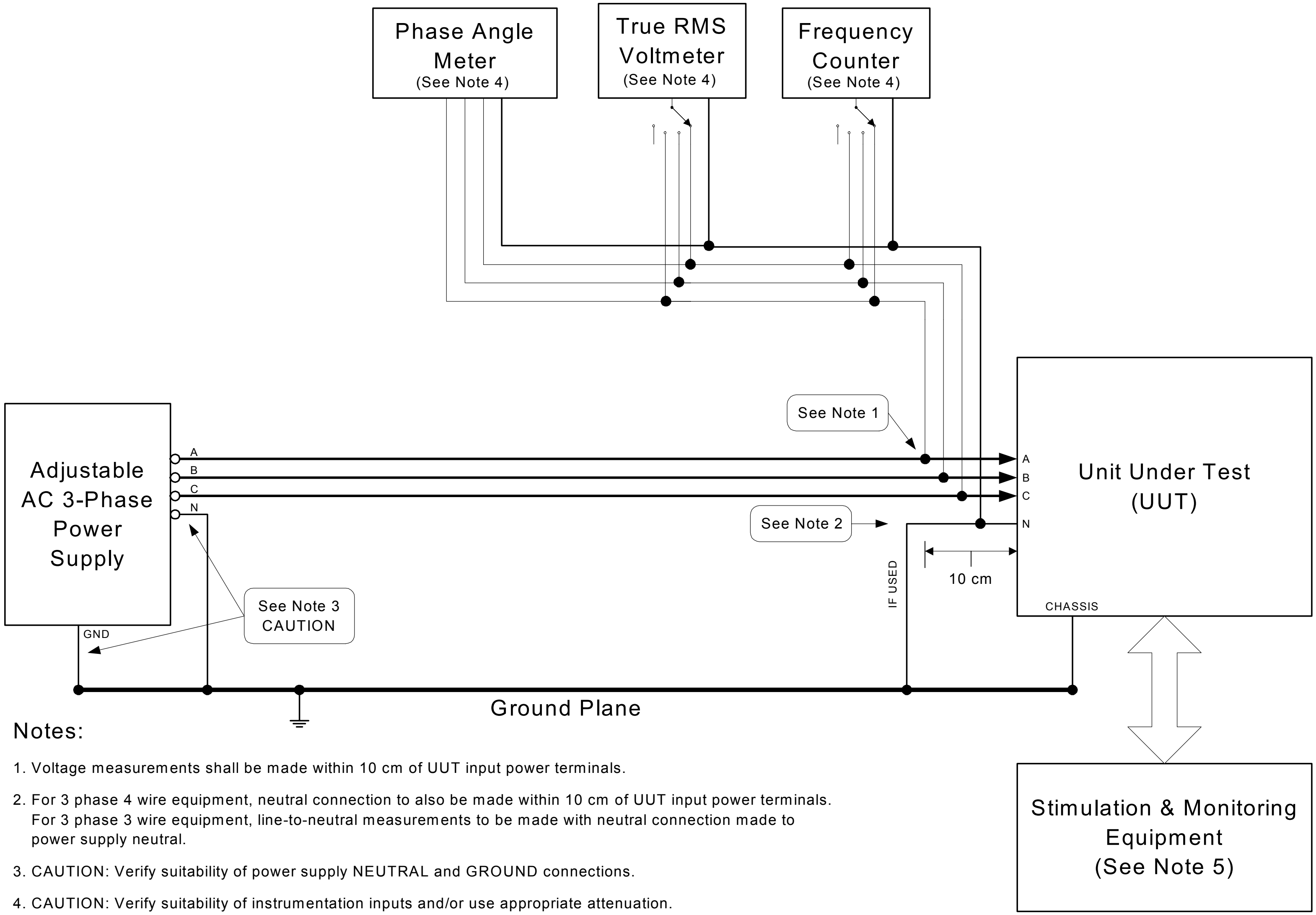
frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A and B noted in table TVF103-II, the UUT must remain for a length of time that confirms the utilization equipment can continuously operate with voltage phase differences and should be, not less than thirty (30) minutes. The phase angles are referenced to Van. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltages, frequency, phase angles, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table TVF103-III. Repeat for each mode of operation of the UUT. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Adjust the phase angles to Van 0°, Vbn 120°, and Vcn 240°. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TVF103-II. Test conditions for voltage phase difference for three phase, variable frequency utilization equipment.

Test Condition	Voltage Phase Angle Van	Voltage Phase Angle Vbn	Voltage Phase Angle Vcn
A	0°	116°	240°
B	0°	124°	240°



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TVF103-1. Voltage phase difference.

TABLE TVF103-III. Sample data sheet for TVF103 voltage phase difference for three phase, variable frequency utilization equipment.

Test Condition	Parameters										Performance
	Phase	Voltage		Frequency		Phase Angle			Time Duration at Test Condition		Pass/Fail
Test performed at **400 Hz** steady state frequency											
A	A		V_{rms}		Hz	Van		°		min	
	B		V_{rms}			Vbn		°			
	C		V_{rms}			Vcn		°			
B	A		V_{rms}		Hz	Van		°		min	
	B		V_{rms}			Vbn		°			
	C		V_{rms}			Vcn		°			
Test performed at **360 Hz** steady state frequency											
A	A		V_{rms}		Hz	Van		°		min	
	B		V_{rms}			Vbn		°			
	C		V_{rms}			Vcn		°			
B	A		V_{rms}		Hz	Van		°		min	
	B		V_{rms}			Vbn		°			
	C		V_{rms}			Vcn		°			
Test performed at **600 Hz** steady state frequency											
A	A		V_{rms}		Hz	Van		°		min	
	B		V_{rms}			Vbn		°			
	C		V_{rms}			Vcn		°			
B	A		V_{rms}		Hz	Van		°		min	
	B		V_{rms}			Vbn		°			
	C		V_{rms}			Vcn		°			

TABLE TVF103-III. Sample data sheet for TVF103 voltage phase difference for three phase, variable frequency utilization equipment.- Continued

Test Condition	Parameters										Performance
	Phase	Voltage		Frequency		Phase Angle			Time Duration at Test Condition		Pass/Fail
Test performed at **800 Hz** steady state frequency											
A	A		V_{rms}		Hz	Van		°		min	
	B		V_{rms}			Vbn		°			
	C		V_{rms}			Vcn		°			
B	A		V_{rms}		Hz	Van		°		min	
	B		V_{rms}			Vbn		°			
	C		V_{rms}			Vcn		°			

METHOD TVF104
Voltage Modulation

POWER GROUP: Three Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Voltage Modulation

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to voltage modulation as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having voltage modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table TVF104-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage modulation. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TVF104-I. MIL-STD-704 limits for voltage modulation for three phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Voltage Modulation	N/A	N/A	N/A	N/A	N/A	2.5 Vrms max

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure TVF104-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TVF104-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization

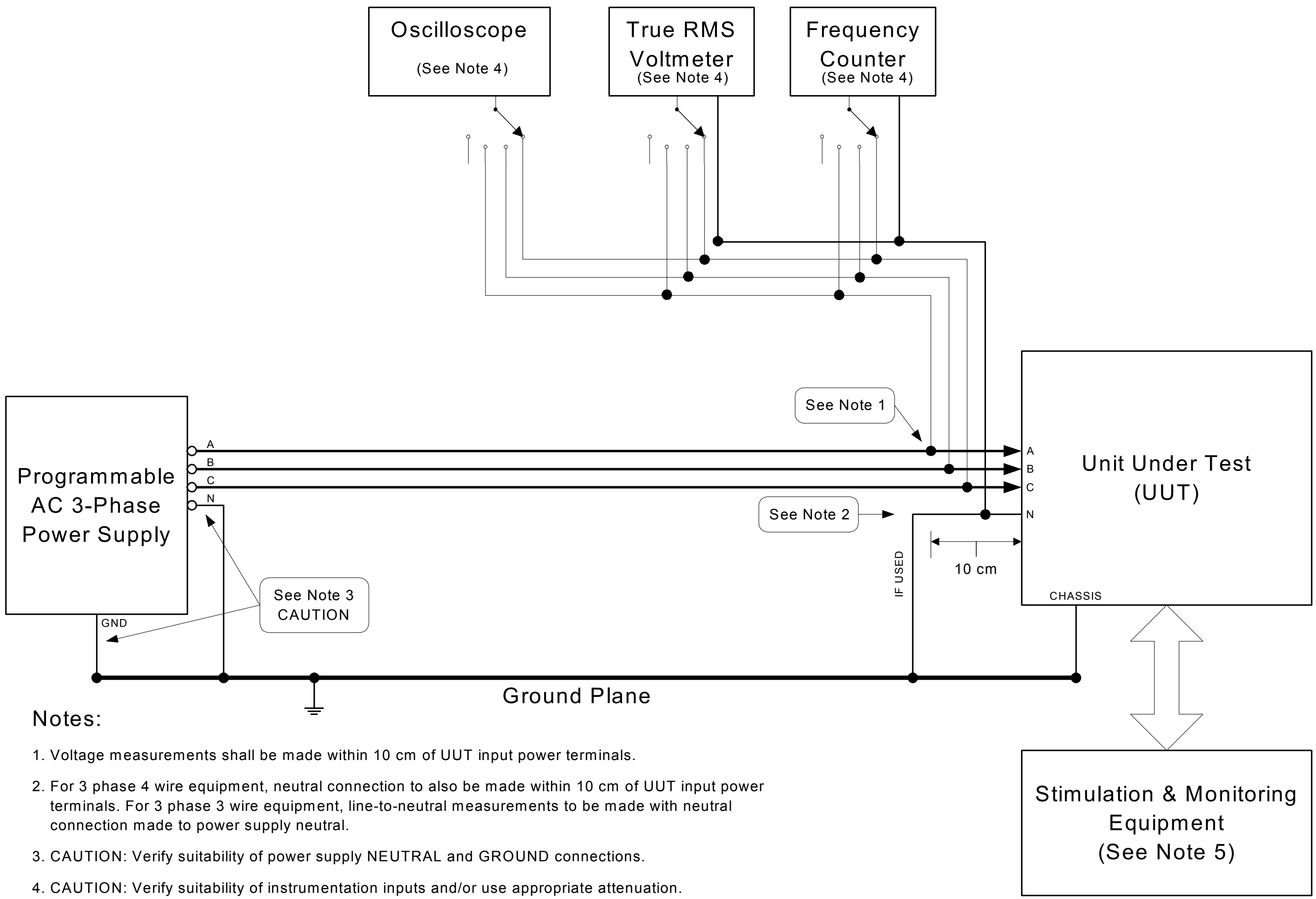
equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through G noted in table TVF104-II, set the voltage modulation amplitude and frequency of voltage modulation. The UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate, and should be at least ten (10) minutes at an average steady state voltage of 115 Vrms, at least ten (10) minutes at an average steady state voltage of 109.25 Vrms, and at least ten (10) minutes at an average steady state voltage of 116.75 Vrms. During the test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record average voltages, frequency, amplitude of voltage modulation, frequency of voltage modulation, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table TVF104-III. Repeat for each mode of operation of the UUT. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TVF104-II. Test conditions for voltage modulation for three phase, variable frequency utilization equipment.

Test Condition	Frequency of Voltage Modulation	MIL-STD-704F Amplitude of Voltage Modulation Vrms
A	1.0 Hz	0.375 Vrms
B	1.7 Hz	0.375 Vrms
C	10 Hz	2.5 Vrms
D	25 Hz	2.5 Vrms
E	70 Hz	0.375 Vrms
F	100 Hz	0.375 Vrms
G	200 Hz	0.375 Vrms



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TVF104-1. Voltage modulation.

TABLE TVF104-III. Sample data sheet for TVF104 voltage modulation for three phase, variable frequency utilization equipment.

Test Condition	Parameters						Performance
	Phase	Average Voltage	Frequency	Amplitude of Voltage Modulation	Frequency of Voltage Modulation	Time Duration at Test Condition	Pass/Fail
Test performed at **400 Hz** steady state frequency							
A-1	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		
A-2	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		
A-3	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		
B-1	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		
B-2	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		
B-3	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		
C-1	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		

TABLE TVF104-III. Sample data sheet for TVF104 voltage modulation for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Test Condition		Pass/Fail
Test performed at **400 Hz** steady state frequency												
C-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
C-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
D-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
D-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
D-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
E-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
E-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			

TABLE TVF104-III. Sample data sheet for TVF104 voltage modulation for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters						Performance
	Phase	Average Voltage	Frequency	Amplitude of Voltage Modulation	Frequency of Voltage Modulation	Time Duration at Test Condition	Pass/Fail
Test performed at **400 Hz** steady state frequency							
E-3	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		
F-1	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		
F-2	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		
F-3	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		
G-1	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		
G-2	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		
G-3	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		

TABLE TVF104-III. Sample data sheet for TVF104 voltage modulation for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Test Condition		Pass/Fail
Test performed at **360 Hz** steady state frequency												
A-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
A-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
A-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
B-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
B-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
B-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
C-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			

TABLE TVF104-III. Sample data sheet for TVF104 voltage modulation for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Test Condition		Pass/Fail
Test performed at **360 Hz** steady state frequency												
C-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
C-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
D-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
D-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
D-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
E-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
E-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			

TABLE TVF104-III. Sample data sheet for TVF104 voltage modulation for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance Pass/Fail
	Phase	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Test Condition		
Test performed at **360 Hz** steady state frequency												
E-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
F-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
F-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
F-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
G-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
G-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
G-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			

TABLE TVF104-III. Sample data sheet for TVF104 voltage modulation for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters						Performance
	Phase	Average Voltage	Frequency	Amplitude of Voltage Modulation	Frequency of Voltage Modulation	Time Duration at Test Condition	Pass/Fail
Test performed at **600 Hz** steady state frequency							
A-1	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		
A-2	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		
A-3	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		
B-1	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		
B-2	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		
B-3	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		
C-1	A	V_{rms}	Hz	V_{rms}	Hz	min	
	B	V_{rms}		V_{rms}	Hz		
	C	V_{rms}		V_{rms}	Hz		

TABLE TVF104-III. Sample data sheet for TVF104 voltage modulation for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Test Condition		Pass/Fail
Test performed at **600 Hz** steady state frequency												
C-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
C-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
D-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
D-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
D-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
E-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
E-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			

TABLE TVF104-III. <u>Sample data sheet for TVF104 voltage modulation for three phase, variable frequency utilization equipment</u>. - Continued

Test Condition	Parameters											Performance
	Phase	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Test Condition		Pass/Fail
Test performed at **600 Hz** steady state frequency												
E-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
F-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
F-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
F-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
G-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
G-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
G-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			

TABLE TVF104-III. Sample data sheet for TVF104 voltage modulation for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Test Condition		Pass/Fail
Test performed at **800 Hz** steady state frequency												
A-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
A-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
A-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
B-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
B-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
B-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
C-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			

TABLE TVF104-III. Sample data sheet for TVF104 voltage modulation for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Test Condition		Pass/Fail
Test performed at **800 Hz** steady state frequency												
C-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
C-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
D-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
D-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
D-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
E-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
E-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			

TABLE TVF104-III. Sample data sheet for TVF104 voltage modulation for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Test Condition		Pass/Fail
Test performed at **800 Hz** steady state frequency												
E-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
F-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
F-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
F-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
G-1	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
G-2	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			
G-3	A		V_{rms}		Hz		V_{rms}		Hz		min	
	B		V_{rms}				V_{rms}		Hz			
	C		V_{rms}				V_{rms}		Hz			

METHOD TVF105
Frequency Modulation

POWER GROUP:	Three Phase, Variable Frequency, 115 V
AIRCRAFT ELECTRICAL OPERATING CONDITION:	Normal
PARAMETER:	Frequency Modulation

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to frequency modulation as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having frequency modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table TVF105-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having frequency modulation and should be, not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TVF105-I. MIL-STD-704 limits for frequency modulation for three phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Frequency Modulation	N/A	N/A	N/A	N/A	N/A	4 Hz

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure TVF105-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TVF105-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization

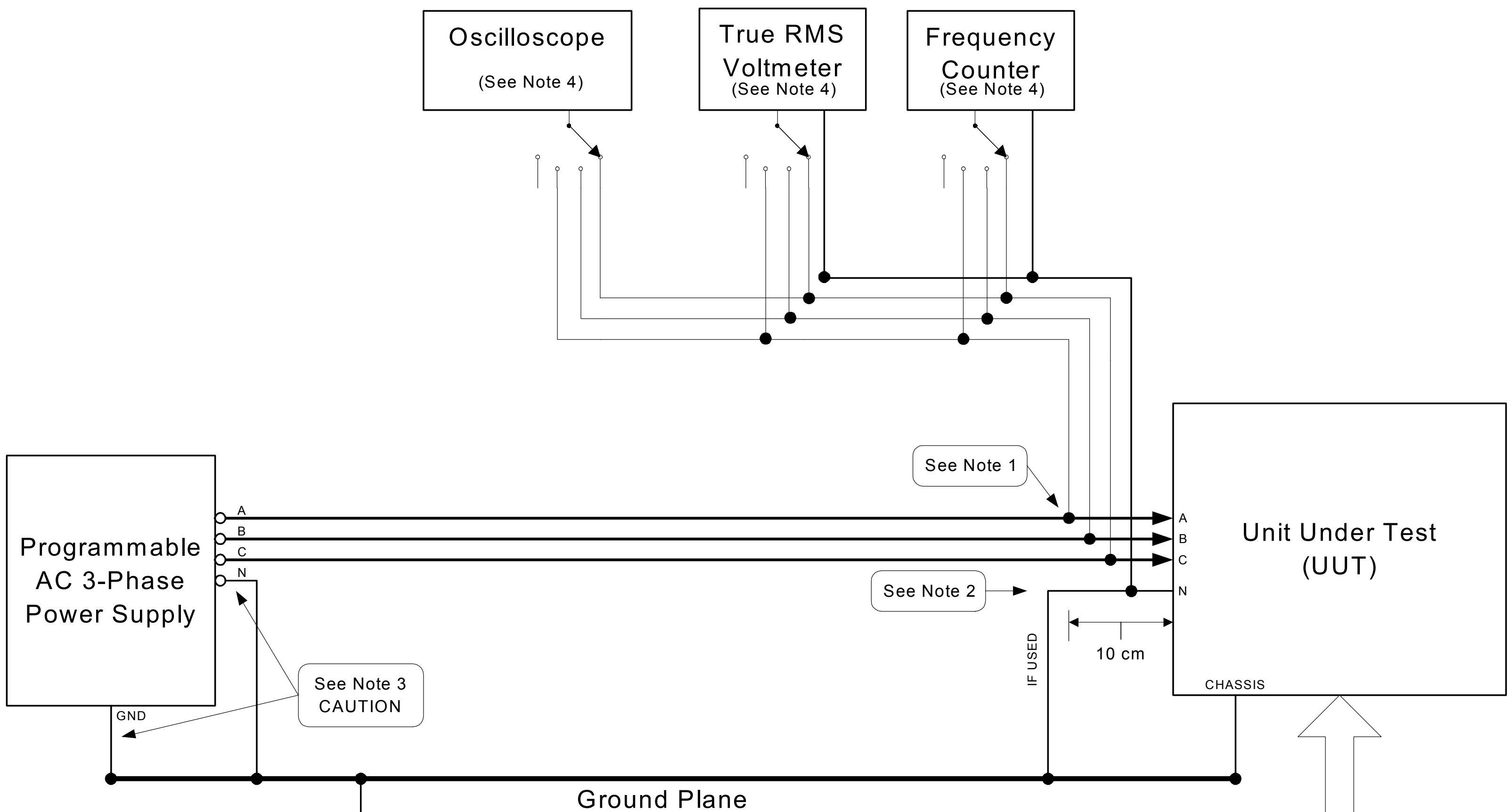
equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

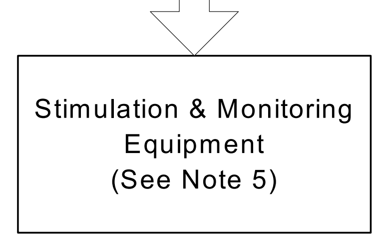
For each test condition A through E noted in table TVF105-II, set the amplitude of frequency modulation and rate of change for frequency modulation. The UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate, and should be at least thirty (30) minutes. At each test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record voltages, average frequency, amplitude of frequency modulation, rate of change for frequency modulation, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table TVF105-III. Repeat for each mode of operation of the UUT. Repeat the testing at an average frequency of 362 Hz, 600 Hz, and 798 Hz.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TVF105-II. Test conditions for frequency modulation for three phase, variable frequency utilization equipment.

Test Condition	Rate of change for frequency modulation	MIL-STD-704F Amplitude of Frequency Modulation
A	1 Hz/sec	4 Hz (± 2 Hz)
B	5 Hz/sec	4 Hz (± 2 Hz)
C	10 Hz/sec	4 Hz (± 2 Hz)
D	25 Hz/sec	4 Hz (± 2 Hz)
E	100 Hz/sec	4 Hz (± 2 Hz)





Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TVF105-1. Frequency modulation.

TABLE TVF105-III. Sample data sheet for TVF105 frequency modulation for three phase, variable frequency utilization equipment.

Test Condition	Parameters											Performance
	Phase	Voltage		Average Frequency		Amplitude of Frequency Modulation		Rate of change for frequency modulation		Time Duration at Test Condition		Pass/Fail
Testing performed at an average frequency of **400 Hz**												
A	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
B	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
C	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
D	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
E	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									

TABLE TVF105-III. Sample data sheet for TVF105 frequency modulation for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Voltage		Average Frequency		Amplitude of Frequency Modulation		Rate of change for frequency modulation		Time Duration at Test Condition		Pass/Fail
Testing performed at an average frequency of **362 Hz**												
A	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
B	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
C	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
D	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
E	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									

TABLE TVF105-III. Sample data sheet for TVF105 frequency modulation for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Voltage		Average Frequency		Amplitude of Frequency Modulation		Rate of change for frequency modulation		Time Duration at Test Condition		Pass/Fail
Testing performed at an average frequency of **600 Hz**												
A	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
B	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
C	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
D	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
E	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									

TABLE TVF105-III. Sample data sheet for TVF105 frequency modulation for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Voltage		Average Frequency		Amplitude of Frequency Modulation		Rate of change for frequency modulation		Time Duration at Test Condition		Pass/Fail
Testing performed at an average frequency of **798 Hz**												
A	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
B	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
C	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
D	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									
E	A		V_{rms}		Hz		± Hz		Hz/sec		min	
	B		V_{rms}									
	C		V_{rms}									

METHOD TVF106
Voltage Distortion Spectrum

POWER GROUP: Three Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Voltage Distortion Spectrum

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to voltage distortion of frequencies and amplitudes as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage distortions as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704 and as noted in table TVF106-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage distortion. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: This test method subjects the UUT to voltage distortion having frequencies components from 50 Hz to 10 kHz. These voltage distortions simulate voltage distortions within aircraft due to the cumulative effects of generators, electrical distribution systems equipments, and aircraft loads. MIL-STD-461, (Requirements For The Control of Electromagnetic Interference Characteristics of Subsystems and Equipment), Test Method CS101, (Conducted Susceptibility, Power Leads, 30 Hz to 150 kHz) is a complimentary test. Power levels of the voltage distortions differ for the two test methods. Performance of Test Method TVF106 of this handbook does not relinquish the requirement to perform test Method CS101 of MIL-STD-461, and performance of Method CS101 of MIL-STD-461 does not relinquish the requirement to perform Test Method TVF106 of this handbook.

TABLE TVF106-I. MIL-STD-704 limits for voltage distortion spectrum for three phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Voltage Distortion Spectrum	N/A	N/A	N/A	N/A	N/A	figure 7 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Adjustable AC power supply
b. Variable frequency power source
c. Coupling transformer
d. True RMS voltmeter
e. Frequency counter
f. Spectrum analyzer
g. (3) Inductors, 50 μH
h. (3) Capacitor, 10 μF
i. Resistor, calibrated load

4. Test setup. Configure the test setup as shown in figure TVF106-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

4.1. Calibration (50 Hz to 10 kHz). Install a calibrated resistive load in the test setup shown in figure TVF106-1 in place of the UUT. The calibrated resistive load must be sized to draw the same current as the UUT. Turn on the adjustable AC power supply and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Set the variable frequency power source to output a sine wave and adjust the frequency and amplitude so that the voltage distortion measured at the input to the calibrated resistive load conforms to each test condition A through H in table TVF106-II of the applicable edition(s) of MIL-STD-704. Record the settings of the variable frequency power source for each test condition. Repeat the calibration at steady state frequencies of 360 Hz, 600 Hz, and 800 Hz.

5. Compliance test. With the adjustable AC power supply off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TVF106-1. Figure TVF106-1 shows the coupling transformer installed in phase A. The test will be repeated with the coupling transformer installed in Phase B and Phase C. Turn on the adjustable AC power supply and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

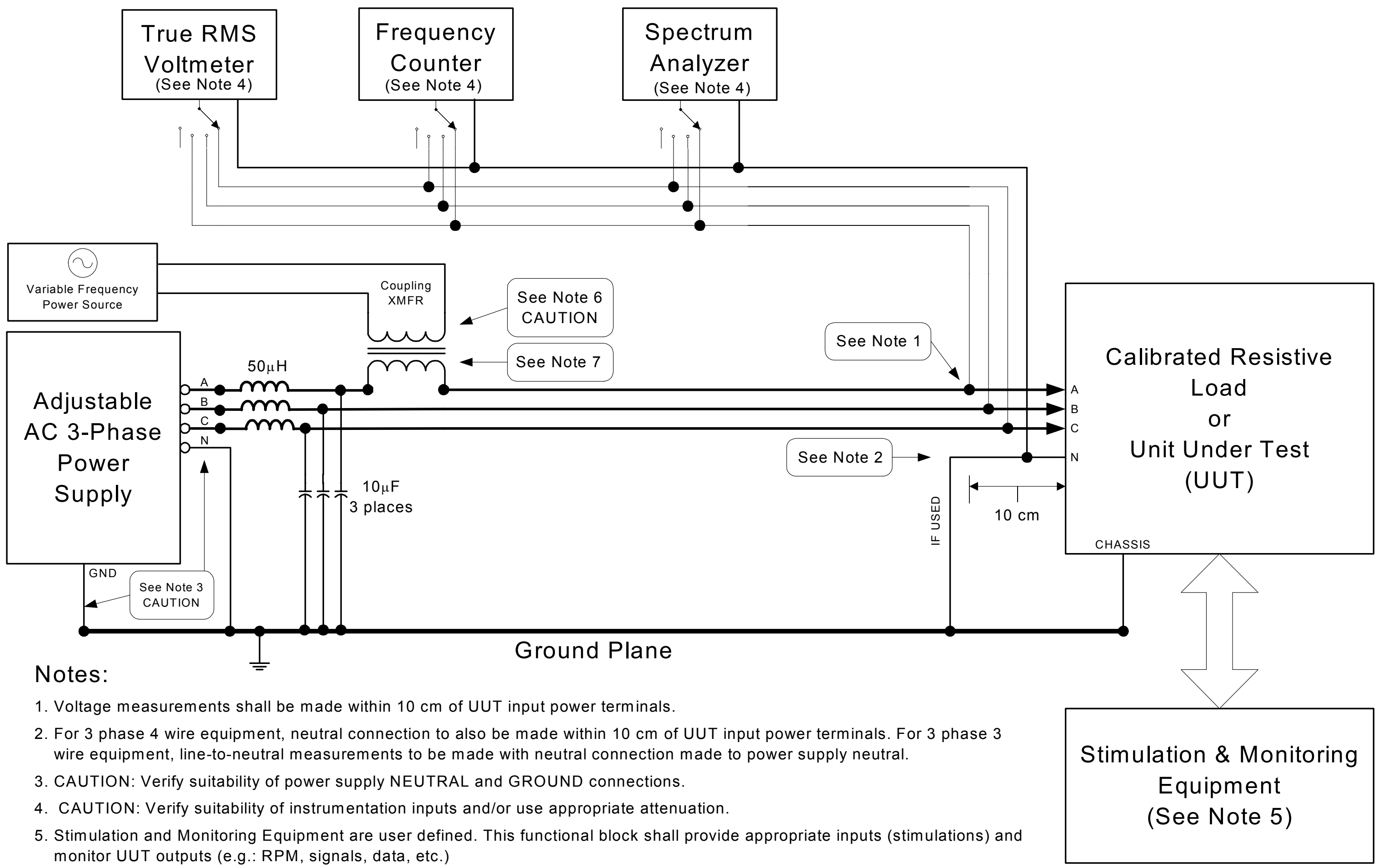
Set the variable frequency power source to the settings recorded for test condition A of the calibration procedure. For each test condition, remain for a length of time that confirms the utilization equipment can continuously operate with the voltage distortion and should be, not less than five (5) minutes. At each test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. After each test condition, monitor the voltage distortion frequency and amplitude while slowly increasing the variable frequency power source frequency and adjusting the amplitude until the next test condition is reached. Do not exceed the voltage distortion spectrum limits. Repeat for each test condition A through H noted in table TVF106-II. For each test condition, record the phase tested, voltage, frequency, frequency of voltage distortion, amplitude of voltage distortion, time duration at test condition, and the performance of the UUT in the data sheet shown in table TVF106-III. Repeat for each mode of operation of the UUT. Turn the adjustable AC power supply off, install the coupling transformer in phase B, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and the frequency to a steady state frequency of 400 Hz and repeat the testing for phase B. Turn the adjustable AC power supply off, install the coupling transformer in phase C, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and the frequency to a steady state frequency of 400 Hz and repeat the testing for Phase C. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

After all test conditions are complete, turn the adjustable AC power supply off and remove the coupling transformer from the circuit. Turn on the adjustable AC power supply. Adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TVF106-II. Test conditions for voltage distortion spectrum for three phase, variable frequency utilization equipment.

Test Condition	Frequency of Voltage Distortion	MIL-STD-704B C, D, E & F 1/ Amplitude of Voltage Distortion Voltage rms
A	50 Hz	0.316 Vrms
B	100 Hz	0.316 Vrms
C	500 Hz	1.580 Vrms
D	1 kHz	3.160 Vrms
E	2 kHz	3.160 Vrms
F	3 kHz	3.160 Vrms
G	5 kHz	1.900 Vrms
H	10 kHz	0.950 Vrms

1/. For utilization equipment being tested to MIL-STD-704 edition A, use MIL-STD-704B limits.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)
6. CAUTION: Verify suitability of variable frequency power source and coupling transformer for distortion spectrum testing.
7. Coupling Transformer shown is connected in series on Phase A. Testing is repeated with Coupling Transformer connected in series on Phase B and Phase C.

FIGURE TVF106-1. Normal operation - voltage distortion spectrum (50 Hz to 10 kHz).

TABLE TVF106-III. Sample data sheet for TVF106 voltage distortion spectrum for three phase, variable frequency utilization equipment.

Test Condition	Parameter											Performance
	Phase	Voltage		Frequency		Frequency of Voltage Distortion		Amplitude of Voltage Distortion		Time Duration at Test Condition		Pass/Fail
Testing performed at **400 Hz**												
	A											
A			V_{rms}		Hz		Hz		V_{rms}		min	
B			V_{rms}		Hz		Hz		V_{rms}		min	
C			V_{rms}		Hz		Hz		V_{rms}		min	
D			V_{rms}		Hz		kHz		V_{rms}		min	
E			V_{rms}		Hz		kHz		V_{rms}		min	
F			V_{rms}		Hz		kHz		V_{rms}		min	
G			V_{rms}		Hz		kHz		V_{rms}		min	
H			V_{rms}		Hz		kHz		V_{rms}		min	
Testing performed at **400 Hz**												
	B											
A			V_{rms}		Hz		Hz		V_{rms}		min	
B			V_{rms}		Hz		Hz		V_{rms}		min	
C			V_{rms}		Hz		Hz		V_{rms}		min	
D			V_{rms}		Hz		kHz		V_{rms}		min	
E			V_{rms}		Hz		kHz		V_{rms}		min	
F			V_{rms}		Hz		kHz		V_{rms}		min	
G			V_{rms}		Hz		kHz		V_{rms}		min	
H			V_{rms}		Hz		kHz		V_{rms}		min	

TABLE TVF106-III. Sample data sheet for TVF106 voltage distortion spectrum for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameter											Performance
	Phase	Voltage		Frequency		Frequency of Voltage Distortion		Amplitude of Voltage Distortion		Time Duration at Test Condition		Pass/Fail
Testing performed at **400 Hz**												
	C											
A			V_{rms}		Hz		Hz		V_{rms}		min	
B			V_{rms}		Hz		Hz		V_{rms}		min	
C			V_{rms}		Hz		Hz		V_{rms}		min	
D			V_{rms}		Hz		kHz		V_{rms}		min	
E			V_{rms}		Hz		kHz		V_{rms}		min	
F			V_{rms}		Hz		kHz		V_{rms}		min	
G			V_{rms}		Hz		kHz		V_{rms}		min	
H			V_{rms}		Hz		kHz		V_{rms}		min	

TABLE TVF106-III. Sample data sheet for TVF106 voltage distortion spectrum for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameter										Performance
	Phase	Voltage		Frequency		Frequency of Voltage Distortion		Amplitude of Voltage Distortion		Time Duration at Test Condition	Pass/Fail
Testing performed at **360 Hz**											
	A										
A			V_{rms}		Hz		Hz		V_{rms}		min	
B			V_{rms}		Hz		Hz		V_{rms}		min	
C			V_{rms}		Hz		Hz		V_{rms}		min	
D			V_{rms}		Hz		kHz		V_{rms}		min	
E			V_{rms}		Hz		kHz		V_{rms}		min	
F			V_{rms}		Hz		kHz		V_{rms}		min	
G			V_{rms}		Hz		kHz		V_{rms}		min	
H			V_{rms}		Hz		kHz		V_{rms}		min	
Testing performed at **360 Hz**											
	B										
A			V_{rms}		Hz		Hz		V_{rms}		min	
B			V_{rms}		Hz		Hz		V_{rms}		min	
C			V_{rms}		Hz		Hz		V_{rms}		min	
D			V_{rms}		Hz		kHz		V_{rms}		min	
E			V_{rms}		Hz		kHz		V_{rms}		min	
F			V_{rms}		Hz		kHz		V_{rms}		min	
G			V_{rms}		Hz		kHz		V_{rms}		min	
H			V_{rms}		Hz		kHz		V_{rms}		min	

TABLE TVF106-III. Sample data sheet for TVF106 voltage distortion spectrum for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameter											Performance
	Phase	Voltage		Frequency		Frequency of Voltage Distortion		Amplitude of Voltage Distortion		Time Duration at Test Condition		Pass/Fail
Testing performed at **360 Hz**												
	C											
A			V_{rms}		Hz		Hz		V_{rms}		min	
B			V_{rms}		Hz		Hz		V_{rms}		min	
C			V_{rms}		Hz		Hz		V_{rms}		min	
D			V_{rms}		Hz		kHz		V_{rms}		min	
E			V_{rms}		Hz		kHz		V_{rms}		min	
F			V_{rms}		Hz		kHz		V_{rms}		min	
G			V_{rms}		Hz		kHz		V_{rms}		min	
H			V_{rms}		Hz		kHz		V_{rms}		min	

TABLE TVF106-III. Sample data sheet for TVF106 voltage distortion spectrum for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameter										Performance
	Phase	Voltage		Frequency		Frequency of Voltage Distortion		Amplitude of Voltage Distortion		Time Duration at Test Condition	Pass/Fail
Testing performed at **600 Hz**											
	A										
A			V_{rms}		Hz		Hz		V_{rms}		min	
B			V_{rms}		Hz		Hz		V_{rms}		min	
C			V_{rms}		Hz		Hz		V_{rms}		min	
D			V_{rms}		Hz		kHz		V_{rms}		min	
E			V_{rms}		Hz		kHz		V_{rms}		min	
F			V_{rms}		Hz		kHz		V_{rms}		min	
G			V_{rms}		Hz		kHz		V_{rms}		min	
H			V_{rms}		Hz		kHz		V_{rms}		min	
Testing performed at **600 Hz**											
	B										
A			V_{rms}		Hz		Hz		V_{rms}		min	
B			V_{rms}		Hz		Hz		V_{rms}		min	
C			V_{rms}		Hz		Hz		V_{rms}		min	
D			V_{rms}		Hz		kHz		V_{rms}		min	
E			V_{rms}		Hz		kHz		V_{rms}		min	
F			V_{rms}		Hz		kHz		V_{rms}		min	
G			V_{rms}		Hz		kHz		V_{rms}		min	
H			V_{rms}		Hz		kHz		V_{rms}		min	

TABLE TVF106-III. Sample data sheet for TVF106 voltage distortion spectrum for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameter											Performance
	Phase	Voltage		Frequency		Frequency of Voltage Distortion		Amplitude of Voltage Distortion		Time Duration at Test Condition		Pass/Fail
Testing performed at **600 Hz**												
	C											
A			V_{rms}		Hz		Hz		V_{rms}		min	
B			V_{rms}		Hz		Hz		V_{rms}		min	
C			V_{rms}		Hz		Hz		V_{rms}		min	
D			V_{rms}		Hz		kHz		V_{rms}		min	
E			V_{rms}		Hz		kHz		V_{rms}		min	
F			V_{rms}		Hz		kHz		V_{rms}		min	
G			V_{rms}		Hz		kHz		V_{rms}		min	
H			V_{rms}		Hz		kHz		V_{rms}		min	

TABLE TVF106-III. Sample data sheet for TVF106 voltage distortion spectrum for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameter											Performance
	Phase	Voltage		Frequency		Frequency of Voltage Distortion		Amplitude of Voltage Distortion		Time Duration at Test Condition		Pass/Fail
Testing performed at **800 Hz**												
	A											
A			V_{rms}		Hz		Hz		V_{rms}		min	
B			V_{rms}		Hz		Hz		V_{rms}		min	
C			V_{rms}		Hz		Hz		V_{rms}		min	
D			V_{rms}		Hz		kHz		V_{rms}		min	
E			V_{rms}		Hz		kHz		V_{rms}		min	
F			V_{rms}		Hz		kHz		V_{rms}		min	
G			V_{rms}		Hz		kHz		V_{rms}		min	
H			V_{rms}		Hz		kHz		V_{rms}		min	
Testing performed at **800 Hz**												
	B											
A			V_{rms}		Hz		Hz		V_{rms}		min	
B			V_{rms}		Hz		Hz		V_{rms}		min	
C			V_{rms}		Hz		Hz		V_{rms}		min	
D			V_{rms}		Hz		kHz		V_{rms}		min	
E			V_{rms}		Hz		kHz		V_{rms}		min	
F			V_{rms}		Hz		kHz		V_{rms}		min	
G			V_{rms}		Hz		kHz		V_{rms}		min	
H			V_{rms}		Hz		kHz		V_{rms}		min	

TABLE TVF106-III. Sample data sheet for TVF106 voltage distortion spectrum for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameter											Performance
	Phase	Voltage		Frequency		Frequency of Voltage Distortion		Amplitude of Voltage Distortion		Time Duration at Test Condition		Pass/Fail
Testing performed at **800 Hz**												
	C											
A			V_{rms}		Hz		Hz		V_{rms}		min	
B			V_{rms}		Hz		Hz		V_{rms}		min	
C			V_{rms}		Hz		Hz		V_{rms}		min	
D			V_{rms}		Hz		kHz		V_{rms}		min	
E			V_{rms}		Hz		kHz		V_{rms}		min	
F			V_{rms}		Hz		kHz		V_{rms}		min	
G			V_{rms}		Hz		kHz		V_{rms}		min	
H			V_{rms}		Hz		kHz		V_{rms}		min	

METHOD TVF107
Total Voltage Distortion

POWER GROUP: Three Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Total Voltage Distortion

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to voltage waveforms having a distortion factor as specified by the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage waveforms having a distortion factor as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TVF107-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to distorted voltage waveforms and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TVF107-I. MIL-STD-704 limits for total voltage distortion for three phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Voltage Distortion Factor	N/A	N/A	N/A	N/A	N/A	0.05

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Spectrum analyzer
e. Distortion meter

4. Test setup. Configure the test setup as shown in figure TVF107-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

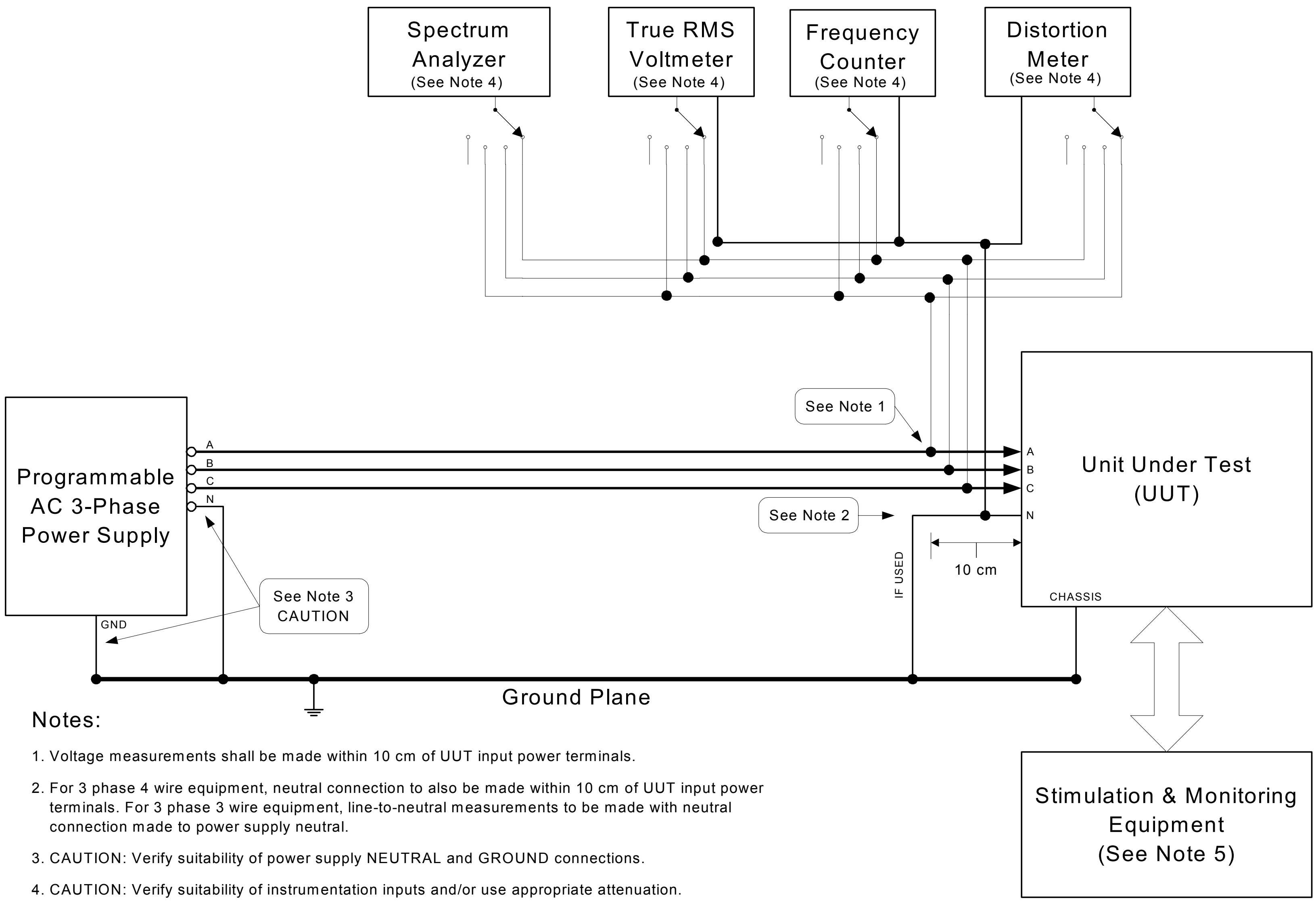
4.1 Calibration. Install a resistive load in the test setup shown in figure TVF107-1 in place of the UUT. The resistive load must be sized to draw the same current as the UUT. Set the programmable power supply to produce a voltage waveform having harmonic contents listed in table TVF107-II. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Confirm that the programmable power supply is producing a voltage waveform having harmonic content listed in table TVF107-II. Record the settings of the programmable power supply.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TVF107-1. Set the programmable power supply to the settings recorded during the calibration procedure. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. The UUT must remain for a length of time that confirms the utilization equipment can continuously operate with the total voltage distortion and should be not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltage, frequency, voltage distortion factor, voltage harmonics, time duration at test condition, and the performance of the UUT in the data sheet shown in table TVF107-III. Repeat for each mode of operation of the UUT. Repeat the testing at a fundamental frequency of 360 Hz, 600 Hz, and 800 Hz.

After all test conditions are complete, set the programmable power supply to produce sine waves for each of the three phases. Adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TVF107-II. Voltage harmonics as percent of fundamental for total voltage distortion test for three phase, variable frequency utilization equipment.

Harmonic	MIL-STD-704F Percent of Fundamental
Fundamental	100%
2nd	0%
3rd	2.75%
4th	0%
5th	2.75%
6th	0%
7th	1.97%
8th	0%
9th	1.53%
10th	0%
11th	1.25%
12th	0%
13th	1.06%
14th	0%
15th	0.92%



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TVF107-1. Total voltage distortion.

TABLE TVF107-III. Sample data sheet for TVF107 total voltage distortion for three phase, variable frequency utilization equipment.

Parameters									Performance
Phase	Voltage		Frequency		Voltage Distortion Factor		Time Duration at Test Condition		Pass/Fail
Testing performed at a fundamental frequency of **400 Hz**									
A		V_{rms}		Hz		No units		min	
B		V_{rms}				No units			
C		V_{rms}				No units			

Voltage Harmonics Phase A			Voltage Harmonics Phase B			Voltage Harmonics Phase C		
Fund		%	Fund		%	Fund		%
2nd		%	2nd		%	2nd		%
3rd		%	3rd		%	3rd		%
4th		%	4th		%	4th		%
5th		%	5th		%	5th		%
6th		%	6th		%	6th		%
7th		%	7th		%	7th		%
8th		%	8th		%	8th		%
9th		%	9th		%	9th		%
10th		%	10th		%	10th		%
11th		%	11th		%	11th		%
12th		%	12th		%	12th		%
13th		%	13th		%	13th		%
14th		%	14th		%	14th		%
15th		%	15th		%	15th		%

TABLE TVF107-III. Sample data sheet for TVF107 total voltage distortion for three phase, variable frequency utilization equipment. - Continued

Parameters									Performance
Phase	Voltage		Frequency		Voltage Distortion Factor		Time Duration at Test Condition		Pass/Fail
Testing performed at a fundamental frequency of **360 Hz**									
A		V_{rms}		Hz		No units		min	
B		V_{rms}				No units			
C		V_{rms}				No units			

Voltage Harmonics Phase A			Voltage Harmonics Phase B			Voltage Harmonics Phase C		
Fund		%	Fund		%	Fund		%
2^{nd}		%	2^{nd}		%	2^{nd}		%
3^{rd}		%	3^{rd}		%	3^{rd}		%
4^{th}		%	4^{th}		%	4^{th}		%
5^{th}		%	5^{th}		%	5^{th}		%
6^{th}		%	6^{th}		%	6^{th}		%
7^{th}		%	7^{th}		%	7^{th}		%
8^{th}		%	8^{th}		%	8^{th}		%
9^{th}		%	9^{th}		%	9^{th}		%
10^{th}		%	10^{th}		%	10^{th}		%
11^{th}		%	11^{th}		%	11^{th}		%
12^{th}		%	12^{th}		%	12^{th}		%
13^{th}		%	13^{th}		%	13^{th}		%
14^{th}		%	14^{th}		%	14^{th}		%
15^{th}		%	15^{th}		%	15^{th}		%

TABLE TVF107-III. Sample data sheet for TVF107 total voltage distortion for three phase, variable frequency utilization equipment. - Continued

Parameters									Performance
Phase	Voltage		Frequency		Voltage Distortion Factor		Time Duration at Test Condition		Pass/Fail
Testing performed at a fundamental frequency of **600 Hz**									
A		V_{rms}		Hz		No units		min	
B		V_{rms}				No units			
C		V_{rms}				No units			

Voltage Harmonics Phase A			Voltage Harmonics Phase B			Voltage Harmonics Phase C		
Fund		%	Fund		%	Fund		%
2nd		%	2nd		%	2nd		%
3rd		%	3rd		%	3rd		%
4th		%	4th		%	4th		%
5th		%	5th		%	5th		%
6th		%	6th		%	6th		%
7th		%	7th		%	7th		%
8th		%	8th		%	8th		%
9th		%	9th		%	9th		%
10th		%	10th		%	10th		%
11th		%	11th		%	11th		%
12th		%	12th		%	12th		%
13th		%	13th		%	13th		%
14th		%	14th		%	14th		%
15th		%	15th		%	15th		%

TABLE TVF107-III. Sample data sheet for TVF107 total voltage distortion for three phase, variable frequency utilization equipment. - Continued

Parameters									Performance
Phase	Voltage		Frequency		Voltage Distortion Factor		Time Duration at Test Condition		Pass/Fail
Testing performed at a fundamental frequency of **800 Hz**									
A		V_{rms}		Hz		No units		min	
B		V_{rms}				No units			
C		V_{rms}				No units			

Voltage Harmonics Phase A			Voltage Harmonics Phase B			Voltage Harmonics Phase C		
Fund		%	Fund		%	Fund		%
2^{nd}		%	2^{nd}		%	2^{nd}		%
3^{rd}		%	3^{rd}		%	3^{rd}		%
4^{th}		%	4^{th}		%	4^{th}		%
5^{th}		%	5^{th}		%	5^{th}		%
6^{th}		%	6^{th}		%	6^{th}		%
7^{th}		%	7^{th}		%	7^{th}		%
8^{th}		%	8^{th}		%	8^{th}		%
9^{th}		%	9^{th}		%	9^{th}		%
10^{th}		%	10^{th}		%	10^{th}		%
11^{th}		%	11^{th}		%	11^{th}		%
12^{th}		%	12^{th}		%	12^{th}		%
13^{th}		%	13^{th}		%	13^{th}		%
14^{th}		%	14^{th}		%	14^{th}		%
15^{th}		%	15^{th}		%	15^{th}		%

METHOD TVF108
DC Voltage Component

POWER GROUP: Three Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: DC Voltage Component

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TVF108-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to a direct current component of AC voltage and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TVF108-I. MIL-STD-704 limits for direct current component of AC voltage for three phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
DC Voltage Component of the AC Voltage	N/A	N/A	N/A	N/A	N/A	± 0.10 V

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter (with capability to measure DC component of AC waveform)
c. Frequency counter

4. Test setup. Configure the test setup as shown in figure TVF108-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

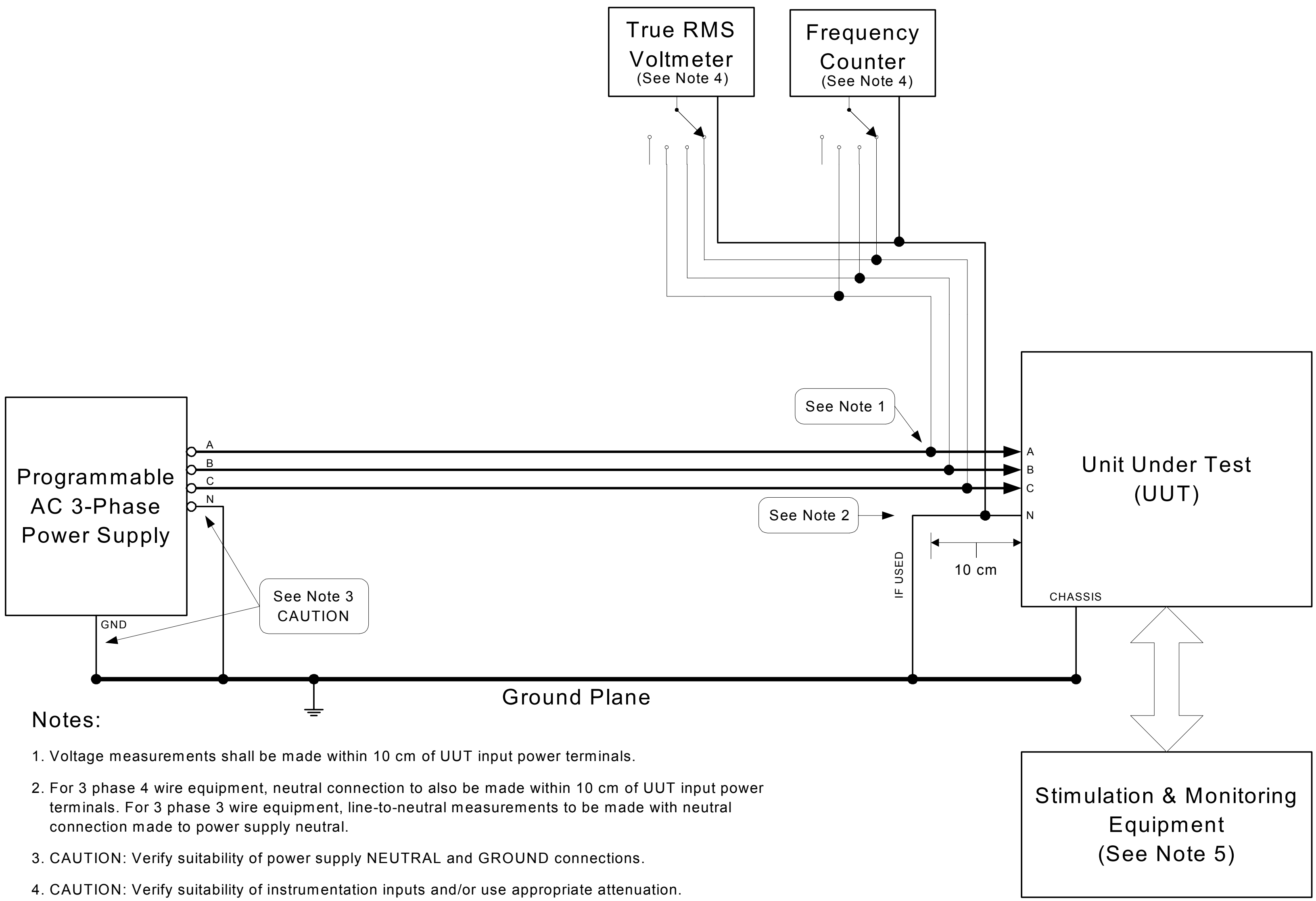
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TVF108-1. Set the programmable power

supply to produce voltage waveforms having a DC component on each of the three phases for test condition A as noted in table TVF108-II. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. The UUT must remain for a length of time that confirms the utilization equipment can continuously operate with the direct current component of the AC voltage and should be not less than thirty (30) minutes. Repeat the test for test condition B as noted in table TVF108-II. Record the voltages, frequency, DC voltage component, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table TVF108-III. Repeat for each mode of operation of the UUT. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

After all test conditions are complete, set the programmable power supply to produce voltage sine waves without a DC component. Adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TVF108-II. Test conditions for direct current component of AC voltage for three phase, variable frequency utilization equipment.

Test Condition	MIL-STD-704F Direct Current Component of AC Voltage
A	+ 0.10V
B	– 0.10 V



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TVF108-1. DC voltage component.

TABLE TVF108-III. Sample data sheet for TVF108 DC voltage component for three phase, variable frequency utilization equipment.

Test Condition	Parameters									Performance
	Phase	Voltage		Frequency		DC Voltage Component		Time Duration at Test Condition		Pass/Fail
Testing Performed at **400 Hz**										
A	A		V_{rms}		Hz		V_{dc}		min	
	B		V_{rms}				V_{dc}			
	C		V_{rms}				V_{dc}			
B	A		V_{rms}		Hz		V_{dc}		min	
	B		V_{rms}				V_{dc}			
	C		V_{rms}				V_{dc}			
Testing Performed at **360 Hz**										
A	A		V_{rms}		Hz		V_{dc}		min	
	B		V_{rms}				V_{dc}			
	C		V_{rms}				V_{dc}			
B	A		V_{rms}		Hz		V_{dc}		min	
	B		V_{rms}				V_{dc}			
	C		V_{rms}				V_{dc}			
Testing Performed at **600 Hz**										
A	A		V_{rms}		Hz		V_{dc}		min	
	B		V_{rms}				V_{dc}			
	C		V_{rms}				V_{dc}			
B	A		V_{rms}		Hz		V_{dc}		min	
	B		V_{rms}				V_{dc}			
	C		V_{rms}				V_{dc}			

TABLE TVF108-III. Sample data sheet for TVF108 DC voltage component for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters								Performance
	Phase	Voltage		Frequency		DC Voltage Component		Time Duration at Test Condition	Pass/Fail
Testing Performed at **800 Hz**									
A	A		V_{rms}		Hz		V_{dc}		min	
	B		V_{rms}				V_{dc}			
	C		V_{rms}				V_{dc}			
B	A		V_{rms}		Hz		V_{dc}		min	
	B		V_{rms}				V_{dc}			
	C		V_{rms}				V_{dc}			

METHOD TVF109
Normal Voltage Transients

POWER GROUP:	Three Phase, Variable Frequency, 115 V
AIRCRAFT ELECTRICAL OPERATING CONDITION:	Normal
PARAMETER:	Normal Voltage Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to normal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table TVF109-I. The utilization equipment must maintain specified performance during and after the voltage transients. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TVF109-I. MIL-STD-704 limits for normal voltage transients for three phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Normal Voltage Transients	N/A	N/A	N/A	N/A	N/A	figure 3 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure TVF109-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TVF109-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization

equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

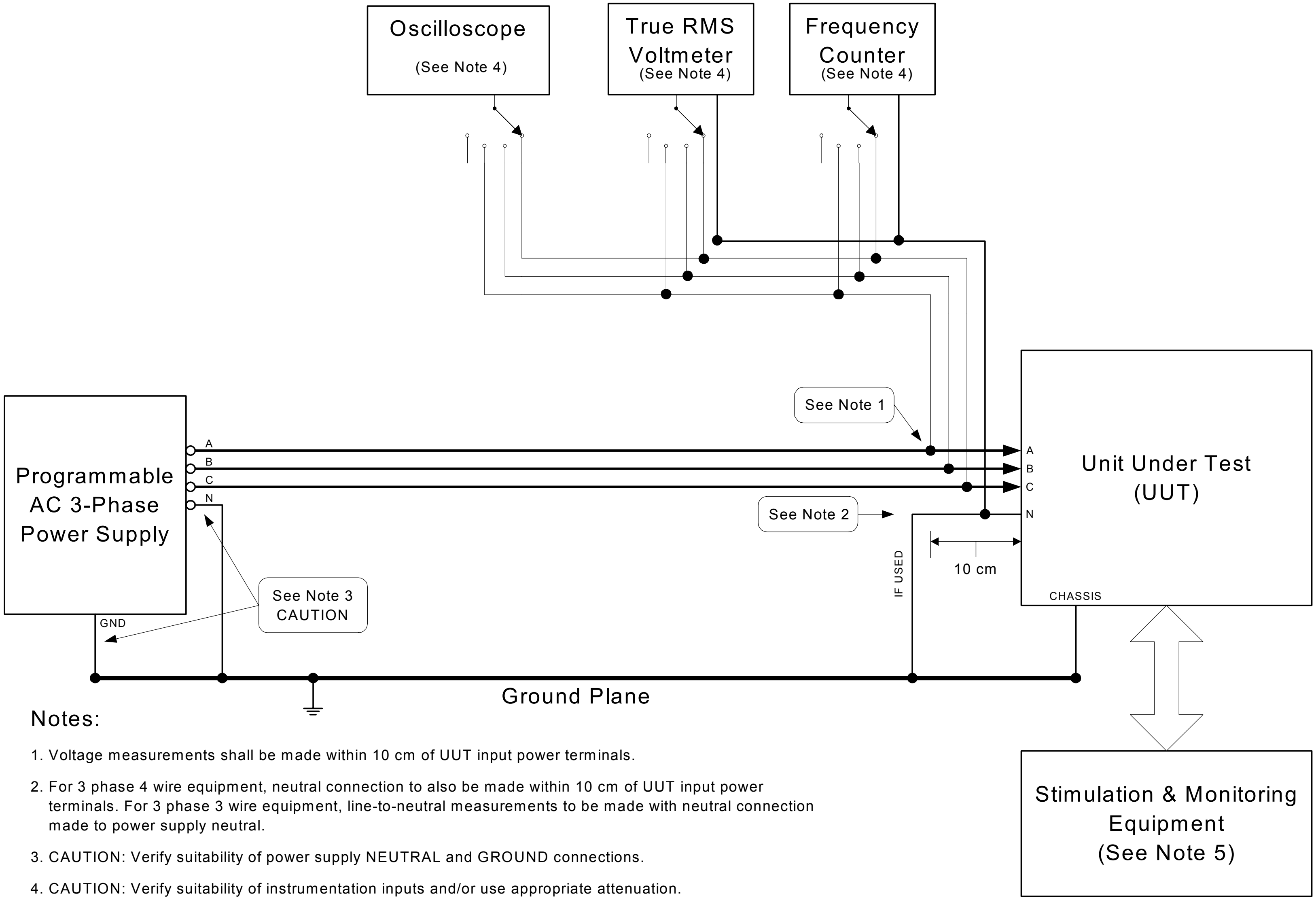
The UUT must be subjected to the voltage transients for each test condition A through M noted in table TVF109-II. The voltage must increase or decrease from steady state voltage to the voltage transient level within ½ cycle. The voltage must remain at the voltage transient level for the duration noted in table TVF109-II. The voltage must return to steady state over the time duration noted in table TVF109-II. For test condition G, three overvoltage transients of 180 Vrms for 10 milliseconds are performed, separated by 0.5 seconds. For test condition L, three undervoltage transients of 80 Vrms for 10 milliseconds are performed, separated by 0.5 seconds. For test condition M, an undervoltage transient of 80 Vrms for 10 milliseconds is immediately followed by an overvoltage transient of 180 Vrms for 10 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal steady state limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltages, steady state frequency, voltage transient level, time duration at voltage transient, oscilloscope trace, and the performance of the UUT for each test condition in the data sheet shown in table TVF109-III. Repeat for each mode of operation of the UUT. In addition perform the repetitive normal voltage transient test described below. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

5.1 Repetitive normal voltage transients test. Program the power supply to provide a continually repeating voltage transient that decreases from 115 Vrms to 90 Vrms in ½ cycle, then increases to 140 Vrms over 50 msec, then decreases to 115 Vrms over ½ cycle. The voltage transient is repeated every 0.5 seconds, see figure TVF109-2. The UUT must be subjected to the repetitive voltage transient for a length of time that confirms the utilization equipment can continuously operate and should be not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltages, steady state frequency, high voltage transient level, low voltage transient level, oscilloscope trace, time duration at test condition, and the performance of the UUT in the data sheet shown in table TVF109-III. Repeat for each mode of operation of the UUT. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TVF109-II. Test conditions for normal voltage transients for three phase, variable frequency utilization equipment.

Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage milliseconds
Overvoltage Transients				
A	< ½ cycle	140 Vrms	60 msec	< ½ cycle
B	< ½ cycle	140 Vrms	60 msec	25 msec
C	< ½ cycle	160 Vrms	34 msec	< ½ cycle
D	< ½ cycle	160 Vrms	34 msec	52 msec
E	< ½ cycle	180 Vrms	10 msec	< ½ cycle
F	< ½ cycle	180 Vrms	10 msec	77 msec
G	< ½ cycle	180 Vrms (3 times)	10 msec every 0.5 sec	< ½ cycle
Undervoltage Transients				
H	< ½ cycle	90 Vrms	35 msec	< ½ cycle
I	< ½ cycle	90 Vrms	35 msec	45 msec
J	< ½ cycle	80 Vrms	10 msec	< ½ cycle
K	< ½ cycle	80 Vrms	10 msec	70 msec
L	< ½ cycle	80 Vrms (3 times)	10 msec every 0.5 sec	< ½ cycle
Combined Transient				
M	< ½ cycle then < ½ cycle	80 Vrms 180 Vrms	10 msec 10 msec	< ½ cycle 77 msec



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TVF109-1. Normal voltage transients.

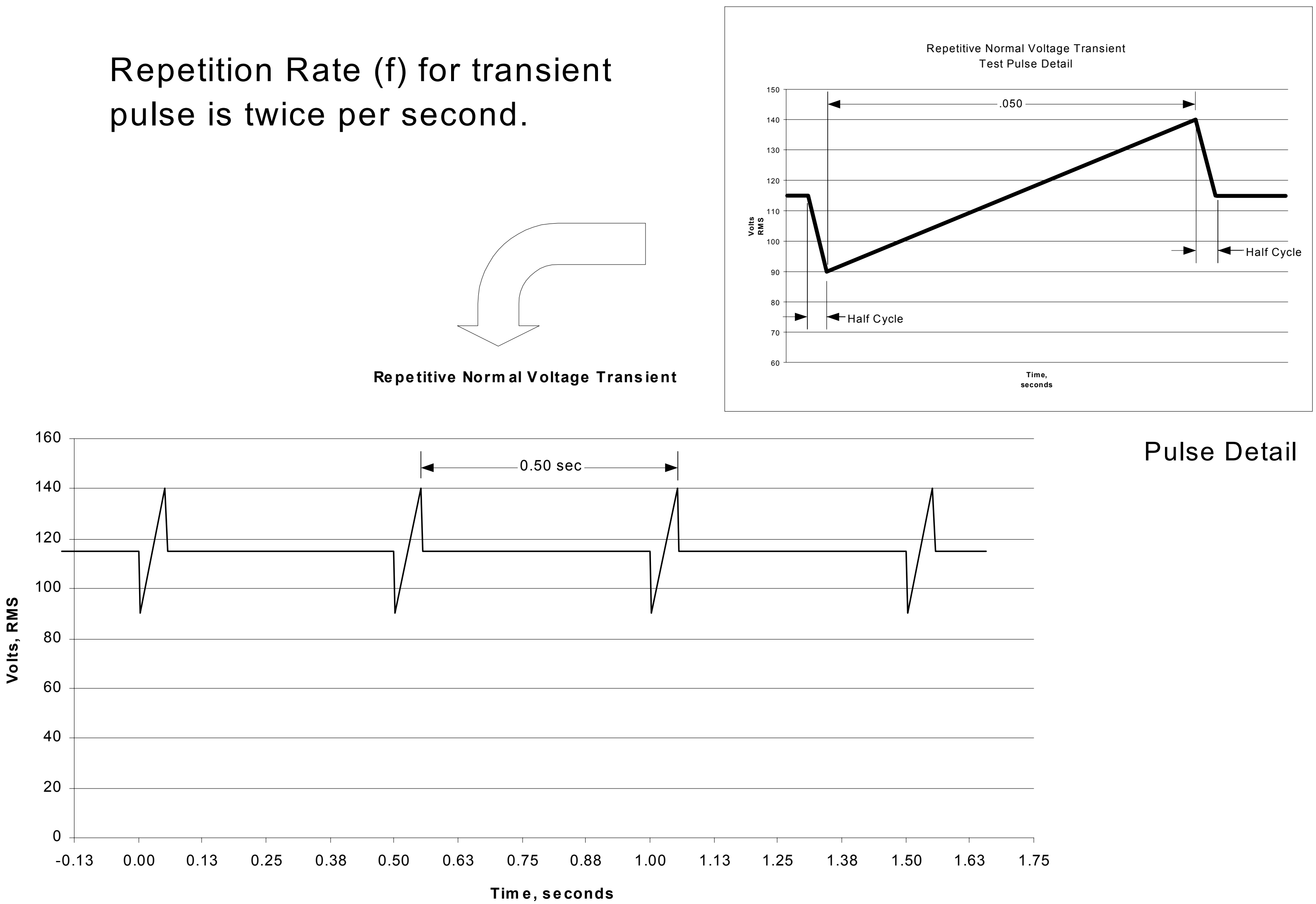


FIGURE TVF109-2. Repetitive Normal Voltage Transient.

TABLE TVF109-III. Sample data sheet for TVF109 normal voltage transients for three phase, variable frequency utilization equipment.

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing performed at **400 Hz**												
A	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
B	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
C	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
D	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
E	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
F	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
G	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			

TABLE TVF109-III. Sample data sheet for TVF109 normal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing performed at **400 Hz**												
H	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
I	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
J	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
K	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
L	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
M	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
	A						V_{rms}		msec			
	B						V_{rms}		msec			
	C						V_{rms}		msec			

TABLE TVF109-III. Sample data sheet for TVF109 normal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing performed at **400 Hz**												
Repetitive Transient	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
	A						V_{rms}		msec			
	B						V_{rms}		msec			
	C						V_{rms}		msec			
		Time duration at test condition									min	

TABLE TVF109-III. Sample data sheet for TVF109 normal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing performed at **360 Hz**												
A	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
B	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
C	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
D	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
E	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
F	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
G	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			

TABLE TVF109-III. Sample data sheet for TVF109 normal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters										Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace	Pass/Fail
Testing performed at **360 Hz**											
H	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
I	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
J	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
K	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
L	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
M	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
	A						V_{rms}		msec		
	B						V_{rms}		msec		
	C						V_{rms}		msec		

TABLE TVF109-III. Sample data sheet for TVF109 normal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing performed at **360 Hz**												
Repetitive Transient	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
	A						V_{rms}		msec			
	B						V_{rms}		msec			
	C						V_{rms}		msec			
		Time duration at test condition									min	

TABLE TVF109-III. Sample data sheet for TVF109 normal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters										Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace	Pass/Fail
Testing performed at **600 Hz**											
A	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace | V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
B	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace | V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
C	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace | V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
D	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace | V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
E	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace | V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
F	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace | V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
G	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace | V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		

TABLE TVF109-III. Sample data sheet for TVF109 normal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing performed at **600 Hz**												
H	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
I	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
J	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
K	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
L	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
M	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
	A						V_{rms}		msec			
	B						V_{rms}		msec			
	C						V_{rms}		msec			

TABLE TVF109-III. Sample data sheet for TVF109 normal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing performed at **600 Hz**												
Repetitive Transient	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
	A						V_{rms}		msec			
	B						V_{rms}		msec			
	C						V_{rms}		msec			
		Time duration at test condition									min	

TABLE TVF109-III. Sample data sheet for TVF109 normal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing performed at **800 Hz**												
A	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
B	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
C	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
D	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
E	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
F	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
G	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			

TABLE TVF109-III. Sample data sheet for TVF109 normal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing performed at **800 Hz**												
H	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
I	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
J	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
K	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
L	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
M	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
	A						V_{rms}		msec			
	B						V_{rms}		msec			
	C						V_{rms}		msec			

TABLE TVF109-III. Sample data sheet for TVF109 normal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing performed at **800 Hz**												
Repetitive Transient	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
	A						V_{rms}		msec			
	B						V_{rms}		msec			
	C						V_{rms}		msec			
		Time duration at test condition									min	

METHOD TVF110
Normal Frequency Transients

POWER GROUP: Three Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: Normal Frequency Transients

1. Scope

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to normal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to frequency transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table TVF110-I. The utilization equipment must maintain specified performance during and after the frequency transients. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TVF110-I. MIL-STD-704 limits for normal frequency transients for three phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Normal Frequency Transients	N/A	N/A	N/A	N/A	N/A	360 Hz to 800 Hz Maximum Rate of Change of Frequency 250 Hz/sec

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure TVF110-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

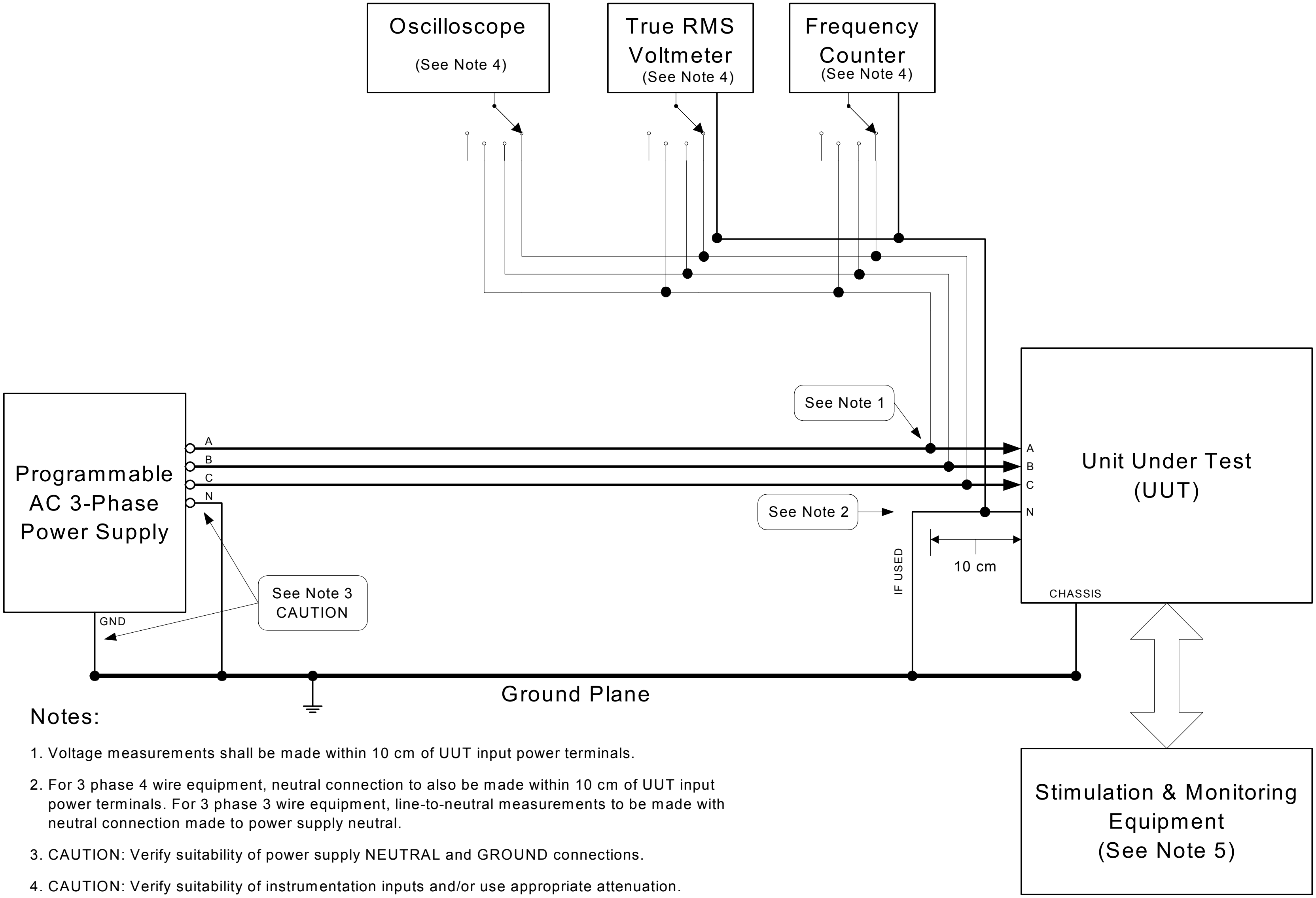
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TVF110-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

The UUT must be subjected to the frequency transients for each test condition A through I noted in table TVF110-II. The frequency must increase or decrease from the start frequency to the frequency transient level over the duration noted; the frequency must remain at the frequency transient level for the duration noted; and the frequency must return from the frequency transient level over the duration noted. For test condition I, an underfrequency transient is immediately followed by an overfrequency transient. For each test condition, monitoring the performance of the UUT during the frequency transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to the start frequency, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltages, start frequency, frequency transient level, time at frequency transient, oscilloscope trace (Hz vs time), and the performance of the UUT for each test condition in the data sheet shown in table TVF110-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TVF110-II. Test conditions for MIL-STD-704 normal frequency transients for three phase, variable frequency utilization equipment.

Test Condition	Start Frequency	Time From Start Frequency to Frequency Transient Level	Frequency Transient Level	Duration at Frequency Transient Level	Time From Frequency Transient Level to Start Frequency
Overfrequency Transients					
A	360 Hz	1.76 seconds	800 Hz	½ cycle	1.76 seconds
B	360 Hz	1.76 seconds	800 Hz	1second	1.76 seconds
C	360 Hz	0.96 seconds	600 Hz	½ cycle	0.96 seconds
D	360 Hz	0.96 seconds	600 Hz	1second	0.96 seconds
Underfrequency Transients					
E	800 Hz	1.76 seconds	360 Hz	½ cycle	1.76 seconds
F	800 Hz	1.76 seconds	360 Hz	1second	1.76 seconds
G	800 Hz	0.80 seconds	600 Hz	½ cycle	0.80 seconds
H	800 Hz	0.80 seconds	600 Hz	1second	0.80 seconds
Combined Transient					
I	600 Hz	0.96 seconds then 0.80 seconds	360 Hz 800 Hz	½ cycle ½ cycle	0.96 seconds 0.80 seconds



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TVF110-1. Normal frequency transients.

TABLE TVF110-III. Sample data sheet for TVF110 normal frequency transients for three phase, variable frequency utilization equipment.

Test Condition	Parameters										Performance
	Phase	Steady State Voltage		Start Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace	Pass/Fail
A	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs Time	
	B		V_{rms}									
	C		V_{rms}									
B	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs Time	
	B		V_{rms}									
	C		V_{rms}									
C	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs Time	
	B		V_{rms}									
	C		V_{rms}									
D	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs Time	
	B		V_{rms}									
	C		V_{rms}									
E	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs Time	
	B		V_{rms}									
	C		V_{rms}									
F	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs Time	
	B		V_{rms}									
	C		V_{rms}									
G	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs Time	
	B		V_{rms}									
	C		V_{rms}									

TABLE TVF110-III. Sample data sheet for TVF110 normal frequency transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Start Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace		Pass/Fail
H	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs Time	
	B		V_{rms}									
	C		V_{rms}									
I	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs Time	
	B		V_{rms}									
	C		V_{rms}									
							Hz		msec			

METHOD TVF201
Power Interrupt

POWER GROUP: Three Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Transfer Interrupt

PARAMETER: Power Interrupt

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to power interrupts as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for transfer aircraft electrical conditions when subjected to power interrupts as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TVF201-I. The utilization equipment must maintain the specified performance during power interrupts. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TVF201-I. MIL-STD-704 power transfer limits for three phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Power Interrupt	N/A	N/A	N/A	N/A	N/A	50 msec
Voltage NLSS	N/A	N/A	N/A	N/A	N/A	108 V
Voltage NHSS	N/A	N/A	N/A	N/A	N/A	118 V

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope
e. Resistive dummy load

4. Test setup. Configure the test setup as shown in figure TVF201-1. The dummy resistive load placed in parallel to the UUT should be sized to draw three times the steady state current of the

UUT up to a maximum of 25 kW dummy load. Note: This is done to ensure that the UUT test does not lose stored energy to other aircraft loads during power interrupts. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

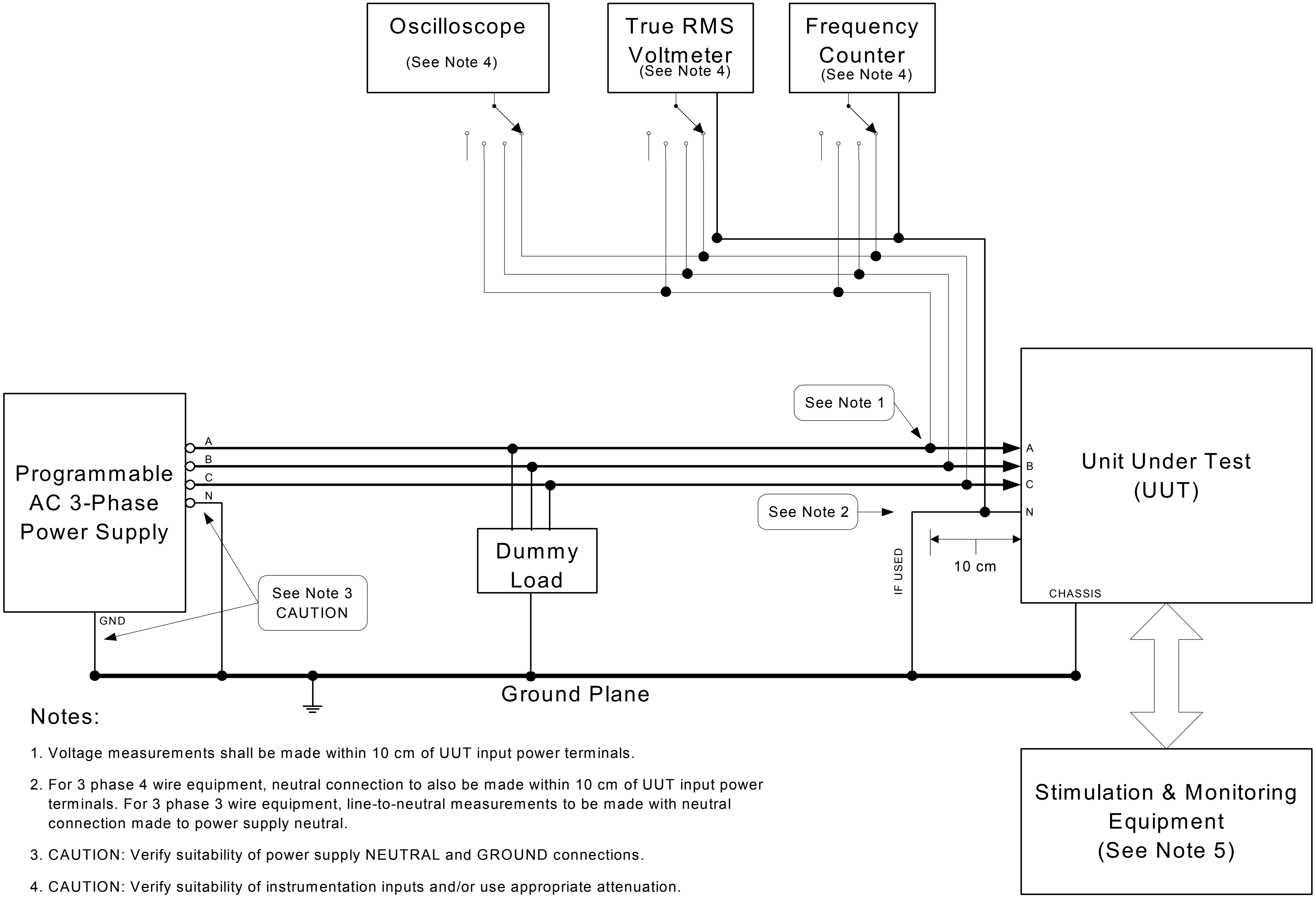
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TVF201-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through K noted in table TVF201-II, adjust the voltage to the steady state voltage listed. Perform a power interrupt (0 V) of the duration listed. The voltage must decrease from the steady state voltage to 0 Volts within ½ cycle, remain at 0 Volts for the duration listed for the test condition, and return from 0 Volts to the steady state voltage within ½ cycle. For test condition J, three 50 milliseconds power interrupts are performed, separated by 0.5 second. For test condition K a normal overvoltage transient follows the power interrupt. The normal voltage transient is 160 Vrms for 30 milliseconds and returns to nominal voltage over the next 40 milliseconds. For test condition L a normal undervoltage transient follows the power interrupt. The normal voltage transient is 70 Vrms for 30 milliseconds and returns to nominal voltage over the next 40 milliseconds. For each test condition, monitor the performance of the UUT according to the utilization equipment performance test procedures for power transfer operation to verify that the UUT is providing specified performance for transfer aircraft electrical conditions. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing the performance specified for normal aircraft electrical conditions (if the UUT is allowed degraded performance during power interrupts, verify the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage). Record the steady state voltages, steady state frequency, time duration of power interrupts, and the performance of the UUT for each test condition in the data sheet shown in table TVF201-III. Repeat each test condition 5 times. Repeat for each mode of operation of the UUT. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TVF201-II. Test conditions for transfer interrupt for three phase, variable frequency utilization equipment.

Test Condition	Steady State Voltage	Duration of Interrupt
A	Nominal Voltage	50 msec
B	NLSS Voltage	50 msec
C	NHSS Voltage	50 msec
D	Nominal Voltage	30 msec
E	NLSS Voltage	30 msec
F	NHSS Voltage	30 msec
G	Nominal Voltage	10 msec
H	NLSS Voltage	10 msec
I	NHSS Voltage	10 msec
J	Nominal Voltage	50 msec (repeated 3 times, separated by 0.5 sec)
K	Nominal Voltage	50 msec (followed by a normal voltage transient of 160 Vrms for 30 msec and return to steady state voltage in 40 msec)
L	Nominal Voltage	50 msec (followed by a normal voltage transient of 70 Vrms for 30 msec and return to steady state voltage in 40 msec)



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TVF201-1. Power interrupt.

TABLE TVF201-III. Sample data sheet for TVF201 power interrupt for three phase, variable frequency utilization equipment.

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration of Power Interrupt		Pass/Fail
Testing performed at **400 Hz**								
A	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
B	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
C	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
D	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
E	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
F	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
G	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	

TABLE TVF201-III. Sample data sheet for TVF201 power interrupt for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration of Power Interrupt		Pass/Fail
Testing performed at **400 Hz**								
H	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
I	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
J	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
K	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
	Voltage Transient Level					Time at Voltage Transient Level		
	A		V_{rms}				msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	

TABLE TVF201-III. Sample data sheet for TVF201 power interrupt for three phase, variable frequency utilization equipment. - Continued

<table>
<tr><th rowspan="2">Test Condition</th><th colspan="7">Parameter</th><th>Performance</th></tr>
<tr><th>Phase</th><th colspan="2">Voltage</th><th colspan="2">Frequency</th><th colspan="2">Time Duration of Power Interrupt</th><th>Pass/Fail</th></tr>
<tr><td colspan="9">Testing performed at 400 Hz</td></tr>
<tr><td rowspan="10">L</td><td>A</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td rowspan="10"></td></tr>
<tr><td>B</td><td></td><td>V_{rms}</td><td colspan="2" rowspan="2"></td><td></td><td>msec</td></tr>
<tr><td>C</td><td></td><td>V_{rms}</td><td></td><td>msec</td></tr>
<tr><td colspan="3">Voltage Transient Level</td><td colspan="2" rowspan="4"></td><td colspan="2">Time at Voltage Transient Level</td></tr>
<tr><td>A</td><td></td><td>V_{rms}</td><td></td><td>msec</td></tr>
<tr><td>B</td><td></td><td>V_{rms}</td><td></td><td>msec</td></tr>
<tr><td>C</td><td></td><td>V_{rms}</td><td></td><td>msec</td></tr>
</table>

TABLE TVF201-III. Sample data sheet for TVF201 power interrupt for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration of Power Interrupt		Pass/Fail
Testing performed at **360 Hz**								
A	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
B	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
C	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
D	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
E	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
F	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
G	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	

TABLE TVF201-III. Sample data sheet for TVF201 power interrupt for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration of Power Interrupt		Pass/Fail
Testing performed at **360 Hz**								
H	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
I	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
J	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
K	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
	Voltage Transient Level					Time at Voltage Transient Level		
	A		V_{rms}				msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	

TABLE TVF201-III. Sample data sheet for TVF201 power interrupt for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration of Power Interrupt		Pass/Fail
Testing performed at **360 Hz**								
L	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
	Voltage Transient Level					Time at Voltage Transient Level		
	A		V_{rms}				msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	

TABLE TVF201-III. Sample data sheet for TVF201 power interrupt for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration of Power Interrupt		Pass/Fail
Testing performed at **600 Hz**								
A	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
B	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
C	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
D	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
E	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
F	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
G	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	

TABLE TVF201-III. Sample data sheet for TVF201 power interrupt for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration of Power Interrupt		Pass/Fail
Testing performed at **600 Hz**								
H	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
I	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
J	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
K	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
	Voltage Transient Level					Time at Voltage Transient Level		
	A		V_{rms}				msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	

TABLE TVF201-III. Sample data sheet for TVF201 power interrupt for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration of Power Interrupt		Pass/Fail
Testing performed at **600 Hz**								
L	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
	Voltage Transient Level					Time at Voltage Transient Level		
	A		V_{rms}				msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	

TABLE TVF201-III. Sample data sheet for TVF201 power interrupt for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration of Power Interrupt		Pass/Fail
Testing performed at **800 Hz**								
A	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
B	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
C	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
D	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
E	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
F	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
G	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	

TABLE TVF201-III. Sample data sheet for TVF201 power interrupt for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration of Power Interrupt		Pass/Fail
Testing performed at **800 Hz**								
H	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
I	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
J	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
K	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
	Voltage Transient Level					Time at Voltage Transient Level		
	A		V_{rms}				msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	

TABLE TVF201-III. Sample data sheet for TVF201 power interrupt for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration of Power Interrupt		Pass/Fail
Testing performed at **800 Hz**								
L	A		V_{rms}		Hz		msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	
	Voltage Transient Level					Time at Voltage Transient Level		
	A		V_{rms}				msec	
	B		V_{rms}				msec	
	C		V_{rms}				msec	

METHOD TVF301
Abnormal Steady State Limits for Voltage and Frequency

POWER GROUP: Three Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Abnormal

PARAMETER: Abnormal Steady State Limits for Voltage and Frequency

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, variable frequency power utilization equipment klkklk operates and maintains specified performance when provided power with voltage and frequency at the Abnormal Low Steady State (ALSS) limits and the Abnormal High Steady State (AHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when supplied input power of voltage and frequency at the specified abnormal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table TVF301-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the abnormal steady state voltage and frequency limits and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the abnormal steady state voltage and frequency limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TVF301-I. MIL-STD-704 abnormal limits for steady state voltage and frequency for three phase, variable frequency utilization equipment.

Abnormal Limit	704A	704B	704C	704D	704E	704F
Voltage ALSS	N/A	N/A	N/A	N/A	N/A	100 V
Voltage AHSS	N/A	N/A	N/A	N/A	N/A	125 V
Frequency ALSS	N/A	N/A	N/A	N/A	N/A	360 Hz
Frequency AHSS	N/A	N/A	N/A	N/A	N/A	800 Hz

3. Apparatus. The test equipment should be as follows:

a. Adjustable AC power supply
b. True RMS voltmeter
c. Frequency counter

4. Test setup. Configure the test setup as shown in figure TVF301-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

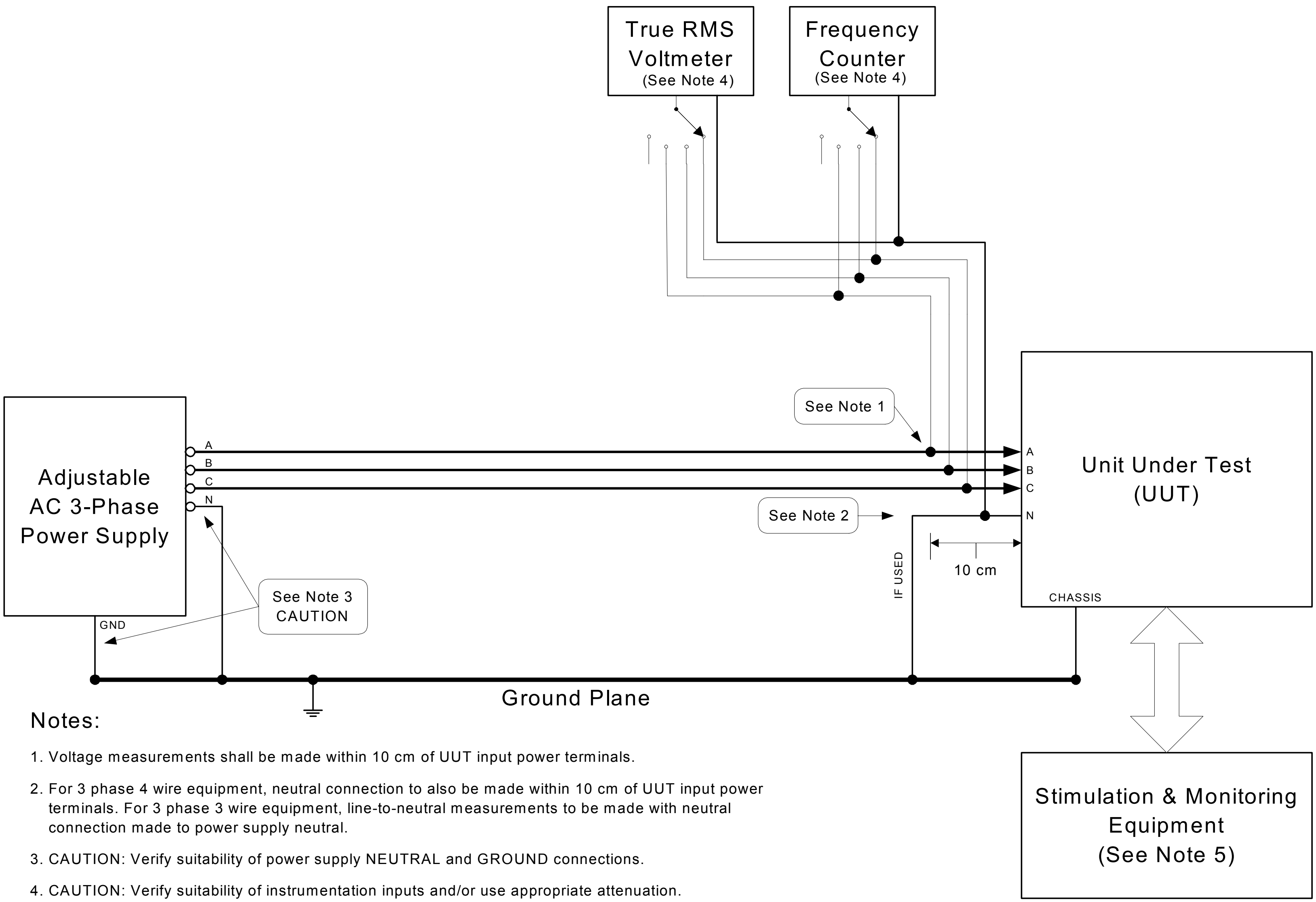
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TVF301-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through H noted in table TVF301-II, the UUT must remain for a length of time that confirms the utilization equipment can perform as specified at the abnormal steady state voltage and frequency limits and should be, not less than thirty (30) minutes. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. For each test condition shutdown the UUT and verify that the UUT can be re-started. After re-start conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Adjust the voltage to the nominal steady state voltage of 115 Vrms and adjust the frequency to the steady state frequency of the test condition. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the voltages, frequency, time duration at test condition, successful/unsuccessful re-start and the performance of the UUT for each test condition in the data sheet shown in table TVF301-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TVF301-II. Test conditions for abnormal steady state limits of voltage and frequency for three phase, variable frequency utilization equipment.

Test Condition	Voltage	Frequency
Balanced Voltages		
A	100 V	400 Hz
B	100 V	360 Hz
C	100 V	600 Hz
D	100 V	800 Hz
E	125 V	400 Hz
F	125 V	360 Hz
G	125 V	600 Hz
H	125 V	800 Hz



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TVF301-1. Abnormal steady state limits for voltage and frequency.

TABLE TVF301-III. Sample data sheet for TVF301 abnormal steady state limits for voltage and frequency for three phase, variable frequency utilization equipment.

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration at Test Condition		Pass/Fail
A	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
B	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
C	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
D	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
E	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
F	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					

TABLE TVF301-III. Sample data sheet for TVF301 abnormal steady state limits for voltage and frequency for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameter							Performance
	Phase	Voltage		Frequency		Time Duration at Test Condition		Pass/Fail
G	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
H	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					

METHOD TVF302
Abnormal Voltage Transients

POWER GROUP: Three Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Abnormal

PARAMETER: Abnormal Voltage Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to abnormal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to voltage transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table TVF302-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TVF302-I. MIL-STD-704 limits for abnormal voltage transients for three phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Abnormal Voltage Transients	N/A	N/A	N/A	N/A	N/A	figure 4 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure TVF302-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TVF302-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the

frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

The UUT must be subjected to the voltage transients for each test condition A through O noted in table TVF302-II. The voltage must increase or decrease from steady state voltage to the voltage transient level within ½ cycle. The voltage must remain at the voltage transient level for the duration noted in table TVF302-II. The voltage must return to steady state over the time duration noted in table TVF302-II. For test condition G, three over-voltage transients of 180 Vrms for 20 milliseconds are performed, separated by 0.5 seconds. For test condition N, three under-voltage transients of 45 Vrms for 20 milliseconds are performed, separated by 0.5 seconds. For test condition O, an under-voltage transient of 45 Vrms for 20 milliseconds is immediately followed by an overvoltage transient of 180 Vrms for 50 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits, and has not suffered damage. Record the steady state voltages, steady state frequency, voltage transient level, time duration at voltage transient, oscilloscope trace, and the performance of the UUT for each test condition in the data sheet shown in table TVF302-III. Repeat for each mode of operation of the UUT. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

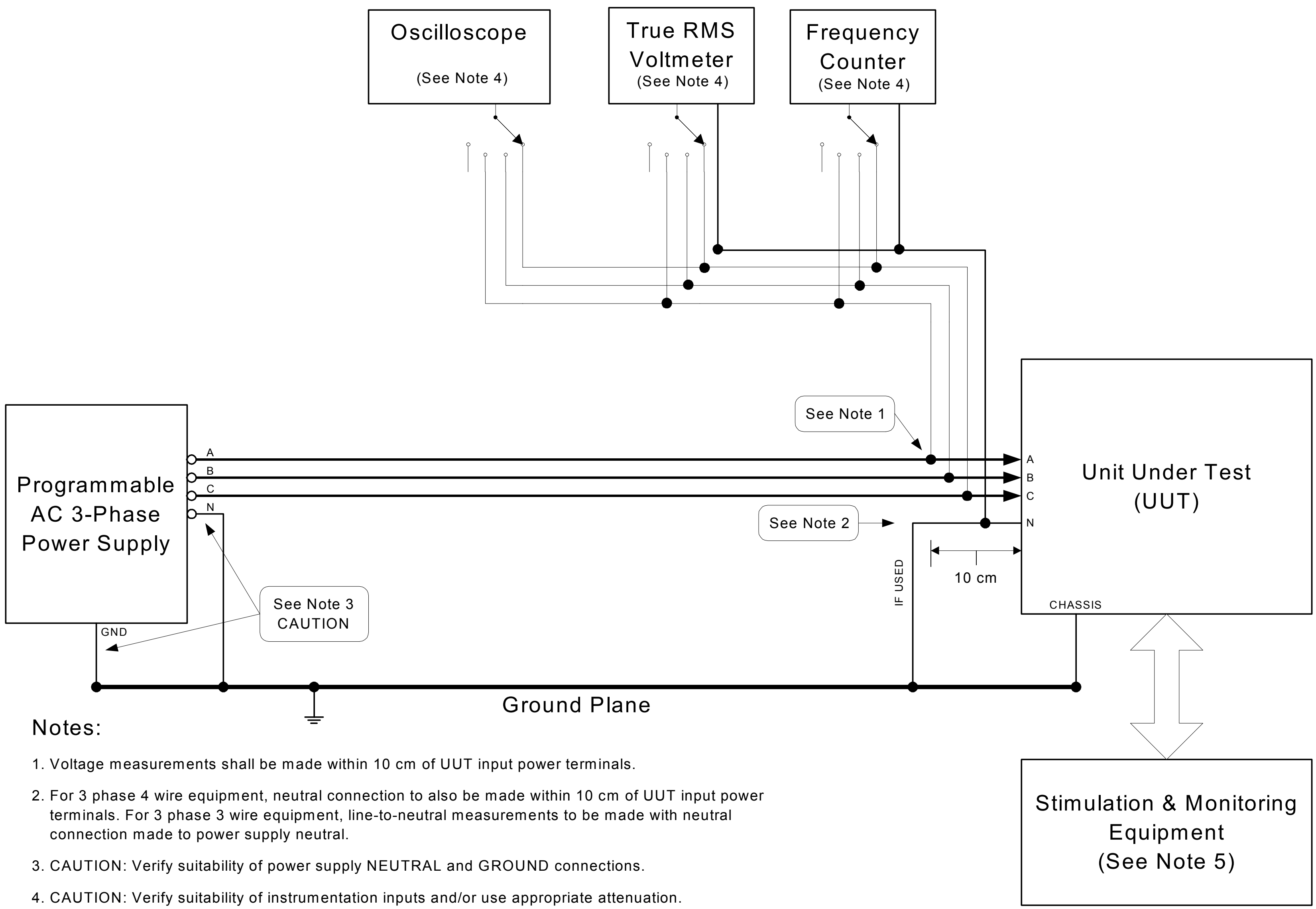
After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TVF302-II. Test conditions for abnormal voltage transients for three phase, variable frequency utilization equipment.

Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Overvoltage Transients				
A	< ½ cycle	140 Vrms	180 msec	< ½ cycle
B	< ½ cycle	140 Vrms	180 msec	87 msec
	then	135 Vrms	decreasing	253 msec
	then	130 Vrms	decreasing	6.41 sec
	then	125 Vrms	decreasing	>10 sec
		115 Vrms		
C	< ½ cycle	160 Vrms	78 msec	< ½ cycle
D	< ½ cycle	160 Vrms	78 msec	31 msec
	then	150 Vrms	decreasing	71 msec
	then	140 Vrms	decreasing	87 msec
	then	135 Vrms	decreasing	253 msec
	then	130 Vrms	decreasing	6.41 sec
	then	125 Vrms	decreasing	>10 sec
		115 Vrms		
E	< ½ cycle	180 Vrms	50 msec	< ½ cycle
F	< ½ cycle	180 Vrms	50 msec	11 msec
	then	170 Vrms	decreasing	17 msec
	then	160 Vrms	decreasing	31 msec
	then	150 Vrms	decreasing	71 msec
	then	140 Vrms	decreasing	87 msec
	then	135 Vrms	decreasing	253 msec
	then	130 Vrms	decreasing	6.41 sec
	then	125 Vrms	decreasing	>10 sec
		115 Vrms		
G	< ½ cycle	180 Vrms (3 times)	20 msec every 0.5 sec	< ½ cycle

TABLE TVF302-II. Test conditions for abnormal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Undervoltage Transients				
H	< ½ cycle	85 Vrms	180 msec	< ½ cycle
I	< ½ cycle	85 Vrms	180 msec	87 msec
	then	90 Vrms	increasing	253 msec
	then	95 Vrms	increasing	6.41 sec
	then	100 Vrms	increasing	>10 sec
		115 Vrms		
J	< ½ cycle	66 Vrms	78 msec	< ½ cycle
K	< ½ cycle	65 Vrms	78 msec	31 msec
	then	75 Vrms	increasing	71 msec
	then	85 Vrms	increasing	87 msec
	then	90 Vrms	increasing	253 msec
	then	95 Vrms	increasing	6.41 sec
	then	100 Vrms	increasing	>10 sec
		115 Vrms		
L	< ½ cycle	45 Vrms	50 msec	< ½ cycle
M	< ½ cycle	45 Vrms	50 msec	11 msec
	then	55 Vrms	increasing	17 msec
	then	65 Vrms	increasing	31 msec
	then	75 Vrms	increasing	71 msec
	then	85 Vrms	increasing	87 msec
	then	90 Vrms	increasing	253 msec
	then	95 Vrms	increasing	6.41 sec
	then	100 Vrms	increasing	>10 sec
		115 Vrms		
N	< ½ cycle	45 Vrms (3 times)	20 msec every 0.5 sec	< ½ cycle
Combined Transient				
O	< ½ cycle	45 Vrms then	20 msec	< ½ cycle
	< ½ cycle	180 Vrms	50 msec	11 msec
	then	170 Vrms	decreasing	17 msec
	then	160 Vrms	decreasing	31 msec
	then	150 Vrms	decreasing	71 msec
	then	140 Vrms	decreasing	87 msec
	then	135 Vrms	decreasing	253 msec
	then	130 Vrms	decreasing	6.41 sec
	then	125 Vrms	decreasing	>10 sec
		115 Vrms		



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TVF302-1. Abnormal voltage transients.

TABLE TVF302-III. Sample data sheet for TVF302 abnormal voltage transients for three phase, variable frequency utilization equipment.

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing Performed at **400 Hz**												
A	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
B	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
C	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
D	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
E	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
F	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
G	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			

TABLE TVF302-III. Sample data sheet for TVF302 abnormal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters						Performance
	Phase	Steady State Voltage	Steady State Frequency	Voltage Transient	Time at Voltage Transient Level	Oscilloscope Trace	Pass/Fail
Testing Performed at **400 Hz**							
H	A	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs Time	
	B	V_{rms}		V_{rms}	msec		
	C	V_{rms}		V_{rms}	msec		
I	A	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs Time	
	B	V_{rms}		V_{rms}	msec		
	C	V_{rms}		V_{rms}	msec		
J	A	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs Time	
	B	V_{rms}		V_{rms}	msec		
	C	V_{rms}		V_{rms}	msec		
K	A	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs Time	
	B	V_{rms}		V_{rms}	msec		
	C	V_{rms}		V_{rms}	msec		
L	A	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs Time	
	B	V_{rms}		V_{rms}	msec		
	C	V_{rms}		V_{rms}	msec		
M	A	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs Time	
	B	V_{rms}		V_{rms}	msec		
	C	V_{rms}		V_{rms}	msec		

TABLE TVF302-III. Sample data sheet for TVF302 abnormal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing Performed at **400 Hz**												
N	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
O	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
	A						V_{rms}		msec			
	B						V_{rms}		msec			
	C						V_{rms}		msec			
Testing Performed at **360 Hz**												
A	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
B	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
C	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
D	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			

TABLE TVF302-III. Sample data sheet for TVF302 abnormal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing Performed at **360 Hz**												
E	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
F	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
G	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
H	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
I	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
J	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
K	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			

TABLE TVF302-III. Sample data sheet for TVF302 abnormal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters										Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace	Pass/Fail
Testing Performed at **360 Hz**											
L	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
M	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
N	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
O	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
	A						V_{rms}		msec		
	B						V_{rms}		msec		
	C						V_{rms}		msec		
Testing Performed at **600 Hz**											
A	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		
B	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec		
	C		V_{rms}				V_{rms}		msec		

TABLE TVF302-III. Sample data sheet for TVF302 abnormal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing Performed at **600 Hz**												
C	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
D	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
E	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
F	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
G	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
H	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
I	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			

TABLE TVF302-III. Sample data sheet for TVF302 abnormal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing Performed at **600 Hz**												
J	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
K	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
L	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
M	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
N	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
O	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
	A						V_{rms}		msec			
	B						V_{rms}		msec			
	C						V_{rms}		msec			

TABLE TVF302-III. Sample data sheet for TVF302 abnormal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters						Performance
	Phase	Steady State Voltage	Steady State Frequency	Voltage Transient	Time at Voltage Transient Level	Oscilloscope Trace	Pass/Fail
Testing Performed at **800 Hz**							
A	A	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs Time	
	B	V_{rms}		V_{rms}	msec		
	C	V_{rms}		V_{rms}	msec		
B	A	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs Time	
	B	V_{rms}		V_{rms}	msec		
	C	V_{rms}		V_{rms}	msec		
C	A	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs Time	
	B	V_{rms}		V_{rms}	msec		
	C	V_{rms}		V_{rms}	msec		
D	A	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs Time	
	B	V_{rms}		V_{rms}	msec		
	C	V_{rms}		V_{rms}	msec		
E	A	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs Time	
	B	V_{rms}		V_{rms}	msec		
	C	V_{rms}		V_{rms}	msec		
F	A	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs Time	
	B	V_{rms}		V_{rms}	msec		
	C	V_{rms}		V_{rms}	msec		
G	A	V_{rms}	Hz	V_{rms}	msec	Attach Trace V_{rms} vs Time	
	B	V_{rms}		V_{rms}	msec		
	C	V_{rms}		V_{rms}	msec		

TABLE TVF302-III. Sample data sheet for TVF302 abnormal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing Performed at **800 Hz**												
H	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
I	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
J	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
K	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
L	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
M	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			

TABLE TVF302-III. Sample data sheet for TVF302 abnormal voltage transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Testing Performed at **800 Hz**												
N	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
O	A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs Time	
	B		V_{rms}				V_{rms}		msec			
	C		V_{rms}				V_{rms}		msec			
	A						V_{rms}		msec			
	B						V_{rms}		msec			
	C						V_{rms}		msec			

METHOD TVF303
Abnormal Frequency Transients

POWER GROUP: Three Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Abnormal

PARAMETER: Abnormal Frequency Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to abnormal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to frequency transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table TVF303-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TVF303-I. MIL-STD-704 limits for abnormal frequency transients for three phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Abnormal Frequency Transients	N/A	N/A	N/A	N/A	N/A	360 Hz to 800 Hz Maximum Rate of Change of Frequency 500 Hz/sec

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure TVF303-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

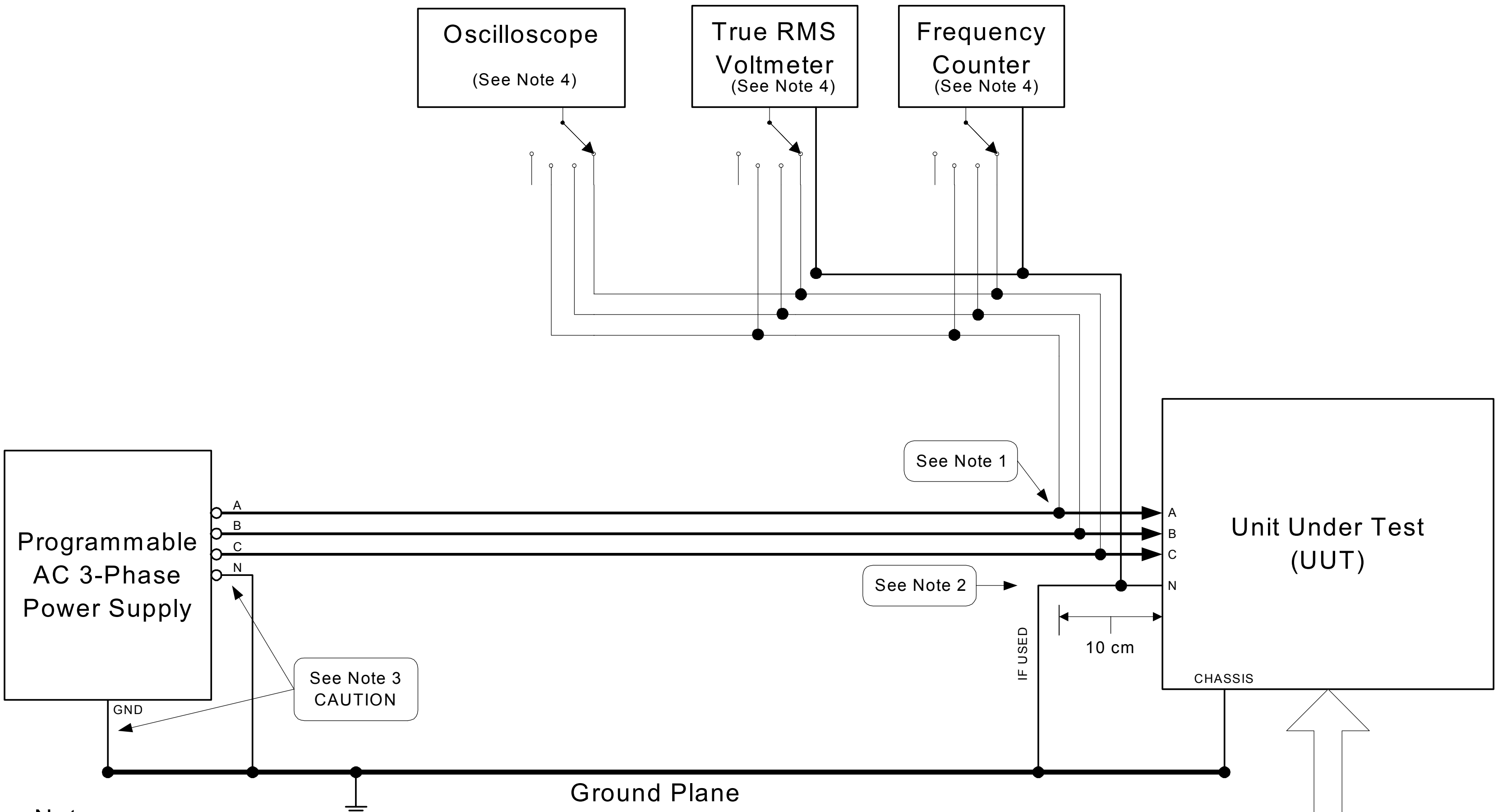
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TVF303-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions.

The UUT must be subjected to the frequency transients for each test condition A through I noted in table TVF303-II. The frequency must increase or decrease from the start frequency to the frequency transient level over the duration noted; the frequency must remain at the frequency transient level for the duration noted; and the frequency must return from the frequency transient level over the duration noted. For test condition E, an underfrequency transient is immediately followed by an overfrequency transient. For each test condition, monitor the performance of the UUT during the frequency transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to start frequency, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions, and has not suffered damage. Record the steady state voltages, start frequency, frequency transient level, time at frequency transient, oscilloscope trace (Hz vs time), and the performance of the UUT for each test condition in the data sheet shown in table TVF303-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TVF303-II. Test conditions for MIL-STD-704F abnormal frequency transients for three phase, variable frequency utilization equipment.

Test Condition	Start Frequency	Time From Start Frequency to Frequency Transient Level	Frequency Transient Level	Duration at Frequency Transient Level	Time From Frequency Transient Level to Start Frequency
Overfrequency Transients					
A	360 Hz	0.88 seconds	800 Hz	½ cycle	0.88 seconds
B	360 Hz	0.88 seconds	800 Hz	1second	0.88 seconds
C	360 Hz	0.48 seconds	600 Hz	½ cycle	0.48 seconds
D	360 Hz	0.48 seconds	600 Hz	1second	0.48 seconds
Underfrequency Transients					
E	800 Hz	0.88 seconds	360 Hz	½ cycle	0.88 seconds
F	800 Hz	0.88 seconds	360 Hz	1second	0.88 seconds
G	800 Hz	0.40 seconds	600 Hz	½ cycle	0.40 seconds
H	800 Hz	0.40 seconds	600 Hz	1second	0.40 seconds
Combined Transient					
I	600 Hz	0.48 seconds then 0.40 seconds	360 Hz 800 Hz	½ cycle ½ cycle	0.48 seconds 0.40 seconds



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TVF303-1. Abnormal frequency transients.

TABLE TVF303-III. Sample data sheet for TVF303 abnormal frequency transients for three phase, variable frequency utilization equipment.

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Start Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace		Pass/Fail
A	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs Time	
	B		V_{rms}									
	C		V_{rms}									
B	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs Time	
	B		V_{rms}									
	C		V_{rms}									
C	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs Time	
	B		V_{rms}									
	C		V_{rms}									
D	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs Time	
	B		V_{rms}									
	C		V_{rms}									
E	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs Time	
	B		V_{rms}									
	C		V_{rms}									
F	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs Time	
	B		V_{rms}									
	C		V_{rms}									
G	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs Time	
	B		V_{rms}									
	C		V_{rms}									

TABLE TVF303-III. Sample data sheet for TVF303 abnormal frequency transients for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters											Performance
	Phase	Steady State Voltage		Start Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace		Pass/Fail
H	A		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs Time	
	B		V_{rms}									
	C		V_{rms}									
I	A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs Time	
	B		V_{rms}									
	C		V_{rms}									
							Hz		msec			

METHOD TVF401
Emergency Steady State Limits for Voltage and Frequency

POWER GROUP: Three Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Emergency

PARAMETER: Emergency Steady State Limits for Voltage and Frequency

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 Volt, variable frequency power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Emergency Low Steady State (ELSS) limits and the Emergency High Steady State (EHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. For MIL-STD-704F, the three phase, 115 volt, variable frequency power utilization equipment normal steady state limits are the same as the emergency steady state limits. The emergency steady state limits for three phase, 115 Volt, variable frequency equipment are noted in table TVF401-I. Performance of test method TVF102 will constitute performance of test method TVF401.

TABLE TVF401-I. MIL-STD-704 Emergency limits for steady state voltage and frequency for three phase, variable frequency utilization equipment.

Emergency Limit	704A	704B	704C	704D	704E	704F
Voltage ELSS	N/A	N/A	N/A	N/A	N/A	108 V
Voltage EHSS	N/A	N/A	N/A	N/A	N/A	118 V
Frequency ELSS	N/A	N/A	N/A	N/A	N/A	360 Hz
Frequency EHSS	N/A	N/A	N/A	N/A	N/A	800 Hz

METHOD TVF501
No Tests

POWER GROUP:	Three Phase, Variable Frequency, 115 V
AIRCRAFT ELECTRICAL OPERATING CONDITION:	Starting
PARAMETER:	No Tests

Starting operations are usually not applicable to AC Utilization Equipment.

METHOD TVF601
Power Failure (Three Phase)

POWER GROUP: Three Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Power Failure

PARAMETER: Power Failure (Three Phase)

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to three phase power failures as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to three phase power failures as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TVF601-I. The utilization equipment must maintain the specified performance during the three phase power failures. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TVF601-I. MIL-STD-704 power failure limits for three phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Power Failure	N/A	N/A	N/A	N/A	N/A	7 sec figure 4 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure TVF601-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

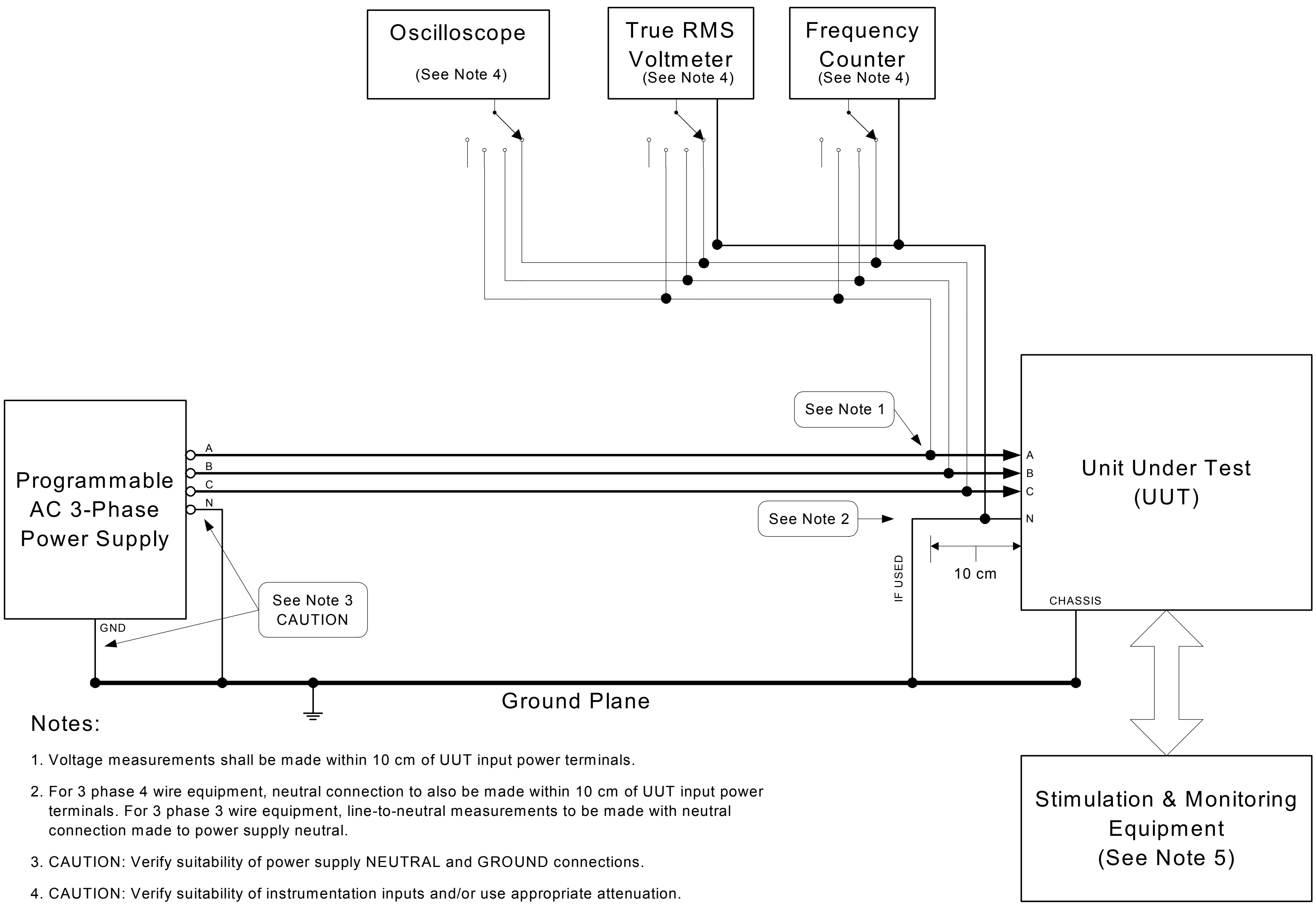
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TVF601-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through D noted in table TVF601-II, perform a three phase power failure (0 V) of the duration listed. The voltage must decrease from the steady state voltage to 0 volts within ½ cycle, remain at 0 volts for the duration listed for the test condition, and return from 0 volts to the steady state voltage within ½ cycle. For each test condition, monitor the performance of the UUT according to the utilization equipment performance test procedures for power failure operation to verify that the UUT is providing specified performance for power failure aircraft electrical conditions. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the steady state voltages, steady state frequency, time duration of power failure, and the performance of the UUT for each test condition in the data sheet shown in table TVF601-III. Repeat each test condition 5 times. Repeat for each mode of operation of the UUT. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TVF601-II. Test conditions for three phase power failures for three phase, variable frequency utilization equipment.

Test Condition	Duration of Power Failure
A	100 msec
B	500 msec
C	3 seconds
D	7 seconds



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TVF601-1. Power failure (three phase).

TABLE TVF601-III. Sample data sheet for TVF601 power failure (three phase) for three phase, variable frequency utilization equipment.

Test Condition	Parameters									Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage during Power Failure		Time Duration of Power Failure		Pass/Fail
Testing Performed at **400 Hz**										
A	A		V_{rms}		Hz		V_{rms}		msec	
	B		V_{rms}				V_{rms}		msec	
	C		V_{rms}				V_{rms}		msec	
B	A		V_{rms}		Hz		V_{rms}		msec	
	B		V_{rms}				V_{rms}		msec	
	C		V_{rms}				V_{rms}		msec	
C	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
D	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	

TABLE TVF601-III. Sample data sheet for TVF601 power failure (three phase) for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters									Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage during Power Failure		Time Duration of Power Failure		Pass/Fail
Testing Performed at **360 Hz**										
A	A		V_{rms}		Hz		V_{rms}		msec	
	B		V_{rms}				V_{rms}		msec	
	C		V_{rms}				V_{rms}		msec	
B	A		V_{rms}		Hz		V_{rms}		msec	
	B		V_{rms}				V_{rms}		msec	
	C		V_{rms}				V_{rms}		msec	
C	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
D	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	

TABLE TVF601-III. Sample data sheet for TVF601 power failure (three phase) for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters									Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage during Power Failure		Time Duration of Power Failure		Pass/Fail
Testing Performed at **600 Hz**										
A	A		V_{rms}		Hz		V_{rms}		msec	
	B		V_{rms}				V_{rms}		msec	
	C		V_{rms}				V_{rms}		msec	
B	A		V_{rms}		Hz		V_{rms}		msec	
	B		V_{rms}				V_{rms}		msec	
	C		V_{rms}				V_{rms}		msec	
C	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
D	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	

TABLE TVF601-III. Sample data sheet for TVF601 power failure (three phase) for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters									Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage during Power Failure		Time Duration of Power Failure		Pass/Fail
Testing Performed at **800 Hz**										
A	A		V_{rms}		Hz		V_{rms}		msec	
	B		V_{rms}				V_{rms}		msec	
	C		V_{rms}				V_{rms}		msec	
B	A		V_{rms}		Hz		V_{rms}		msec	
	B		V_{rms}				V_{rms}		msec	
	C		V_{rms}				V_{rms}		msec	
C	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
D	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	

METHOD TVF602
One and Two Phase Power Failures

POWER GROUP: Three Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Power Failure

PARAMETER: One and Two Phase Power Failures

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 volt, variable frequency power utilization equipment operates and maintains specified performance when subjected to one and two phase power failures (7 seconds and indefinitely) as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to power failures as specified by the applicable edition(s) of MIL-STD-704 and as noted in table TVF602-I. The utilization equipment must maintain the specified performance during one and two phase power failures. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate with one and two phase power failures and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE TVF602-I. MIL-STD-704 power failure limits for three phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Single Phase and Two Phase Power Failure	N/A	N/A	N/A	N/A	N/A	7 sec and indefinitely figure 4 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure TVF602-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

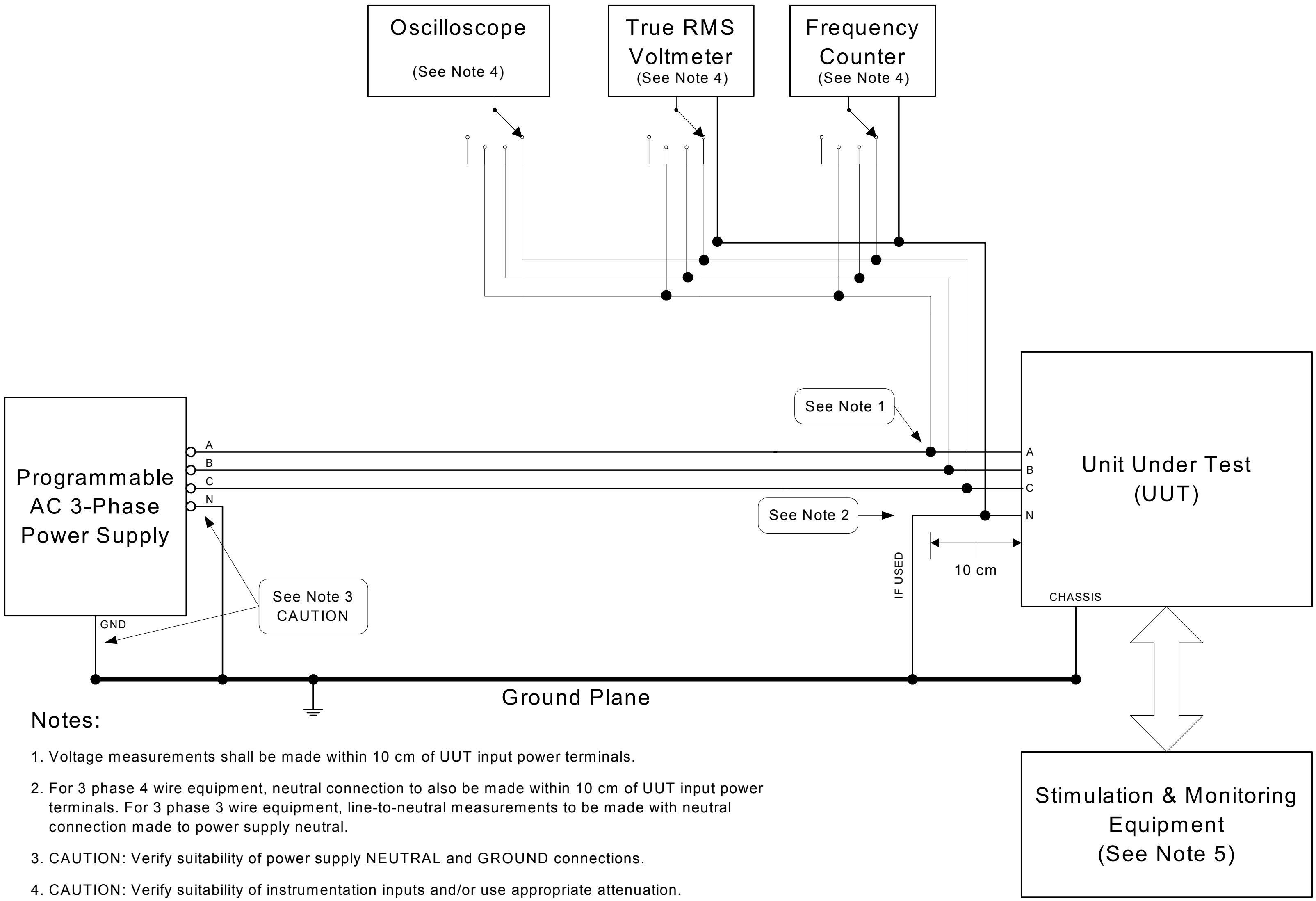
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TVF602-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through J noted in table TVF602-II, perform a power failure (0 V) on the phase(s) noted and of the duration listed. The voltage must decrease from the steady state voltage to 0 volts within ½ cycle, remain at 0 volts for the duration listed for the test condition, and return from 0 volts to the steady state voltage within ½ cycle. For each test condition, monitor the performance of the UUT according to the utilization equipment performance test procedures for power failure operation to verify that the UUT is providing specified performance for power failure aircraft electrical conditions. For the indefinite time duration, the utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be not less than thirty (30) minutes for each of the test conditions. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the steady state voltages, steady state frequency, time duration of power failure, and the performance of the UUT for each test condition in the data sheet shown in table TVF602-III. Repeat test conditions A, B, C, G, and H 5 times. Test conditions D, E, F, I, and J are required to be performed once each. Repeat for each mode of operation of the UUT. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE TVF602-II. Test conditions for one and two phase power failures for three phase, variable frequency utilization equipment.

Test Condition	Phases	Duration of Power Failure
One Phase Power Failure		
A	Phase A	7 seconds
B	Phase B	7 seconds
C	Phase C	7 seconds
D	Phase A	Indefinitely
E	Phase B	Indefinitely
F	Phase C	Indefinitely
Two Phase Power Failures		
G	Phase A & B	7 seconds
H	Phase B & C	7 seconds
I	Phase A & B	Indefinitely
J	Phase B & C	Indefinitely



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TVF602-1. One and two phase power failures.

TABLE TVF602-III. Sample data sheet for TVF602 one and two phase power failures for three phase, variable frequency utilization equipment.

Test Condition	Parameters									Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage during Power Failure		Time Duration of Power Failure		Pass/Fail
Testing Performed at **400 Hz**										
A	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
B	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
C	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
D	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
E	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
F	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
G	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
H	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	

TABLE TVF602-III. Sample data sheet for TVF602 one and two phase power failures for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters									Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage during Power Failure		Time Duration of Power Failure		Pass/Fail
Testing Performed at **400 Hz**										
I	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
J	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	

TABLE TVF602-III. Sample data sheet for TVF602 one and two phase power failures for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters					Performance
	Phase	Steady State Voltage	Steady State Frequency	Voltage during Power Failure	Time Duration of Power Failure	Pass/Fail
Testing Performed at **360 Hz**						
A	A	V_{rms}	Hz	V_{rms}	sec	
	B	V_{rms}		V_{rms}	sec	
	C	V_{rms}		V_{rms}	sec	
B	A	V_{rms}	Hz	V_{rms}	sec	
	B	V_{rms}		V_{rms}	sec	
	C	V_{rms}		V_{rms}	sec	
C	A	V_{rms}	Hz	V_{rms}	sec	
	B	V_{rms}		V_{rms}	sec	
	C	V_{rms}		V_{rms}	sec	
D	A	V_{rms}	Hz	V_{rms}	sec	
	B	V_{rms}		V_{rms}	sec	
	C	V_{rms}		V_{rms}	sec	
E	A	V_{rms}	Hz	V_{rms}	sec	
	B	V_{rms}		V_{rms}	sec	
	C	V_{rms}		V_{rms}	sec	
F	A	V_{rms}	Hz	V_{rms}	sec	
	B	V_{rms}		V_{rms}	sec	
	C	V_{rms}		V_{rms}	sec	
G	A	V_{rms}	Hz	V_{rms}	sec	
	B	V_{rms}		V_{rms}	sec	
	C	V_{rms}		V_{rms}	sec	
H	A	V_{rms}	Hz	V_{rms}	sec	
	B	V_{rms}		V_{rms}	sec	
	C	V_{rms}		V_{rms}	sec	

TABLE TVF602-III. Sample data sheet for TVF602 one and two phase power failures for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters									Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage during Power Failure		Time Duration of Power Failure		Pass/Fail
Testing Performed at **360 Hz**										
I	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
J	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	

TABLE TVF602-III. Sample data sheet for TVF602 one and two phase power failures for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters									Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage during Power Failure		Time Duration of Power Failure		Pass/Fail
Testing Performed at **600 Hz**										
A	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
B	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
C	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
D	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
E	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
F	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
G	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	

TABLE TVF602-III. Sample data sheet for TVF602 one and two phase power failures for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters									Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage during Power Failure		Time Duration of Power Failure		Pass/Fail
Testing Performed at **600 Hz**										
H	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
I	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
J	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	

TABLE TVF602-III. Sample data sheet for TVF602 one and two phase power failures for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters									Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage during Power Failure		Time Duration of Power Failure		Pass/Fail
Testing Performed at **800 Hz**										
A	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
B	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
C	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
D	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
E	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
F	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
G	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	

TABLE TVF602-III. Sample data sheet for TVF602 one and two phase power failures for three phase, variable frequency utilization equipment. - Continued

Test Condition	Parameters									Performance
	Phase	Steady State Voltage		Steady State Frequency		Voltage during Power Failure		Time Duration of Power Failure		Pass/Fail
Testing Performed at **800 Hz**										
H	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
I	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	
J	A		V_{rms}		Hz		V_{rms}		sec	
	B		V_{rms}				V_{rms}		sec	
	C		V_{rms}				V_{rms}		sec	

METHOD TVF603
Phase Reversal (Three Phase)

POWER GROUP: Three Phase, Variable Frequency, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Power Failure

PARAMETER: Phase Reversal (Three Phase)

1. Scope.

1.1 Purpose. This test procedure is used to verify that three phase, 115 volt, variable frequency power utilization equipment is not damaged by phase reversal or a positive physical means is employed to prevent phase reversal.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment is not damaged and does not cause an unsafe condition when the input phase sequence is reversed for the applicable edition(s) of MIL-STD-704 and as noted in table TVF603-I. A positive physical means to prevent phase sequence reversal may be used to fulfill this requirement.

TABLE TVF603-I. MIL-STD-704 phase sequence reversal requirement for three phase, variable frequency utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Phase Reversal	N/A	N/A	N/A	N/A	N/A	Phase Sequence Reversal Does not Cause Damage

3. Apparatus. The test equipment should be as follows:

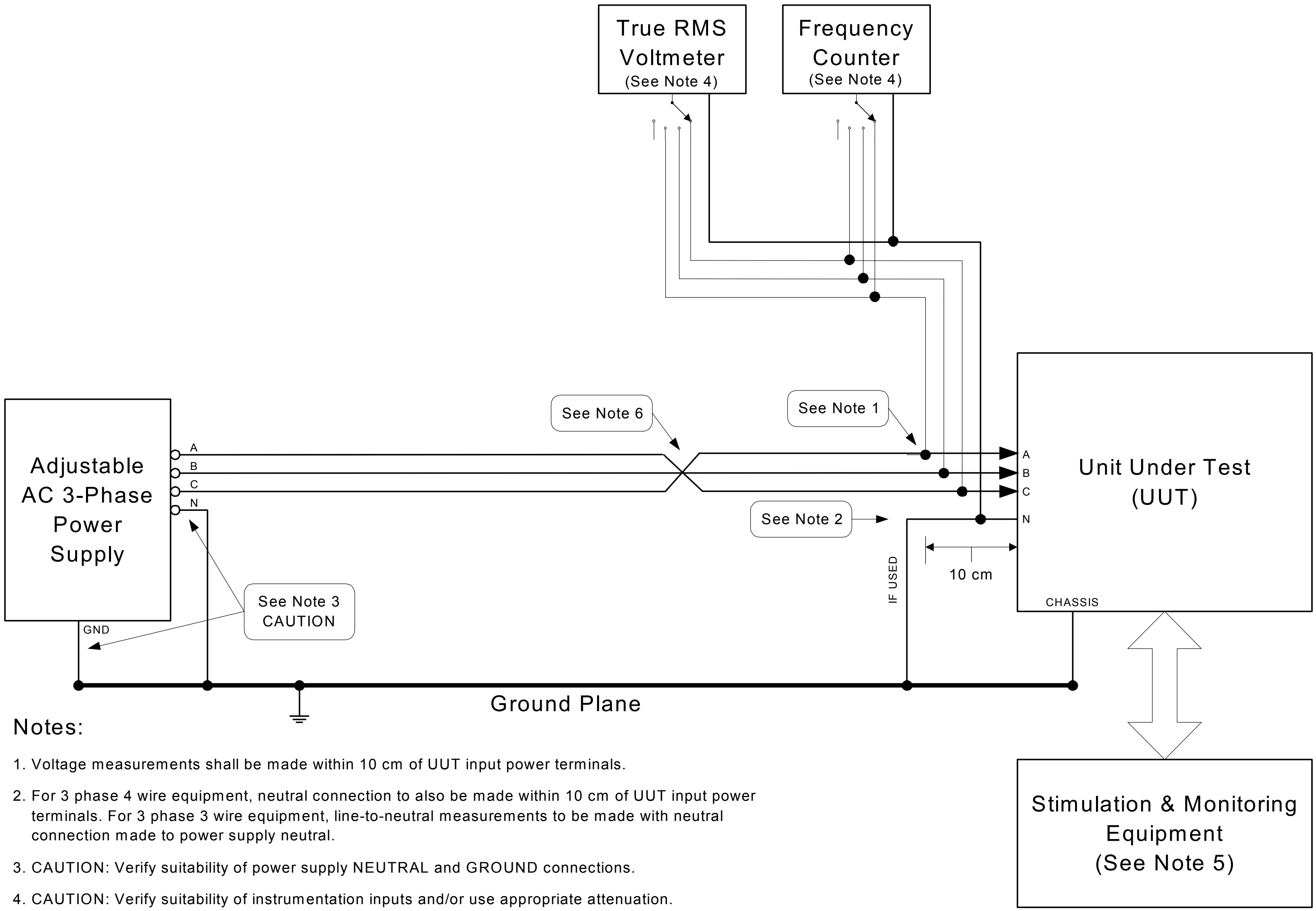
a. Adjustable AC power supply
b. True RMS voltmeter
c. Frequency counter

4. Test setup. Configure the test setup as shown in figure TVF603-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. If a positive physical means is employed to prevent phase sequence reversal, confirm that the phase conductors cannot be reversed.

If the phase sequence can be reversed, with the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TVF603-1 (reversed phase sequence of C-B-A). Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. The UUT must remain for a length of time that confirms the utilization equipment is not damaged and does not cause an unsafe condition due to phase sequence reversal and should be not less than thirty (30) minutes. Record the steady state voltages, steady state frequency, time duration at phase sequence reversal test condition, and the performance of the UUT in the data sheet shown in table TVF603-II. Repeat the testing at a steady state frequency of 360 Hz, 600 Hz, and 800 Hz.

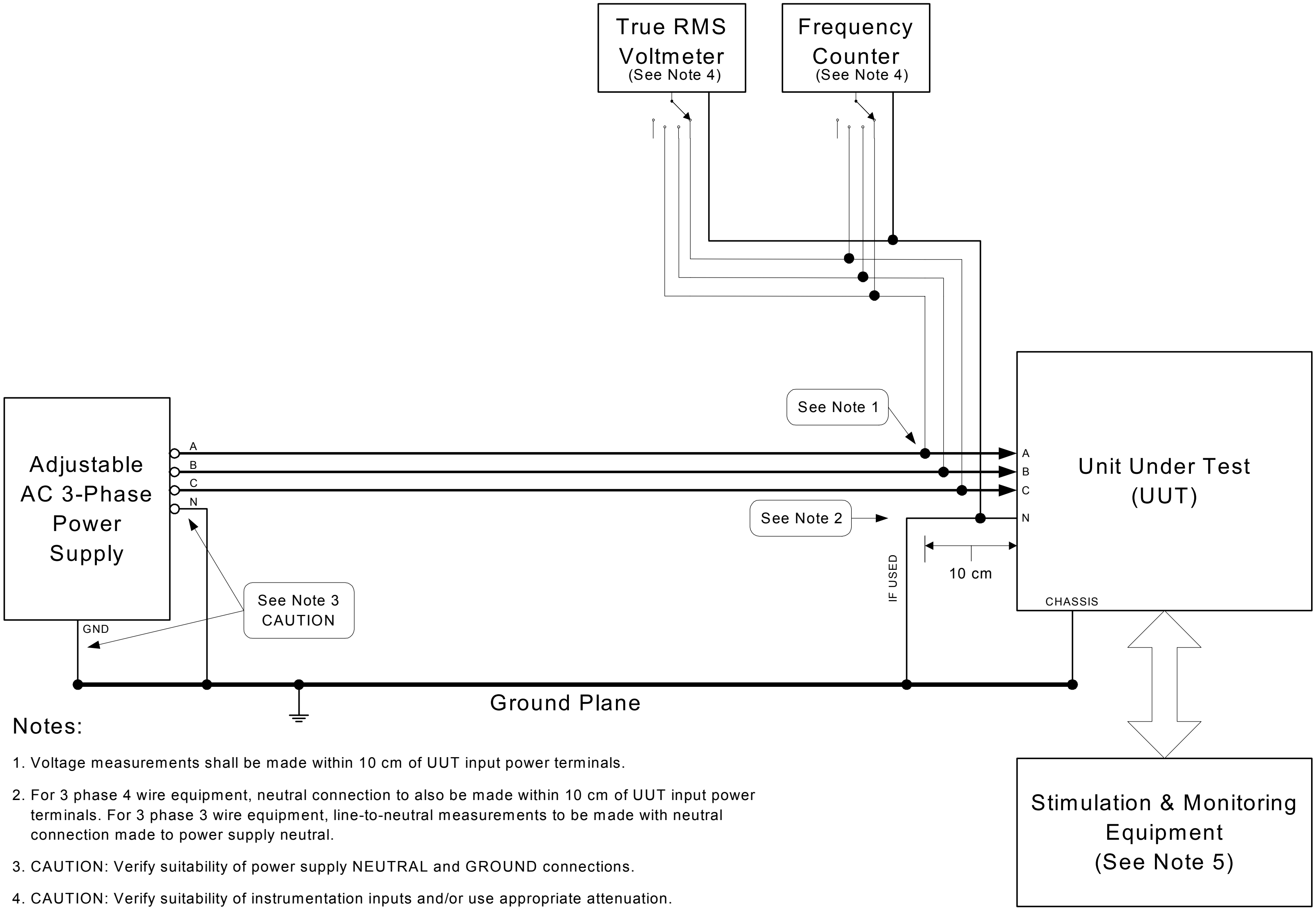
With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure TVF603-2 (correct phase sequence of A-B-C). Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to a steady state frequency of 400 Hz. Energize the UUT. The UUT must remain for a length of time that confirms the utilization equipment was not damaged and does not cause an unsafe condition after the phase sequence reversal and should be not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has returned to the performance specified for normal aircraft electrical conditions and has not suffered damage. Record the steady state voltages, steady state frequency, time duration at test condition, and the performance of the UUT in the data sheet shown in table TVF603-II. Repeat for each mode of operation of the UUT.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)
6. Phase Rotation is reversed.

FIGURE TVF603-1. Phase reversal.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. For 3 phase 4 wire equipment, neutral connection to also be made within 10 cm of UUT input power terminals. For 3 phase 3 wire equipment, line-to-neutral measurements to be made with neutral connection made to power supply neutral.
3. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
4. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
5. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE TVF603-2. Correct phase connection.

TABLE TVF603-II. Sample data sheet for TVF603 phase sequence reversal for three phase, variable frequency utilization equipment.

Test Condition	Parameters							Performance Yes/No
Phase Sequence Reversal Prevented by Positive Physical Means								
If No								
	Phase	Voltage		Frequency		Time Duration at Test Condition		Pass/Fail
Testing Performed at **400 Hz**								
Phase Sequence Reversed (C-B-A)	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
Testing Performed at **360 Hz**								
Phase Sequence Reversed (C-B-A)	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
Testing Performed at **600 Hz**								
Phase Sequence Reversed (C-B-A)	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
Testing Performed at **800 Hz**								
Phase Sequence Reversed (C-B-A)	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					
Testing Performed at **400 Hz**								
Correct Phase Sequence (A-B-C)	A		V_{rms}		Hz		min	
	B		V_{rms}					
	C		V_{rms}					

6. NOTES

6.1 Intended use. This handbook should be used as guidance when establishing test requirements, for inclusion in performance specifications developed for the procurement of utilization equipment, to ensure compliance with the aircraft electrical power characteristics as specified by MIL-STD-704.

6.2 Subject term (keyword) listing.

Aircraft, electrical power
Aircraft, electrical test
Electrical operating areas
Equipment, utilization
Power groups
Specification, utilization equipment

CONCLUDING MATERIAL

Custodians:
Army - AV
Navy - AS
Air Force - 11

Preparing Activity:
Navy - AS

(Project No. SESS-0051)

Review Activities:
Army - CR, MI, TE
Navy - EC, MC, SA, SH, YD

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at www.dodssp.daps.mil.

NOT MEASUREMENT SENSITIVE

MIL-HDBK-704-6
9 April 2004

DEPARTMENT OF DEFENSE HANDBOOK

GUIDANCE FOR TEST PROCEDURES FOR DEMONSTRATION OF UTILIZATION EQUIPMENT COMPLIANCE TO AIRCRAFT ELECTRICAL POWER CHARACTERISTICS SINGLE PHASE, 60 Hz, 115 VOLT
(PART 6 OF 8 PARTS)

This Handbook is for guidance only.
Do not cite this document as a requirement.

AMSC N/A AREA SESS

FOREWORD

1. This handbook is approved for use by all Departments and Agencies of the Department of Defense.

2. This handbook provides guidance on test procedures for demonstration of single phase, 60 Hz, 115 volt utilization equipment to determine compliance with the applicable edition of MIL-STD-704.

3. MIL-HDBK-704-6 is Part 6 in a series of 8 Parts. Part 6 describes the test methods and procedures to demonstrate that single phase, 60 Hz, 115 volt utilization equipment is compatible with the electric power characteristics of MIL-STD-704. These series of handbooks and MIL-STD-704 are companion documents.

4. Comments, suggestions, or questions on this document should be addressed to Commander, Naval Air Systems Command, Code 4.1.4, Highway 547, Lakehurst, NJ 08733-5100 or email to thomas.omara@navy.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil.

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1. SCOPE

1.1 Scope. This handbook provides, as guidance, test methods used to demonstrate that single phase, 60 Hz, 115 volt utilization equipment is compatible with the electric power characteristics of the applicable edition(s) of MIL-STD-704. This handbook is for guidance only and cannot be cited as a requirement.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed below are not necessarily all of the documents referenced herein, but are those needed to understand the information provided by this handbook.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-704	DoD Interface Standard for Aircraft Electric Power Characteristics

(Copies of these documents are available online at http://assist. daps.dla.mil/quicksearch or www.dodssp.daps.mil/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

3. DEFINITIONS

3.1 Acronyms and definitions. The acronyms and definitions of MIL-STD-704 are applicable to this handbook.

4. TEST METHODS INFORMATION

4.1 Demonstration of compatibility. This section contains the test methods which will ensure that single phase, 60 Hz, 115 volt utilization equipment is compatible with the electric power characteristics of the applicable edition(s) of MIL-STD-704, by testing the Unit Under Test (UUT) in accordance with the test procedures as described in test methods SXF101 through SXF603.

4.1.1 Recording performance. In table SXF-I, record the edition(s) of MIL-STD-704 that defined the aircraft electric power characteristics used for testing and the performance of the UUT for each of the test methods.

4.2 Calibration of test equipment. Test equipment and accessories required for measurement in accordance with this handbook should be calibrated in accordance with an approved calibration program traceable to the National Institute for Standards and Technology.

The serial numbers, model, and calibration date of all test equipment should be included with the test data.

4.3 Test methods. The test methods listed in table SXF-I are provided in section 5 of this handbook.

TABLE SXF-I. Summary of single phase, 60 Hz,115 volt utilization equipment MIL-STD-704 compliance tests.

UUT:			
Compliance to MIL-STD-704 Edition(s):			
Test Dates:			
Test Method	Description	Performance (Pass/Fail)	Comments
Normal, Aircraft Electrical Operation			
SXF101	Load and Current Harmonic Measurements		
SXF102	Steady State Limits for Voltage and Frequency		
SXF103	No Test, See Note #1	N/A	N/A
SXF104	Voltage Modulation		
SXF105	Frequency Modulation		
SXF106	Voltage Distortion Spectrum		
SXF107	Total Voltage Distortion		
SXF108	DC Voltage Component		
SXF109	Normal Voltage Transients		
SXF110	Normal Frequency Transients		
Transfer, Aircraft Electrical Operation			
SXF201	Power Interrupt		
Abnormal, Aircraft Electrical Operation			
SXF301	Abnormal Limits for Voltage and Frequency		
SXF302	Abnormal Voltage Transients (Overvoltage/Undervoltage)		
SXF303	Abnormal Frequency Transients (Overfrequency/Underfrequency)		
Emergency, Aircraft Electrical Operation			
SXF401	Emergency Limits for Voltage and Frequency		
Starting, Aircraft Electrical Operation			
SXF501	See Note#2	N/A	N/A
Power Failure, Aircraft Electrical Operation			
SXF601	Power Failure (Single Phase)		
SXF602	No Test, See Note #1	N/A	N/A
SXF603	Phase Reversal		

Note 1: There are no tests required for SXF103 and SXF602. The numbering has been arranged so that the single phase test numbers coincide with the three phase test numbers.
Note 2: Starting operation conditions are usually not applicable to AC utilization equipment. No test is required for SXF501 unless specified by the equipment performance specification.

5. TEST METHODS

METHOD SXF101
Load Measurements

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Load Measurements

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment utilizes only 115 volt line-to-neutral power, does not require more power than allowed, the power factor is within limits, and does not use half-wave rectification for the applicable edition(s) of MIL-STD-704. Additionally, when the utilization equipment performance specification document imposes current waveform requirements, this test procedure is used to verify that the utilization equipment current waveform is within total current distortion and current spectrum (current distortion vs. frequency) limits defined in the utilization equipment performance specification document.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment requires less than or equal to the power limit for single phase equipment, is within the power factor limits, and does not use half-wave rectification for the applicable edition(s) of MIL-STD-704 and as noted in table SXF101-I. If required by the utilization equipment performance specification document, the utilization equipment current waveform must be within the total current distortion and current spectrum limits defined in the utilization equipment performance specification document. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SXF101-I. MIL-STD-704 limits for single phase power, power factor, rectification restriction, current distortion, and current spectrum for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Single Phase kVA	N/A	N/A	N/A	N/A	N/A	0.5 kVA
Power Factor	N/A	N/A	N/A	N/A	N/A	No Leading Power Factor for >100 VA
Rectification Restriction	N/A	N/A	N/A	N/A	N/A	No Half-Wave Rectification
Current Distortion	N/A	N/A	N/A	N/A	N/A	See Note 1/
Current Spectrum	N/A	N/A	N/A	N/A	N/A	See Note 1/

1/. The utilization equipment performance specification document should include requirements that reduce the likelihood of the equipment having an adverse effect on the electrical power characteristics of the aircraft. Current distortion and current spectrum limits may be imposed to minimize undesirable effects to the electrical power characteristics. These limits should take into account the utilization equipment power draw, aircraft electrical system capacity and distribution characteristics, trade-offs with weight, volume, cost, and reliability that are specific to each type of equipment and aircraft.

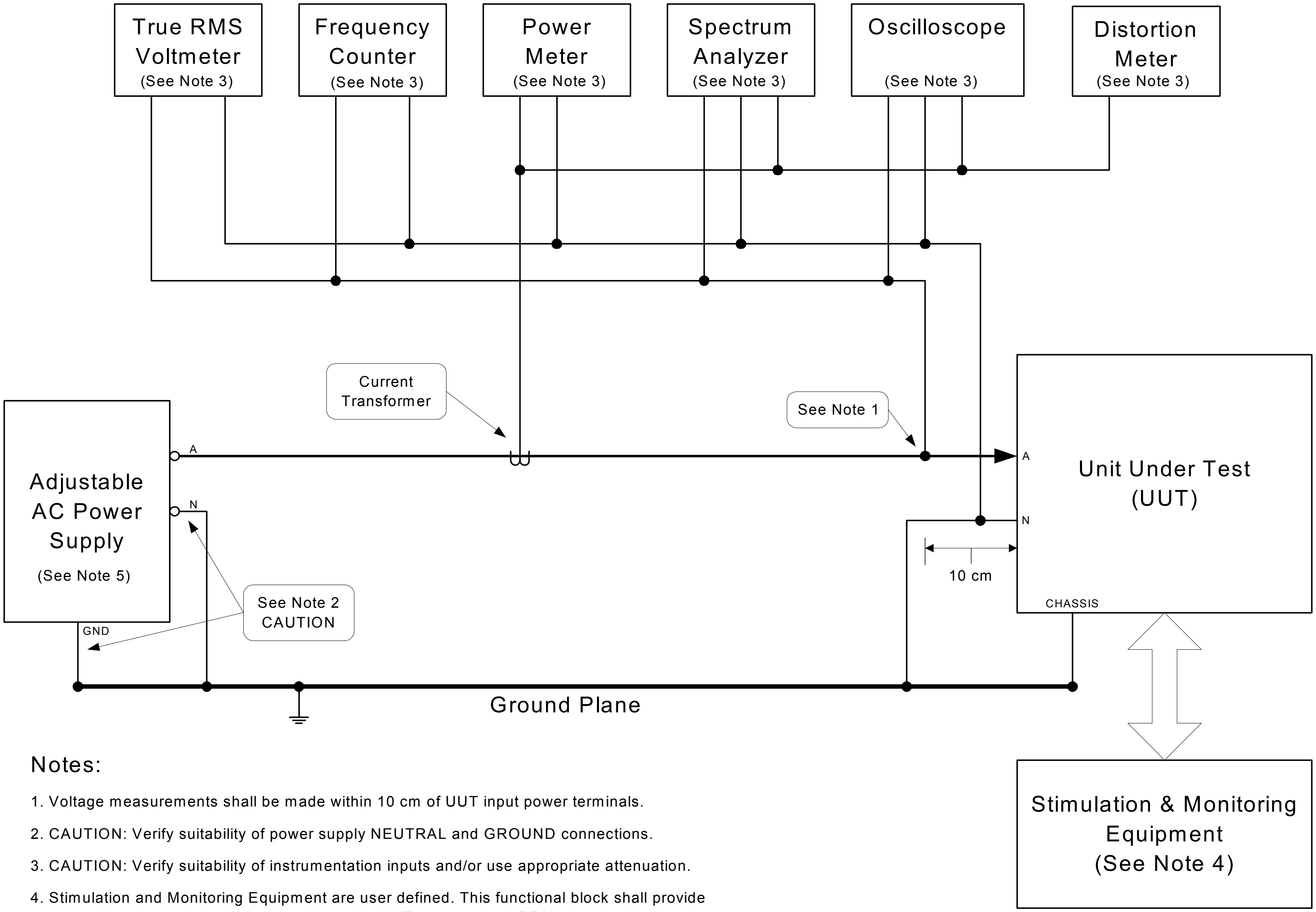
3. Apparatus. The test equipment should be as follows:

a. Adjustable AC power supply (rotating AC source for current waveform limits)
b. True RMS voltmeter
c. Frequency counter
d. Power meter
e. Spectrum analyzer
f. Distortion meter
g. Current transformer
h. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SXF101-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT. Current measurements must be taken from the 115 Volt conductor. If the utilization equipment performance specification document imposes current waveform limits, the AC power source must be a rotating machine.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF101-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz.

Close the circuit breaker, energizing the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltage, frequency, kVA, and power factor in table SXF101-II. Confirm that the utilization equipment does not use half-wave rectification and record in table SXF101-II. Compare the kVA, power factor, and rectification with the required limits/restriction of the applicable edition(s) of MIL-STD-704. If the utilization equipment performance specification document imposes current waveform limits, record the total current distortion and current spectrum in the data sheet shown in table SXF101-II and compare to the limits defined in the utilization equipment performance specification document. Repeat for each mode of operation of the UUT.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)
5. If current waveform limits are imposed by the detailed performance specification, the AC power source shall be a rotating machine.

FIGURE SXF101-1. Load and current distortion measurement.

TABLE SXF101-II. Sample data sheet for SXF101 load measurements for single phase, 60 Hz utilization equipment.

Parameter	Measurement	Unit	Performance Pass/Fail
Voltage		V_{rms}	N/A
Frequency		Hz	N/A
kVA		kVA	
Power Factor		pf	
No Half-Wave Rectification		N/A	
Total Current Distortion		% Current Distortion	
Current Spectrum	Attach Spectrum Plot	Amplitude vs. Frequency	

METHOD SXF102
Steady State Limits for Voltage and Frequency

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Steady State Limits for Voltage and Frequency

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, 60 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at that the Normal Low Steady State (NLSS) limits and the Normal High Steady State (NHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power of voltage and frequency at the specified normal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table SXF102-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be, not less than thirty (30) minutes for each of the test conditions. The utilization equipment must demonstrate re-start at the steady state voltage and frequency limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SXF102-I. MIL-STD-704 normal limits for steady state voltage and frequency for single phase, 60 Hz utilization equipment.

Normal Limit	704A	704B	704C	704D	704E	704F
Voltage NLSS	N/A	N/A	N/A	N/A	N/A	105 V
Voltage NHSS	N/A	N/A	N/A	N/A	N/A	125 V
Frequency NLSS	N/A	N/A	N/A	N/A	N/A	59.5 Hz
Frequency NHSS	N/A	N/A	N/A	N/A	N/A	60.5 Hz

3. Apparatus. The test equipment should be as follows:

a. Adjustable AC power supply
b. True RMS voltmeter
c. Frequency counter

4. Test setup. Configure the test setup as shown in figure SXF102-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

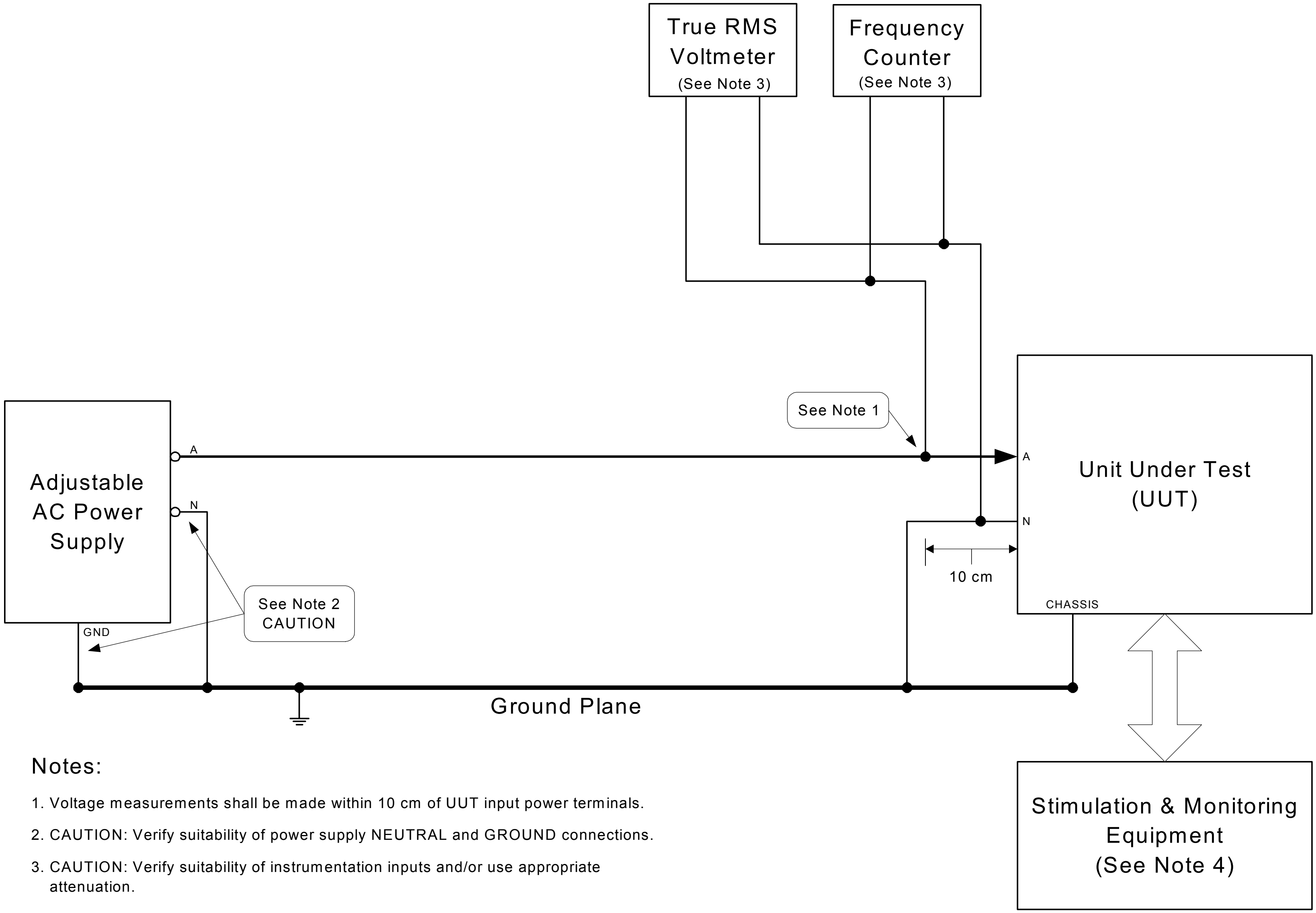
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF102-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through I noted in table SXF102-II, the UUT must remain for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be not less than thirty (30) minutes. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. For each test condition shutdown the UUT and verify that the UUT can be re-started. After re-start conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltage, frequency, time duration at test condition, successful/unsuccessful re-start and the performance of the UUT for each test condition in the data sheet shown in table SXF102-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SXF102-II. Test conditions for steady state limits for voltage and frequency for single phase, 60 Hz utilization equipment.

Test Condition	Voltage	Frequency
A	115 V	60 Hz
B	115 V	59.5 Hz
C	115 V	60.5 Hz
D	105 V	60 Hz
E	105 V	59.5 Hz
F	105 V	60.5 Hz
G	125 V	60 Hz
H	125 V	59.5 Hz
I	125 V	60.5 Hz



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SXF102-1. Steady state limits for voltage and frequency.

TABLE SXF102-III. Sample data sheet for SXF102 steady state limits for voltage and frequency for 60 Hz utilization equipment.

Test Condition	Parameters							Performance
	Voltage		Frequency		Time Duration at Condition		Re-Start (Yes/No)	Pass/Fail
A		V_{rms}		Hz		min		
B		V_{rms}		Hz		min		
C		V_{rms}		Hz		min		
D		V_{rms}		Hz		min		
E		V_{rms}		Hz		min		
F		V_{rms}		Hz		min		
G		V_{rms}		Hz		min		
H		V_{rms}		Hz		min		
I		V_{rms}		Hz		min		

METHOD SXF103
No Test Required

POWER GROUP:	Single Phase, 60 Hz, 115 V
AIRCRAFT ELECTRICAL OPERATING CONDITION:	Normal
PARAMETER:	No Test Required. Test number SXF103 is not used so that the Single Phase, 60 Hz, 115 V(SXF) test numbers coincide with the Three Phase, 115 V (TAC and TVF) test sequence numbers.

METHOD SXF104
Voltage Modulation

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Voltage Modulation

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when subjected to voltage modulation as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having voltage modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table SXF104-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage modulation. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SXF104-I. MIL-STD-704 limits for voltage modulation for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Voltage Modulation	N/A	N/A	N/A	N/A	N/A	2.5 Vrms max

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SXF104-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF104-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the

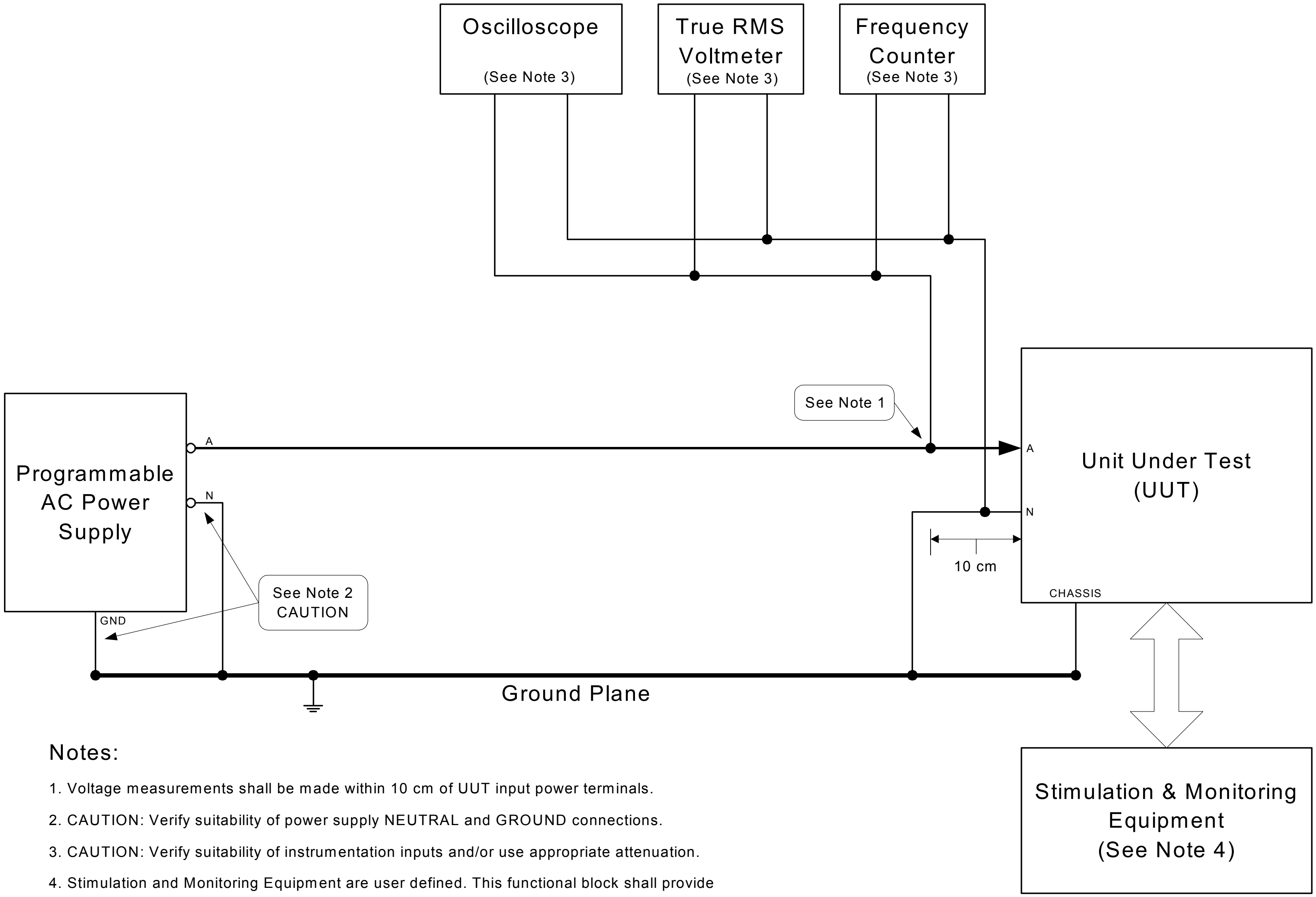
utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through F noted in table SXF104-II, set the voltage modulation amplitude and frequency of voltage modulation. The UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate, and should be at least ten (10) minutes at an average steady state voltage of 115 Vrms, at least ten (10) minutes at an average steady state voltage of 109 Vrms, and at least ten (10) minutes at an average steady state voltage of 117 Vrms. During the test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record average voltage, frequency, amplitude of voltage modulation, frequency of voltage modulation, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table SXF104-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SXF104-II. Test conditions for voltage modulation for single phase, 60 Hz utilization equipment.

Test Condition	Frequency of Voltage Modulation	MIL-STD-704F Amplitude of Voltage Modulation Vrms
A	1.0 Hz	0.375 Vrms
B	1.5 Hz	2.5 Vrms
C	4 Hz	2.5 Vrms
D	10 Hz	0.375 Vrms
E	15 Hz	0.375 Vrms
F	30 Hz	0.375 Vrms



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SXF104-1. Voltage modulation.

TABLE SXF104-III. Sample data sheet for SXF104 voltage modulation for single phase, 60 Hz utilization equipment.

Test Condition	Parameters										Performance
	Average Voltage		Frequency		Amplitude of Voltage Modulation		Frequency of Voltage Modulation		Time Duration at Condition		Pass/Fail
A		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
B		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
C		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
D		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
E		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
F		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	
		V_{rms}		Hz		V_{rms}		Hz		min	

METHOD SXF105
Frequency Modulation

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Frequency Modulation

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, 60 Hz power utilization equipment operates and maintains specified performance when subjected to frequency modulation as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power having frequency modulation as specified in the applicable edition(s) of MIL-STD-704 and as noted in table SXF105-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having frequency modulation. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SXF105-I. MIL-STD-704 limits for frequency modulation for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Frequency Modulation	N/A	N/A	N/A	N/A	N/A	0.5 Hz

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SXF105-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF105-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Energize the UUT. Allow sufficient

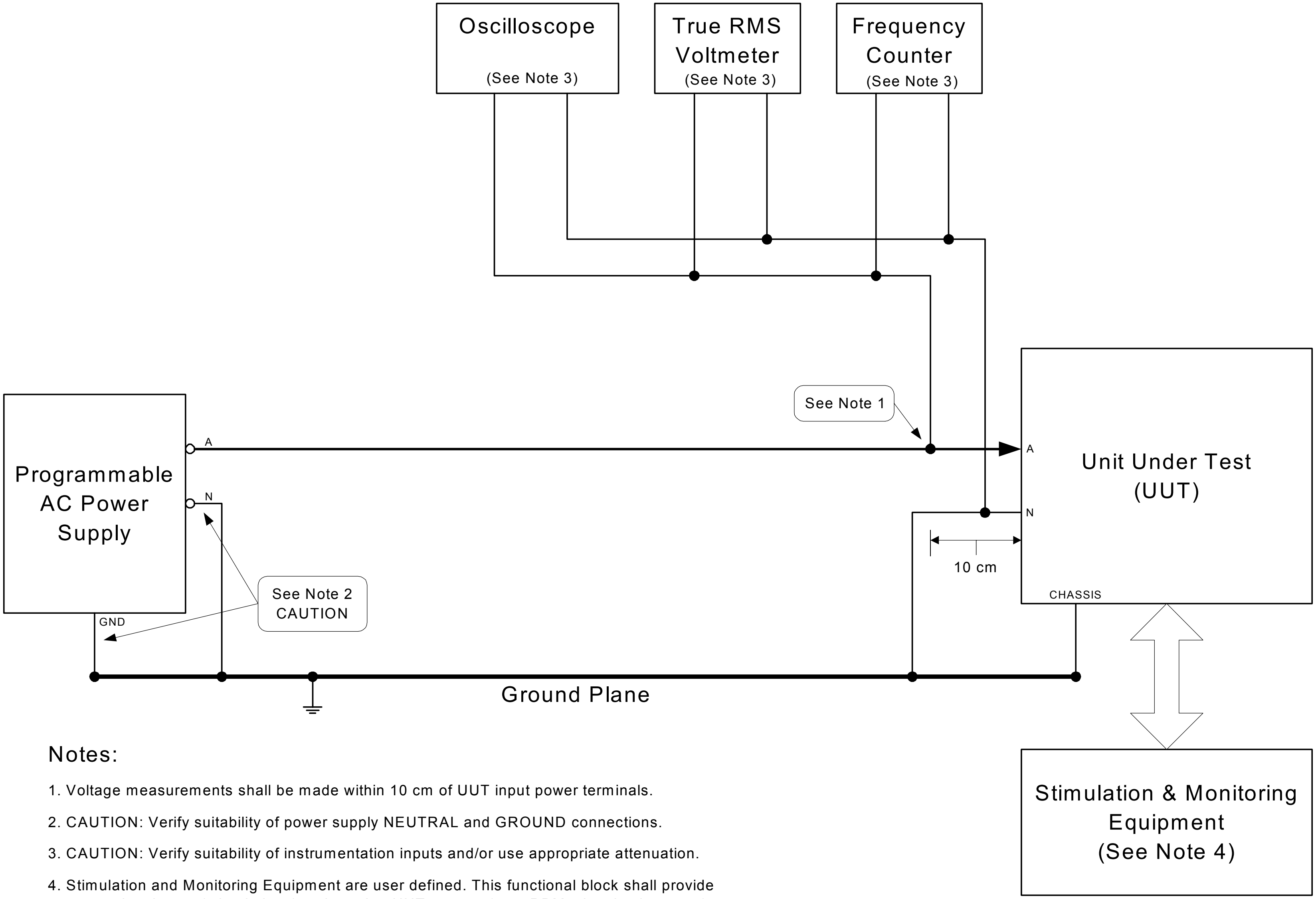
time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through E noted in table SXF105-II, set the amplitude of frequency modulation and rate of change for frequency modulation. The UUT must remain at the test condition for a length of time that confirms the utilization equipment can continuously operate, and should be at least ten (10) minutes at an average steady state frequency of 60 Hz, at least ten (10) minutes at an average steady state frequency of 59.75 Hz, and at least ten (10) minutes at an average steady state frequency of 60.75 Hz. During the test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record voltage, average frequency, amplitude of frequency modulation, rate of change for frequency modulation, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table SXF105-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SXF105-II. Test conditions for frequency modulation for single phase, 60 Hz utilization equipment.

Test Condition	Rate of change for frequency modulation	MIL-STD-704F Amplitude of Frequency Modulation
A	0.1 Hz/sec	0.5 Hz (± 0.25 Hz)
B	0.5 Hz/sec	0.5 Hz (± 0.25 Hz)
C	4 Hz/sec	0.5 Hz (± 0.25 Hz)
D	25 Hz/sec	0.5 Hz (± 0.25 Hz)
E	15 Hz/sec	0.5 Hz (± 0.25 Hz)



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SXF105-1. Frequency modulation.

TABLE SXF105-III. Sample data sheet for SXF105 frequency modulation for single phase, 60 Hz utilization equipment.

Test Condition	Parameters										Performance
	Voltage		Average Frequency		Amplitude of Frequency Modulation		Rate of change for frequency modulation		Time Duration at Condition		Pass/Fail
		V_{rms}		Hz		± Hz		Hz/sec		min	
A		V_{rms}		Hz		± Hz		Hz/sec		min	
		V_{rms}		Hz		± Hz		Hz/sec		min	
		V_{rms}		Hz		± Hz		Hz/sec		min	
B		V_{rms}		Hz		± Hz		Hz/sec		min	
		V_{rms}		Hz		± Hz		Hz/sec		min	
		V_{rms}		Hz		± Hz		Hz/sec		min	
C		V_{rms}		Hz		± Hz		Hz/sec		min	
		V_{rms}		Hz		± Hz		Hz/sec		min	
		V_{rms}		Hz		± Hz		Hz/sec		min	
D		V_{rms}		Hz		± Hz		Hz/sec		min	
		V_{rms}		Hz		± Hz		Hz/sec		min	
		V_{rms}		Hz		± Hz		Hz/sec		min	
E		V_{rms}		Hz		± Hz		Hz/sec		min	
		V_{rms}		Hz		± Hz		Hz/sec		min	

METHOD SXF106
Voltage Distortion Spectrum

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Voltage Distortion Spectrum

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when subjected to voltage distortion of frequencies and amplitudes as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage distortions as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704 and as noted in table SXF106-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage distortion. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: This test method subjects the UUT to voltage distortion having frequencies components from 50 Hz to 10 kHz. These voltage distortions simulate voltage distortions within aircraft due to the cumulative effects of generators, electrical distribution systems equipments, and aircraft loads. MIL-STD-461, (Requirements For The Control of Electromagnetic Interference Characteristics of Subsystems and Equipment), Test Method CS101, (Conducted Susceptibility, Power Leads, 30 Hz to 150 kHz) is a complimentary test. Power levels of the voltage distortions differ for the two test methods. Performance of Test Method SXF106 of this handbook does not relinquish the requirement to perform Test Method CS101 of MIL-STD-461, and performance of Method CS101 of MIL-STD-461 does not relinquish the requirement to perform Test Method SXF106 of this handbook.

TABLE SXF106-I. MIL-STD-704 limits for voltage distortion spectrum for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Voltage Distortion Spectrum	N/A	N/A	N/A	N/A	N/A	figure 12 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Adjustable AC power supply
b. Variable frequency power source
c. Coupling transformer
d. True RMS voltmeter
e. Frequency counter
f. Spectrum analyzer
g. (2) Inductors, 50 μH
h. Capacitor, 10 μF
i. Resistor, calibrated load

4. Test setup. Configure the test setup as shown in figure SXF106-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

4.1 Calibration (50 Hz to 10 kHz). Install a calibrated resistive load in the test setup shown in figure SXF106-1 in place of the UUT. The calibrated resistive load must be sized to draw the same current as the UUT. Turn on the adjustable AC power supply and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Set the variable frequency power source to output a sine wave and adjust the frequency and amplitude so that the voltage distortion measured at the input to the calibrated resistive load conforms to each test condition A through G in table SXF106-II of the applicable edition(s) of MIL-STD-704. Record the settings of the variable frequency power source for each test condition.

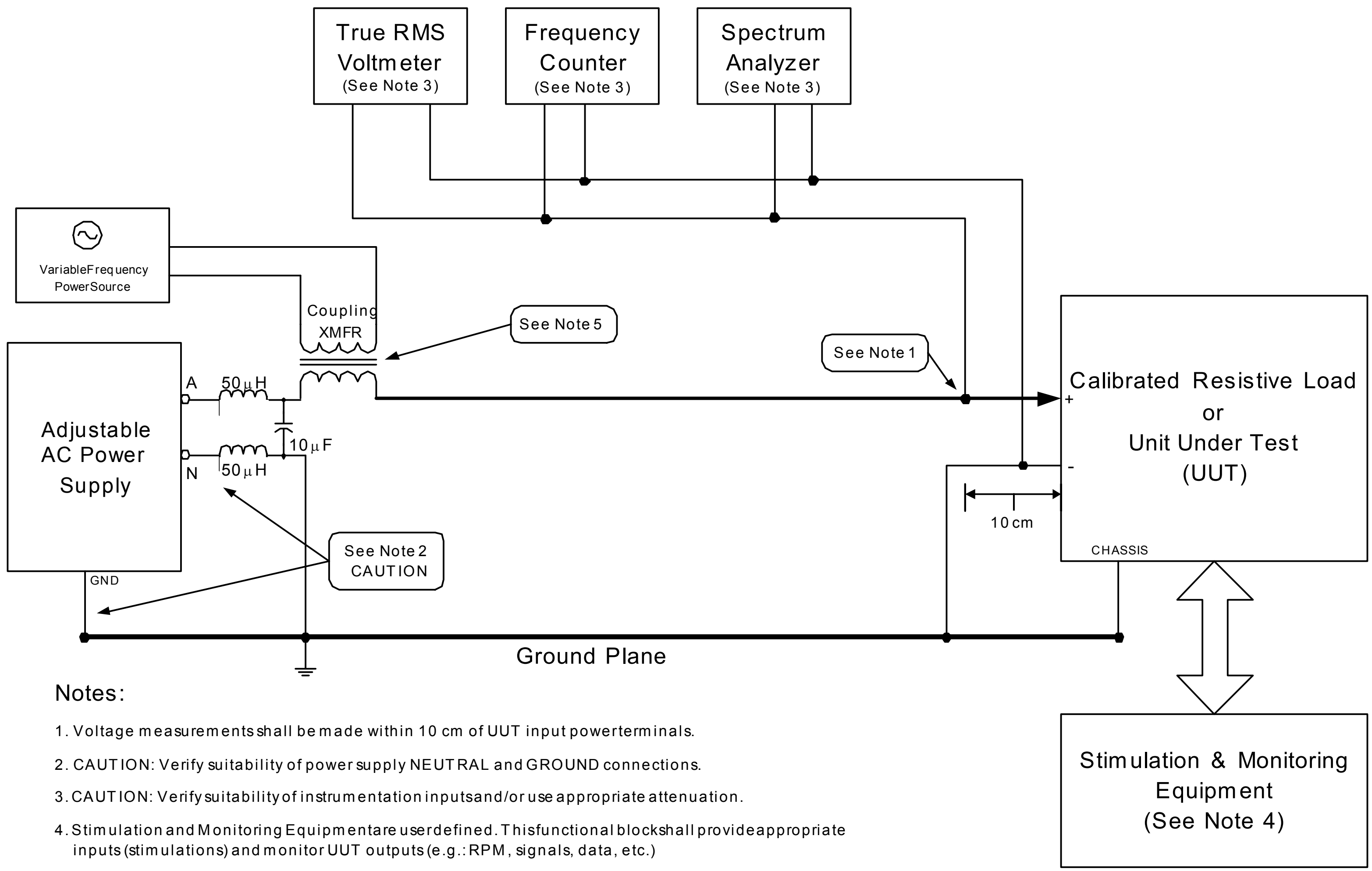
5. Compliance test. With the adjustable AC power supply off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF106-1. Turn on the adjustable AC power supply and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

Set the variable frequency power source to the settings recorded for test condition A of the calibration procedure. For each test condition, remain for a length of time that confirms the utilization equipment can continuously operate with the voltage distortion and should be not less than five (5) minutes. At each test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. After each test condition, monitor the voltage distortion frequency and amplitude while slowly increasing the variable frequency power source frequency and adjusting the amplitude until the next test condition is reached. Do not exceed the voltage distortion spectrum limits. Repeat for each test condition A through G noted in table SXF106-II. For each test condition, record voltage, frequency, frequency of voltage distortion, amplitude of voltage distortion, time duration at test condition, and the performance of the UUT in the data sheet shown in table SXF106-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, turn the adjustable AC power supply off and remove the coupling transformer from the circuit. Turn on the adjustable AC power supply. Adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and the frequency to the nominal steady state frequency of 60 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SXF106-II. Test conditions for voltage distortion spectrum for single phase, 60 Hz utilization equipment.

Test Condition	Frequency of Voltage Distortion	MIL-STD-704F Amplitude of Voltage Distortion Voltage rms
A	50 Hz	1.000 Vrms
B	150 Hz	3.162 Vrms
C	450 Hz	3.162 Vrms
D	1 kHz	1.333 Vrms
E	3 kHz	0.473 Vrms
F	5 kHz	0.282 Vrms
G	10 kHz	0.150 Vrms



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)
5. CAUTION: Verify suitability of variable frequency power source and coupling transformer for distortion spectrum testing.

FIGURE SXF106-1. Normal operation - voltage distortion spectrum (50 Hz to 10 kHz).

TABLE SXF106-III. Sample data sheet for SXF106 voltage distortion spectrum for single phase, 60 Hz utilization equipment.

Test Condition	Parameters										Performance
	Voltage		Frequency		Frequency of Voltage Distortion		Amplitude of Voltage Distortion		Time Duration at Condition		Pass/Fail
A		V_{rms}		Hz		Hz		V_{rms}		min	
B		V_{rms}		Hz		Hz		V_{rms}		min	
C		V_{rms}		Hz		Hz		V_{rms}		min	
D		V_{rms}		Hz		kHz		V_{rms}		min	
E		V_{rms}		Hz		kHz		V_{rms}		min	
F		V_{rms}		Hz		kHz		V_{rms}		min	
G		V_{rms}		Hz		kHz		V_{rms}		min	

METHOD SXF107
Total Voltage Distortion

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Total Voltage Distortion

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when subjected to a voltage waveform having a distortion factor as specified by the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to a voltage waveform having a distortion factor as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SXF107-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to a distorted voltage waveform and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SXF107-I. MIL-STD-704 limits for total voltage distortion for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Voltage Distortion Factor	N/A	N/A	N/A	N/A	N/A	0.05

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Spectrum analyzer
e. Distortion meter

4. Test setup. Configure the test setup as shown in figure SXF107-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

4.1 Calibration. Install a resistive load in the test setup shown in figure SXF107-1 in place of the UUT. The resistive load must be sized to draw the same current as the UUT. Set the programmable power supply to produce a voltage waveform having harmonic contents listed in table SXF107-II. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60Hz. Confirm that the programmable power supply is producing a voltage waveform having harmonic content listed in table SXF107-II. Record the settings of the programmable power supply.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF107-1. Set the programmable power supply to the settings recorded during the calibration procedure. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. The UUT must remain for a length of time that confirms the utilization equipment can continuously operate with the total voltage distortion and should be not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltage, frequency, voltage distortion factor, voltage harmonics, time duration at test condition, and the performance of the UUT in the data sheet shown in table SXF107-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, set the programmable power supply to produce a sine wave. Adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SXF107-II. Voltage harmonics as percent of fundamental for total voltage distortion test for single phase, 60 Hz utilization equipment.

Harmonic	MIL-STD-704F Percent of Fundamental
Fundamental	100%
2nd	0%
3rd	2.75%
4th	0%
5th	2.75%
6th	0%
7th	1.97%
8th	0%
9th	1.53%
10th	0%
11th	1.25%
12th	0%
13th	1.06%
14th	0%
15th	0.92%

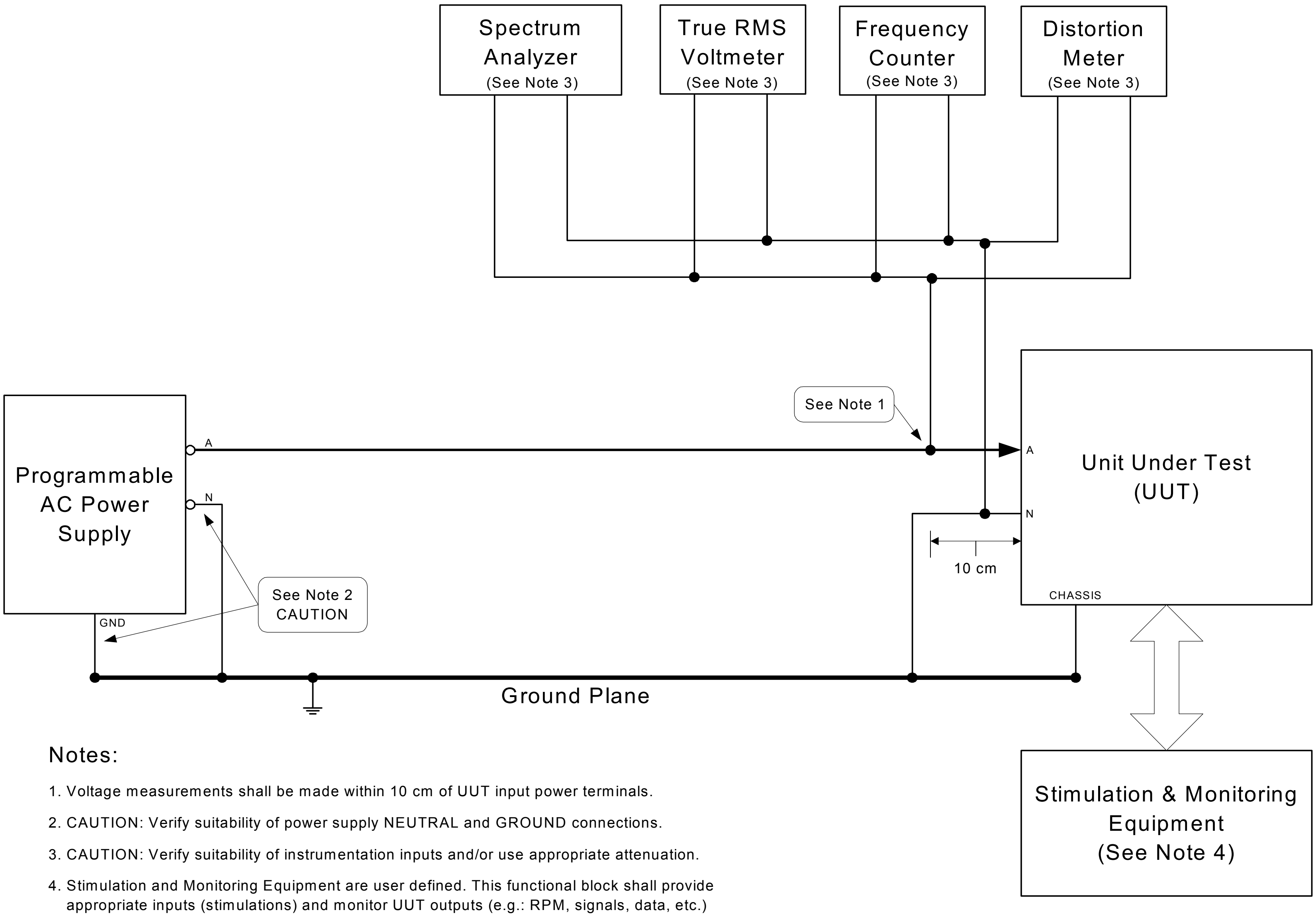


FIGURE SXF107-1. Total distortion.

TABLE SXF107-III. Sample data sheet for SXF107 total voltage distortion for single phase, 60 Hz utilization equipment.

Parameters								Performance
Voltage		Frequency		Voltage Distortion Factor		Time Duration at Condition		Pass/Fail
	V_{rms}		Hz		No Units		min	

Voltage Harmonics		
Fund		%
2nd		%
3rd		%
4th		%
5th		%
6th		%
7th		%
8th		%
9th		%
10th		%
11th		%
12th		%
13th		%
14th		%
15th		%

METHOD SXF108
DC Voltage Component

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: DC Voltage Component

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to a direct current component of AC voltage as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SXF108-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to a direct current component of AC voltage and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SXF108-I. MIL-STD-704 limits for direct current component of AC voltage for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
DC Voltage Component of the AC Voltage	N/A	N/A	N/A	N/A	N/A	± 0.10 V

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter (with capability to measure DC component of AC waveform)
c. Frequency counter

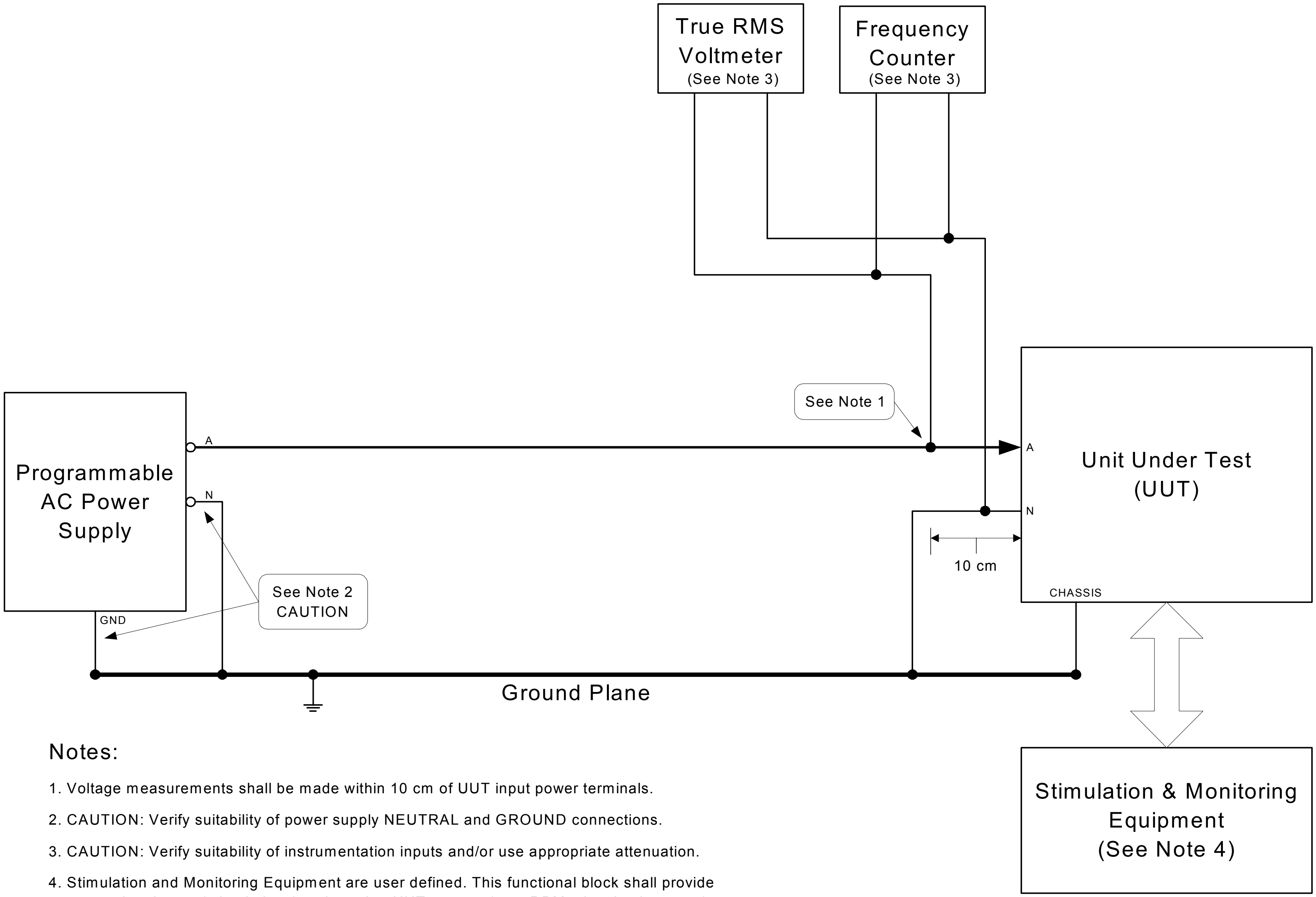
4. Test setup. Configure the test setup as shown in figure SXF108-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF108-1. Set the programmable power supply to produce a voltage waveform having a DC component for test condition A as noted in table SXF108-II. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. The UUT must remain for a length of time that confirms the utilization equipment can continuously operate with the direct current component of the AC voltage and should be not less than thirty (30) minutes. Repeat the test for test condition B as noted in table SXF108-II. Record the voltage, frequency, DC voltage component, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table SXF108-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, set the programmable power supply to produce a voltage sine wave without a DC component. Adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SXF108-II. Test conditions for direct current component of AC voltage for single phase, 60 Hz utilization equipment.

Test Condition	MIL-STD-704F Direct Current Component of AC Voltage
A	+ 0.10V
B	– 0.10 V



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SXF108-1. DC voltage component.

TABLE SXF108-III. Sample data sheet for SXF108 DC voltage component for single phase, 60 Hz utilization equipment.

Test Condition	Parameters								Performance
	Voltage		Frequency		DC Voltage Component		Time Duration at Condition		Pass/Fail
A		V_{rms}		Hz		V_{dc}		min	
B		V_{rms}		Hz		V_{dc}		min	

METHOD SXF109
Normal Voltage Transients

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: Normal Voltage Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when subjected to normal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SXF109-I. The utilization equipment must maintain specified performance during and after the voltage transients. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SXF109-I. MIL-STD-704 limits for normal voltage transients for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Normal Voltage Transients	N/A	N/A	N/A	N/A	N/A	figure 8 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SXF109-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF109-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the

utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

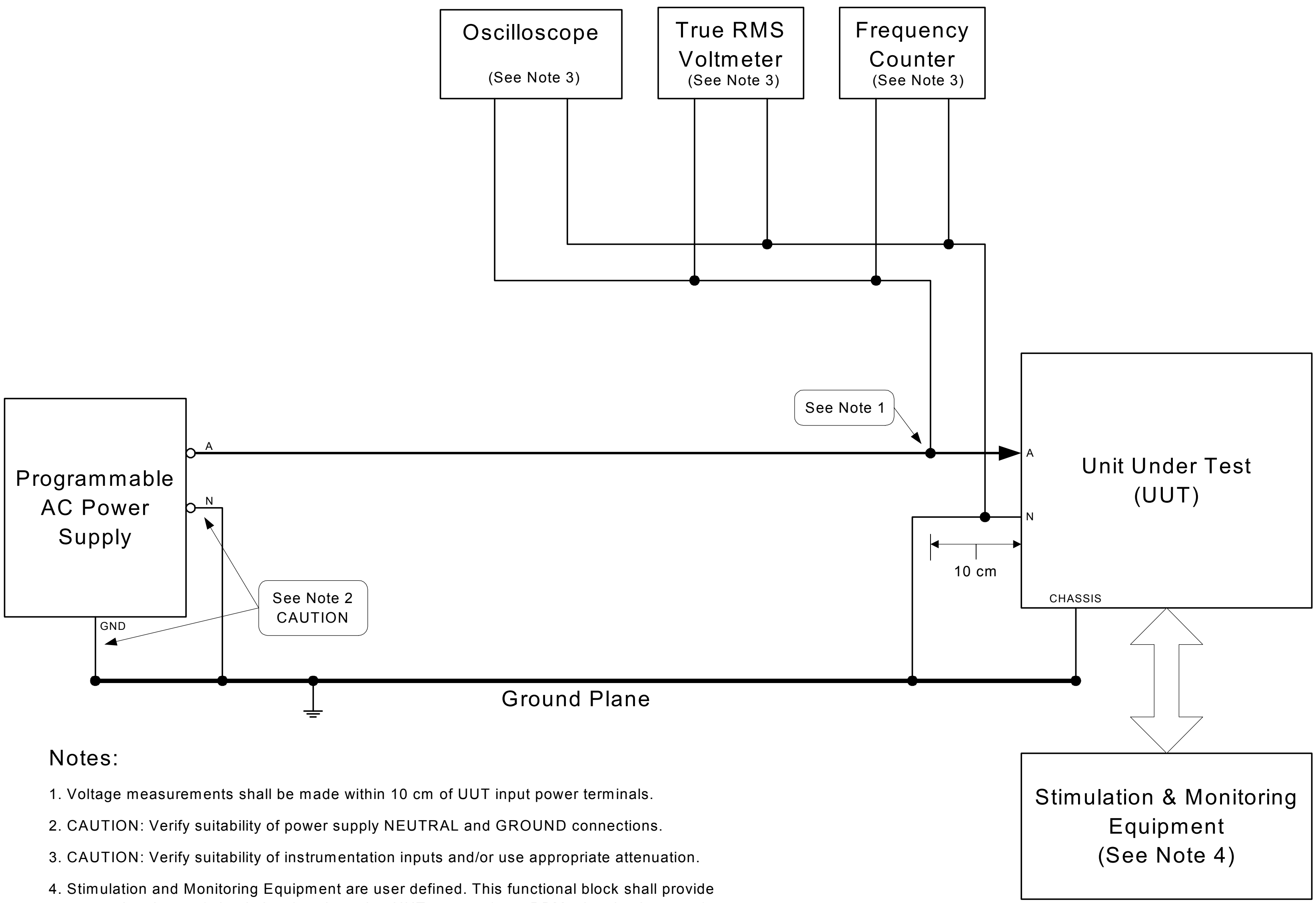
The UUT must be subjected to the voltage transients for each test condition A through I noted in table SXF109-II. The voltage must increase or decrease from steady state voltage to the voltage transient level within ½ cycle (8.33 milliseconds). The voltage must remain at the voltage transient level for the duration noted in table SXF109-II. The voltage must return to steady state over the time duration noted in table SXF109-II. For test condition D, three over-voltage transients of 130 Vrms for 16.67 milliseconds are performed, separated by 0.5 seconds. For test condition H, three under-voltage transients of 70 Vrms for 16.67 milliseconds are performed, separated by 0.5 seconds. For test condition I, an under-voltage transient of 70 Vrms for 16.67 milliseconds is immediately followed by an overvoltage transient of 130 Vrms for 16.67 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal steady state limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltage, steady state frequency, voltage transient level, time duration at voltage transient, oscilloscope trace, and the performance of the UUT for each test condition in the data sheet shown in table SXF109-III. Repeat for each mode of operation of the UUT. In addition, perform the repetitive normal voltage transient test described below.

5.1 Repetitive normal voltage transients test. Program the power supply to provide a continually repeating voltage transient that decreases from 115 Vrms to 100 Vrms in 8.33 msec, then increases to 128 Vrms over 50 msec, then decreases to 115 Vrms over 8.33 msec. The voltage transient is repeated every 0.5 seconds, see figure SXF109-2. The UUT must be subjected to the repetitive voltage transient for a length of time that confirms the utilization equipment can continuously operate and should be not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltage, steady state frequency, high voltage transient level, low voltage transient level, oscilloscope trace, time duration at test condition, and the performance of the UUT in the data sheet shown in table SXF109-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SXF109-II. Test conditions for normal voltage transients for single phase, 60 Hz utilization equipment.

Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage milliseconds
Overvoltage Transients				
A	N/A	152 Vrms	1/2 cycle	N/A
B	< 8.333 msec	130 Vrms	1 cycle	< 8.333 msec
C	< 8.333 msec	130 Vrms	1 cycle	250 msec
D	< 8.333 msec	130 Vrms (3 times)	1 cycle every 0.5 sec	< 8.333 msec
Undervoltage Transients				
E	N/A	31 Vrms	1/2 cycle	N/A
F	< 8.333 msec	70 Vrms	1 cycle	< 8.333 msec
G	< 8.333 msec	70 Vrms	1 cycle	107 msec
H	< 8.333 msec	70 Vrms (3 times)	1 cycle every 0.5 sec	< 8.333 msec
Combined Transient				
I	< 8.333 msec then < 8.333 msec	70 Vrms 130 Vrms	1 cycle 1 cycle	< 8.333 msec 250 msec



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SXF109-1. Normal voltage transients.

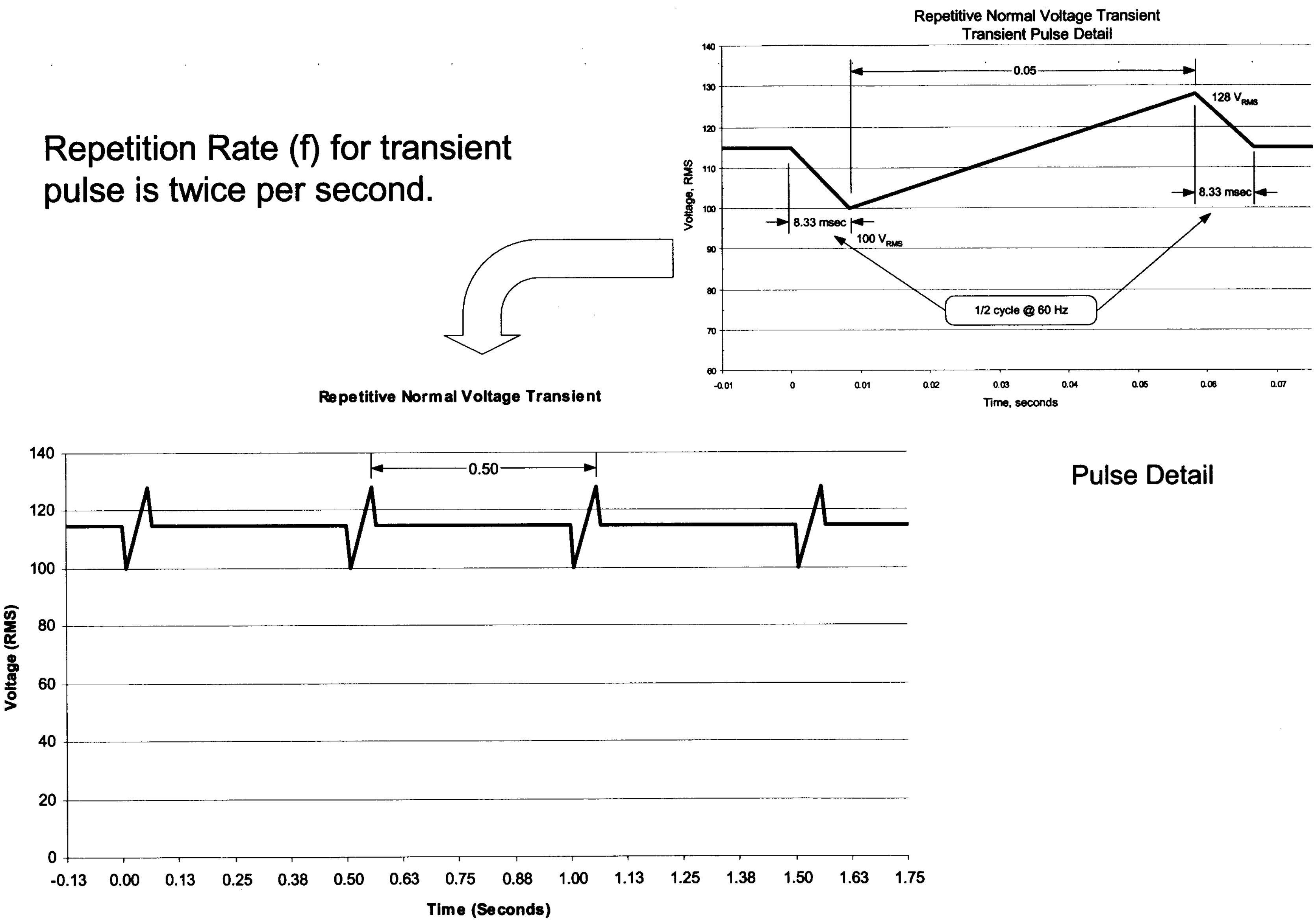


FIGURE SXF109-2. Repetitive normal voltage transient.

TABLE SXF109-III. Sample data sheet for SXF109 normal voltage transients for MIL-STD-704 for single phase, 60 Hz utilization equipment.

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
B		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
C		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
D		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
E		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
F		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
G		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
H		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
I		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
						V_{rms}		msec			
Repetitive Normal Voltage Transient											
Repetitive Transient	Steady State Voltage		Steady State Frequency		High Voltage Transient		Low Voltage Transient		Oscilloscope Trace		
		V_{rms}		Hz		V_{rms}		V_{rms}	Attach Trace	V_{rms} vs. Time	
	Time Duration at Test Condition										
		minutes									

METHOD SXF110
Normal Frequency Transients

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Normal Frequency Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when subjected to normal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to frequency transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SXF110-I. The utilization equipment must maintain specified performance during and after the frequency transients. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SXF110-I. MIL-STD-704 limits for normal frequency transients for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Normal Frequency Transients	N/A	N/A	N/A	N/A	N/A	figure 10 MIL-STD-704F
Normal Maximum Rate of Change of Frequency	N/A	N/A	N/A	N/A	N/A	100 Hz/sec

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SXF110-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

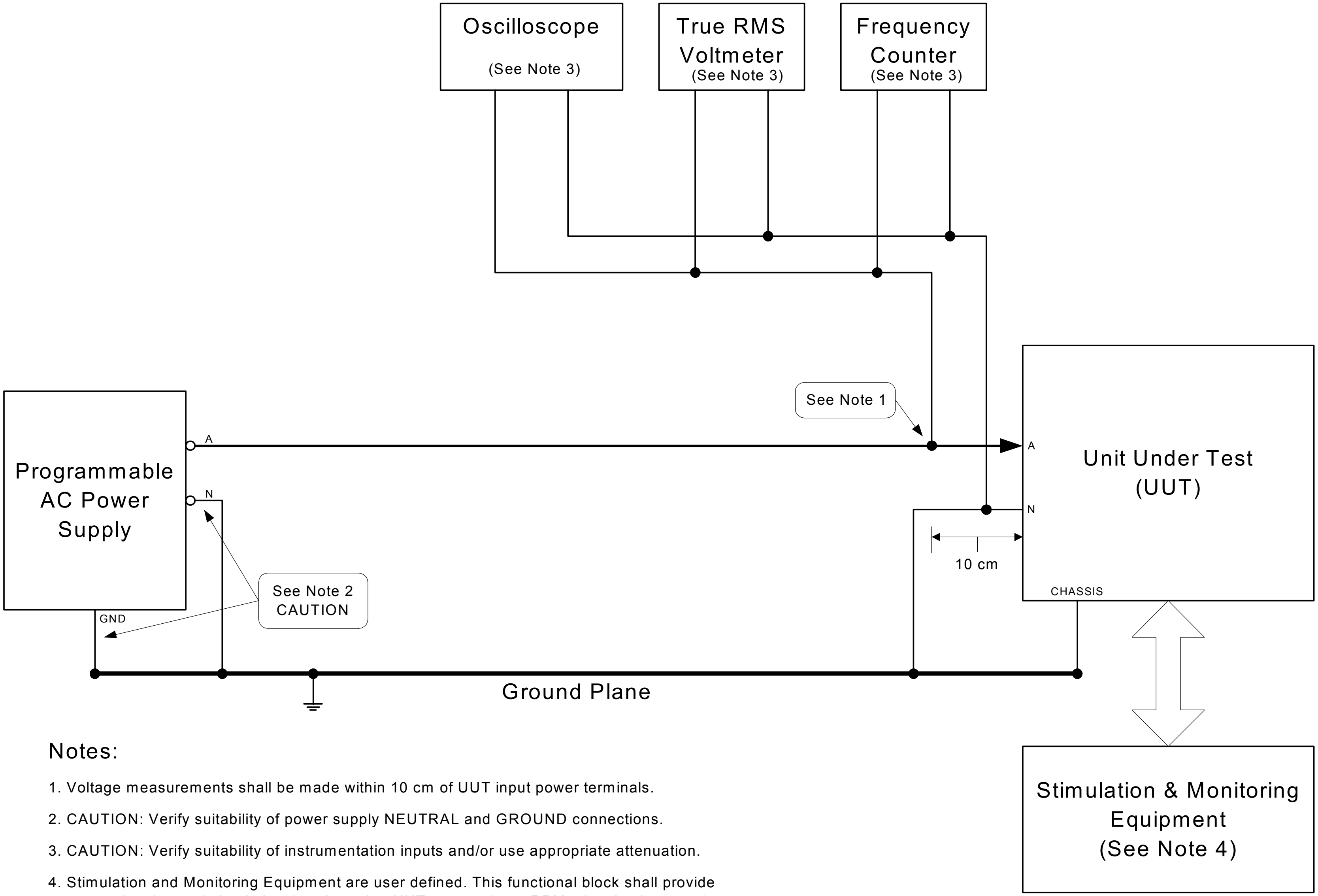
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF110-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

The UUT must be subjected to the frequency transients for each test condition A through E noted in table SXF110-II. The frequency must increase or decrease from steady state frequency to the frequency transient level over the duration noted; the frequency must remain at the frequency transient level for the duration noted; and the frequency must return from the frequency transient level over the duration noted. For test condition E, an underfrequency transient of 59 Hz is immediately followed by an overfrequency transient of 61 Hz. For each test condition, monitor the performance of the UUT during the frequency transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal steady state limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltage, steady state frequency, frequency transient level, time at frequency transient, oscilloscope trace (Hz vs. time), and the performance of the UUT for each test condition in the data sheet shown in table SXF110-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SXF110-II. Test conditions for normal frequency transients for single phase, 60 Hz utilization equipment.

Test Condition	Time From Steady State Frequency to Frequency Transient Level milliseconds	Frequency Transient Level Hz	Duration at Frequency Transient Level	Time From Frequency Transient Level to Steady State Frequency
Overfrequency Transients				
A	10 msec	61 Hz	½ cycle	10 msec
B	10 msec	61 Hz	5 sec	10 msec
Underfrequency Transients				
C	10 msec	59 Hz	½ cycle	10 msec
D	10 msec	59 Hz	5 sec	10 msec
Combined Transient				
E	10 msec then 10 msec	59 Hz 61 Hz	½ cycle ½ cycle	10 msec 10 msec



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SXF110-1. Normal frequency transients.

TABLE SXF110-III. Sample data sheet for SXF110 normal frequency transients for MIL-STD-704 for single phase, 60 Hz utilization equipment.

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace		Pass/Fail
A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
B		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
C		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
D		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
E		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
						Hz		msec			

METHOD SXF201
Power Interrupt

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Transfer Interrupt

PARAMETER: Power Interrupt

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when subjected to power interrupts as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for transfer aircraft electrical conditions when subjected to power interrupts as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SXF201-I. The utilization equipment must maintain the specified performance during power interrupts. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SXF201-I. MIL-STD-704 power transfer limits for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Power Interrupt	N/A	N/A	N/A	N/A	N/A	50 msec
Voltage NLSS	N/A	N/A	N/A	N/A	N/A	105 V
Voltage NHSS	N/A	N/A	N/A	N/A	N/A	125 V

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope
e. Resistive dummy load

4. Test setup. Configure the test setup as shown in figure SXF201-1. The dummy resistive load placed in parallel to the UUT should be sized to draw three times the steady state current of the

UUT. Note: This is done to ensure that the UUT test does not lose stored energy to other aircraft loads during power interrupts. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

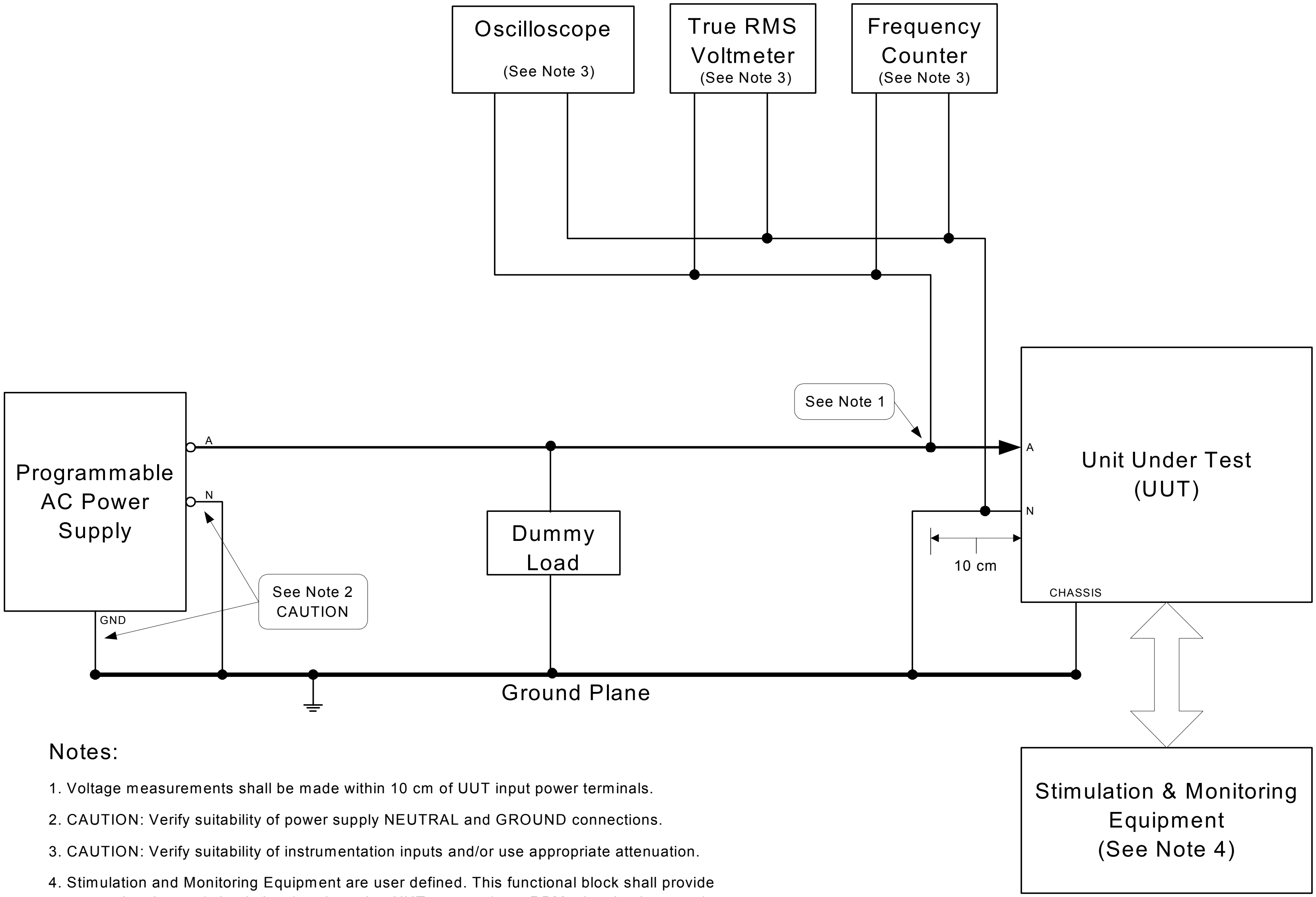
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF201-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through K noted in table SXF201-II, adjust the voltage to the steady state voltage listed. Perform a power interrupt (0 V) of the duration listed. The voltage must decrease from the steady state voltage to 0 Volts within ½ cycle (8.33 milliseconds), remain at 0 Volts for the duration listed for the test condition, and return form 0 Volts to the steady state voltage within ½ cycle (8.33 milliseconds). For test condition J, three 50 millisecond power interrupts are performed, separated by 0.5 seconds. For test condition K a normal overvoltage transient follows the power interrupt. The normal voltage transient is 130 Vrms for 1 cycle and returns to nominal voltage over the next 250 milliseconds. For test condition L a normal undervoltage transient follows the power interrupt. The normal voltage transient is 70 Vrms for 1 cycle and returns to nominal voltage over the next 107 milliseconds. For each test condition, monitoring the performance of the UUT according to the utilization equipment performance test procedures for power transfer operation to verify that the UUT is providing specified performance for transfer aircraft electrical conditions. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing the performance specified for normal aircraft electrical conditions (if the UUT is allowed degraded performance during power interrupts, verify the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage). Record the steady state voltage, steady state frequency, time duration of power interrupts, and the performance of the UUT for each test condition in the data sheet shown in table SXF201-III. Repeat each test condition 5 times. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SXF201-II. Test conditions for transfer interrupt for single phase, 60 Hz utilization equipment.

Test Condition	Steady State Voltage	Duration of Interrupt
A	Nominal Voltage	50 msec
B	NLSS Voltage	50 msec
C	NHSS Voltage	50 msec
D	Nominal Voltage	30 msec
E	NLSS Voltage	30 msec
F	NHSS Voltage	30 msec
G	Nominal Voltage	10 msec
H	NLSS Voltage	10 msec
I	NHSS Voltage	10 msec
J	Nominal Voltage	50 msec (repeated 3 times, separated by 0.5 sec)
K	Nominal Voltage	50 msec (followed by a normal voltage transient of 130 Vrms for 1 cycle and return to steady state voltage in 250 msec)
L	Nominal Voltage	50 msec (followed by a normal voltage transient of 70 Vrms for 1 cycle and return to steady state voltage in 107 msec)



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SXF201-1. Power interrupt.

TABLE SXF201-III. Sample data sheet for SXF201 power interrupt for single phase, 60 Hz utilization equipment.

<table>
<tr><th rowspan="2">Test Condition</th><th colspan="6">Parameters</th><th>Performance</th></tr>
<tr><th colspan="2">Voltage</th><th colspan="2">Frequency</th><th colspan="2">Time Duration of Power Interrupt</th><th>Pass/Fail</th></tr>
<tr><td>A</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>B</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>C</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>D</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>E</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>F</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>G</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>H</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>I</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td>J</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td></td></tr>
<tr><td rowspan="4">K</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td rowspan="4"></td></tr>
<tr><td colspan="6">Overvoltage Transient</td></tr>
<tr><td colspan="3">Voltage Transient</td><td colspan="3">Time at Voltage Transient Level</td></tr>
<tr><td></td><td colspan="2">V_{rms}</td><td colspan="2"></td><td>msec</td></tr>
<tr><td rowspan="4">L</td><td></td><td>V_{rms}</td><td></td><td>Hz</td><td></td><td>msec</td><td rowspan="4"></td></tr>
<tr><td colspan="6">Overvoltage Transient</td></tr>
<tr><td colspan="3">Voltage Transient</td><td colspan="3">Time at Voltage Transient Level</td></tr>
<tr><td></td><td colspan="2">V_{rms}</td><td colspan="2"></td><td>msec</td></tr>
</table>

METHOD SXF301
Abnormal Steady State Limits for Voltage and Frequency

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Abnormal

PARAMETER: Abnormal Steady State Limits for Voltage and Frequency

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Abnormal Low Steady State (ALSS) limits and the Abnormal High Steady State (AHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when supplied input power of voltage and frequency at the specified abnormal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table SXF301-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the abnormal steady state voltage and frequency limits and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the abnormal steady state voltage and frequency limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SXF301-I. MIL-STD-704 abnormal limits for steady state voltage and frequency for single phase, 60 Hz utilization equipment.

Abnormal Limit	704A	704B	704C	704D	704E	704F
Voltage ALSS	N/A	N/A	N/A	N/A	N/A	100 V
Voltage AHSS	N/A	N/A	N/A	N/A	N/A	128 V
Frequency ALSS	N/A	N/A	N/A	N/A	N/A	59.5 Hz
Frequency AHSS	N/A	N/A	N/A	N/A	N/A	60.5 Hz

3. Apparatus. The test equipment should be as follows:

a. Adjustable AC power supply
b. True RMS voltmeter
c. Frequency counter

4. Test setup. Configure the test setup as shown in figure SXF301-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

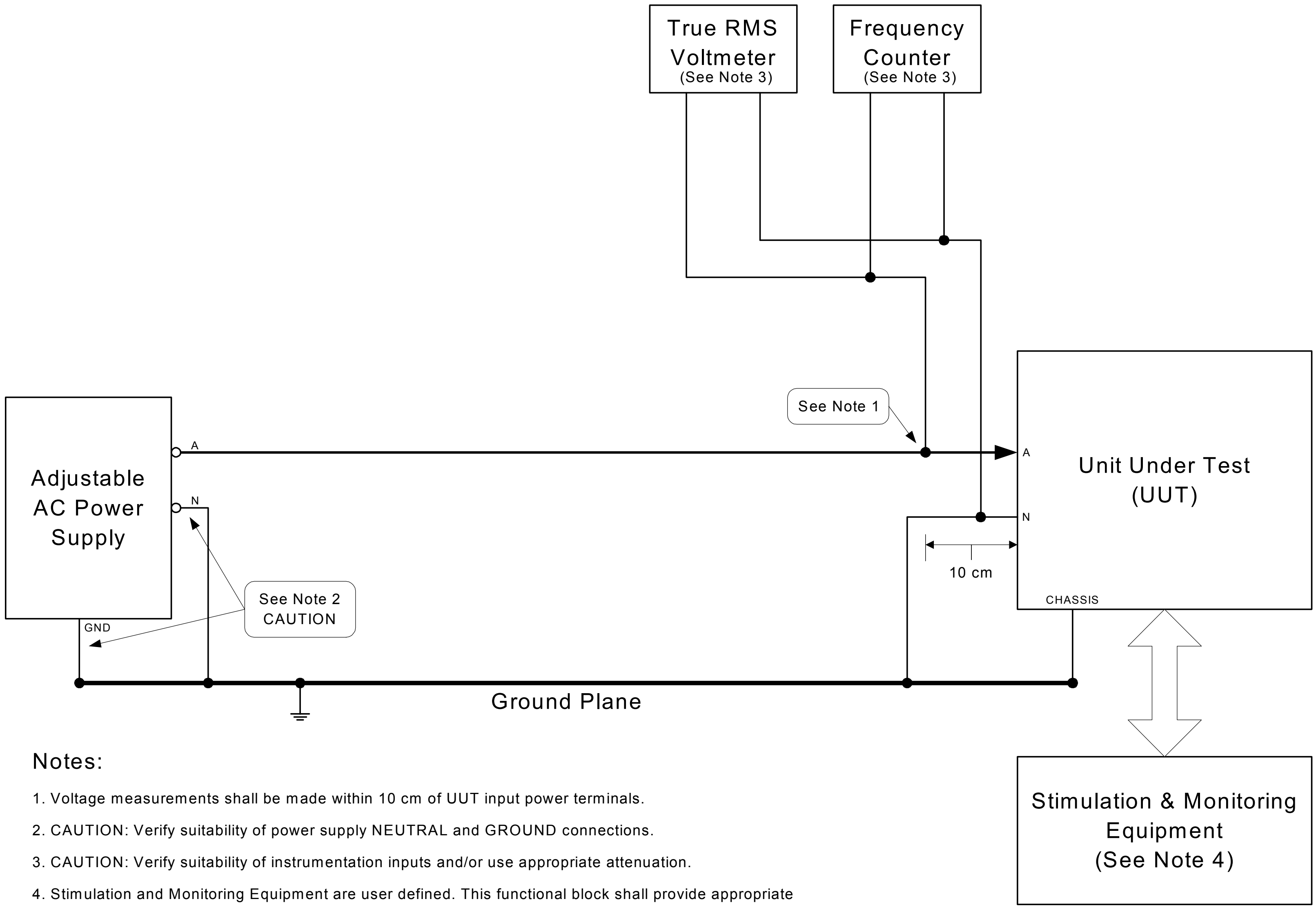
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF301-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through H noted in table SXF301-II, the UUT must remain for a length of time that confirms the utilization equipment can perform as specified at the abnormal steady state voltage and frequency limits and should be not less than thirty (30) minutes. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. For each test condition shut down the UUT and verify that the UUT can be re-started. After re-start conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Adjust the voltage to the nominal steady state voltage of 115 Vrms and adjust the frequency to the nominal steady state frequency of 60 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the voltage, frequency, time duration at test condition, successful/unsuccessful re-start and the performance of the UUT for each test condition in the data sheet shown in table SXF301-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SXF301-II. Test conditions for abnormal steady state limits for voltage and frequency for single phase, 60 Hz utilization equipment.

Test Condition	Voltage	Frequency
A	Nominal Voltage	ALSS Frequency
B	Nominal Voltage	AHSS Frequency
C	ALSS Voltage	Nominal Frequency
D	ALSS Voltage	ALSS Frequency
E	ALSS Voltage	AHSS Frequency
F	AHSS Voltage	Nominal Frequency
G	AHSS Voltage	ALSS Frequency
H	AHSS Voltage	AHSS Frequency



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SXF301-1. Abnormal steady state limits for voltage and frequency.

TABLE SXF301-III. Sample data sheet for SXF301 abnormal steady state limits for voltage and frequency for single phase, 60 Hz utilization equipment.

Test Condition	Parameters							Performance
	Voltage		Frequency		Time Duration at Condition		Re-Start (Yes/No)	Pass/Fail
A		V_{rms}		Hz		min		
B		V_{rms}		Hz		min		
C		V_{rms}		Hz		min		
D		V_{rms}		Hz		min		
E		V_{rms}		Hz		min		
F		V_{rms}		Hz		min		
G		V_{rms}		Hz		min		
H		V_{rms}		Hz		min		

METHOD SXF302
Abnormal Voltage Transients

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Abnormal

PARAMETER: Abnormal Voltage Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when subjected to abnormal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to voltage transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SXF302-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SXF302-I. MIL-STD-704 limits for abnormal voltage transients for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Abnormal Voltage Transients	N/A	N/A	N/A	N/A	N/A	figure 9 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

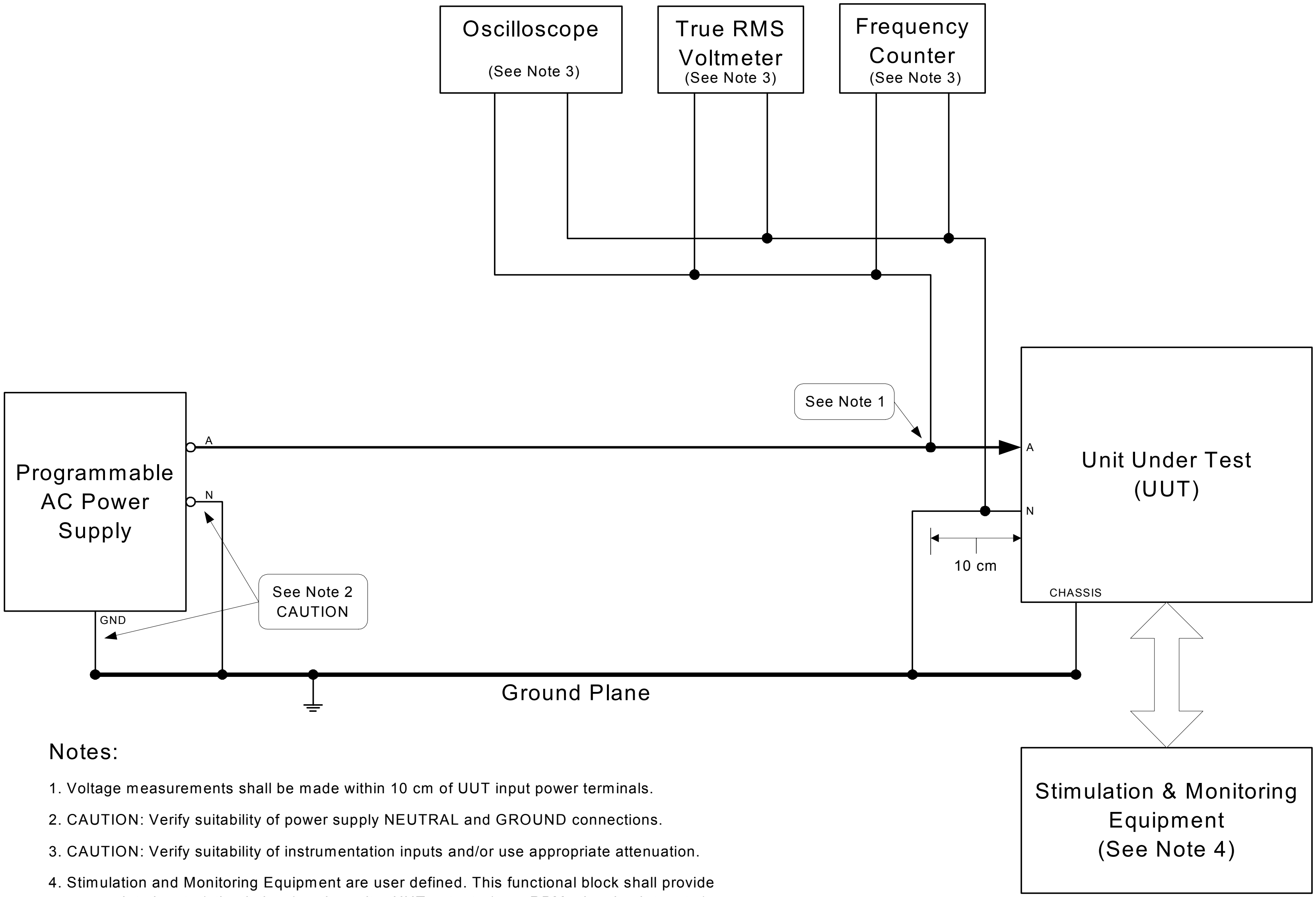
4. Test setup. Configure the test setup as shown in figure SXF302-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. <u>Compliance test</u>. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF302-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

The UUT must be subjected to the voltage transients for each test condition A through K noted in table SXF302-II. The voltage must increase or decrease from steady state voltage to the voltage transient level within ½ cycle (8.33 milliseconds). The voltage must remain at the voltage transient level for the duration noted in table SXF302-II. The voltage must return to steady state over the time duration noted in table SXF302-II. For test condition E, three over-voltage transients of 180 Vrms for 1/2 cycle are performed, separated by 0.5 second. For test condition J, three under-voltage transients of 50 Vrms for 1/2 cycle are performed, separated by 0.5 seconds. For test condition K, an under-voltage transient of 50 Vrms for 1/2 cycle is immediately followed by an overvoltage transient of 180 Vrms for 1/2 cycle and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits, and has not suffered damage. Record the steady state voltage, steady state frequency, voltage transient level, time duration at voltage transient, oscilloscope trace, and the performance of the UUT for each test condition in the data sheet shown in table SXF302-III. Repeat for each mode of operation of the UUT.

TABLE SXF302-II. Test conditions for abnormal voltage transients for single phase, 60 Hz utilization equipment.

Test Condition	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vrms	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Overvoltage Transients				
A	< 8.333 msec	180 Vrms	1/2 cycle	< 8.333 msec
B	< 8.333 msec	180 Vrms	1/2 cycle	16.67 msec
	then	147 Vrms	Decreasing	16.67 msec
	then	140 Vrms	Decreasing	2.0 sec
		115 Vrms		
C	< 8.333 msec	160 Vrms	1 cycle	< 8.333 msec
D	< 8.333 msec	160 Vrms	1 cycle	16.67 msec
	then	140 Vrms	Decreasing	2.0 sec
		115 Vrms		
E	< 8.333 msec	180 Vrms (3 times)	1/2 cycle every 0.5 sec	< 8.333 msec
Undervoltage Transients				
F	< 8.333 msec	50 Vrms	1/2 cycle	< 8.333 msec
G	< 8.333 msec	50 Vrms	1/2 cycle	16.67 msec
	then	83 Vrms	Increasing	16.67 msec
	then	90 Vrms	Increasing	2.0 sec
		115 Vrms		
H	< 8.333 msec	70 Vrms	1 cycle	< 8.333 msec
I	< 8.333 msec	70 Vrms	1 cycle	16.67 msec
	then	90 Vrms	Increasing	2.0 sec
		115 Vrms		
J	< 8.333 msec	50 Vrms (3 times)	1/2 cycle every 0.5 sec	< 8.333 msec
Combined Transient				
K	< 8.333 msec	50 Vrms	1/2 cycle	< 8.333 msec
	< 8.333 msec	180 Vrms	1/2 cycle	16.67 msec
	then	147 Vrms	Decreasing	16.67 msec
	then	140 Vrms	Decreasing	2.0 sec
		115 Vrms		



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE SXF302-1. Abnormal voltage transients.

TABLE SXF302-III. Sample data sheet for SXF302 abnormal voltage transients for single phase, 60 Hz utilization equipment.

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
A		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
B		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
C		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
D		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
E		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
F		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
G		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
H		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
I		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
J		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
K		V_{rms}		Hz		V_{rms}		msec	Attach Trace	V_{rms} vs. Time	
						V_{rms}		msec			

METHOD SXF303
Abnormal Frequency Transients

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Abnormal

PARAMETER: Abnormal Frequency Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when subjected to abnormal frequency transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to frequency transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table SXF303-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SXF303-I. MIL-STD-704 limits for abnormal frequency transients for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Abnormal Frequency Transients	N/A	N/A	N/A	N/A	N/A	figure 11 MIL-STD-704F
Abnormal Maximum Rate of Change of Frequency	N/A	N/A	N/A	N/A	N/A	150 Hz/sec

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SXF303-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF303-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions.

The UUT must be subjected to the frequency transients for each test condition A through E noted in table SXF303-II. The frequency must increase or decrease from steady state frequency to the frequency transient level over the duration noted; the frequency must remain at the frequency transient level for the duration noted; and the frequency must return from the frequency transient level over the duration noted. For test condition E, an underfrequency transient of 320 Hz is immediately followed by an overfrequency transient of 480 Hz. For each test condition, monitor the performance of the UUT during the frequency transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions, and has not suffered damage. Record the steady state voltage, steady state frequency, frequency transient level, time at frequency transient, oscilloscope trace (Hz vs. time), and the performance of the UUT for each test condition in the data sheet shown in table SXF303-III. Repeat for each mode of operation of the UUT.

TABLE SXF303-II. Test conditions for MIL-STD-704 abnormal frequency transients for single phase, 60 Hz utilization equipment.

Test Condition	Time From Steady State Frequency to Frequency Transient Level milliseconds	Frequency Transient Level Hz	Duration at Frequency Transient Level	Time From Frequency Transient Level to Steady State Frequency milliseconds
Overfrequency Transients				
A	½ cycle	61 Hz	½ cycle	½ cycle
B	½ cycle	61 Hz	6.968 seconds	½ cycle
Underfrequency Transients				
C	½ cycle	50 Hz	½ cycle	½ cycle
D	½ cycle	50 Hz	6.968 seconds	½ cycle
Combined Transient				
E	½ cycle ½ cycle	50 Hz then 61 Hz	½ cycle ½ cycle	½ cycle ½ cycle

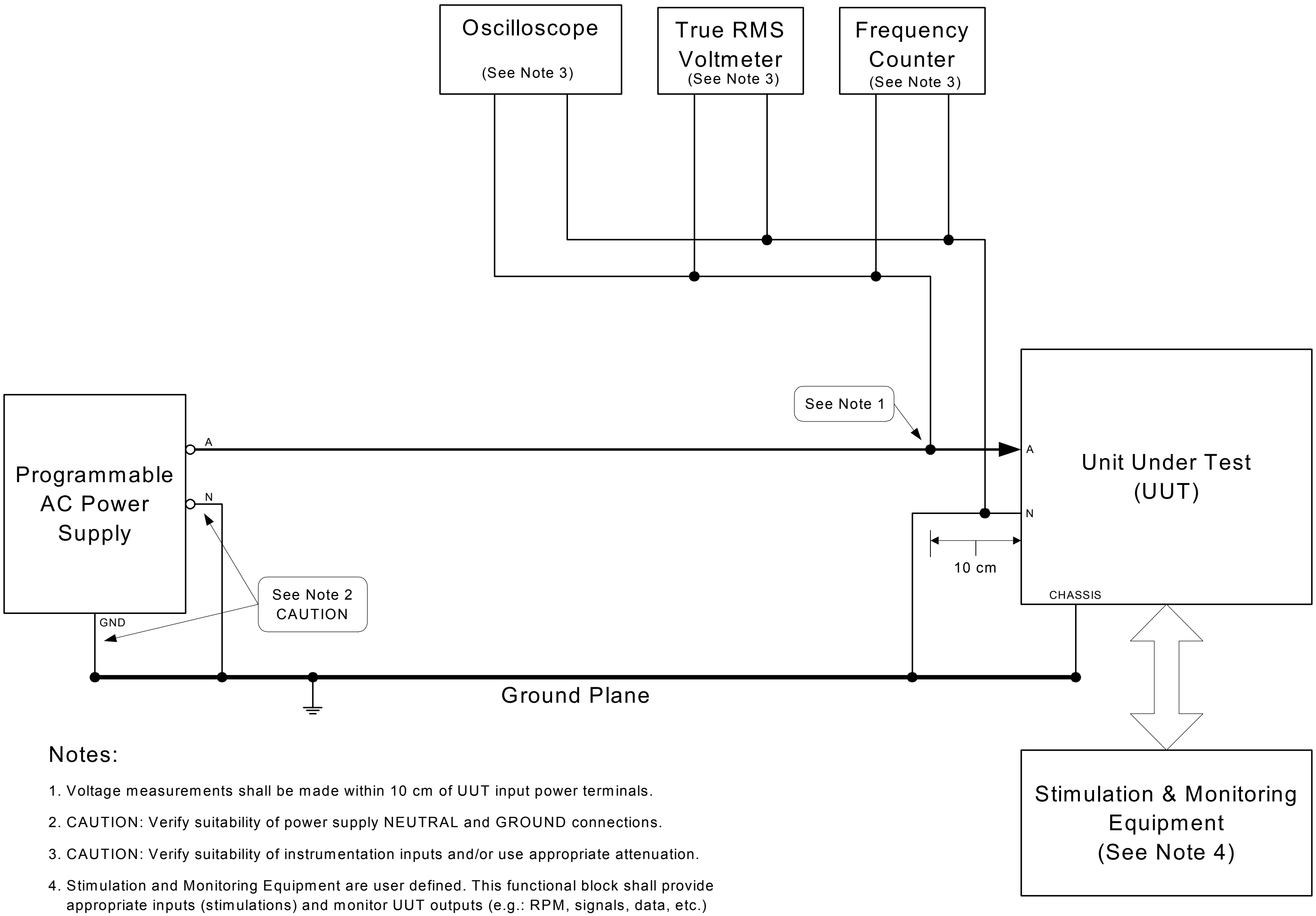


FIGURE SXF303-1. Abnormal frequency transients.

TABLE SXF303-III. Sample data sheet for SXF303 abnormal frequency transients for MIL-STD-704A for single phase, 60 Hz utilization equipment.

Test Condition	Parameters										Performance
	Steady State Voltage		Steady State Frequency		Frequency Transient		Time at Frequency Transient Level		Oscilloscope Trace		Pass/Fail
A		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
B		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
C		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
D		V_{rms}		Hz		Hz		sec	Attach Trace	Hz vs. Time	
E		V_{rms}		Hz		Hz		msec	Attach Trace	Hz vs. Time	
						Hz		msec			

METHOD SXF401
Emergency Steady State Limits for Voltage and Frequency

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Emergency

PARAMETER: Emergency Steady State Limits for Voltage and Frequency

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment operates and maintains specified performance when provided power with voltage and frequency at the Emergency Low Steady State (ELSS) limits and the Emergency High Steady State (EHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. For MIL-STD-704F, the single phase, 115 volt, 60 Hz power utilization equipment normal steady state limits are the same as the emergency steady state limits. The emergency steady state limits for single phase, 115 Volt, 60 Hz equipment are noted in table SXF401-I. Performance of test method SXF102 will constitute performance of test method SXF401.

TABLE SXF401-I. MIL-STD-704 emergency limits for steady state voltage and frequency for single phase, 60 Hz utilization equipment.

Emergency Limit	704A	704B	704C	704D	704E	704F
Voltage ELSS	N/A	N/A	N/A	N/A	N/A	105 V
Voltage EHSS	N/A	N/A	N/A	N/A	N/A	125 V
Frequency ELSS	N/A	N/A	N/A	N/A	N/A	59.5 Hz
Frequency EHSS	N/A	N/A	N/A	N/A	N/A	60.5 Hz

METHOD SXF501
No Tests

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Starting

PARAMETER: No Tests

Starting operations are usually not applicable to AC utilization equipment.

METHOD SXF601
Power Failure (Single Phase)

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL OPERATING CONDITION: Power Failure

PARAMETER: Power Failure (Single Phase)

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 Volt, 60 Hz power utilization equipment operates and maintains specified performance when subjected to power failures as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to power failures as specified by the applicable edition(s) of MIL-STD-704 and as noted in table SXF601-I. The utilization equipment must maintain the specified performance during the power failures. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE SXF601-I. MIL-STD-704 power failure limits for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Power Failure	N/A	N/A	N/A	N/A	N/A	2 sec figure 9 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable AC power supply
b. True RMS voltmeter
c. Frequency counter
d. Oscilloscope

4. Test setup. Configure the test setup as shown in figure SXF601-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF601-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through C noted in table SXF601-II, perform a power failure (0 V) of the duration listed. The voltage must decrease from the steady state voltage to 0 Volts within ½ cycle (8.33 milliseconds), remain at 0 Volts for the duration listed for the test condition, and return from 0 Volts to the steady state voltage within ½ cycle (8.33 milliseconds). For each test condition, monitor the performance of the UUT according to the utilization equipment performance test procedures for power failure operation to verify that the UUT is providing specified performance for power failure aircraft electrical conditions. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the steady state voltage, steady state frequency, time duration of power failure, and the performance of the UUT for each test condition in the data sheet shown in table SXF601-III. Repeat each test condition 5 times. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE SXF601-II. Test conditions for single phase power failures for single phase, 60 Hz utilization equipment.

Test Condition	Duration of Power Failure
A	100 msec
B	500 msec
C	2 seconds

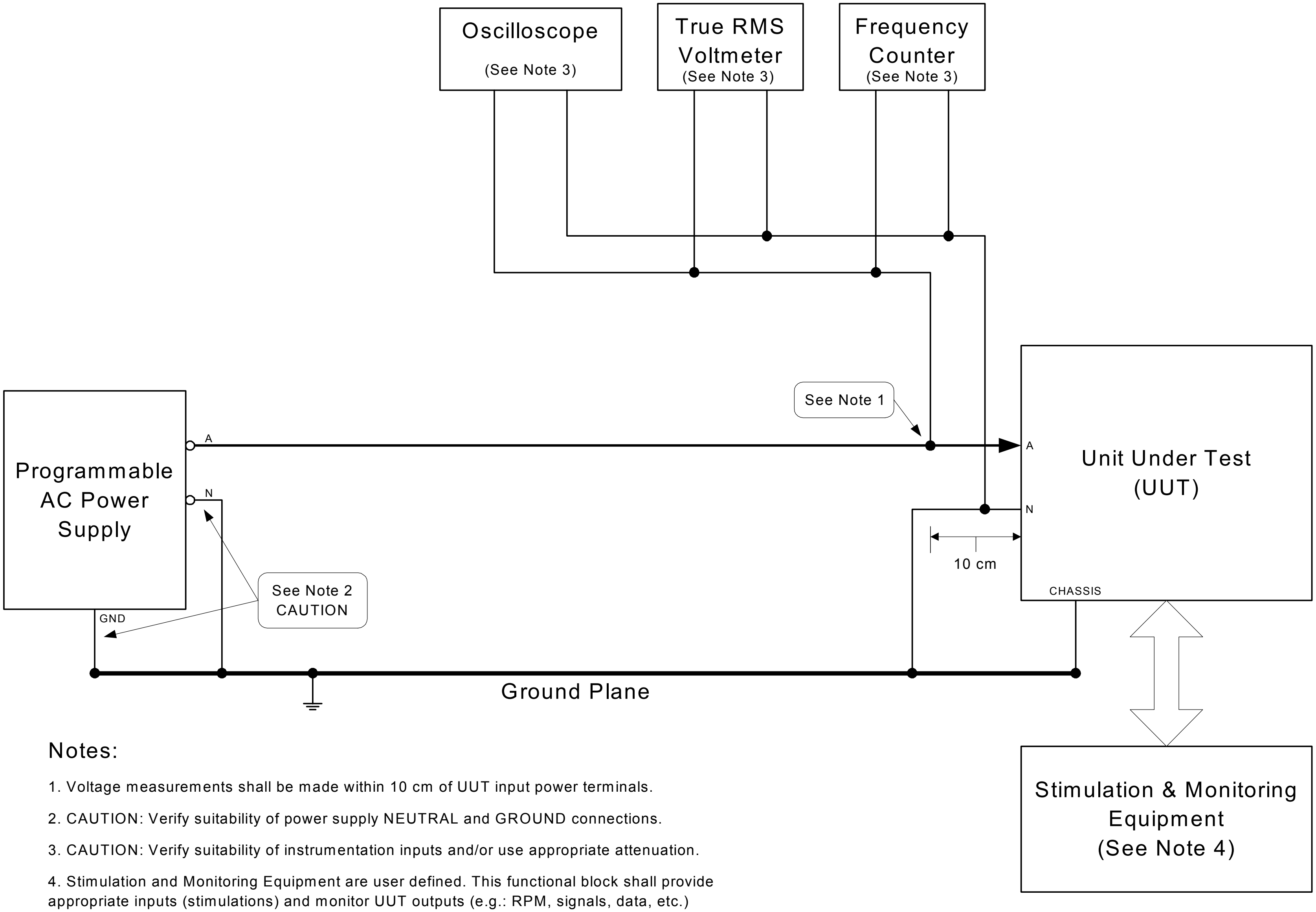


FIGURE SXF601-1. Power failure.

TABLE SXF601-III. Sample data sheet for SXF601 power failure (single phase) for single phase, 60 Hz utilization equipment.

Test Condition	Parameters						Performance
	Voltage		Frequency		Time Duration of Power Failure		Pass/Fail
A		V_{rms}		Hz		msec	
B		V_{rms}		Hz		msec	
C		V_{rms}		Hz		sec	

TEST METHOD SXF602
No Test Required

POWER GROUP:	Single Phase, 60 Hz, 115 V
AIRCRAFT ELECTRICAL OPERATING CONDITION:	Power Failure
PARAMETER:	No Test Required. Test number SXF602 is not used so that the Single Phase, 60 Hz, 115 V (SXF) test numbers coincide with the Three Phase, 115 V (TAC and TVF) test sequence numbers.

METHOD SXF603
Phase Reversal (Single Phase)

POWER GROUP: Single Phase, 60 Hz, 115 V

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Power Failure

PARAMETER: Phase Reversal (Single Phase)

1. Scope.

1.1 Purpose. This test procedure is used to verify that single phase, 115 volt, 60 Hz power utilization equipment is not damaged by phase reversal or a positive physical means is employed to prevent phase reversal.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment is not damaged and does not cause an unsafe condition when the line and neutral connection are reversed for the applicable edition(s) of MIL-STD-704 and as noted in table SXF603-I. A positive physical means to prevent phase reversal may be used to fulfill this requirement.

TABLE SXF603-I. MIL-STD-704 phase reversal requirement for single phase, 60 Hz utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Phase Reversal	N/A	N/A	N/A	N/A	N/A	Phase Reversal Does not Cause Damage

3. Apparatus. The test equipment should be as follows:

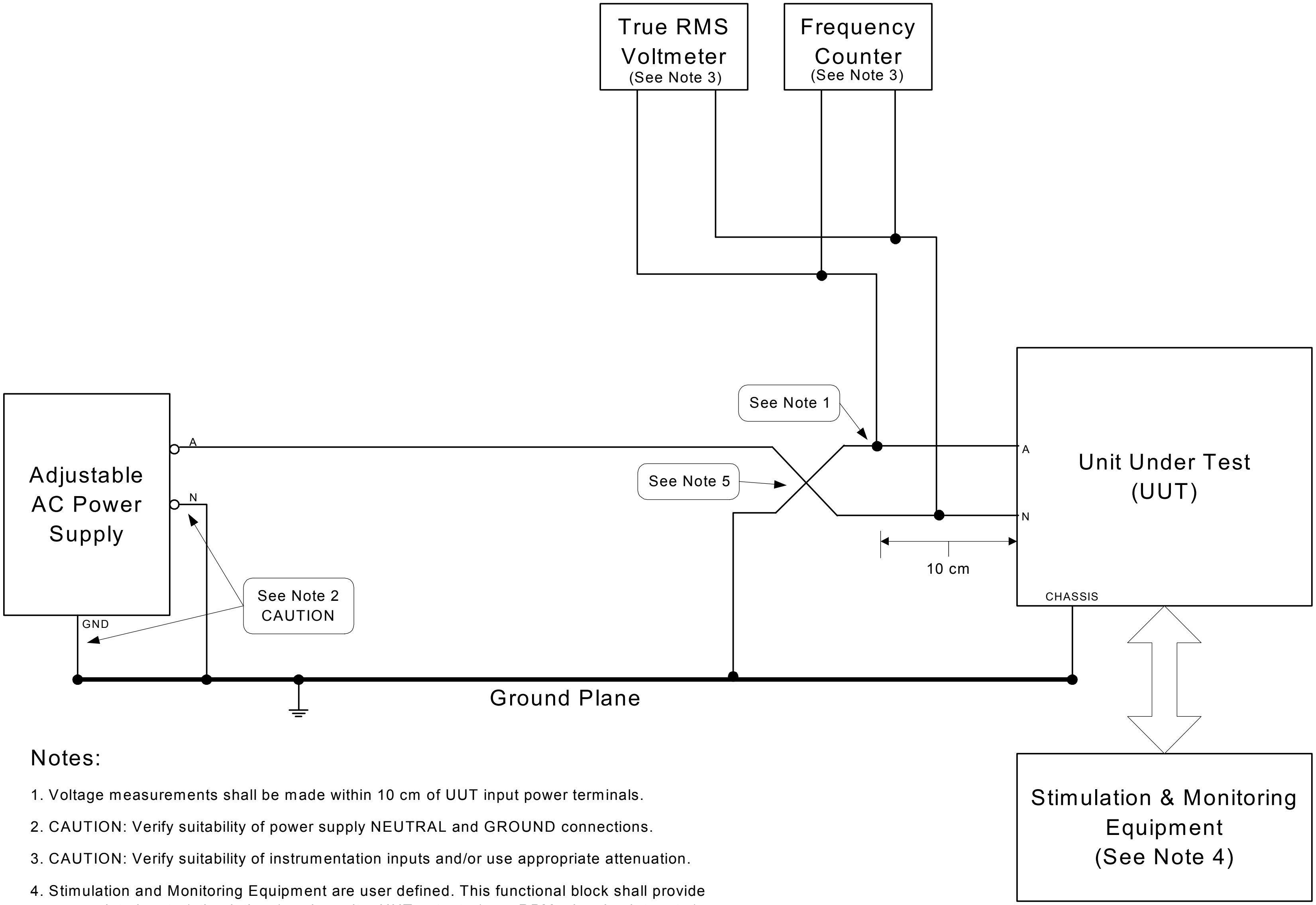
a. Adjustable AC power supply
b. True RMS voltmeter
c. Frequency counter

4. Test setup. Configure the test setup as shown in figure SXF603-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. If a positive physical means is employed to prevent phase reversal, confirm that the line and neutral conductor cannot be reversed.

If the line and neutral conductor can be reversed, with the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF603-1 (line and neutral conductors reversed). Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Energize the UUT. The UUT must remain for a length of time that confirms the utilization equipment is not damaged and does not cause an unsafe condition due to phase reversal and should be not less than thirty (30) minutes. Record the steady state voltage, steady state frequency, time duration at phase reversal test condition, and the performance of the UUT in the data sheet shown in table SXF603-II.

With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure SXF603-2 (line and neutral conductors connected properly). Turn on the power source and adjust the voltage to the nominal steady state voltage of 115 Vrms (line-to-neutral) and adjust the frequency to the nominal steady state frequency of 60 Hz. Energize the UUT. The UUT must remain for a length of time that confirms the utilization equipment was not damaged and does not cause an unsafe condition after the phase reversal and should be not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has returned to the performance specified for normal aircraft electrical conditions and has not suffered damage. Record the steady state voltage, steady state frequency, time duration at test condition, and the performance of the UUT in the data sheet shown in table SXF603-II. Repeat for each mode of operation of the UUT.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply NEUTRAL and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)
5. Phase Polarity is reversed.

FIGURE SXF603-1. Phase reversal.

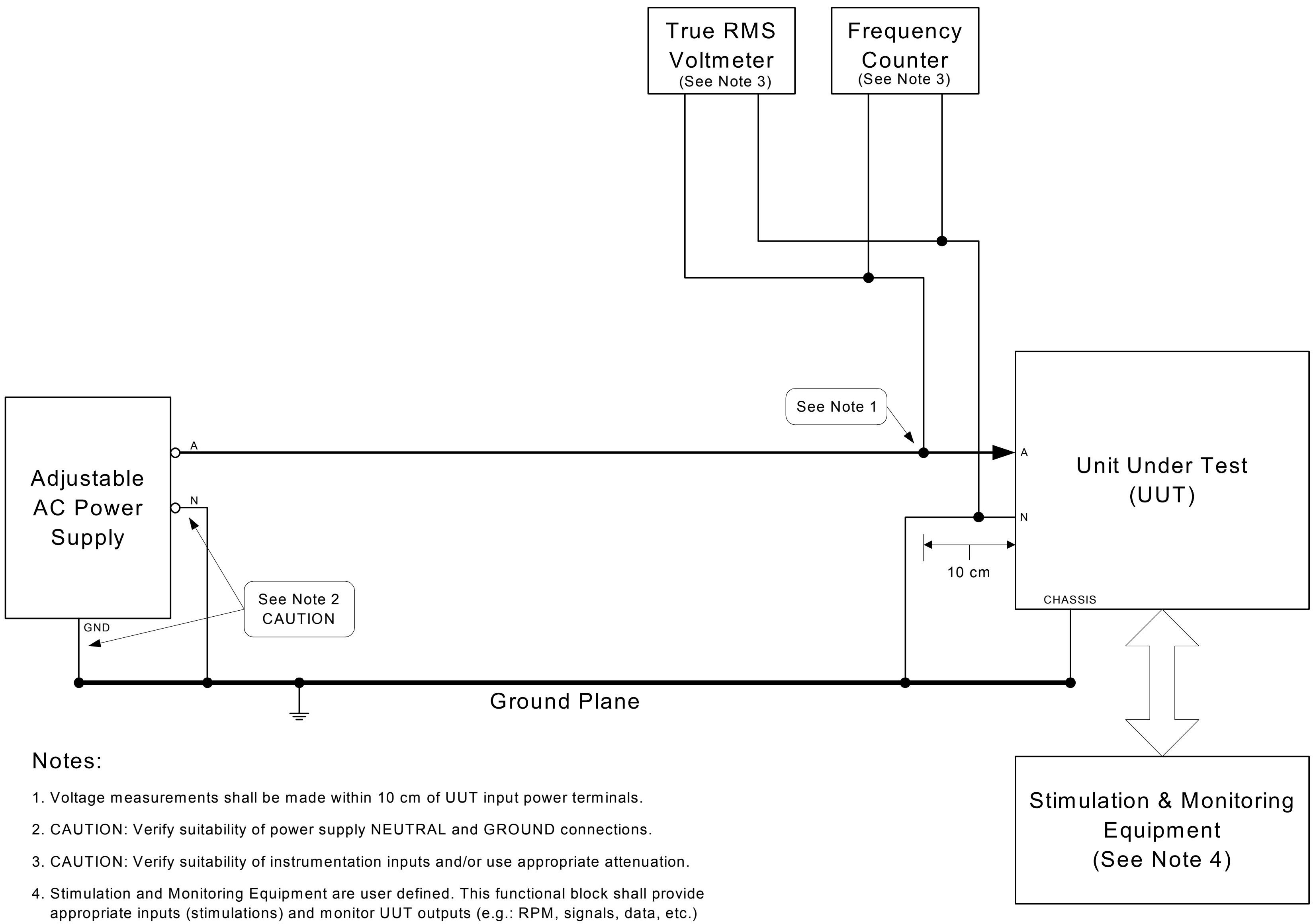


FIGURE SXF603-2. Correct phase connection.

TABLE SXF603-II. Sample data sheet for SXF603 phase reversal for single phase, 60 Hz utilization equipment.

Test Condition	Parameters						Performance
							Yes/No
Phase Reversal Prevented by Positive Physical Means							
If No							
	Voltage		Frequency		Time Duration at Condition		Pass/Fail
Phase Reversal		V_{rms}		Hz		min	
Correct Phase Connection		V_{rms}		Hz		min	

6. NOTES

6.1 Intended use. This handbook should be used as guidance when establishing test requirements, for inclusion in performance specifications developed for the procurement of utilization equipment, to ensure compliance with the aircraft electrical power characteristics as specified by MIL-STD-704.

6.2 Single phase test numbers. There are no tests required for SXF103 and SXF602. This is done so that the single phase test numbers coincide with the three phase test numbers.

6.3 Subject term (keyword) listing.

Aircraft, electrical power
Aircraft, electrical test
Electrical operating areas
Equipment, utilization
Power groups
Specification, utilization equipment

CONCLUDING MATERIAL

Custodians:	Preparing Activity:
Army - AV	Navy - AS
Navy - AS	
Air Force - 11	(Project No. SESS-0052)

Review Activities:
Army - CR, MI, TE
Navy - EC, MC, SA, SH, YD

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at www.dodssp.daps.mil.

NOT MEASUREMENT
SENSITIVE

MIL-HDBK-704-7
9 April 2004

DEPARTMENT OF DEFENSE
HANDBOOK

GUIDANCE FOR
TEST PROCEDURES FOR DEMONSTRATION OF
UTILIZATION EQUIPMENT COMPLIANCE TO
AIRCRAFT ELECTRICAL POWER CHARACTERISTICS
270 VDC
(PART 7 OF 8 PARTS)

This Handbook is for guidance only.
Do not cite this document as a requirement.

AMSC N/A AREA SESS

FOREWORD

1. This handbook is approved for use by all Departments and Agencies of the Department of Defense.

2. This handbook provides guidance on test procedures for demonstration of 270 VDC utilization equipment to determine compliance with the applicable edition of MIL-STD-704.

3. MIL-HDBK-704-7 is Part 7 in a series of 8 Parts. Part 7 describes the test methods and procedures to demonstrate that 270 VDC utilization equipment is compatible with the electric power characteristics of MIL-STD-704. These series of handbooks and MIL-STD-704 are companion documents.

4. Comments, suggestions, or questions on this document should be addressed to Commander, Naval Air Systems Command, Code 4.1.4, Highway 547, Lakehurst, NJ 08733-5100 or email to thomas.omara@navy.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil/.

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1. SCOPE

1.1 Scope. This handbook provides, as guidance, test methods used to demonstrate that 270 VDC utilization equipment is compatible with the electric power characteristics of the applicable edition(s) of MIL-STD-704. This handbook is for guidance only and cannot be cited as a requirement.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed below are not necessarily all of the documents referenced herein, but are those needed to understand the information provided by this handbook.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-704	DoD Interface Standard for Aircraft Electric Power Characteristics

(Copies of these documents are available online at http://assist. daps.dla.mil/quicksearch or www.dodssp.daps.mil/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

3. DEFINITIONS

3.1 Acronyms and definitions. The acronyms and definitions of MIL-STD-704 are applicable to this handbook.

4. TEST METHODS INFORMATION

4.1 Demonstration of compatibility. This section contains the test methods which will ensure that 270 VDC utilization equipment is compatible with the electric power characteristics of the applicable edition(s) of MIL-STD-704, by testing the Unit Under Test (UUT) in accordance with the test procedures as described in test methods HDC101 through HDC602.

4.1.1 Recording performance. In table HDC-I, record the edition(s) of MIL-STD-704 that defined the aircraft electric power characteristics used for testing and the performance of the UUT for each of the test methods.

4.2 Calibration of test equipment. . Test equipment and accessories required for measurement in accordance with this handbook should be calibrated in accordance with an approved calibration program traceable to the National Institute for Standards and Technology.

The serial numbers, model, and calibration date of all test equipment should be included with the test data.

4.3 Test methods. The test methods listed in table HDC-I are provided in section 5 of this handbook.

TABLE HDC-I. Summary of 270 VDC utilization equipment MIL-STD-704 compliance tests.

UUT:			
Compliance to MIL-STD-704 Edition(s):			
Test Dates:			
Test Method	Description	Performance (Pass/Fail)	Comments
Normal, Aircraft Electrical Operation			
HDC101	Load Measurements		
HDC102	Steady State Limits for Voltage		
HDC103	Voltage Distortion Spectrum		
HDC104	Total Ripple		
HDC105	Normal Voltage Transients		
Transfer, Aircraft Electrical Operation			
HDC201	Power Interrupt		
Abnormal, Aircraft Electrical Operation			
HDC301	Abnormal Steady State Limits for Voltage		
HDC302	Abnormal Voltage Transients (Overvoltage/Undervoltage)		
Emergency, Aircraft Electrical Operation			
HDC401	Emergency Limits for Voltage		
Starting, Aircraft Electrical Operation			
HDC501	Starting Voltage Transients		
Power Failure, Aircraft Electrical Operation			
HDC601	Power Failure		
HDC602	Polarity Reversal		

5. TEST METHODS

METHOD HDC101
Load Measurements

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Load Measurements

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment meets the load limits, inrush limits, current distortion limits and current spectrum limits that may be required by the utilization equipment performance specification document.

2. Validation criteria. If required by the utilization equipment performance specification document, the utilization equipment is considered to have passed if the utilization equipment is within the load limits, inrush current limits, the current distortion limit, and the current spectrum limits specified in the utilization equipment performance specification document. As noted in table HDC101-I, the load limits, inrush current limits, the current distortion limit, and the current spectrum limits are not specified in MIL-STD-704 versions A through F. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: The utilization equipment performance specification document should include requirements that reduce the likelihood of the equipment having an adverse effect on the electrical power characteristics of the aircraft. Load, inrush currents, current distortion and current spectrum limits may be imposed to minimize undesirable effects to the electrical power characteristics. These limits should take into account the utilization equipment power draw, aircraft electrical system capacity and distribution characteristics, trade-offs with weight, volume, cost, and reliability that are specific to each type of equipment and aircraft.

TABLE HDC101-I. MIL-STD-704 limits for load, inrush current, current distortion factor, and current spectrum for 270 volt DC utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Inrush Current	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]
Load (VA)	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]
Current Distortion Factor	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]
Current Spectrum	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]

1/. Limits for load, inrush current, current distortion factor, and current spectrum must be defined in the utilization equipment performance specification document and are unique to each equipment.

3. Apparatus. The test equipment should be as follows:

a. Adjustable DC power supply
b. True RMS voltmeter
c. Power meter
d. Spectrum analyzer
e. Distortion meter
f. Current transformer
g. Oscilloscope

4. Test setup. Configure the test setup as shown in figure HDC101-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT. The current measurement must be taken from the 270 volt DC conductor.

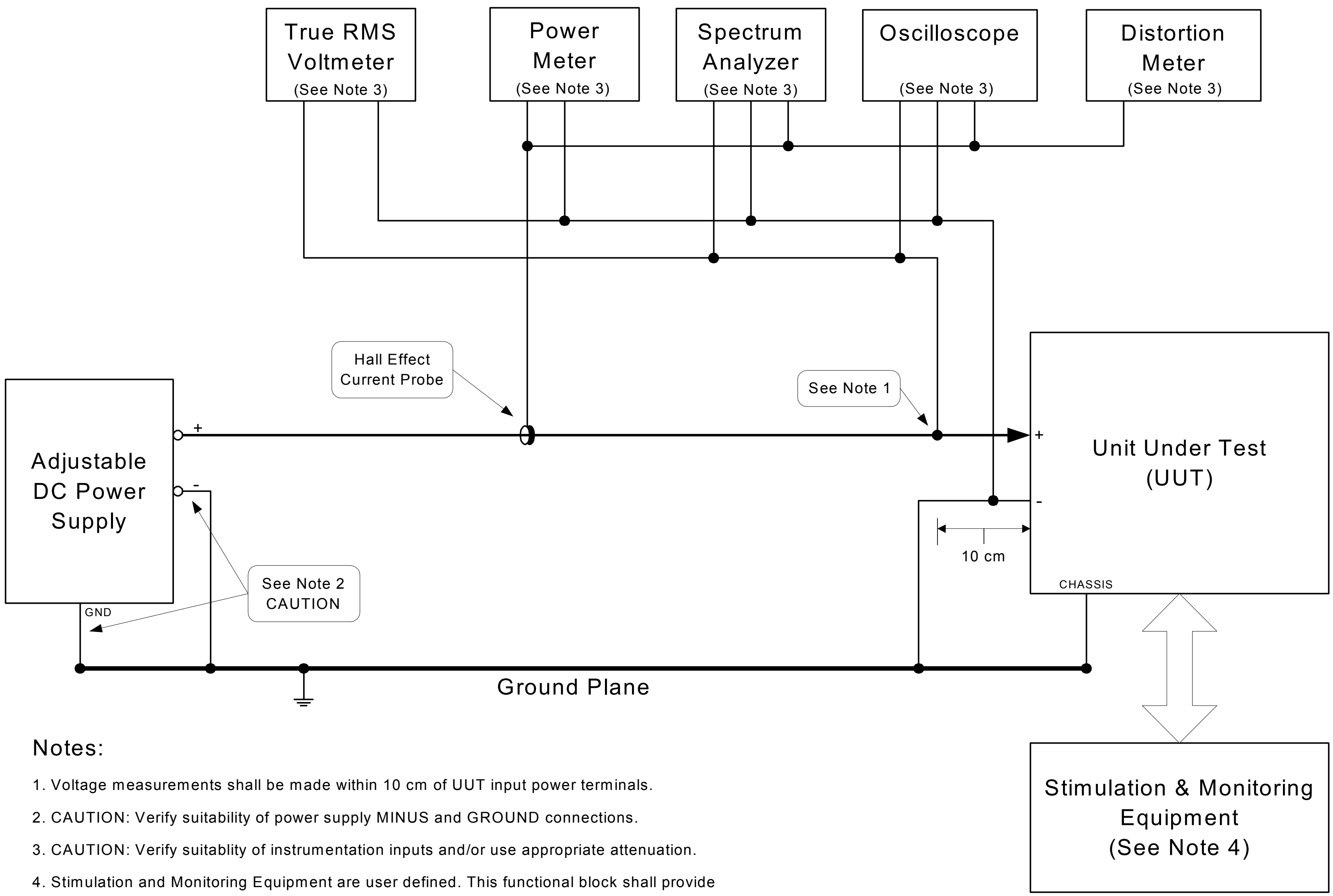
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC101-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. If the utilization equipment performance specification document:

a. Imposes inrush current limits, close the circuit breaker, energizing the UUT. Record the inrush current in the data sheet shown in table HDC101-II and compare with the limits of utilization equipment performance specification document. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat for each mode of operation of the UUT.

b. Imposes load limits, energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the load (Volt-Amps) and the voltage in the data sheet shown in table HDC101-II and compare with the limits of utilization equipment performance specification document. Repeat for each mode of operation of the UUT.

c. Imposes current distortion limits, energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the current distortion factor in the data sheet shown in table HDC101-II and compare with the limits of utilization equipment performance specification document. Repeat for each mode of operation of the UUT.

d. Imposes current spectrum limits, energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the current spectrum (current amplitude vs. frequency) in the data sheet shown in table HDC101-II and compare with the limits of utilization equipment performance specification document. Repeat for each mode of operation of the UUT.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitablity of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE HDC101-1. Normal operation - load and current distortion measurement.

TABLE HDC101-II. Sample data sheet for HDC101 load measurements.

Parameter	Measurement	Unit	Performance Pass/Fail
Inrush Current		Amps	
Voltage		VDC	N/A
Load (VA)		VA	
Total Current Distortion		% Current Distortion	
Current Spectrum	Attach Spectrum Plot	Amplitude vs. Frequency	

METHOD HDC102
Steady State Limits for Voltage

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: Steady State Limits for Voltage

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment operates and maintains specified performance when provided power with voltage at that the Normal Low Steady State (NLSS) limits and the Normal High Steady State (NHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power of voltage at the specified normal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table HDC102-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be, not less than thirty (30) minutes for each of the test conditions. The utilization equipment must demonstrate re-start at the steady state voltage limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: If the utilization has exactly the same full performance requirements for abnormal steady state limits and emergency steady state limits as required for the normal aircraft electrical conditions, then performance of test methods HDC301 and HDC401 will constitute performance of HDC102.

TABLE HDC102-I. MIL-STD-704 normal limits for steady state voltage.

Normal Limit	704A	704B	704C	704D	704E	704F
Voltage NLSS	N/A	250 VDC	250 VDC	250 VDC	250 VDC	250 VDC
Voltage NHSS	N/A	280 VDC	280 VDC	280 VDC	280 VDC	280 VDC

3. Apparatus. The test equipment should be as follows:

   a. Adjustable DC power supply
   b. True RMS voltmeter

4. Test setup. Configure the test setup as shown in figure HDC102-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC102-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through C noted in table HDC102-II, the UUT must remain for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage limits and should be not less than thirty (30) minutes. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. For each test condition shutdown the UUT and verify that the UUT can be re-started. After re-start conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltage, frequency, time duration at test condition, successful/unsuccessful re-start and the performance of the UUT for each test condition in the data sheet shown in table HDC102-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 270 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE HDC102-II. Test conditions for steady state limits of DC voltage.

Test Condition	Voltage
A	Nominal Voltage
B	NLSS Voltage
C	NHSS Voltage

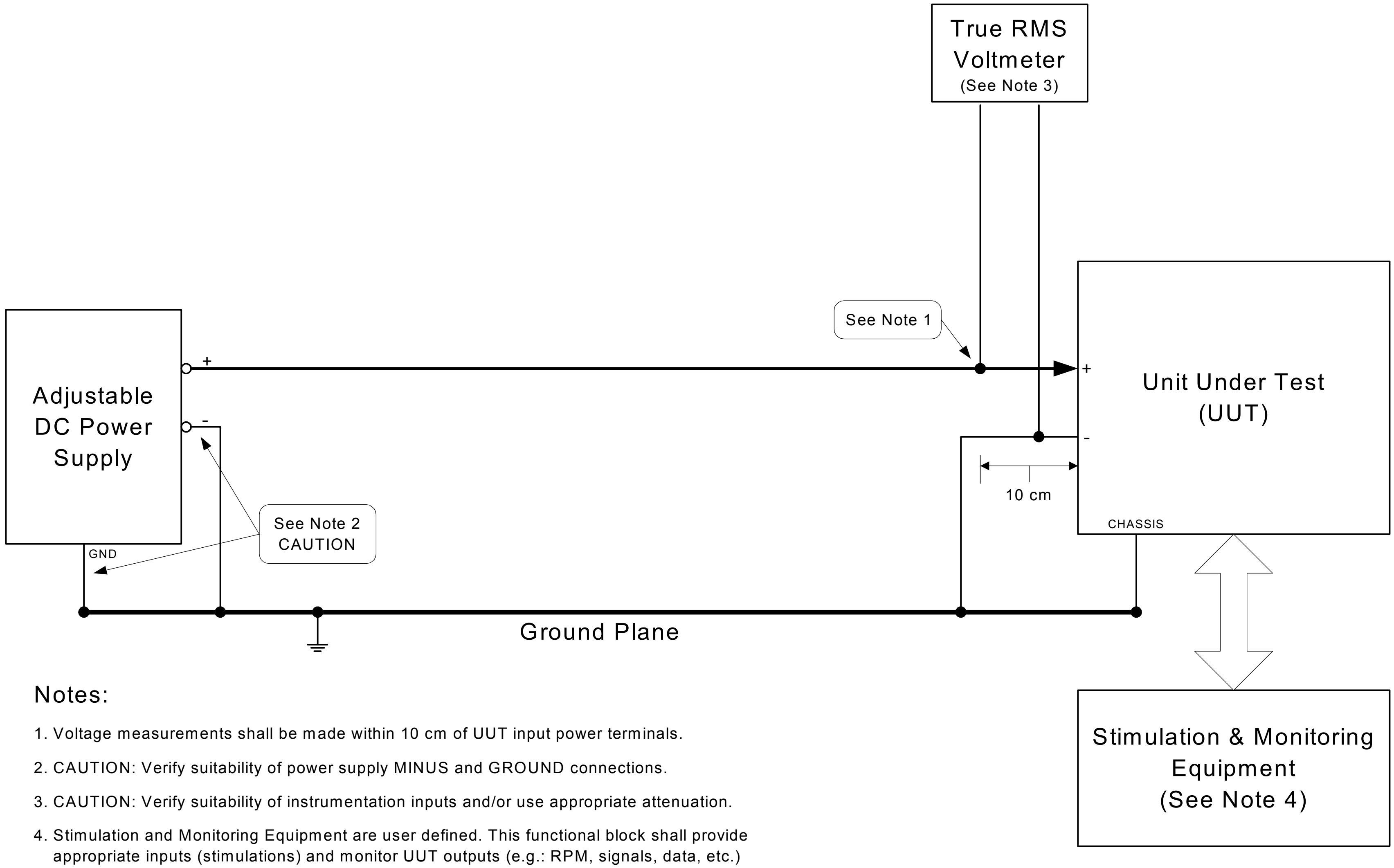


FIGURE HDC102-1. Normal operation - steady state limits for voltage.

TABLE HDC102-III. Sample data sheet for HDC102 steady state limits for voltage.

Test Condition	Parameters							Performance
	Voltage		Frequency		Time Duration at Condition		Re-Start (Yes/No)	Pass/Fail
A		V_{dc}		Hz		min		
B		V_{dc}		Hz		min		
C		V_{dc}		Hz		min		

METHOD HDC103
Voltage Distortion Spectrum

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Voltage Distortion Spectrum

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment operates and maintains specified performance when subjected to voltage distortion of frequencies and amplitudes as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage distortions as specified by the voltage distortion spectrum in the applicable edition(s) of MIL-STD-704 and as noted in table HDC103-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage distortion. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: This test method subjects the UUT to voltage distortion having frequencies components from 50 Hz to 10 kHz. These voltage distortions simulate voltage distortions within aircraft due to the cumulative effects of generators, electrical distribution systems equipments, and aircraft loads. MIL-STD-461, (Requirements For The Control of Electromagnetic Interference Characteristics of Subsystems and Equipment), Test Method CS101, (Conducted Susceptibility, Power Leads, 30 Hz to 150 kHz) is a complimentary test. Power levels of the voltage distortions differ for the two test methods. Performance of Test Method HDC103 of this handbook does not relinquish the requirement to perform test Method CS101 of MIL-STD-461, and performance of Method CS101 of MIL-STD-461 does not relinquish the requirement to perform Test Method HDC103 of this handbook.

TABLE HDC103-I. MIL-STD-704 limits for voltage distortion spectrum.

Limit	704A	704B	704C	704D	704E	704F
Voltage Distortion Spectrum	N/A	figure 6 MIL-STD-704B	figure 9 MIL-STD-704C	figure 9 MIL-STD-704D	figure 13 MIL-STD-704E	figure 18 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable DC power supply
b. Variable frequency power source
c. Coupling transformer
d. True RMS voltmeter
e. Spectrum analyzer
f. (2) Inductors, 50 μH
g. Capacitor, 10 μF
h. Resistor, calibrated load

4. Test setup (10 Hz and 25 Hz). Configure the test setup as shown in figure HDC103-1 voltage distortion spectrum setup for 10 Hz and 25 Hz. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test (10 Hz and 25 Hz). With the programmable DC power supply off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC103-1. Turn on the programmable DC power supply and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For test condition A noted in table HDC103-II, set the DC programmable power supply to vary the amplitude of the DC voltage at a 10 Hz rate at an average DC voltage of 270 VDC to create a voltage distortion (ripple) for test condition A of the appropriate edition of MIL-STD-704. Remain for a length of time that confirms the utilization equipment can continuously operate with the voltage distortion and should be, not less than five (5) minutes. At each test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. For each test condition, record voltage, frequency of voltage distortion, amplitude of voltage distortion, time duration at test condition, and the performance of the UUT in the data sheet shown in table HDC103-III. Repeat for test condition B by setting the DC programmable power supply to vary the amplitude of the DC voltage at a 25 Hz rate at an average DC voltage of 270 Vdc to create a voltage distortion (ripple) specified for test condition B of the appropriate edition of MIL-STD-704. Repeat for each mode of operation of the UUT.

6. Test setup (50 Hz to 10 kHz). Configure the test setup as shown in figure HDC103-2. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

6.1 Calibration (50 Hz to 10 kHz). Install a calibrated resistive load in the test setup shown in figure HDC103-2 in place of the UUT. The calibrated resistive load must be sized to draw the same current as the UUT. Turn on the programmable DC power supply and adjust the voltage to the nominal steady state voltage of 270 VDC. Set the variable frequency power source to output a sine wave and adjust the frequency and amplitude so that the voltage distortion measured at the input to the calibrated resistive load conforms to each test condition C through K as noted in table HDC103-II of the applicable edition(s) of MIL-STD-704. Record the settings of the variable frequency power source for each test condition.

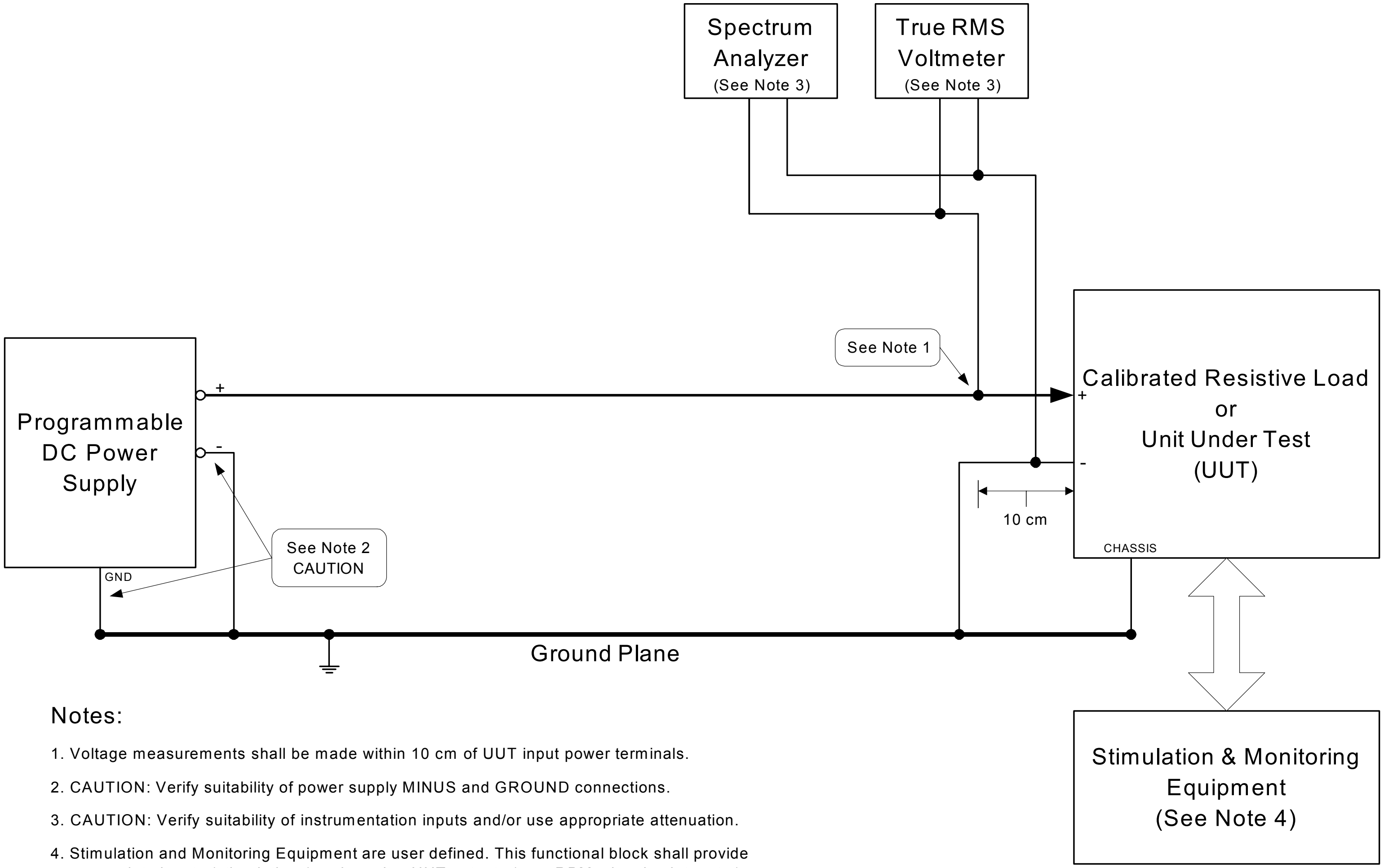
7. Compliance test (50 Hz to 10 kHz). With the programmable DC power supply off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC103-2. Turn on the programmable DC power supply and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

Set the variable frequency power source to the settings recorded for test condition C of the calibration procedure. For each test condition, remain for a length of time that confirms the utilization equipment can continuously operate with the voltage distortion and should be, not less than five (5) minutes. At each test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. After each test condition, monitor the voltage distortion frequency and amplitude while slowly increasing the variable frequency power source frequency and adjusting the amplitude until the next test condition is reached. Do not exceed the voltage distortion spectrum limits. Repeat for each test condition C through K noted in table HDC103-II. For each test condition, record voltage, frequency of voltage distortion, amplitude of voltage distortion, time duration at test condition, and the performance of the UUT in the data sheet shown in table HDC103-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, turn the programmable DC power supply off and remove the coupling transformer from the circuit. Turn on the programmable DC power supply. Adjust the voltage to the nominal steady state voltage of 270 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE HDC103-II. Test conditions for voltage distortion spectrum.

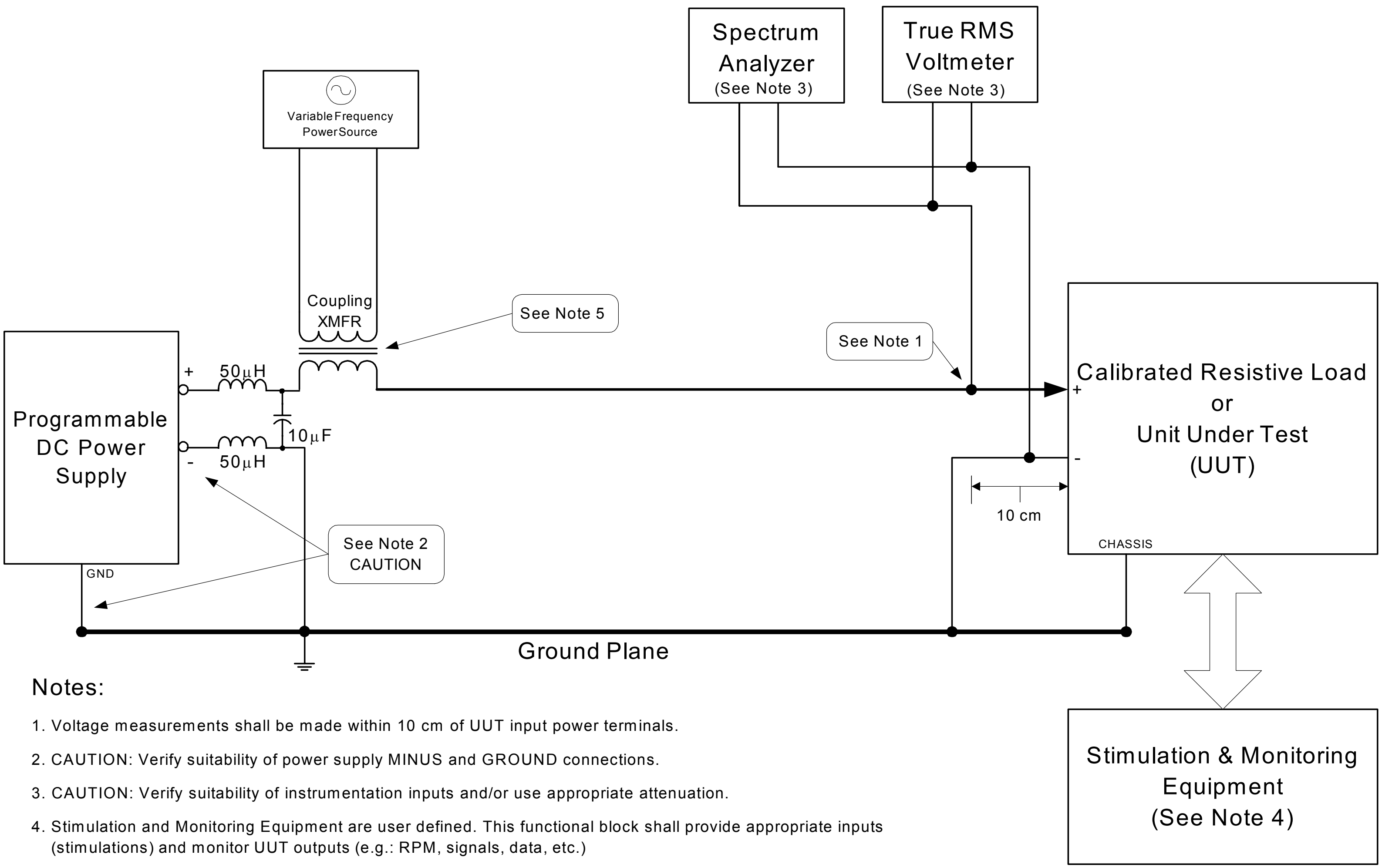
Test Condition	Frequency of Voltage Distortion	MIL-STD-704B, C, & D Amplitude of Voltage Distortion Voltage rms	MIL-STD-704E & F Amplitude of Voltage Distortion Voltage rms
A	10 Hz	0.600 Vrms	0.316 Vrms
B	25 Hz	0.893 Vrms	0.500 Vrms
C	50 Hz	1.197 Vrms	0.562 Vrms
D	60 Hz	1.307 Vrms	0.775 Vrms
E	250 Hz	2.430 Vrms	1.581 Vrms
F	1 kHz	4.439 Vrms	3.162 Vrms
G	1.7 kHz	5.591 Vrms	3.162 Vrms
H	2 kHz	6.000 Vrms	3.162 Vrms
I	5 kHz	1.844 Vrms	3.162 Vrms
J	6.5 kHz	1.315 Vrms	2.433 Vrms
K	10 kHz	0.755 Vrms	1.581 Vrms



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE HDC103-1. Normal operation - voltage distortion spectrum (10 Hz and 25 Hz).



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)
5. CAUTION: Verify suitability of variable frequency power source and coupling transformer for distortion spectrum testing.

FIGURE HDC103-2. Normal operation - voltage distortion spectrum (50 Hz to 10 kHz).

TABLE HDC103-III. Sample data sheet for HDC103 voltage distortion spectrum.

Test Condition	Parameters								Performance
	Voltage		Frequency of Voltage Distortion		Amplitude of Voltage Distortion		Time Duration at Condition		Pass/Fail
A		V_{DC}		Hz		V_{rms}		min	
B		V_{DC}		Hz		V_{rms}		min	
C		V_{DC}		Hz		V_{rms}		min	
D		V_{DC}		Hz		V_{rms}		min	
E		V_{DC}		Hz		V_{rms}		min	
F		V_{DC}		kHz		V_{rms}		min	
G		V_{DC}		kHz		V_{rms}		min	
H		V_{DC}		kHz		V_{rms}		min	
I		V_{DC}		kHz		V_{rms}		min	
J		V_{DC}		kHz		V_{rms}		min	
K		V_{DC}		kHz		V_{rms}		min	

METHOD HDC104
Total Ripple

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: Total Ripple

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment operates and maintains specified performance when subjected to voltage having a ripple as specified by the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to ripple as specified by the applicable edition(s) of MIL-STD-704 and as noted in table HDC104-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to a distorted voltage waveform and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE HDC104-I. MIL-STD-704 limits for ripple DC voltage distortion.

Limit	704A	704B	704C	704D	704E	704F
Voltage Ripple	N/A	6 Volts Peak to Average And figure 6 MIL-STD-704B	6 Volts Peak to Average And figure 9 MIL-STD-704C	6 Volts Peak to Average And figure 9 MIL-STD-704D	6 Volts Peak to Average And figure 13 MIL-STD-704E	6 Volts Peak to Average And figure 18 MIL-STD-704F

3. Apparatus. The test should be as follows.

a. Programmable DC power supply
b. True RMS voltmeter
c. Spectrum analyzer
d. Distortion meter

4. Test setup. Configure the test setup as shown in figure HDC104-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

4.1 Calibration. Install a resistive load in the test setup shown in figure HDC104-1 in place of the UUT. The resistive load must be sized to draw the same current as the UUT. Set the programmable power supply to produce a DC voltage waveform having ripple as noted for test condition A in table HDC104-II for the applicable edition(s) of MIL-STD-704. The ripple should include all the frequencies components with amplitudes noted for test condition A. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. Confirm that the programmable power supply is producing a voltage waveform having ripple content listed in table HDC104-II. Record the settings of the programmable power supply. Repeat the process for test condition B in table HDC104-II.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC104-1. Set the programmable power supply to the settings recorded during the calibration procedure for condition A. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. Measure the ripple frequencies spectrum and record the DC ripple frequency components and amplitudes. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Remain for a length of time that confirms the utilization equipment can continuously operate with the ripple voltage, and should be not less than thirty (30) minutes. Repeat for test condition B noted in table HDC104-II. For each test condition, record the voltage, distortion factor, frequency spectrum of ripple, time duration at test condition, and the performance of the UUT in the data sheet shown in table HDC104-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, set the programmable power supply to produce a DC waveform without ripple. Adjust the voltage to the nominal steady state voltage of 270 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE HDC104-II. Ripple frequency and amplitude.

Test Condition	Ripple Frequency Components	MIL-STD-704B, C, D, E, & F Vrms
A	1200 Hz	3.16 Vrms
	2400 Hz	0.96 Vrms
	3600 Hz	1.56 Vrms
	4800 Hz	0.48 Vrms
	6000 Hz	0.78 Vrms
	7200 Hz	0.24 Vrms
	8400 Hz	0.36 Vrms
B	2400 Hz	3.16 Vrms
	4800 Hz	0.96 Vrms
	7200 Hz	1.56 Vrms
	9600 Hz	0.48 Vrms
	12000 Hz	0.78 Vrms
	14400 Hz	0.24 Vrms
	16800 Hz	0.36 Vrms

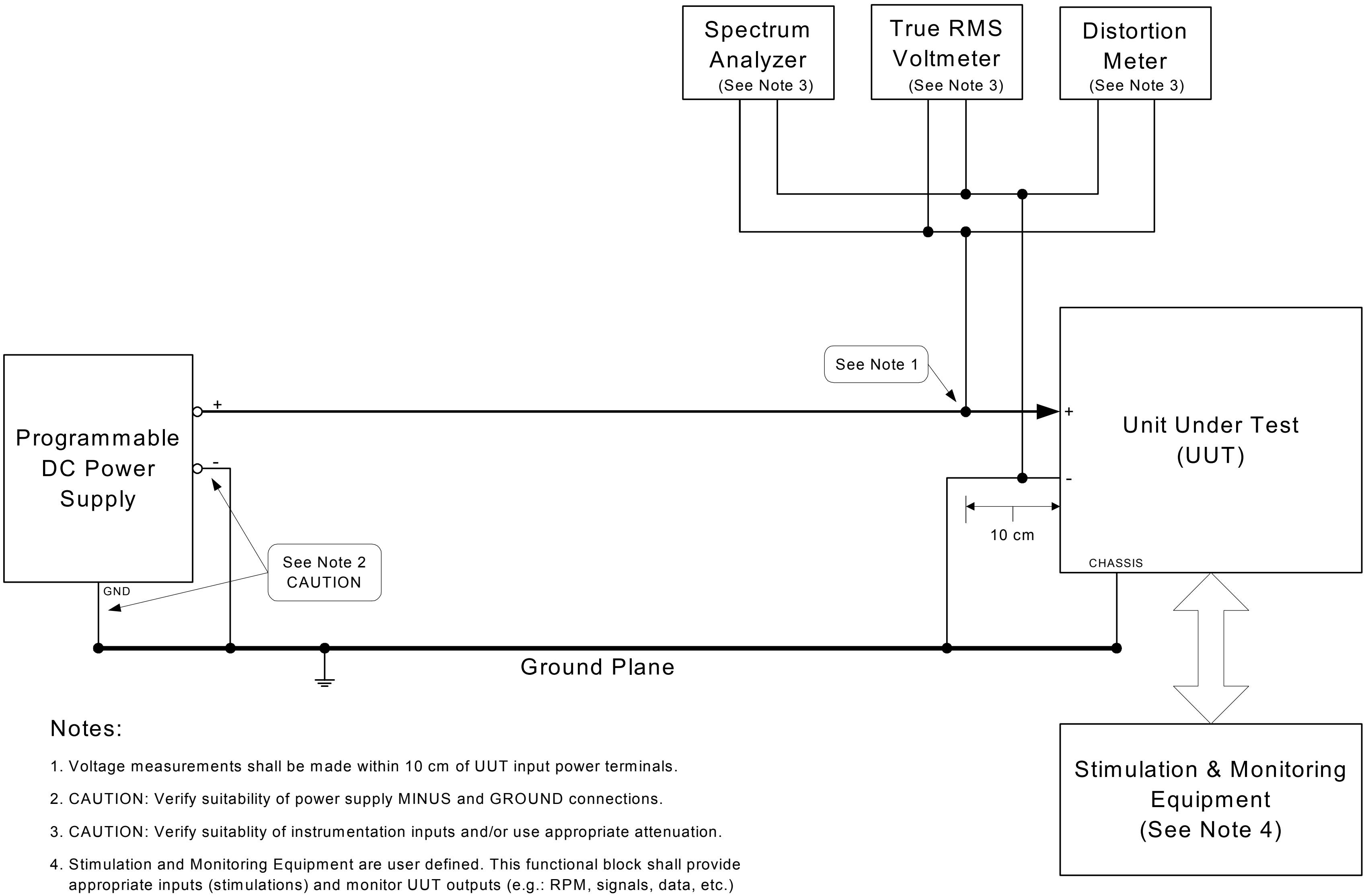


FIGURE HDC104-1. Normal operation - total ripple.

TABLE HDC104-III. Sample data sheet for HDC104 total ripple.

Test Condition	Parameters						Performance
	Voltage		Voltage Distortion Factor		Time Duration at Condition		Pass/Fail
A		Vdc		No Units		min	
	Ripple Frequency Component		Amplitude of Ripple				
		Hz		Vrms			
		Hz		Vrms			
		Hz		Vrms			
		Hz		Vrms			
		Hz		Vrms			
		Hz		Vrms			
		Hz		Vrms			
B	Voltage		Voltage Distortion Factor		Time Duration at Condition		Pass/Fail
		Vdc		No Units		min	
	Ripple Frequency Component		Amplitude of Ripple				
		Hz		Vrms			
		Hz		Vrms			
		Hz		Vrms			
		Hz		Vrms			
		Hz		Vrms			
		Hz		Vrms			
		Hz		Vrms			

METHOD HDC105
Normal Voltage Transients

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Normal Voltage Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment operates and maintains specified performance when subjected to normal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage transients within the normal limits of the applicable edition(s) of MIL-STD-704 and as noted in table HDC105-I. The utilization equipment must maintain specified performance during and after the voltage transients. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE HDC105-I. MIL-STD-704 limits for normal voltage transients.

Limit	704A	704B	704C	704D	704E	704F
Normal Voltage Transients	N/A	figure 9 MIL-STD-704B	figure 11 MIL-STD-704C	figure 11 MIL-STD-704D	figure 10 MIL-STD-704E	figure 16 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable DC power supply
b. True RMS voltmeter
c. Oscilloscope

4. Test setup. Configure the test setup as shown in figure HDC105-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC105-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

5.1 Compliance test for MIL-STD-704B, C, and D. The UUT must be subjected to the voltage transients for each test condition A through V noted in table HDC105-II. The voltage must increase or decrease from steady state voltage as noted in table HDC105-II to the voltage transient level within 1 millisecond. The voltage must remain at the voltage transient level for the duration noted in table HDC105-II. The voltage must return to steady state over the time duration noted in table HDC105-II. For test condition E and J, three over-voltage transients of 475 Vdc for 10 milliseconds are performed, separated by 0.5 second. For test condition O and T, three under-voltage transients of 125 Vdc for 10 millisecond are performed, separated by 0.5 second. For test condition U and V, an under-voltage transient of 125 Vdc for 10 milliseconds is immediately followed by an over-voltage transient of 475 Vdc for 10 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal steady state limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltage, voltage transient (oscilloscope trace), and the performance of the UUT for each test condition in the data sheet shown in table HDC105-IV. Repeat for each mode of operation of the UUT. In addition, for MIL-STD-704B, C, and D test compliance perform the repetitive voltage transient test described in 5.3.

5.2 Compliance test for MIL-STD-704E & F. The UUT must be subjected to the voltage transients for each test condition AA through RR noted in table HDC105-III. The voltage must increase or decrease from steady state voltage as noted in table HDC105-III to the voltage transient level within 1 millisecond. The voltage must remain at the voltage transient level for the duration noted in table HDC105-III. The voltage must return to steady state over the time duration noted in table HDC105-III. For test condition EE and JJ, three over-voltage transients of 330 Vdc for 10 milliseconds are performed, separated by 0.5 second. For test condition MM and PP, three under-voltage transients of 200 Vdc for 10 milliseconds are performed, separated by 0.5 second. For test condition QQ and RR, an under-voltage transient of 200 Vdc for 10 milliseconds is immediately followed by an overvoltage transient of 330 Vdc for 20 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal steady state limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltage, voltage transient (oscilloscope trace), and the performance of the UUT for each test condition in the data sheet shown in table HDC105-V. Repeat for each mode of operation of the UUT. In addition, for MIL-STD-704E, & F test compliance perform the repetitive voltage transient test described in 5.3.

5.3 Repetitive normal voltage transients test. Program the power supply to provide a continually repeating voltage transient that decreases from 270 Vdc to 215 Vdc in 2.5 msec, then increases to 315 Vdc over 30 msec, then decreases to 270 Vdc over 2.5 msec. The voltage transient is repeated every 0.5 second, see figure HDC105-2. The UUT must be subjected to the repetitive voltage transient for a length of time that confirms the utilization equipment can continuously operate and should be not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltage, voltage transient (oscilloscope trace), time duration at test condition, and the performance of the UUT in the data sheet shown in table HDC105-V. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 270 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE HDC105-II. Test conditions for MIL-STD-704B, C, and D normal voltage transients.

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage milliseconds
Overvoltage Transients					
A	280 Vdc	< 1 msec	475 Vdc	10 msec	< 1 msec
B	280 Vdc	< 1 msec	475 Vdc	10 msec	40 msec
C	280 Vdc	< 1 msec	375 Vdc	30 msec	< 1 msec
D	280 Vdc	< 1 msec	375 Vdc	30 msec	20 msec
E	280 Vdc	< 1 msec	475 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec
F	250 Vdc	< 1 msec	475 Vdc	10 msec	< 1 msec
G	250 Vdc	< 1 msec	475 Vdc	10 msec	44 msec
H	250 Vdc	< 1 msec	375 Vdc	30 msec	< 1 msec
I	250 Vdc	< 1 msec	375 Vdc	30 msec	27 msec
J	250 Vdc	< 1 msec	475 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec
Undervoltage Transients					
K	280 Vdc	< 1 msec	125 Vdc	50 msec	< 1 msec
L	280 Vdc	< 1 msec	125 Vdc	50 msec	63 msec
M	280 Vdc	< 1 msec	175 Vdc	70 msec	< 1 msec
N	280 Vdc	< 1 msec	175 Vdc	70 msec	43 msec
O	280 Vdc	< 1 msec	125 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec
P	250 Vdc	< 1 msec	125 Vdc	50 msec	< 1 msec
Q	250 Vdc	< 1 msec	125 Vdc	50 msec	50 msec
R	250 Vdc	< 1 msec	175 Vdc	70 msec	< 1 msec
S	250 Vdc	< 1 msec	175 Vdc	70 msec	30 msec
T	250 Vdc	< 1 msec	125 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec
Combined Transient					
U	280 Vdc then	< 1 msec < 1 msec	125 Vdc 475 Vdc	10 msec 10 msec	< 1 msec 40 msec
V	250 Vdc then	< 1 msec < 1 msec	125 Vdc 475 Vdc	10 msec 10 msec	< 1 msec 44 msec

TABLE HDC105-III. Test conditions for MIL-STD-704E and F normal voltage transients.

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage milliseconds
Overvoltage Transients					
AA	280 Vdc	< 1 msec	330 Vdc	20 msec	< 1 msec
BB	280 Vdc	< 1 msec	330 Vdc	20 msec	20 msec
CC	280 Vdc	< 1 msec	305 Vdc	30 msec	< 1 msec
DD	280 Vdc	< 1 msec	305 Vdc	30 msec	37.5 msec
EE	280 Vdc	< 1 msec	330 Vdc (3 times)	10 msec Every 0.5 msec	< 1 msec
FF	250 Vdc	< 1 msec	330 Vdc	20 msec	< 1 msec
GG	250 Vdc	< 1 msec	330 Vdc	20 msec	33 msec
HH	250 Vdc	< 1 msec	305 Vdc	30 msec	< 1 msec
II	250 Vdc	< 1 msec	305 Vdc	30 msec	21 msec
JJ	250 Vdc	< 1 msec	330 Vdc (3 times)	10 msec Every 0.5 msec	< 1 msec
Undervoltage Transients					
KK	280 Vdc	< 1 msec	200 Vdc	10 msec	< 1 msec
LL	280 Vdc	< 1 msec	200 Vdc	10 msec	49 msec
MM	280 Vdc	< 1 msec	200 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec
NN	250 Vdc	< 1 msec	200 Vdc	10 msec	< 1 msec
OO	250 Vdc	< 1 msec	200 Vdc	10 msec	30 msec
PP	250 Vdc	< 1 msec	200 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec
Combined Transient					
QQ	280 Vdc then	< 1 msec < 1 msec	200 Vdc 330 Vdc	10 msec 20 msec	< 1 msec 20 msec
RR	250 Vdc then	< 1 msec < 1 msec	200 Vdc 330 Vdc	10 msec 20 msec	< 1 msec 33 msec

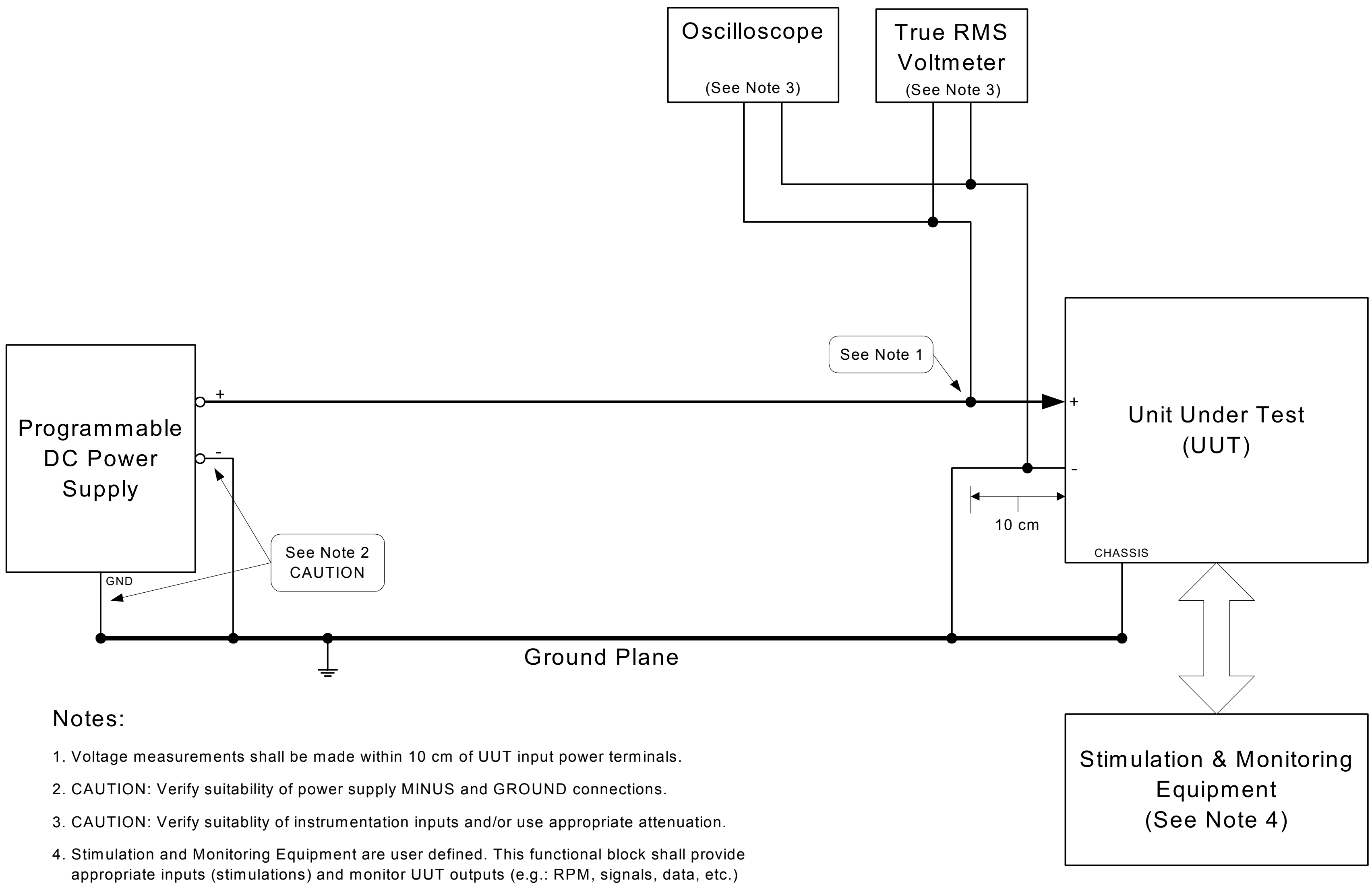


FIGURE HDC105-1. Normal operation - normal voltage transients.

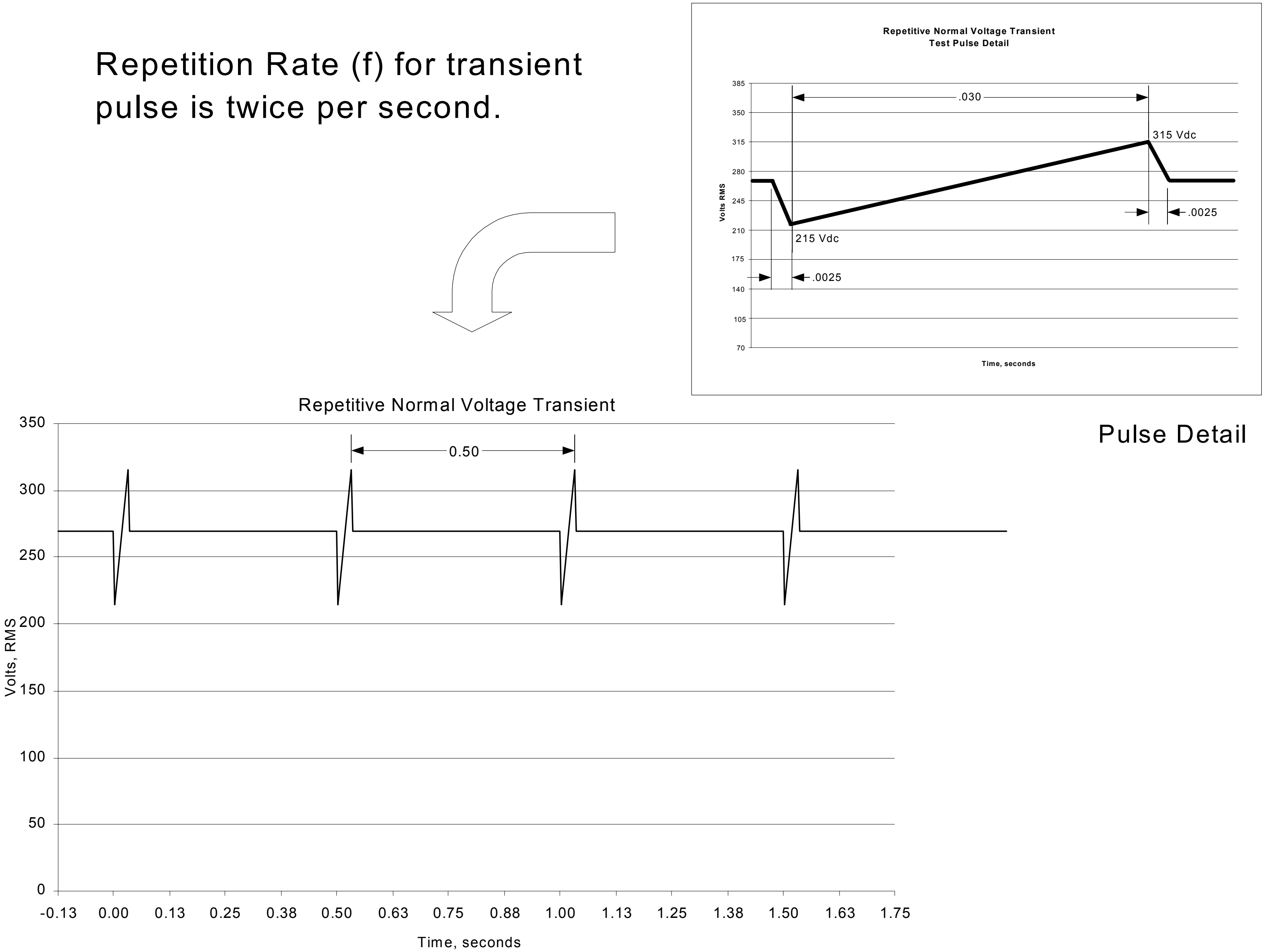


FIGURE HDC105-2. Repetitive normal voltage transient.

TABLE HDC105-IV. Sample data sheet for HDC105 normal voltage transients for MIL-STD-704A, B, C, & D.

Test Condition	Parameters								Performance
	Steady State Voltage		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
A		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
B		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
C		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
D		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
E		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
F		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
G		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
H		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
I		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
J		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
K		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
L		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
M		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
N		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
O		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
P		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
Q		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
R		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
S		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
T		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
U		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
				V_{DC}		msec			
V		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
				V_{DC}		msec			

TABLE HDC105-IV. Sample data sheet for HDC105 normal voltage transients for MIL-STD-704A, B, C, & D. - Continued

<table>
<tr><th rowspan="2">Test Condition</th><th colspan="8">Parameters</th><th>Performance</th></tr>
<tr><th colspan="2">Steady State Voltage</th><th colspan="2">Voltage Transient</th><th colspan="2">Time at Voltage Transient Level</th><th colspan="2">Oscilloscope Trace</th><th>Pass/Fail</th></tr>
<tr><td rowspan="4">Repetitive Transient</td><td></td><td>V_{DC}</td><td></td><td>V_{DC}</td><td></td><td>msec</td><td>Attach Trace</td><td>V_{DC} vs. Time</td><td rowspan="4"></td></tr>
<tr><td colspan="2"></td><td></td><td>V_{DC}</td><td></td><td>msec</td><td colspan="2"></td></tr>
<tr><td colspan="2">Time Duration At Test Condition</td><td colspan="6" rowspan="2"></td></tr>
<tr><td></td><td>min</td></tr>
</table>

TABLE HDC105-V. Sample data sheet for HDC105 normal voltage transients for MIL-STD-704E, & F.

Test Condition	Parameters								Performance
	Steady State Voltage		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
AA		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
BB		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
CC		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
DD		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
EE		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
FF		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
GG		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
HH		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
II		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
JJ		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
KK		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
LL		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
MM		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
NN		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
OO		V_{DC}		V_{DC}		msec			
PP		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
QQ		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
				V_{DC}		msec			
RR		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
				V_{DC}		msec			

TABLE HDC105-V. Sample data sheet for HDC105 normal voltage transients for MIL-STD-704E, & F. - Continued

<table>
<tr><th rowspan="2">Test Condition</th><th colspan="8">Parameters</th><th>Performance</th></tr>
<tr><th colspan="2">Steady State Voltage</th><th colspan="2">Voltage Transient</th><th colspan="2">Time at Voltage Transient Level</th><th colspan="2">Oscilloscope Trace</th><th>Pass/Fail</th></tr>
<tr><td rowspan="4">Repetitive Transient</td><td></td><td>V_{DC}</td><td></td><td>V_{DC}</td><td></td><td>msec</td><td>Attach Trace</td><td>V_{DC} vs. Time</td><td rowspan="4"></td></tr>
<tr><td colspan="2"></td><td></td><td>V_{DC}</td><td></td><td>msec</td><td colspan="2"></td></tr>
<tr><td colspan="2">Time Duration At Test Condition</td><td colspan="6" rowspan="2"></td></tr>
<tr><td></td><td>min</td></tr>
</table>

METHOD HDC201
Power Interrupt

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Transfer Interrupt

PARAMETER: Power Interrupt

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment operates and maintains specified performance when subjected to power interrupts as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for transfer aircraft electrical conditions when subjected to power interrupts as specified by the applicable edition(s) of MIL-STD-704 and as noted in table HDC201-I. The utilization equipment must maintain the specified performance during power interrupts. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE HDC201-I. MIL-STD-704 power transfer limits.

Limit	704A	704B	704C	704D	704E	704F
Power Interrupt	N/A	50 msec	50 msec	50 msec	50 msec	50 msec
Voltage NLSS	N/A	250 Vdc	250 Vdc	250 Vdc	250 Vdc	250 Vdc
Voltage NHSS	N/A	280 Vdc	280 Vdc	280 Vdc	280 Vdc	280 Vdc

3. Apparatus. The test equipment should be as follows:

a. Programmable DC power supply
b. True RMS voltmeter
c. Oscilloscope
d. Resistive dummy load

4. Test setup. Configure the test setup as shown in figure HDC201-1. The dummy resistive load placed in parallel to the UUT should be sized to draw three times the steady state current of the UUT up to a maximum 25 kW dummy load. Note: This is done to ensure that the UUT test

does not lose stored energy to other aircraft loads during power interrupts. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

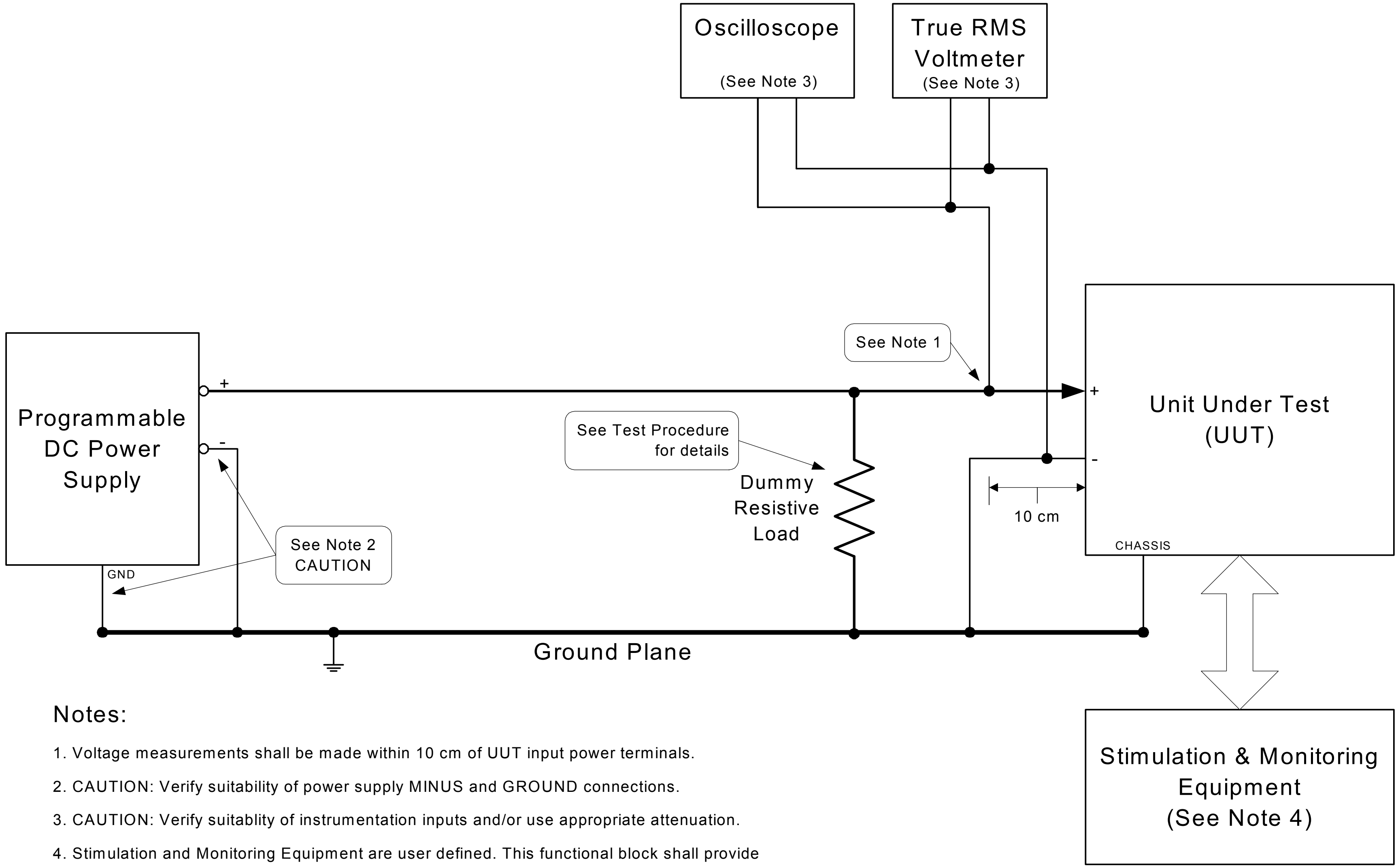
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC201-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 Vdc. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through K noted in table HDC201-II, adjust the voltage to the steady state voltage listed. Perform a power interrupt (0 V) of the duration listed. The voltage must decrease from the steady state voltage to 0 Volts within 0.25 milliseconds, remain at 0 Volts for the duration listed for the test condition, and return from 0 Volts to the steady state voltage within 0.25 milliseconds. For test condition J, three 50 millisecond power interrupts are performed, separated by 0.5 seconds. For test condition K a normal overvoltage transient follows the power interrupt. The normal voltage transient is 330 Vdc for 20 milliseconds and returns to nominal voltage over the next 20 milliseconds. For test condition L a normal undervoltage transient follows the power interrupt. The normal voltage transient is 200 Vdc for 10 milliseconds and returns to nominal voltage over the next 30 milliseconds. For each test condition, monitor the performance of the UUT according to the utilization equipment performance test procedures for power transfer operation to verify that the UUT is providing specified performance for transfer aircraft electrical conditions. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltage, time duration of power interrupt, and the performance of the UUT for each test condition in the data sheet shown in table HDC201-III. Repeat each test condition 5 times. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 270 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE HDC201-II. Test conditions for transfer interrupt.

Test Condition	Steady State Voltage	Duration of Interrupt
A	Nominal Voltage	50 msec
B	NLSS Voltage	50 msec
C	NHSS Voltage	50 msec
D	Nominal Voltage	30 msec
E	NLSS Voltage	30 msec
F	NHSS Voltage	30 msec
G	Nominal Voltage	10 msec
H	NLSS Voltage	10 msec
I	NHSS Voltage	10 msec
J	Nominal Voltage	50 msec (repeated 3 times, separated by 0.5 sec)
K	Nominal Voltage	50 msec (followed by a normal voltage transient of 330 Vdc for 20 msec and return to steady state voltage in 20 msec)
L	Nominal Voltage	50 msec (followed by a normal voltage transient of 200 Vdc for 10 msec and return to steady state voltage in 30 msec)



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitablity of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE HDC201-1. Transfer interrupt - power interrupt.

TABLE HDC201-III. Sample data sheet for HDC201 power interrupt.

<table>
<tr><td rowspan="2">Test Condition</td><td colspan="4">Parameters</td><td>Performance</td></tr>
<tr><td colspan="2">Voltage</td><td colspan="2">Time Duration of Power Interrupt</td><td>Pass/Fail</td></tr>
<tr><td>A</td><td></td><td>V_{DC}</td><td></td><td>msec</td><td></td></tr>
<tr><td>B</td><td></td><td>V_{DC}</td><td></td><td>msec</td><td></td></tr>
<tr><td>C</td><td></td><td>V_{DC}</td><td></td><td>msec</td><td></td></tr>
<tr><td>D</td><td></td><td>V_{DC}</td><td></td><td>msec</td><td></td></tr>
<tr><td>E</td><td></td><td>V_{DC}</td><td></td><td>msec</td><td></td></tr>
<tr><td>F</td><td></td><td>V_{DC}</td><td></td><td>msec</td><td></td></tr>
<tr><td>G</td><td></td><td>V_{DC}</td><td></td><td>msec</td><td></td></tr>
<tr><td>H</td><td></td><td>V_{DC}</td><td></td><td>msec</td><td></td></tr>
<tr><td>I</td><td></td><td>V_{DC}</td><td></td><td>msec</td><td></td></tr>
<tr><td>J</td><td></td><td>V_{DC}</td><td></td><td>msec</td><td></td></tr>
<tr><td rowspan="4">K</td><td></td><td>V_{DC}</td><td></td><td>msec</td><td rowspan="4"></td></tr>
<tr><td colspan="4">Overvoltage Transient</td></tr>
<tr><td colspan="2">Voltage Transient</td><td colspan="2">Time at Voltage Transient Level</td></tr>
<tr><td></td><td>V_{DC}</td><td></td><td>msec</td></tr>
<tr><td rowspan="4">L</td><td></td><td>V_{DC}</td><td></td><td>msec</td><td rowspan="4"></td></tr>
<tr><td colspan="4">Overvoltage Transient</td></tr>
<tr><td colspan="2">Voltage Transient</td><td colspan="2">Time at Voltage Transient Level</td></tr>
<tr><td></td><td>V_{DC}</td><td></td><td>msec</td></tr>
</table>

METHOD HDC301
Steady State Limits for Voltage

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL OPERATING CONDITION: Abnormal Operation

PARAMETER: Steady State Limits for Voltage

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment operates and maintains specified performance when provided power with voltage at that the Abnormal Low Steady State (ALSS) limits and the Abnormal High Steady State (AHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when supplied input power of voltage at the specified abnormal steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table HDC301-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the abnormal steady state voltage limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE HDC301-I. MIL-STD-704 abnormal limits for steady state voltage.

Abnormal Limit	704A	704B	704C	704D	704E	704F
Voltage NLSS	N/A	245 Vdc	245 Vdc	245 Vdc	240 Vdc	240 Vdc
Voltage NHSS	N/A	285 Vdc	285 Vdc	285 Vdc	290 Vdc	290 Vdc

3. Apparatus. The test equipment should be as follows:

a. Adjustable DC power supply
b. True RMS voltmeter

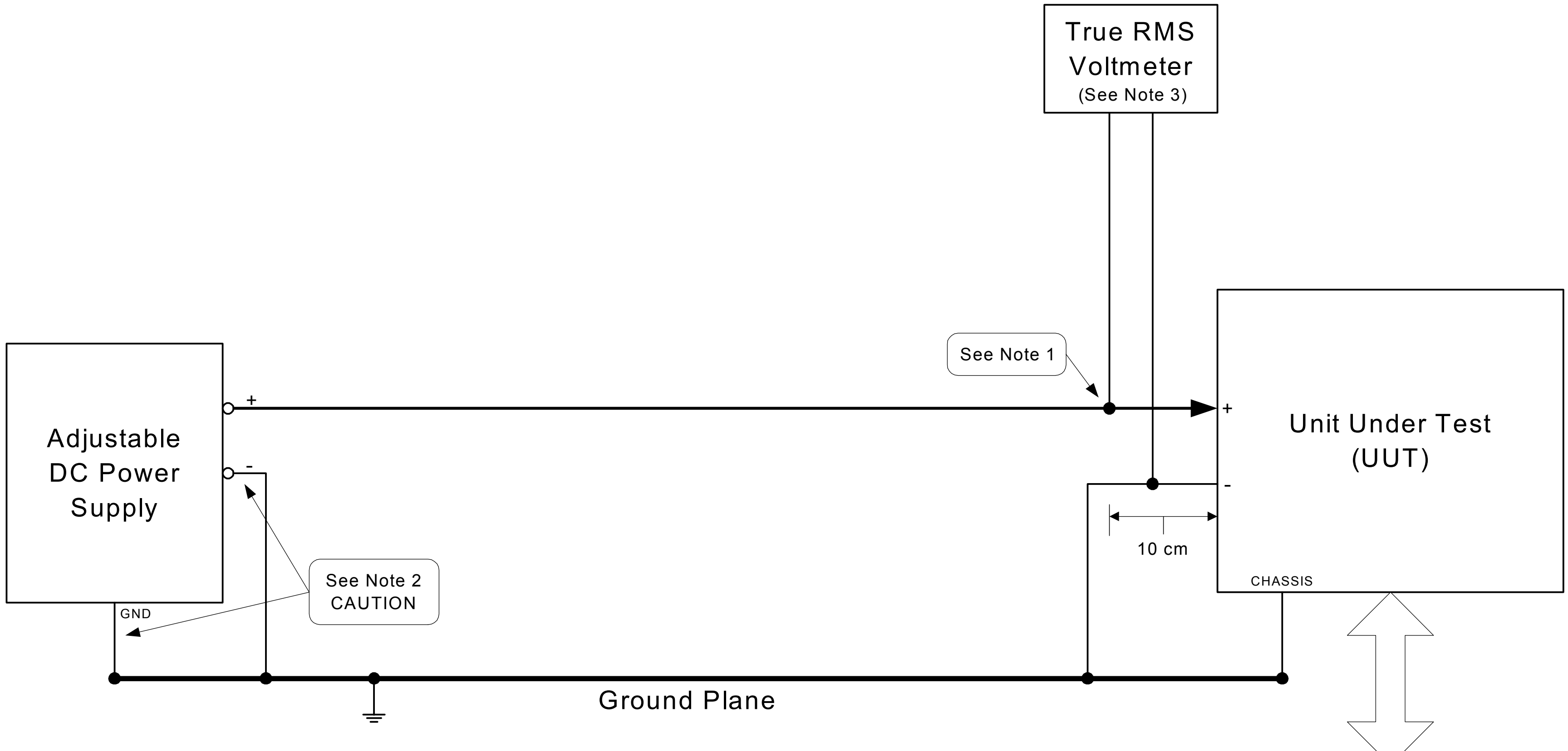
4. Test setup. Configure the test setup as shown in figure HDC301-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC301-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A and B noted in table HDC301-II, the UUT must remain for a length of time that confirms the utilization equipment can perform as specified at the abnormal steady state voltage limits and should be not less than thirty (30) minutes. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. For each test condition shutdown the UUT and verify that the UUT can be re-started. After re-start conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Adjust the voltage to the nominal steady state voltage of 270VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the voltage, time duration at test condition, successful/unsuccessful re-start and the performance of the UUT for each test condition in the data sheet shown in table HDC301-III. Repeat for each mode of operation of the UUT.

TABLE HDC301-II. Test conditions for abnormal steady state limits of DC voltage.

Test Condition	Voltage
A	ALSS Voltage
B	AHSS Voltage



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitablity of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE HDC301-1. Abnormal operation - steady state limits for voltage.

TABLE HDC301-III. Sample data sheet for HDC301 abnormal steady state limits for voltage.

Test Condition	Parameters					Performance
	Voltage		Time Duration at Test Condition		Re-Start (Yes/No)	Pass/Fail
A		V_{DC}		min		
B		V_{DC}		min		

METHOD HDC302
Abnormal Voltage Transients

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Abnormal Operation

PARAMETER: Abnormal Voltage Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment operates and maintains specified performance when subjected to abnormal voltage transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to voltage transients within the abnormal limits of the applicable edition(s) of MIL-STD-704 and as noted in table HDC302-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE HDC302-I. MIL-STD-704 limits for abnormal voltage transients.

Limit	704A	704B	704C	704D	704E	704F
Abnormal Voltage Transients	N/A	figure 10 MIL-STD-704B	figure 13 MIL-STD-704C	figure 13 MIL-STD-704D	figure 12 MIL-STD-704E	figure 17 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable DC power supply
b. True RMS voltmeter
c. Oscilloscope

4. Test setup. Configure the test setup as shown in figure HDC302-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC302-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

5.1 Compliance test for MIL-STD-704B, C, & D. The UUT must be subjected to the voltage transients for each test condition A through N noted in table HDC302-II. The voltage must increase or decrease from steady state voltage as noted in table HDC302-II to the voltage transient level within 1 millisecond. The voltage must remain at the voltage transient level for the duration noted in table HDC302-II. The voltage must return to steady state over the time duration noted in table HDC302-II. For test condition C and F, three over-voltage transients of 475 Vdc for 10 milliseconds are performed, separated by 0.5 seconds. For test condition I and L, three under-voltage transients of 65 Vdc for 10 milliseconds are performed, separated by 0.5 second. For test condition M and N, an under-voltage transient of 65 Vdc for 10 milliseconds is immediately followed by an over-voltage transient of 475 Vdc for 27 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits. Record the steady state voltage, voltage transient (oscilloscope trace), and the performance of the UUT for each test condition in the data sheet shown in table HDC302-IV. Repeat for each mode of operation of the UUT.

5.2 Compliance test for MIL-STD-704E & F. The UUT must be subjected to the voltage transients for each test condition AA through NN noted in table HDC302-III. The voltage must increase or decrease from steady state voltage as noted in table HDC302-III to the voltage transient level within 1 millisecond. The voltage must remain at the voltage transient level for the duration noted in table HDC302-III. The voltage must return to steady state over the time duration noted in table HDC302-III. For test condition CC and FF, three over-voltage transients of 350 Vdc for 50 milliseconds are performed, separated by 0.5 second. For test condition II and LL, three under-voltage transients of 180 Vdc for 50 milliseconds are performed, separated by 0.5 second. For test condition MM and NN, an under-voltage transient of 180 Vdc for 10 milliseconds is immediately followed by an over-voltage transient of 350 Vdc for 50 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits. Record the steady state voltage, voltage transient (oscilloscope trace), and the performance of the UUT for each test condition in the data sheet shown in table HDC302-V. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 270 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE HDC302-II. Test conditions for MIL-STD-704B, C, and D abnormal voltage transients.

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Overvoltage Transients					
A	280 Vdc	< 1 msec	475 Vdc	27 msec	< 1 msec
B	280 Vdc	< 1 msec	475 Vdc	27 msec	9 msec
		then	430 Vdc	decreasing	10 msec
		then	400 Vdc	decreasing	25 msec
		then	360 Vdc	decreasing	30 msec
		then	340 Vdc	decreasing	50 msec
		then	320 Vdc	decreasing	150 msec
		then	300 Vdc	decreasing	400 msec
		then	280 Vdc		
C	280 Vdc	< 1 msec	475 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec
D	250 Vdc	< 1 msec	475 Vdc	27 msec	< 1 msec
E	250 Vdc	< 1 msec	475 Vdc	27 msec	9 msec
		then	430 Vdc	decreasing	10 msec
		then	400 Vdc	decreasing	25 msec
		then	360 Vdc	decreasing	30 msec
		then	340 Vdc	decreasing	50 msec
		then	320 Vdc	decreasing	150 msec
		then	300 Vdc	decreasing	2.7 sec
		then	250 Vdc		
F	250 Vdc	< 1 msec	475 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec

TABLE HDC302-II. Test conditions for MIL-STD-704B, C, and D abnormal voltage transients. - Continued

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Undervoltage Transients					
G	280 Vdc	< 1 msec	65 Vdc	27 msec	< 1 msec
H	280 Vdc	< 1 msec	65 Vdc	27 msec	9 msec
		then	110 Vdc	increasing	10 msec
		then	140 Vdc	increasing	25 msec
		then	180 Vdc	increasing	30 msec
		then	200 Vdc	increasing	50 msec
		then	220 Vdc	increasing	150 msec
		then	240 Vdc	increasing	2.7 sec
		then	280 Vdc		
I	280 Vdc	< 1 msec	65 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec
J	250 Vdc	< 1 msec	65 Vdc	27 msec	< 1 msec
K	250 Vdc	< 1 msec	65 Vdc	27 msec	9 msec
		then	110 Vdc	increasing	10 msec
		then	140 Vdc	increasing	25 msec
		then	180 Vdc	increasing	30 msec
		then	200 Vdc	increasing	50 msec
		then	220 Vdc	increasing	150 msec
		then	240 Vdc	increasing	400 msec
		then	250 Vdc		
L	250 Vdc	< 1 msec	65 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec

TABLE HDC302-II. Test conditions for MIL-STD-704B, C, and D abnormal voltage transients. - Continued

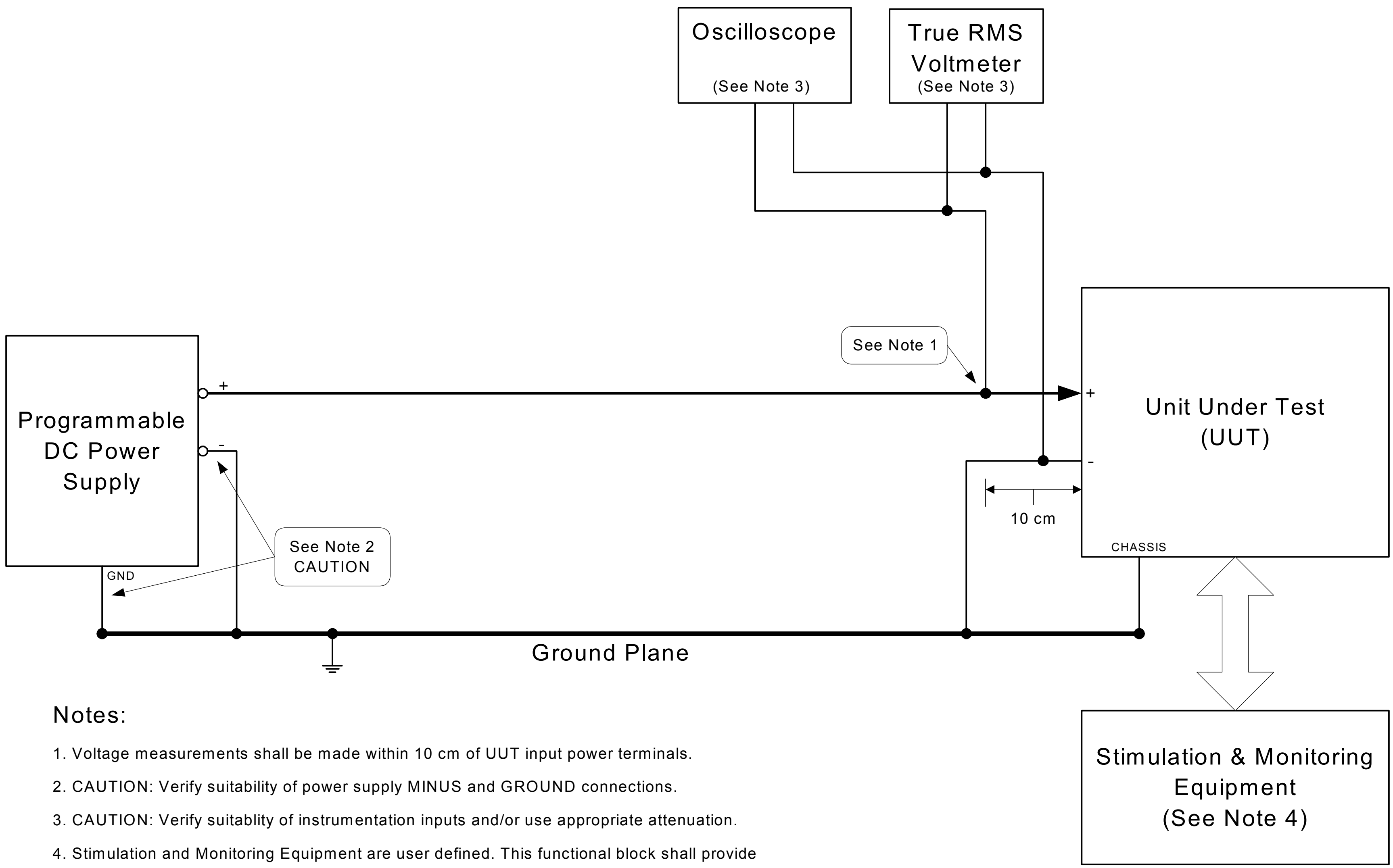
Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Combined Transient					
M	280 Vdc	< 1 msec < 1 msec	65 Vdc 475 Vdc	10 msec 27 msec	< 1 msec 9 msec
		then	430 Vdc	decreasing	10 msec
		then	400 Vdc	decreasing	25 msec
		then	360 Vdc	decreasing	30 msec
		then	340 Vdc	decreasing	50 msec
		then	320 Vdc	decreasing	150 msec
		then	300 Vdc	decreasing	400 msec
		then	280 Vdc		
N	250 Vdc	< 1 msec < 1 msec	65 Vdc 475 Vdc	10 msec 27 msec	< 1 msec 9 msec
		then	430 Vdc	decreasing	10 msec
		then	400 Vdc	decreasing	25 msec
		then	360 Vdc	decreasing	30 msec
		then	340 Vdc	decreasing	50 msec
		then	320 Vdc	decreasing	150 msec
		then	300 Vdc	decreasing	2.7 sec
		then	250 Vdc		

TABLE HDC302-III. Test conditions for MIL-STD-704E and F abnormal voltage transients.

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Overvoltage Transients					
AA	280 Vdc	< 1 msec	350 Vdc	50 msec	< 1 msec
BB	280 Vdc	< 1 msec	350 Vdc	50 msec	10 msec
		then	340 Vdc	decreasing	15 msec
		then	330 Vdc	decreasing	25 msec
		then	320 Vdc	decreasing	190 msec
		then	300 Vdc	decreasing	1.71 sec
			280 Vdc		
CC	280 Vdc	< 1 msec	350 Vdc (3 times)	50 msec Every 0.5 sec	< 1 msec
DD	250 Vdc	< 1 msec	350 Vdc	50 msec	< 1 msec
EE	250 Vdc	< 1 msec	350 Vdc	50 msec	10 msec
		then	340 Vdc	decreasing	15 msec
		then	330 Vdc	decreasing	25 msec
		then	320 Vdc	decreasing	190 msec
		then	300 Vdc	decreasing	6.7 sec
		then	250 Vdc		
FF	250 Vdc	< 1 msec	350 Vdc (3 times)	50 msec Every 0.5 sec	< 1 msec
Undervoltage Transients					
GG	280 Vdc	< 1 msec	180 Vdc	50 msec	< 1 msec
HH	280 Vdc	< 1 msec	180 Vdc	50 msec	10 msec
		then	190 Vdc	increasing	15 msec
		then	200 Vdc	increasing	25 msec
		then	210 Vdc	increasing	190 msec
		then	230 Vdc	increasing	6.7 sec
		then	280 Vdc		
II	280 Vdc	< 1 msec	180 Vdc (3 times)	50 msec Every 0.5 sec	< 1 msec
JJ	250 Vdc	< 1 msec	180 Vdc	50 msec	< 1 msec
KK	250 Vdc	< 1 msec	180 Vdc	50 msec	10 msec
		then	190 Vdc	increasing	15 msec
		then	200 Vdc	increasing	25 msec
		then	210 Vdc	increasing	190 msec
		then	230 Vdc	increasing	1.71 sec
		then	250 Vdc		
LL	250 Vdc	< 1 msec	180 Vdc (3 times)	50 msec Every 0.5 sec	< 1 msec

TABLE HDC302-III. Test conditions for MIL-STD-704E and F abnormal voltage transients. - Continued

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Combined Transient					
MM	280 Vdc	< 1 msec < 1 msec	180 Vdc 350 Vdc	10 msec 50 msec	< 1 msec 10 msec
		then	340 Vdc	decreasing	15 msec
		then	330 Vdc	decreasing	25 msec
		then	320 Vdc	decreasing	190 msec
		then	300 Vdc	decreasing	1.71 sec
			280 Vdc		
NN	250 Vdc	< 1 msec < 1 msec	180 Vdc 350 Vdc	10 msec 50 msec	< 1 msec 10 msec
		then	340 Vdc	decreasing	15 msec
		then	330 Vdc	decreasing	25 msec
		then	320 Vdc	decreasing	190 msec
		then	300 Vdc	decreasing	6.7 sec
		then	250 Vdc		



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitablity of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE HDC302-1. Abnormal operation - abnormal voltage transients.

TABLE HDC302-IV. Sample data sheet for HDC302 abnormal voltage transients for MIL-STD-704 B, C, & D.

Test Condition	Parameters								Performance
	Steady State Voltage		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
A		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
B		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
C		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
D		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
E		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
F		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
G		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
H		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
I		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
J		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
K		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
L		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
M		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
				V_{DC}		msec			
N		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
				V_{DC}		msec			

TABLE HDC302-V. Sample data sheet for HDC302 abnormal voltage transients for MIL-STD-704E, & F.

Test Condition	Parameters								Performance
	Steady State Voltage		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
AA		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
BB		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
CC		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
DD		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
EE		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
FF		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
GG		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
HH		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
II		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
JJ		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
KK		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
LL		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
MM		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
				V_{DC}		msec			
NN		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs. Time	
				V_{DC}		msec			

METHOD HDC401
Steady State Limits for Voltage

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL OPERATING CONDITION: Emergency Operation

PARAMETER: Steady State Limits for Voltage

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment operates and maintains specified performance when provided power with voltage at that the Emergency Low Steady State (ELSS) limits and the Emergency High Steady State (EHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for emergency aircraft electrical conditions when supplied input power of voltage at the specified emergency steady state limits of the applicable edition(s) of MIL-STD-704 and as noted in table HDC401-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the emergency steady state voltage limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE HDC401-I. MIL-STD-704 emergency limits for steady state voltage.

Emergency Limit	704A	704B	704C	704D	704E	704F
Voltage ELSS	N/A	240 Vdc	240 Vdc	240 Vdc	250 Vdc	250 Vdc
Voltage EHSS	N/A	290 Vdc	290 Vdc	290 Vdc	280 Vdc	280 Vdc

3. Apparatus. The test equipment should be as follows:

a. Adjustable DC power supply
b. True RMS voltmeter

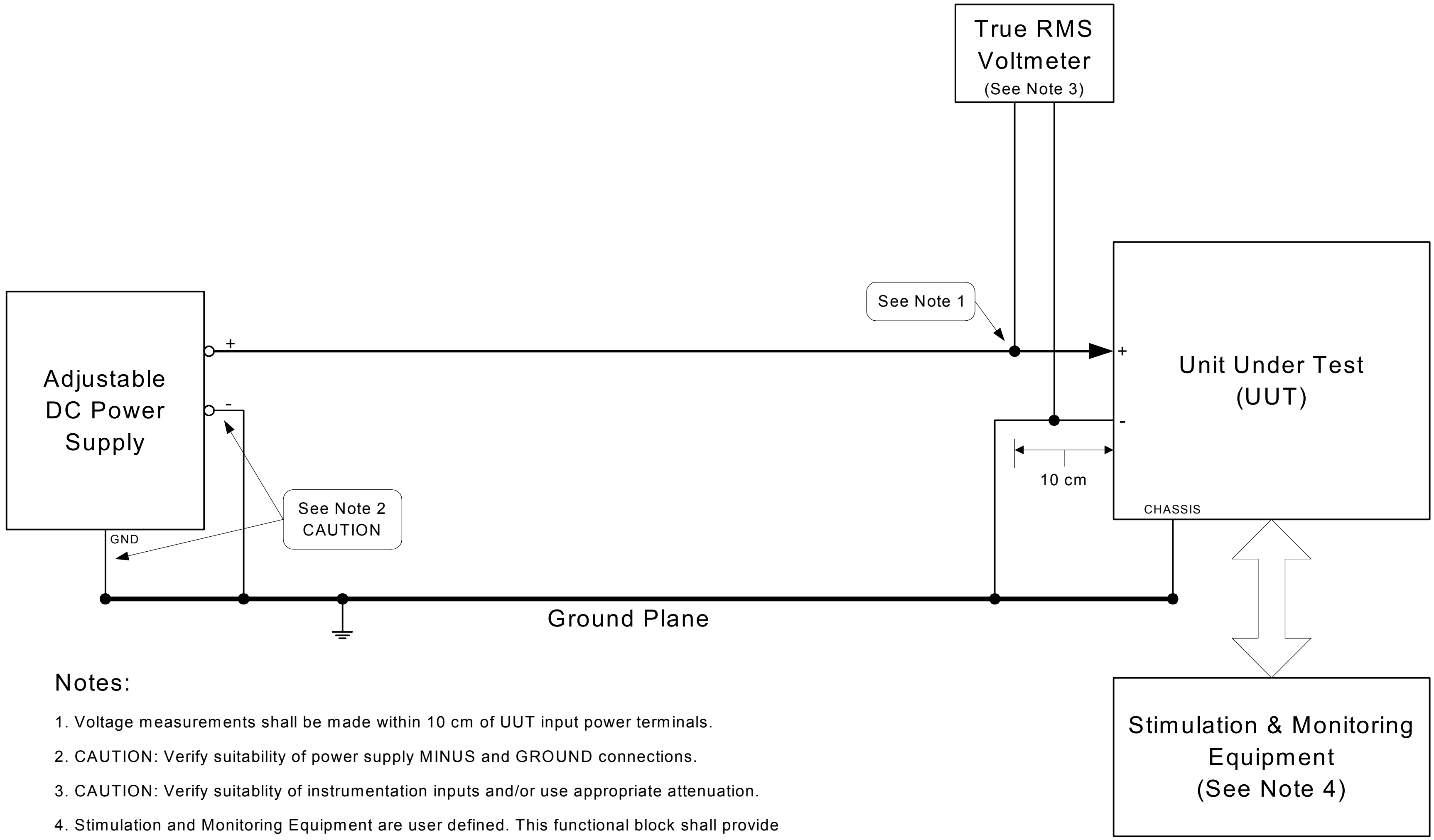
4. Test setup. Configure the test setup as shown in figure HDC401-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC401-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A and B noted in table HDC401-II, the UUT must remain for a length of time that confirms the utilization equipment can perform as specified at the emergency steady state voltage limits and should be not less than thirty (30) minutes. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for emergency aircraft electrical conditions. For each test condition shutdown the UUT and verify that the UUT can be re-started. After re-start conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for emergency aircraft electrical conditions. Adjust the voltage to the nominal steady state voltage of 270VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the voltage, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table HDC401-III. Repeat for each mode of operation of the UUT.

TABLE HDC401-II. Test conditions for emergency steady state limits of DC voltage.

Test Condition	Voltage
A	ELSS Voltage
B	EHSS Voltage



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitablity of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE HDC401-1. Emergency operation - steady state limits for voltage.

TABLE HDC401-III. Sample data sheet for HDC401 emergency steady state limits for voltage and frequency.

Test Condition	Parameters				Performance
	Voltage		Time Duration at Test Condition		Pass/Fail
A		V_{DC}		min	
B		V_{DC}		min	

METHOD HDC501
Starting Voltage Transients

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL OPERATING CONDITION: Starting Operation

PARAMETER: Starting Voltage Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment operates and maintains specified performance when subjected to starting voltage transients as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for starting aircraft electrical conditions when subjected to starting voltage transients for the applicable edition(s) of MIL-STD-704 and as noted in table HDC501-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE HDC501-I. MIL-STD-704 limits for starting voltage transients.

Limit	704A	704B	704C	704D	704E	704F
Starting Voltage Transients	N/A	Use Limits of 704 C	155 Vdc to 280 Vdc	115 Vdc to 280 Vdc	115 Vdc to 280 Vdc	115 Vdc to 280 Vdc

3. Apparatus. The test equipment should be as follows:

a. Programmable DC power supply
b. True RMS voltmeter
c. Oscilloscope

4. Test setup. Configure the test setup as shown in figure HDC501-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC501-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

5.1 Compliance test for MIL-STD-704B and C. The UUT must be subjected to the starting voltage transients described in table HDC501-II (test condition A). The voltage must decrease from steady state voltage to 155 Vdc within 1 millisecond. The voltage must return to steady state at a constant rate over 30 seconds. Monitor the performance of the UUT during the starting voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for starting aircraft electrical conditions. Repeat the test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits. Record the steady state voltage, voltage transient (oscilloscope trace), and the performance of the UUT in the data sheet shown in table HDC501-IV. Repeat for each mode of operation of the UUT.

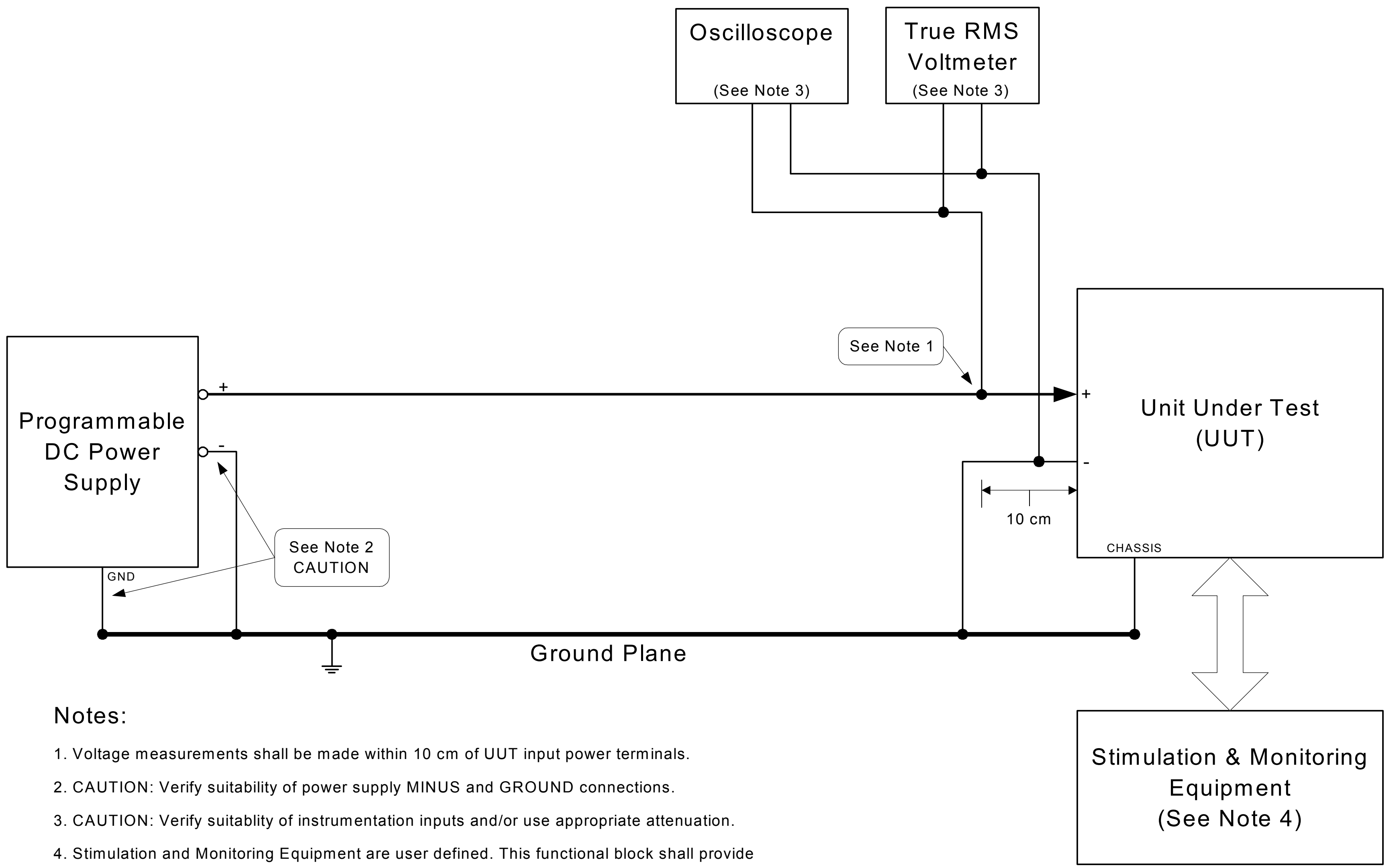
5.2 Compliance test for MIL-STD-704D, E, and F. The UUT must be subjected to the starting voltage transients described in table HDC501-III (test condition AA). The voltage must decrease from steady state voltage to 115 Vdc within 1 millisecond. The voltage must return to steady state at a constant rate over 30 seconds. Monitor the performance of the UUT during the starting voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for starting aircraft electrical conditions. Repeat the test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits. Record the steady state voltage, voltage transient (oscilloscope trace), and the performance of the UUT in the data sheet shown in table HDC501-IV. Repeat for each mode of operation of the UUT.

TABLE HDC501-II. Test conditions for MIL-STD-704B and C starting voltage transients.

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Time From Voltage Transient Level to Steady State Voltage
A	280 Vdc	< 1 msec	155 Vdc	30 sec

TABLE HDC501-III. Test conditions for MIL-STD-704D, E, and F starting voltage transients.

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Time From Voltage Transient Level to Steady State Voltage
AA	280 Vdc	< 1 msec	115 Vdc	30 sec



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitablity of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE HDC501-1. Starting operation - starting voltage.

TABLE HDC501-IV. Sample data sheet for HDC501 starting voltage transients for MIL-STD-704B, C, D, E, & F.

Test Condition	Parameters								Performance
	Steady State Voltage		Voltage Transient		Time to Return to Steady State Voltage		Oscilloscope Trace		Pass/Fail
		V_{DC}		V_{DC}		sec	Attach Trace	V_{DC} vs. Time	

METHOD HDC601
Power Failure

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Power Failure

PARAMETER: Power Failure

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment operates and maintains specified performance when subjected to Power Failures as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to power failures as specified by the applicable edition(s) of MIL-STD-704 and as noted in table HDC601-I. The utilization equipment must maintain the specified performance during power failures. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE HDC601-I. MIL-STD-704 Power failure limits.

Limit	704A	704B	704C	704D	704E	704F
Power Failure	N/A	7 sec figure 10 MIL-STD-704B	7 sec figure 13 MIL-STD-704C	7 sec figure 13 MIL-STD-704D	7 sec figure 12 MIL-STD-704E	7 sec figure 17 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable DC power supply
b. True RMS voltmeter
c. Oscilloscope

4. Test setup. Configure the test setup as shown in figure HDC601-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC601-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to

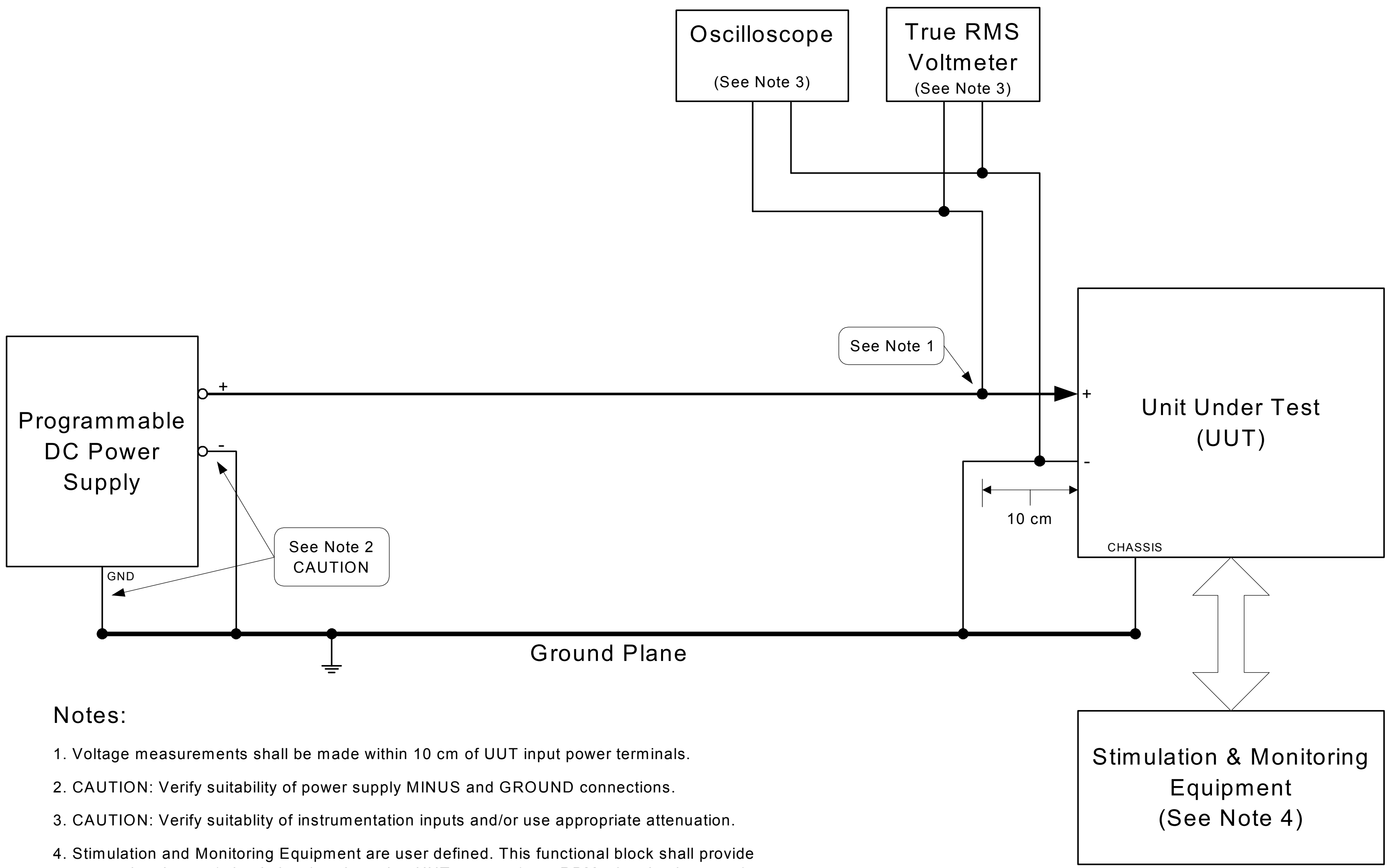
the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through D noted in table HDC601-II, perform a power failure (0 V) of the duration listed. The voltage must decrease from the steady state voltage to 0 volts within 0.25 milliseconds, remain at 0 volts for the duration listed for the test condition, and return from 0 volts to the steady state voltage within 0.25 milliseconds. For each test condition, monitor the performance of the UUT according to the utilization equipment performance test procedures for power failure operation to verify that the UUT is providing specified performance for power failure aircraft electrical conditions. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the steady state voltage, time duration of power failure, and the performance of the UUT for each test condition in the data sheet shown in table HDC601-III. Repeat each test condition 5 times. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 270 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE HDC601-II. Test conditions for power failures.

Test Condition	Duration of Power Failure
A	100 msec
B	500 msec
C	3 seconds
D	7 seconds



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitablity of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE HDC601-1. Power Failure.

TABLE HDC601-III. Sample data sheet for HDC601 power failure.

Test Condition	Parameters				Performance
	Voltage		Time Duration of Power Failure		Pass/Fail
A		V_{DC}		msec	
B		V_{DC}		msec	
C		V_{DC}		sec	
D		V_{DC}		sec	

METHOD HDC602
Phase Reversal

POWER GROUP: 270 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Power Failure

PARAMETER: Phase Reversal

1. Scope.

1.1 Purpose. This test procedure is used to verify that 270 volt DC power utilization equipment is not damaged by phase reversal or a positive physical means is employed to prevent phase reversal.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment is not damaged and does not cause an unsafe condition when the positive and negative connection are reversed for the applicable edition(s) of MIL-STD-704 and as noted in table HDC602-I. A positive physical means to prevent phase reversal may be used to fulfill this requirement.

TABLE HDC602-I. MIL-STD-704 phase reversal requirement.

Limit	704A	704B	704C	704D	704E	704F
Phase Reversal	N/A	N/A	N/A	N/A	N/A	Phase Reversal Does not Cause Damage

3. Apparatus. The test equipment should be as follows:

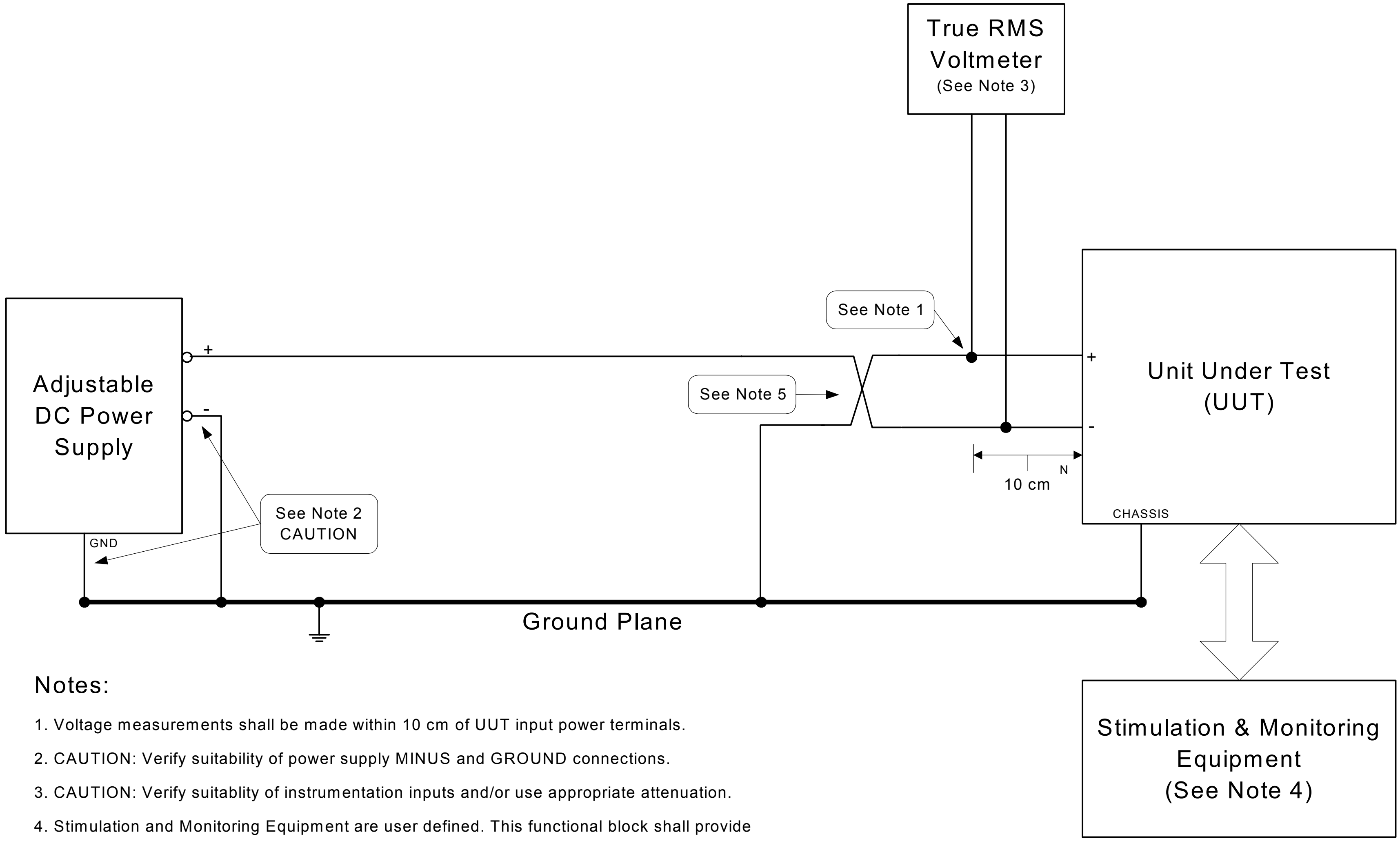
a. Adjustable DC power supply
b. True RMS voltmeter

4. Test setup. Configure the test setup as shown in figure HDC602-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. If a positive physical means is employed to prevent phase reversal, confirm that the positive and negative conductors cannot be reversed.

If the positive and negative conductors can be reversed, with the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC602-1 (positive and negative conductors reversed). Turn on the power source and adjust the voltage to the nominal steady state voltage of 270 VDC. Energize the UUT. The UUT must remain for a length of time that confirms the utilization equipment is not damaged and does not cause an unsafe condition due to phase reversal and should be not less than thirty (30) minutes. Record the steady state voltage, time duration at phase reversal test condition, and the performance of the UUT in the data sheet shown in table HDC602-II. Repeat for each mode of operation of the UUT.

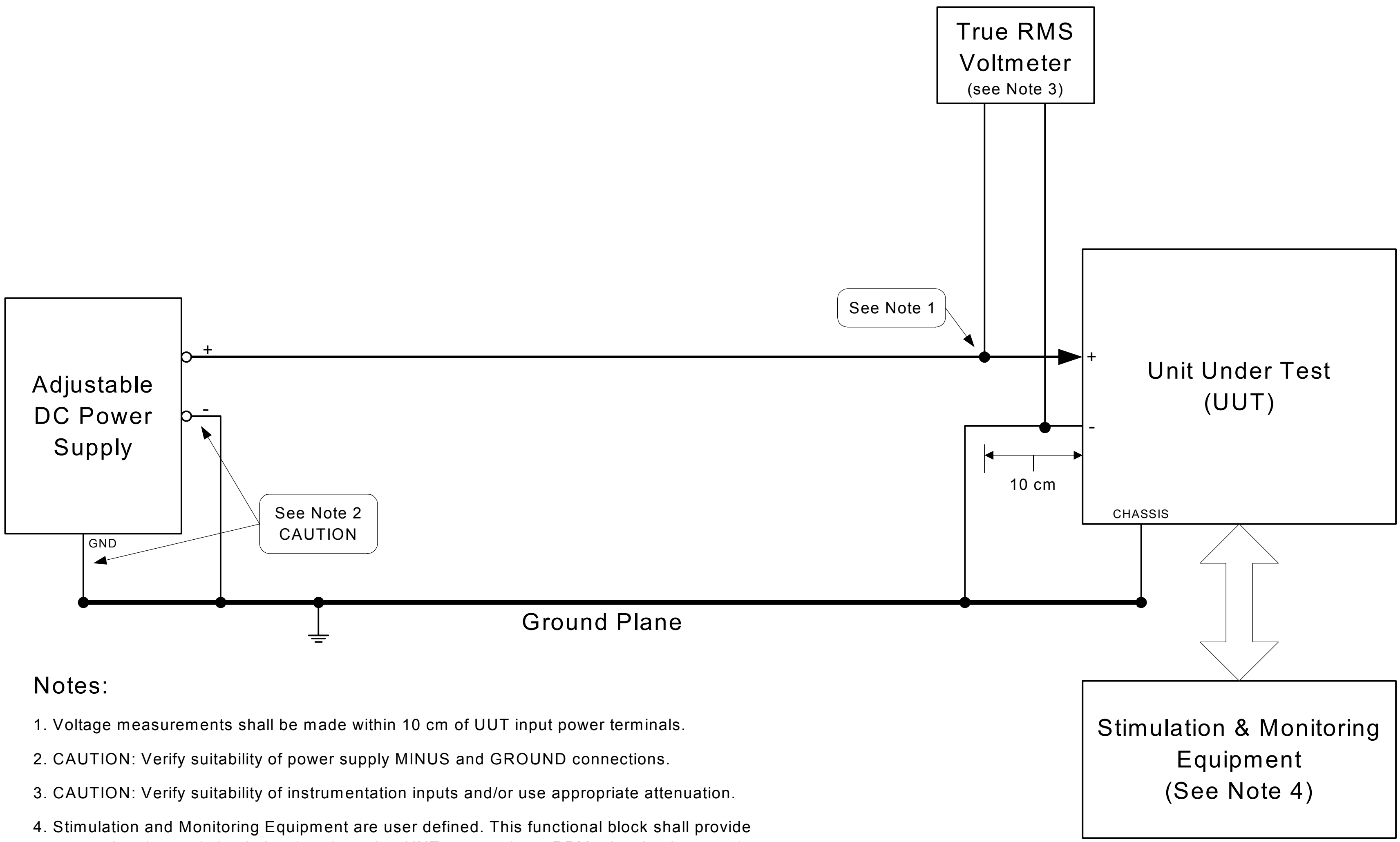
With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure HDC602-2 (positive and negative conductors connected properly). Turn on the power source and adjust the voltage to the nominal steady state voltage of 270VDC. Energize the UUT. The UUT must remain for a length of time that confirms the utilization equipment was not damaged and does not cause an unsafe condition after the phase reversal and should be not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has returned to the performance specified for normal aircraft electrical conditions and has not suffered damage. Record the steady state voltage, time duration at test condition, and the performance of the UUT in the data sheet shown in table HDC602-II. Repeat for each mode of operation of the UUT.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitablity of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)
5. Phase Polarity is reversed.

FIGURE HDC602-1. Phase reversal.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE HDC602-2. Correct phase connection.

TABLE HDC602-II. Sample data sheet for HDC602 phase reversal.

<table>
<tr><td rowspan="2">Test Condition</td><td colspan="4" rowspan="2">Parameters</td><td>Performance</td></tr>
<tr><td>Yes/No</td></tr>
<tr><td colspan="5">Phase Reversal Prevented by Positive Physical Means</td><td></td></tr>
<tr><td colspan="6">If No</td></tr>
<tr><td></td><td colspan="2">Voltage</td><td colspan="2">Time Duration at Condition</td><td>Pass/Fail</td></tr>
<tr><td>Phase Reversal</td><td></td><td>V_{dc}</td><td></td><td>min</td><td></td></tr>
<tr><td>Correct Phase Connection</td><td></td><td>V_{dc}</td><td></td><td>min</td><td></td></tr>
</table>

6. NOTES

6.1 Intended use. This handbook should be used as guidance when establishing test requirements, for inclusion in performance specifications developed for the procurement of utilization equipment, to ensure compliance with the aircraft electrical power characteristics as specified by MIL-STD-704.

6.2 Subject term (keyword) listing.

Aircraft, electrical power
Aircraft, electrical test
Electrical operating areas
Equipment, utilization
Power groups
Specification, utilization equipment

CONCLUDING MATERIAL

Custodians:
Army - AV
Navy - AS
Air Force - 11

Preparing Activity:
Navy - AS

(Project No. SESS-0053)

Review Activities:
Army - CR, MI, TE
Navy - EC, MC, SA, SH, YD

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at www.dodssp.daps.mil.

NOT MEASUREMENT
SENSITIVE

MIL-HDBK-704-8
9 April 2004

DEPARTMENT OF DEFENSE
HANDBOOK

GUIDANCE FOR
TEST PROCEDURES FOR DEMONSTRATION OF
UTILIZATION EQUIPMENT COMPLIANCE TO
AIRCRAFT ELECTRICAL POWER CHARACTERISTICS
28 VDC
(PART 8 OF 8 PARTS)

This Handbook is for guidance only.
Do not cite this document as a requirement.

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FOREWORD

1. This handbook is approved for use by all Departments and Agencies of the Department of Defense.

2. This handbook provides guidance on test procedures for demonstration of 28 VDC utilization equipment to determine compliance with the applicable edition of MIL-STD-704.

3. MIL-HDBK-704-8 is Part 8 in a series of 8 Parts. Part 8 describes the test methods and procedures to demonstrate that 28 VDC utilization equipment is compatible with the electric power characteristics of MIL-STD-704. These series of handbooks and MIL-STD-704 are companion documents.

4. Comments, suggestions, or questions on this document should be addressed to Commander, Naval Air Systems Command, Code 4.1.4, Highway 547, Lakehurst, NJ 08733-5100 or email to thomas.omara@navy.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil.

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1. SCOPE

1.1 Scope. This handbook provides, as guidance, test methods used to demonstrate that 28 VDC utilization equipment is compatible with the electric power characteristics of the applicable edition(s) of MIL-STD-704. This handbook is for guidance only and cannot be cited as a requirement.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed below are not necessarily all of the documents referenced herein, but are those needed to understand the information provided by this handbook.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-704	DoD Interface Standard for Aircraft Electric Power Characteristics

(Copies of these documents are available online at http://assist. daps.dla.mil/quicksearch or www.dodssp.daps.mil/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

3. DEFINITIONS

3.1 Acronyms and definitions. The acronyms and definitions of MIL-STD-704 are applicable to this handbook.

4. TEST METHODS INFORMATION

4.1 Demonstration of compatibility. This section contains the test methods which will ensure that 28 VDC utilization equipment is compatible with the electric power characteristics of the applicable edition(s) of MIL-STD-704, by testing the Unit Under Test (UUT) in accordance with the test procedures as described in test methods LDC101 through LDC602.

4.1.1 Recording performance. In table LDC-I, record the edition(s) of MIL-STD-704 that defined the aircraft electric power characteristics used for testing and the performance of the UUT for each of the test methods.

4.2 Calibration of test equipment. Test equipment and accessories required for measurement in accordance with this handbook should be calibrated in accordance with an approved calibration program traceable to the National Institute for Standards and Technology.

The serial numbers, model, and calibration date of all test equipment should be included with the test data.

4.3 Test methods. The test methods listed in table LDC-I are provided in section 5 of this handbook.

TABLE LDC-I. Summary of 28 VDC utilization equipment MIL-STD-704 compliance tests.

UUT:			
Compliance to MIL-STD-704 Edition(s):			
Test Dates:			
Test Method	Description	Performance (Pass/Fail)	Comments
Normal, Aircraft Electrical Operation			
LDC101	Load Measurements		
LDC102	Steady State Limits for Voltage		
LDC103	Voltage Distortion Spectrum		
LDC104	Total Ripple		
LDC105	Normal Voltage Transients		
Transfer, Aircraft Electrical Operation			
LDC201	Power Interrupt		
Abnormal, Aircraft Electrical Operation			
LDC301	Abnormal Steady State Limits for Voltage		
LDC302	Abnormal Voltage Transients (Overvoltage/Undervoltage)		
Emergency, Aircraft Electrical Operation			
LDC401	Emergency Limits for Voltage		
Starting, Aircraft Electrical Operation			
LDC501	Starting Voltage Transients		
Power Failure, Aircraft Electrical Operation			
LDC601	Power Failure		
LDC602	Polarity Reversal		

5. TEST METHODS

METHOD LDC101
Load Measurements

POWER GROUP: 28 Volt DC

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Load Measurements

1. Scope.

1.1 Purpose. This test procedure is used to verify that 28 volt DC power utilization equipment meets the load limits, inrush limits, current distortion limits and current spectrum limits that may be required by the utilization equipment performance specification document.

2. Validation criteria. If required by the utilization equipment performance specification document, the utilization equipment is considered to have passed if the utilization equipment is within the load limits, inrush current limits, the current distortion limit, and the current spectrum limits specified in the utilization equipment performance specification document. As noted in table LDC101-I, the load limits, inrush current limits, the current distortion limit, and the current spectrum limits are not specified in MIL-STD-704 versions A through F. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: The utilization equipment performance specification document should include requirements that reduce the likelihood of the equipment having an adverse effect on the electrical power characteristics of the aircraft. Load, inrush currents, current distortion and current spectrum limits may be imposed to minimize undesirable effects to the electrical power characteristics. These limits should take into account the utilization equipment power draw, aircraft electrical system capacity and distribution characteristics, trade-offs with weight, volume, cost, and reliability that are specific to each type of equipment and aircraft.

TABLE LDC101-I. MIL-STD-704 limits for load, inrush current, current distortion factor, and current spectrum for 28 volt DC utilization equipment.

Limit	704A	704B	704C	704D	704E	704F
Inrush Current	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]
Load (~~VA~~)	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]
Current Distortion Factor	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]
Current Spectrum	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]	N/A[1/]

1/. Limits for Load, Inrush Current, Current Distortion Factor, and Current Spectrum must be defined in the utilization equipment performance specification document and are unique to each equipment.

3. Apparatus. The test equipment should be as follows:

a. Adjustable DC power supply
b. True RMS voltmeter
c. Power meter
d. Spectrum analyzer
e. Distortion meter
f. Current transformer
g. Oscilloscope

4. Test setup. Configure the test setup as shown in figure LDC101-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT. The current measurement must be taken from the 28 volt DC conductor.

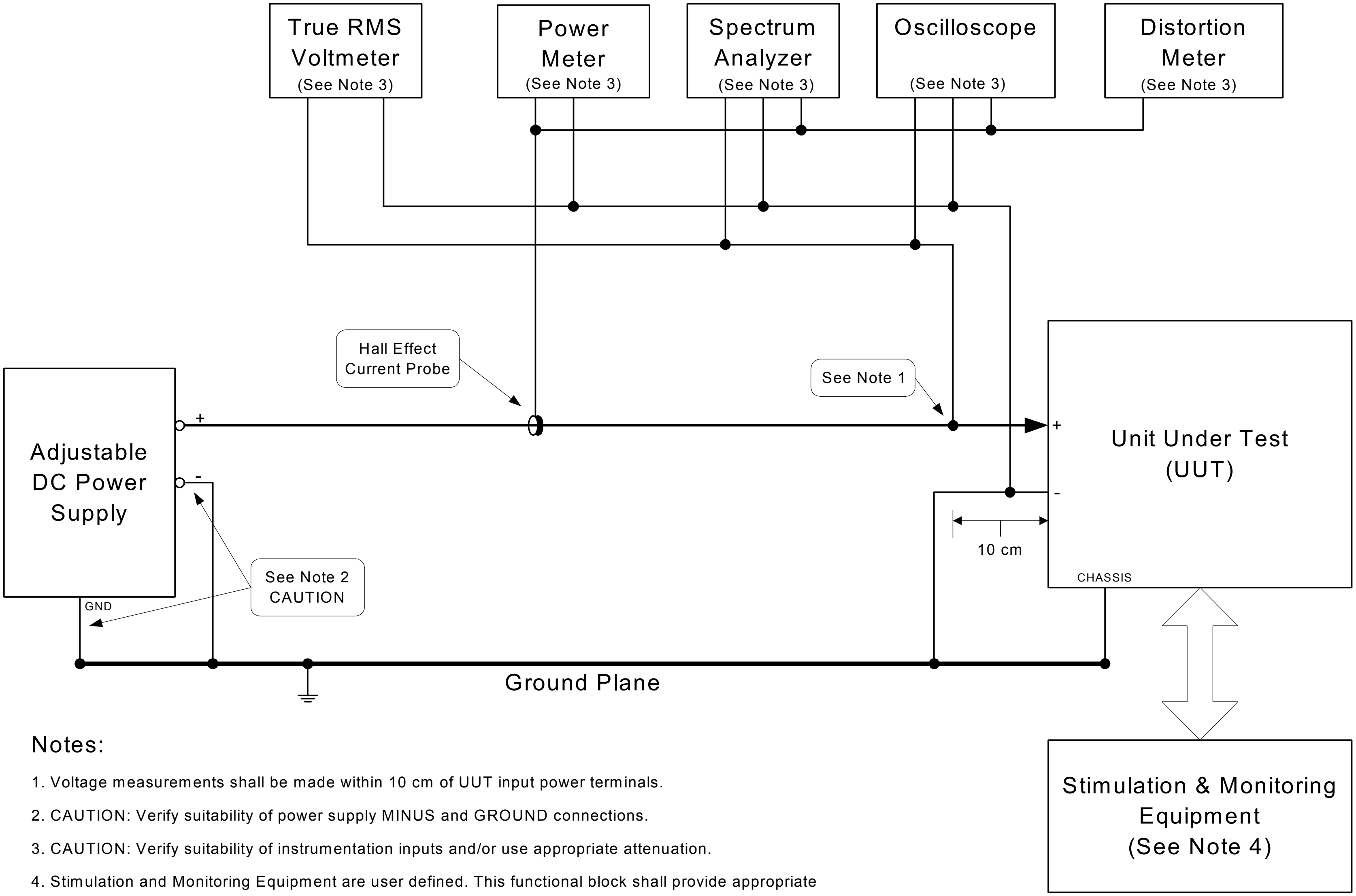
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure LDC101-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 28 VDC. If the utilization equipment performance specification document:

a. Imposes inrush current limits, close the circuit breaker, energizing the UUT. Record the inrush current in the data sheet shown in table LDC101-II and compare with the limits of utilization equipment performance specification document. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat for each mode of operation of the UUT.

b. Imposes load limits, energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the load (Volt-Amps) and the voltage in the data sheet shown in table LDC101-II and compare with the limits of utilization equipment performance specification document. Repeat for each mode of operation of the UUT.

c. Imposes current distortion limits, energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the current distortion factor in the data sheet shown in table LDC101-II and compare with the limits of utilization equipment performance specification document. Repeat for each mode of operation of the UUT.

d. Imposes current spectrum limits, energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the current spectrum (current amplitude vs. frequency) in the data sheet shown in table LDC101-II and compare with the limits of utilization equipment performance specification document. Repeat for each mode of operation of the UUT.



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE LDC101-1. Normal operation - load and current distortion measurement.

TABLE LDC101-II. Sample data sheet for LDC101 load measurements.

Parameter	Measurement	Unit	Performance Pass/Fail
Inrush Current		Amps	
Voltage		V_{dc}	N/A
Load (VA)		VA	
Total Current Distortion		% Current Distortion	
Current Spectrum	Attach Spectrum Plot	Amplitude vs. Frequency	

METHOD LDC102
Steady State Limits for Voltage

POWER GROUP: 28 Volt DC

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Steady State Limits for Voltage

1. Scope.

1.1 Purpose. This test procedure is used to verify that 28 volt DC power utilization equipment operates and maintains specified performance when provided power with voltage at that the Normal Low Steady State (NLSS) limits and the Normal High Steady State (NHSS) limits as specified in the applicable edition(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when supplied input power of voltage at the specified normal steady state limits of the applicable editions(s) of MIL-STD-704 and as noted in table LDC102-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and frequency limits and should be not less than thirty (30) minutes for each of the test conditions. The utilization equipment must demonstrate re-start at the steady state voltage limits. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: If the utilization has exactly the same full performance requirements for abnormal steady state limits and emergency steady state limits as required for the normal aircraft electrical conditions, then performance of test methods LDC301 and LDC401 will constitute performance of LDC102.

TABLE LDC102-I. MIL-STD-704 normal limits for steady state voltage.

Normal Limit	704A	704B	704C	704D	704E	704F
Voltage NLSS	24 Vdc	22 Vdc	22 Vdc	22 Vdc	22 Vdc	22 Vdc
Voltage NHSS	28.5 Vdc	29 Vdc	29 Vdc	29 Vdc	29 Vdc	29 Vdc

3. Apparatus. The test equipment should be as follows:

a. Adjustable DC power supply
b. True RMS voltmeter

4. Test setup. Configure the test setup as shown in figure LDC102-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

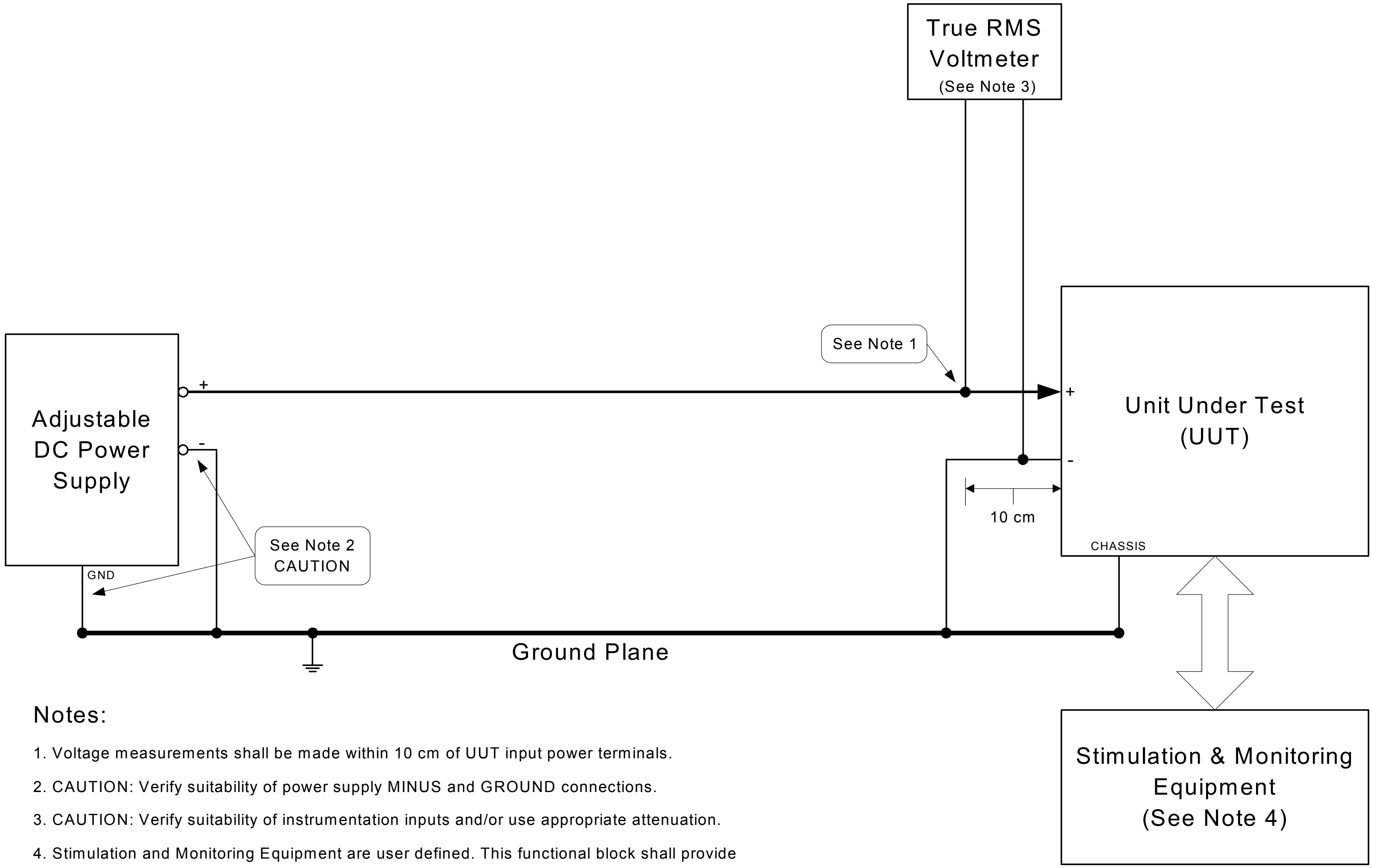
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure LDC102-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 28 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through C noted in table LDC102-II, the UUT must remain for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage limits and should be not less than thirty (30) minutes. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. For each test condition shutdown the UUT and verify that the UUT can be re-started. After re-start conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltage, frequency, time duration at test condition, successful/unsuccessful re-start and the performance of the UUT for each test condition in the data sheet shown in table LDC102-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 28 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE LDC102-II. Test conditions for steady state limits of DC voltage.

Test Condition	Voltage
A	Nominal Voltage
B	NLSS Voltage
C	NHSS Voltage



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE LDC102-1. Normal operation - steady state limits for voltage.

TABLE LDC102-III. Sample data sheet for LDC102 steady state limits for voltage.

Test Condition	Parameters							Performance
	Voltage		Frequency		Time Duration at Condition		Re-Start (Yes/No)	Pass/Fail
A		V_{dc}		Hz		min		
B		V_{dc}		Hz		min		
C		V_{dc}		Hz		min		

METHOD LDC103
Voltage Distortion Spectrum

POWER GROUP: 28 Volt DC

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Voltage Distortion Spectrum

1. Scope.

1.1 Purpose. This test procedure is used to verify that 28 volt DC power utilization equipment operates and maintains specified performance when subjected to voltage distortion of frequencies and amplitudes as specified by the voltage distortion spectrum in the applicable editions(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage distortions as specified by the voltage distortion spectrum in the applicable editions(s) of MIL-STD-704 and as noted in table LDC103-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when provided power having voltage distortion. The utilization equipment must not suffer damage or cause an unsafe condition.

Note: This test method subjects the UUT to voltage distortion having frequencies components from 10 Hz to 10 kHz. These voltage distortions simulate voltage distortions within aircraft due to the cumulative effects of generators, electrical distribution systems equipments, and aircraft loads. MIL-STD-461, (Requirements For The Control of Electromagnetic Interference Characteristics of Subsystems and Equipment), Test Method CS101, (Conducted Susceptibility, Power Leads, 30 Hz to 150 kHz) is a complimentary test. Power levels of the voltage distortions differ for the two test methods. Performance of Test Method LDC103 of this handbook does not relinquish the requirement to perform test Method CS101 of MIL-STD-461, and performance of Method CS101 of MIL-STD-461 does not relinquish the requirement to perform Test Method LDC103 of this handbook.

TABLE LDC103-I. MIL-STD-704 limits for voltage distortion spectrum.

Limit	704A	704B	704C	704D	704E	704F
Voltage Distortion Spectrum	Figure 7 MIL-STD-704A	Figure 6 MIL-STD-704B	Figure 9 MIL-STD-704C	Figure 9 MIL-STD-704D	Figure 8 MIL-STD-704E	Figure 15 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable DC power supply
b. Variable frequency power source
c. Coupling transformer
d. True RMS voltmeter
e. Spectrum analyzer
f. (2) Inductors, 50 μH
g. Capacitor, 10 μF
h. Resistor, calibrated load

4. Test setup (10 Hz and 25 Hz). Configure the test setup as shown in figure LDC103-1 voltage distortion spectrum setup for 10 Hz and 25 Hz. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test (10 Hz and 25 Hz). With the programmable DC power supply off, install the UUT and the stimulation and monitoring equipment into the test setup of figure LDC103-1. Turn on the programmable DC power supply and adjust the voltage to the nominal steady state voltage of 28 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For test condition A noted in table LDC103-II, set the DC programmable power supply to vary the amplitude of the DC voltage at a 10 Hz rate at an average DC voltage of 28 VDC to create a voltage distortion (ripple) for test condition A of the appropriate edition of MIL-STD-704. Remain for a length of time that confirms the utilization equipment can continuously operate with the voltage distortion and should be not less than five (5) minutes. At each test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. For each test condition, record voltage, frequency of voltage distortion, amplitude of voltage distortion, time duration at test condition, and the performance of the UUT in the data sheet shown in table LDC103-III. Repeat for test condition B by setting the DC programmable power supply to vary the amplitude of the DC voltage at a 25 Hz rate at an average DC voltage of 28 VDC to create a voltage distortion (ripple) specified for test condition B of the appropriate edition of MIL-STD-704. Repeat for each mode of operation of the UUT.

6. Test setup (50 Hz to 10 kHz). Configure the test setup as shown in figure LDC103-2. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

6.1 Calibration (50 Hz to 10 kHz). Install a calibrated resistive load in the test setup shown in figure LDC103-2 in place of the UUT. The calibrated resistive load must be sized to draw the same current as the UUT. Turn on the programmable DC power supply and adjust the voltage to the nominal steady state voltage of 28 VDC. Set the variable frequency power source to output a sine wave and adjust the frequency and amplitude so that the voltage distortion measured at the input to the calibrated resistive load conforms to each test condition C through K as noted in table LDC103-II of the applicable editions(s) of MIL-STD-704. Record the settings of the variable frequency power source for each test condition.

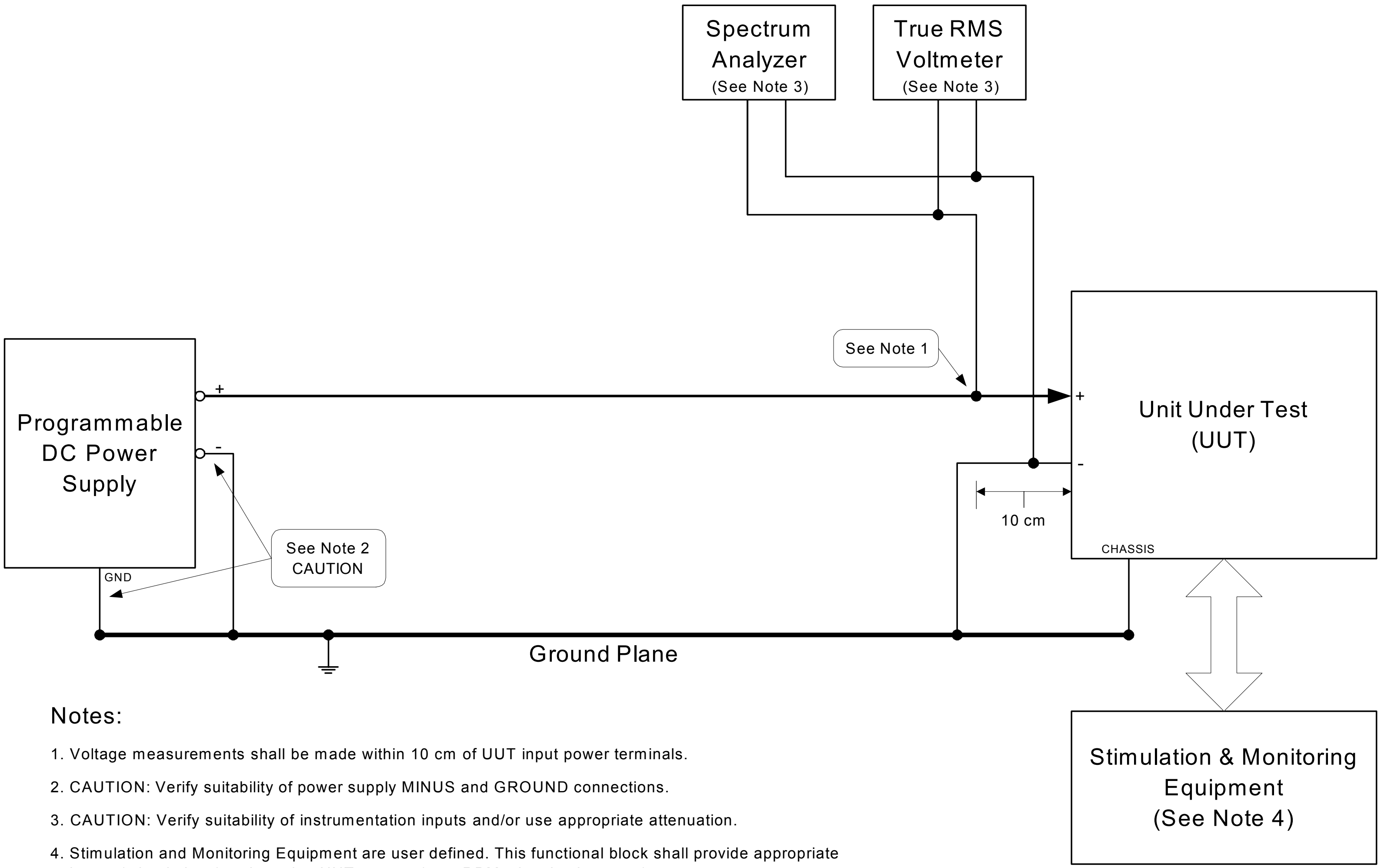
7. Compliance test (50 Hz to 10 kHz). With the programmable DC power supply off, install the UUT and the stimulation and monitoring equipment into the test setup of figure LDC103-2. Turn on the programmable DC power supply and adjust the voltage to the nominal steady state voltage of 28 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

Set the variable frequency power source to the settings recorded for test condition C of the calibration procedure. For each test condition, remain for a length of time that confirms the utilization equipment can continuously operate with the voltage distortion and should be, not less than five (5) minutes. At each test condition, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. After each test condition, monitor the voltage distortion frequency and amplitude while slowly increasing the variable frequency power source frequency and adjusting the amplitude until the next test condition is reached. Do not exceed the voltage distortion spectrum limits. Repeat for each test condition C through K noted in table LDC103-II. For each test condition, record voltage, frequency of voltage distortion, amplitude of voltage distortion, time duration at test condition, and the performance of the UUT in the data sheet shown in table LDC103-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, turn the programmable DC power supply off and remove the coupling transformer from the circuit. Turn on the programmable DC power supply. Adjust the voltage to the nominal steady state voltage of 28 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE LDC103-II. Test conditions for voltage distortion spectrum.

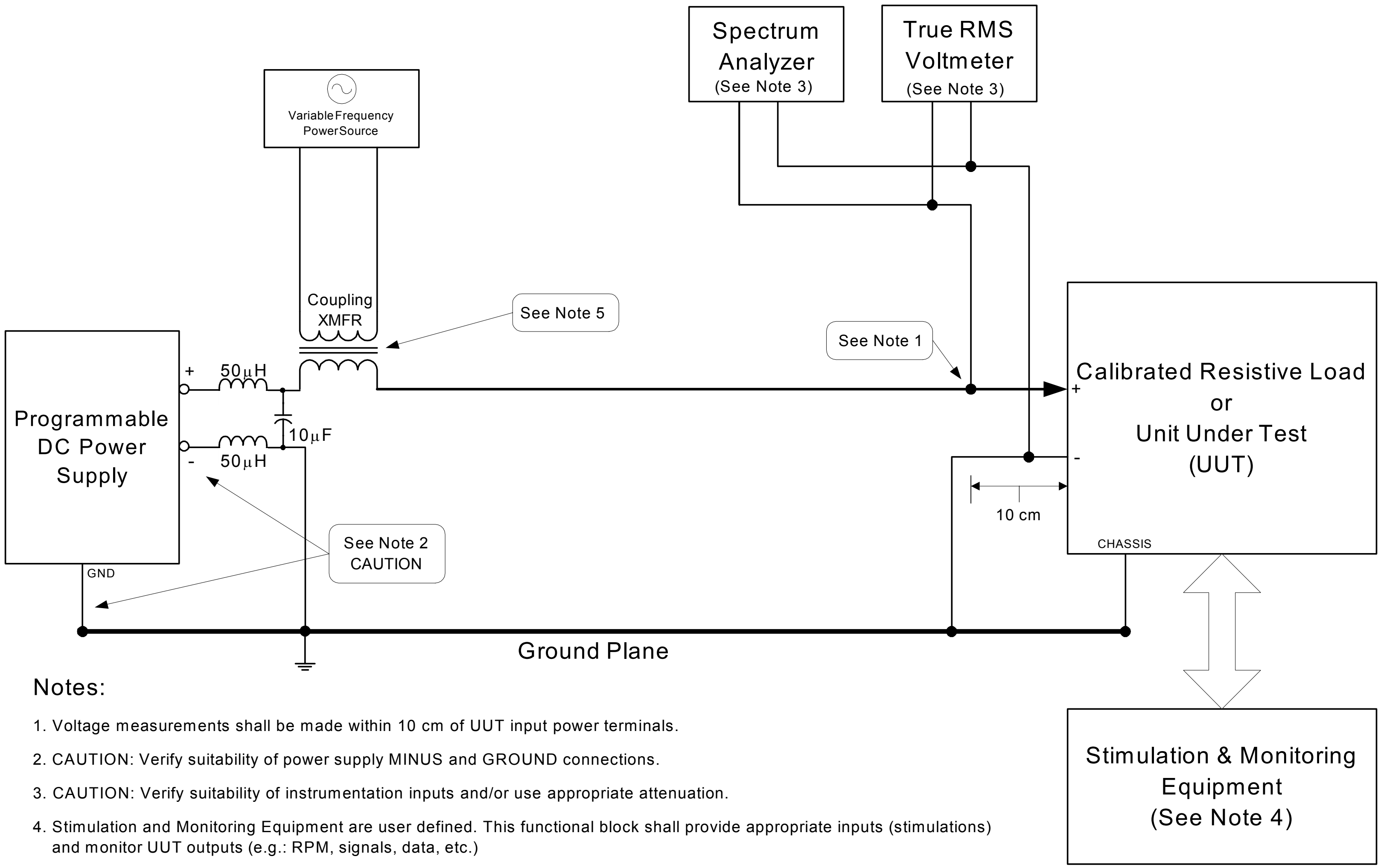
Test Condition	Frequency of Voltage Distortion	MIL-STD-704A Amplitude of Voltage Distortion Voltage rms	MIL-STD-704B, C, & D Amplitude of Voltage Distortion Voltage rms	MIL-STD-704E & F Amplitude of Voltage Distortion Voltage rms
A	10 Hz	0.900 Vrms	0.100 Vrms	0.100 Vrms
B	25 Hz	0.900 Vrms	0.158 Vrms	0.158 Vrms
C	50 Hz	0.400 Vrms	0.200 Vrms	0.223 Vrms
D	60 Hz	0.320 Vrms	0.224 Vrms	0.245 Vrms
E	250 Hz	0.320 Vrms	0.398 Vrms	0.500 Vrms
F	1 kHz	0.790 Vrms	0.707 Vrms	1.000 Vrms
G	1.7 kHz	1.000 Vrms	0.891 Vrms	1.000 Vrms
H	2 kHz	1.000 Vrms	1.000 Vrms	1.000 Vrms
I	5 kHz	1.000 Vrms	0.316 Vrms	1.000 Vrms
J	6.5 kHz	1.000 Vrms	0.707 Vrms	0.707 Vrms
K	10 kHz	0.400 Vrms	0.125 Vrms	0.500 Vrms



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE LDC103-1. Normal operation - voltage distortion spectrum (10 Hz and 25 Hz).



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)
5. CAUTION: Verify suitability of variable frequency power source and coupling transformer for distortion spectrum testing.

FIGURE LDC103-2. Normal operation - voltage distortion spectrum (50 Hz and 10 kHz).

TABLE LDC103-III. Sample data sheet for LDC103 voltage distortion spectrum.

Test Condition	Parameters								Performance
	Voltage		Frequency of Voltage Distortion		Amplitude of Voltage Distortion		Time Duration at Condition		Pass/Fail
A		V_{DC}		Hz		V_{rms}		min	
B		V_{DC}		Hz		V_{rms}		min	
C		V_{DC}		Hz		V_{rms}		min	
D		V_{DC}		Hz		V_{rms}		min	
E		V_{DC}		Hz		V_{rms}		min	
F		V_{DC}		kHz		V_{rms}		min	
G		V_{DC}		kHz		V_{rms}		min	
H		V_{DC}		kHz		V_{rms}		min	
I		V_{DC}		kHz		V_{rms}		min	
J		V_{DC}		kHz		V_{rms}		min	
K		V_{DC}		kHz		V_{rms}		min	

METHOD LDC104
Total Ripple

POWER GROUP: LDC104

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Normal

PARAMETER: Total Ripple

1. Scope.

1.1 Purpose. This test procedure is used to verify that 28 volt DC power utilization equipment operates and maintains specified performance when subjected to voltage having a ripple as specified by the applicable editions(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to ripple as specified by the applicable editions(s) of MIL-STD-704 and as noted in table LDC104-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can operate continuously when subjected to a distorted voltage waveform and should be not less than thirty (30) minutes. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE LDC104-I. MIL-STD-704 limits for ripple DC voltage distortion.

Limit	704A	704B	704C	704D	704E	704F
Voltage Ripple	2 Volts Peak to Mean And Figure 7 MIL-STD-704A	1.5 Volts Peak to Average And Figure 6 MIL-STD-704B	1.5 Volts Peak to Average And Figure 9 MIL-STD-704C	1.5 Volts Peak to Average And Figure 9 MIL-STD-704D	1.5 Volts Peak to Average And Figure 8 MIL-STD-704E	1.5 Volts Peak to Average And Figure 15 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable DC power supply
b. True RMS voltmeter
c. Spectrum analyzer
d. Distortion meter

4. Test setup. Configure the test setup as shown in figure LDC104-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

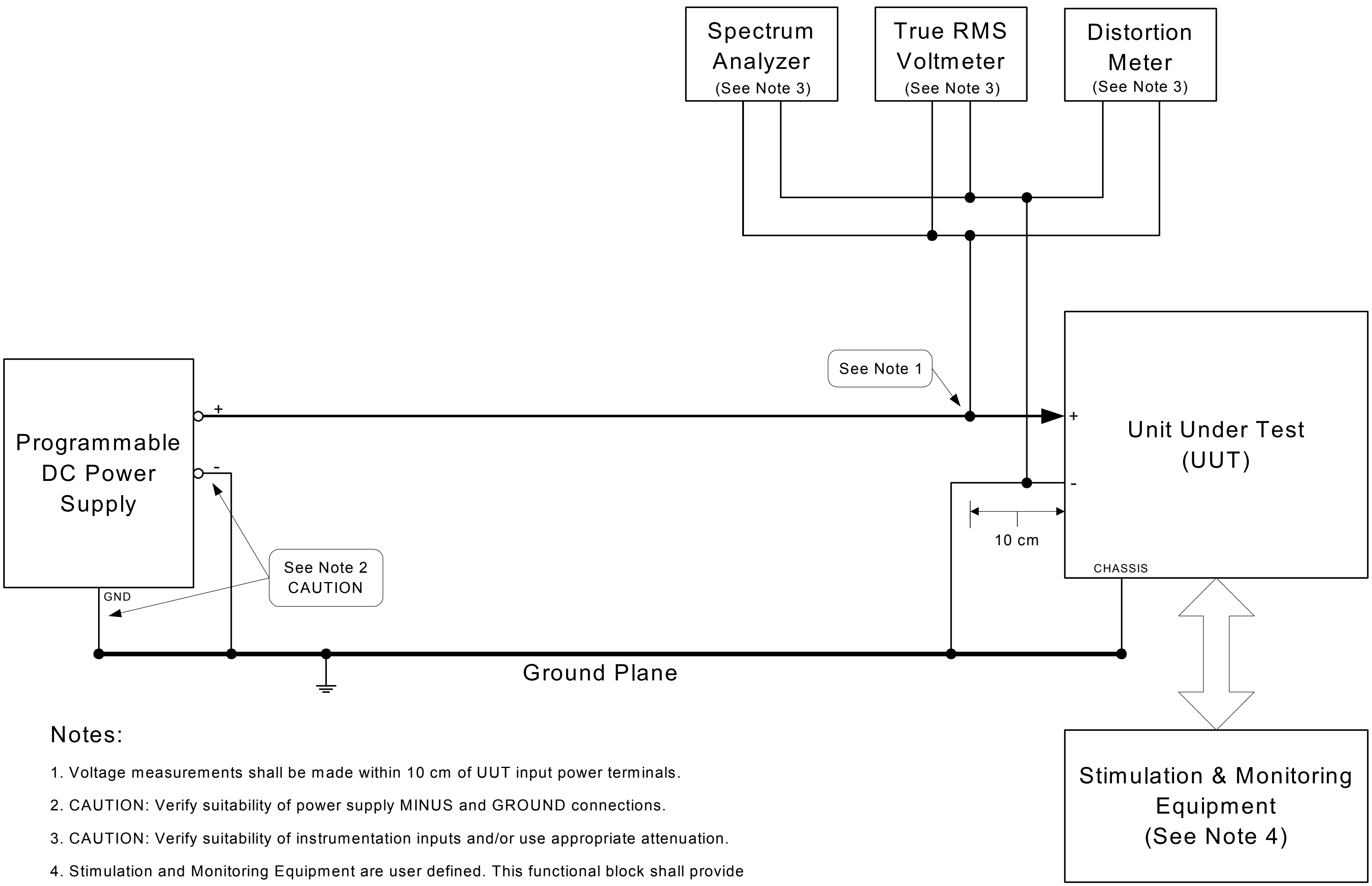
4.1 Calibration. Install a resistive load in the test setup shown in figure LDC104-1 in place of the UUT. The resistive load must be sized to draw the same current as the UUT. Set the programmable power supply to produce a DC voltage waveform having ripple as noted for test condition A in table LDC104-II for the applicable editions(s) of MIL-STD-704. The ripple should include all the frequencies components with amplitudes noted for test condition A. Turn on the programmable DC power supply and adjust the voltage to the nominal steady state voltage of 28 VDC. Confirm that the programmable power supply is producing a voltage waveform having ripple content listed in table LDC104-II. Record the settings of the programmable power supply. Repeat the process for test condition B in table LDC104-II.

5. Compliance test. With the programmable DC power supply off, install the UUT and the stimulation and monitoring equipment into the test setup of figure LDC104-1. Set the programmable power supply to the settings recorded during the calibration procedure for condition A. Turn on the programmable DC power supply and adjust the voltage to the nominal steady state voltage of 28 VDC. Energize the UUT. Measure the ripple frequencies spectrum and record the DC ripple frequency components and amplitudes. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Remain for a length of time that confirms the utilization equipment can continuously operate with the ripple voltage, and should be not less than thirty (30) minutes. Repeat for test condition B noted in table LDC104-II. For each test condition, record the voltage, distortion factor, frequency spectrum of ripple, time duration at test condition, and the performance of the UUT in the data sheet shown in table LDC104-III. Repeat for each mode of operation of the UUT.

After all test conditions are complete, set the programmable power supply to produce a DC waveform without ripple. Adjust the voltage to the nominal steady state voltage of 28 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE LDC104-II. Ripple frequency and amplitude.

Test Condition	Ripple Frequency Components	MIL-STD-704A Amplitude of Ripple Component Vrms	MIL-STD-704B, C, D, E, & F Vrms
A	1200 Hz	1.00 Vrms	0.80 Vrms
	2400 Hz	0.20 Vrms	0.16 Vrms
	3600 Hz	0.33 Vrms	0.26 Vrms
	4800 Hz	0.10 Vrms	0.08 Vrms
	6000 Hz	0.16 Vrms	0.13 Vrms
	7200 Hz	0.05 Vrms	0.04 Vrms
	8400 Hz	0.08 Vrms	0.06 Vrms
B	2400 Hz	0.80 Vrms	0.80 Vrms
	4800 Hz	0.16 Vrms	0.16 Vrms
	7200 Hz	0.26 Vrms	0.26 Vrms
	9600 Hz	0.08 Vrms	0.08 Vrms
	12000 Hz	0.13 Vrms	0.13 Vrms
	14400 Hz	0.04 Vrms	0.04 Vrms
	16800 Hz	0.06 Vrms	0.06 Vrms



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE LDC104-1. Normal operation - total ripple.

TABLE LDC104-III. Sample data sheet for LDC104 total ripple.

Test Condition	Parameters						Performance
	Voltage		Voltage Distortion Factor		Time Duration at Condition		Pass/Fail
A		Vdc		No Units		min	
	Ripple Frequency Component		Amplitude of Ripple				
		Hz		Vrms			
		Hz		Vrms			
		Hz		Vrms			
		Hz		Vrms			
		Hz		Vrms			
		Hz		Vrms			
		Hz		Vrms			
B	Voltage		Voltage Distortion Factor		Time Duration at Condition		Pass/Fail
		Vdc		No Units		min	
	Ripple Frequency Component		Amplitude of Ripple				
		Hz		Vrms			
		Hz		Vrms			
		Hz		Vrms			
		Hz		Vrms			
		Hz		Vrms			
		Hz		Vrms			
		Hz		Vrms			

METHOD LDC105
Normal Voltage Transients

POWER GROUP: 28 Volt DC

AIRCRAFT ELECTRICAL OPERATING CONDITION: Normal

PARAMETER: Normal Voltage Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that 28 volt DC power utilization equipment operates and maintains specified performance when subjected to normal voltage transients as specified in the applicable editions(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for normal aircraft electrical conditions when subjected to voltage transients within the normal limits of the applicable editions(s) of MIL-STD-704 and as noted in table LDC105-I. The utilization equipment must maintain specified performance during and after the voltage transients. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE LDC105-I. MIL-STD-704 limits for normal voltage transients.

Limit	704A	704B	704C	704D	704E	704F
Normal Voltage Transients	Figure 9 MIL-STD-704A Locus of Equivalent Step Function Curves 2 and 3	Figure 7 MIL-STD-704B	Figure 10 MIL-STD-704C	Figure 10 MIL-STD-704D	Figure 9 MIL-STD-704E	Figure 13 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable DC power supply
b. True RMS voltmeter
c. Oscilloscope

4. Test setup. Configure the test setup as shown in figure LDC105-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure LDC105-1. Turn on the power source and

adjust the voltage to the nominal steady state voltage of 28 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

5.1 Compliance test for MIL-STD-704A. The UUT must be subjected to the voltage transients for each test condition A through V noted in table LDC105-II. The voltage must increase or decrease from steady state voltage as noted in table LDC105-II to the voltage transient level within 1 milliseconds. The voltage must remain at the voltage transient level for the duration noted in table LDC105-II. The voltage must return to steady state over the time duration noted in table LDC105-II. For test condition E and J, three over-voltage transients of 70 Vdc for 12 milliseconds are performed, separated by 0.5 second. For test condition O and T, three under-voltage transients of 8 Vdc for 12 milliseconds are performed, separated by 0.5 second. For test condition U and V, an under-voltage transient of 8 Vdc for 10 milliseconds is immediately followed by an over-voltage transient of 70 Vdc for 15 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal steady state limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltage, voltage transient (oscilloscope trace), and the performance of the UUT for each test condition in the data sheet shown in table LDC105-IV. Repeat for each mode of operation of the UUT. In addition, for MIL-STD-704A test compliance perform the repetitive voltage transient test described below.

5.2 Compliance test for MIL-STD-704B, C, D, E, & F. The UUT must be subjected to the voltage transients for each test condition AA through RR noted in table LDC105-III. The voltage must increase or decrease from steady state voltage as noted in table LDC105-III to the voltage transient level within 1 milliseconds. The voltage must remain at the voltage transient level for the duration noted in table LDC105-III. The voltage must return to steady state over the time duration noted in table LDC105-III. For test condition EE and JJ, three over-voltage transients of 50 Vdc for 10 milliseconds are performed, separated by 0.5 second. For test condition MM and PP, three under-voltage transients of 18 Vdc for 10 milliseconds are performed, separated by 0.5 second. For test condition QQ and RR, an under-voltage transient of 18 Vdc for 10 milliseconds is immediately followed by an overvoltage transient of 50 Vdc for 12.5 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal steady state limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltage, voltage transient (oscilloscope trace), and the performance of the UUT for each test condition in the data sheet shown in table LDC105-V. Repeat for each mode of operation of the UUT. In addition, for MIL-STD-704B, C, D, E, & F test compliance perform the repetitive voltage transient test described below.

5.3 Repetitive normal voltage transients test. Program the power supply to provide a continually repeating voltage transient that decreases from 28.5 Vdc to 18 Vdc in 2.5 msec, then increases to 45 Vdc over 30 msec, then decreases to 28.5 Vdc over 2.5 msec. The voltage transient is repeated every 0.5 second, see figure LDC105-2. The UUT must be subjected to the repetitive voltage transient for a length of time that confirms the utilization equipment can continuously operate and should be not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the voltage, voltage transient (oscilloscope trace), time duration at test condition, and the performance of the UUT in the data sheet shown in table LDC105-V. Repeat for each mode of operation of the UUT.

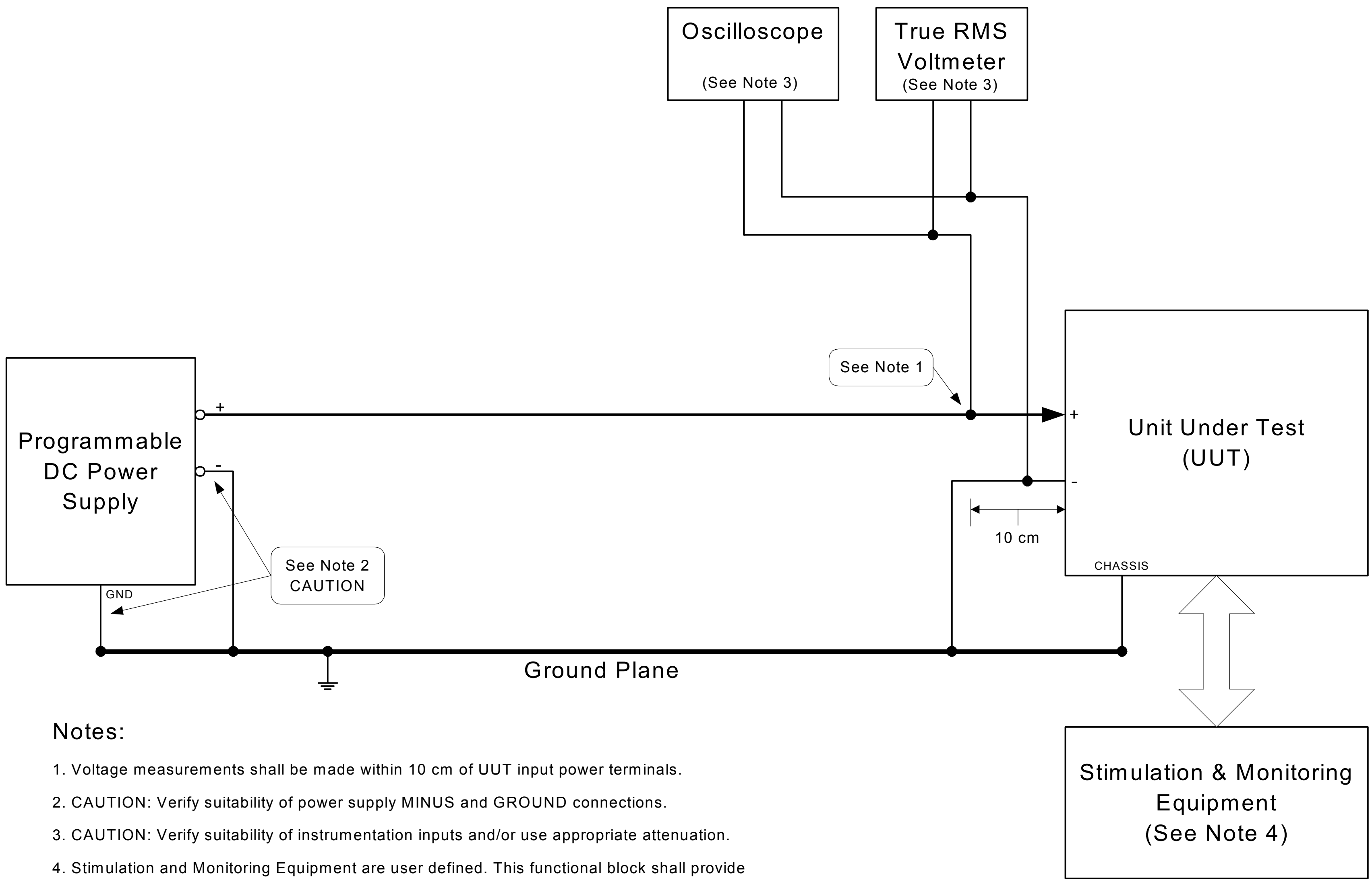
After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 28 Vdc. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE LDC105-II. Test conditions for MIL-STD-704A normal voltage transients.

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage milliseconds
Overvoltage Transients					
A	28.5 Vdc	< 1 msec	70 Vdc	20 msec	< 1 msec
B	28.5 Vdc	< 1 msec	70 Vdc	15 msec	9 msec
C	28.5 Vdc	< 1 msec	50 Vdc	75 msec	< 1 msec
D	28.5 Vdc	< 1 msec	50 Vdc	55 msec	40 msec
E	28.5 Vdc	< 1 msec	70 Vdc (3 times)	12 msec Every 0.5 sec	< 1 msec
F	24 Vdc	< 1 msec	70 Vdc	20 msec	< 1 msec
G	24 Vdc	< 1 msec	70 Vdc	15 msec	10 msec
H	24 Vdc	< 1 msec	50 Vdc	75 msec	< 1 msec
I	24 Vdc	< 1 msec	50 Vdc	55 msec	48 msec
J	24 Vdc	< 1 msec	70 Vdc (3 times)	12 msec Every 0.5 sec	< 1 msec
Undervoltage Transients					
K	28.5 Vdc	< 1 msec	8 Vdc	50 msec	< 1 msec
L	28.5 Vdc	< 1 msec	8 Vdc	38 msec	23 msec
M	28.5 Vdc	< 1 msec	14 Vdc	170 msec	< 1 msec
N	28.5 Vdc	< 1 msec	14 Vdc	128 msec	83 msec
O	28.5 Vdc	< 1 msec	8 Vdc (3 times)	12 msec Every 0.5	< 1 msec
P	24 Vdc	< 1 msec	8 Vdc	50 msec	< 1 msec
Q	24 Vdc	< 1 msec	8 Vdc	38 msec	18 msec
R	24 Vdc	< 1 msec	14 Vdc	170 msec	< 1 msec
S	24 Vdc	< 1 msec	14 Vdc	128 msec	57 msec
T	24 Vdc	< 1 msec	8 Vdc (3 times)	12 msec Every 0.5	< 1 msec
Combined Transient					
U	28.5 Vdc then	< 1 msec < 1 msec	8 Vdc 70 Vdc	10 msec 15 msec	< 1 msec 9 msec
V	24 Vdc then	< 1 msec < 1 msec	8 Vdc 70 Vdc	10 msec 15 msec	< 1 msec 10 msec

TABLE LDC105-III. Test conditions for MIL-STD-704B, C, D, E and F normal voltage transients.

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level milliseconds	Time From Voltage Transient Level to Steady State Voltage milliseconds
Overvoltage Transients					
AA	29 Vdc	< 1 msec	50 Vdc	12.5 msec	< 1 msec
BB	29 Vdc	< 1 msec	50 Vdc	12.5 msec	70 msec
CC	29 Vdc	< 1 msec	40 Vdc	45 msec	< 1 msec
DD	29 Vdc	< 1 msec	40 Vdc	45 msec	37.5 msec
EE	29 Vdc	< 1 msec	50 Vdc (3 times)	10 msec Every 0.5 ~~msec~~	< 1 msec
FF	22 Vdc	< 1 msec	50 Vdc	12.5 msec	< 1 msec
GG	22 Vdc	< 1 msec	50 Vdc	12.5 msec	95 msec
HH	22 Vdc	< 1 msec	40 Vdc	45 msec	< 1 msec
II	22 Vdc	< 1 msec	40 Vdc	45 msec	62.5 msec
JJ	22 Vdc	< 1 msec	50 Vdc (3 times)	10 msec Every 0.5 ~~msec~~	< 1 msec
Undervoltage Transients					
KK	29 Vdc	< 1 msec	18 Vdc	15 msec	< 1 msec
LL	29 Vdc	< 1 msec	18 Vdc	15 msec	234 msec
MM	29 Vdc	< 1 msec	18 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec
NN	22 Vdc	< 1 msec	18 Vdc	15 msec	< 1 msec
OO	22 Vdc	< 1 msec	18 Vdc	15 msec	85 msec
PP	22 Vdc	< 1 msec	18 Vdc (3 times)	10 msec Every 0.5 sec	< 1 msec
Combined Transient					
QQ	29 Vdc then	< 1 msec < 1 msec	18 Vdc 50Vdc	10 msec 12.5 msec	< 1 msec 70 msec
RR	22 Vdc then	< 1 msec < 1 msec	18 Vdc 50Vdc	10 msec 12.5 msec	< 1 msec 62.5 msec



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE LDC105-1. Normal operation - normal voltage transients.

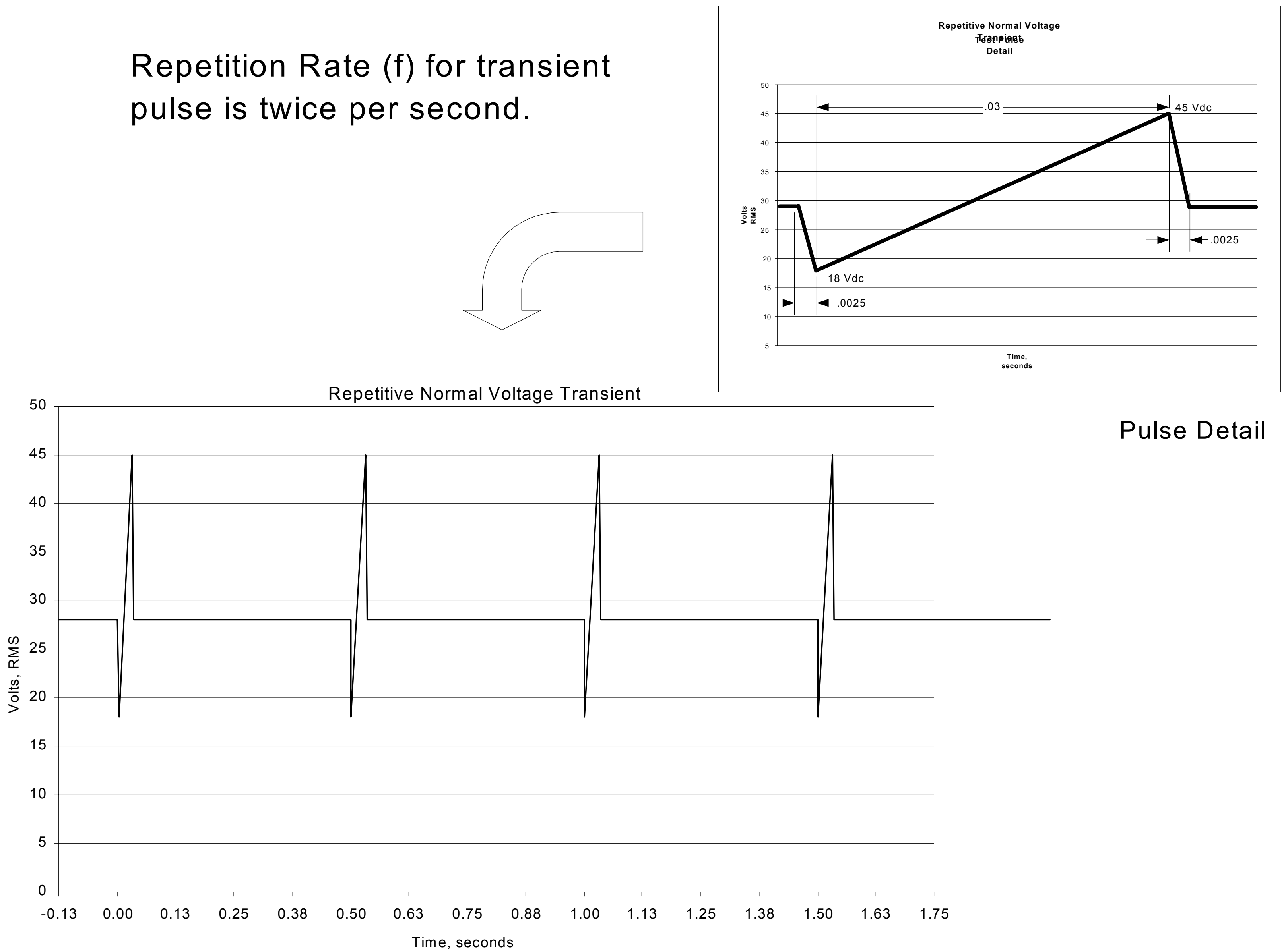


FIGURE LDC105-2. Repetitive normal voltage transient.

TABLE LDC105-IV. Sample data sheet for LDC105 normal voltage transients for MIL-STD-704A.

Test Condition	Parameters								Performance
	Steady State Voltage		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
A		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
B		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
C		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
D		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
E		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
F		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
G		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
H		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
I		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
J		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
K		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
L		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
M		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
N		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
O		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
P		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
Q		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
R		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
S		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
T		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
U		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
				V_{DC}					
V		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
				V_{DC}					

TABLE LDC105-IV. Sample data sheet for LDC105 normal voltage transients for MIL-STD-704A. - Continued

<table>
<tr><th rowspan="2">Test Condition</th><th colspan="8">Parameters</th><th>Performance</th></tr>
<tr><th colspan="2">Steady State Voltage</th><th colspan="2">Voltage Transient</th><th colspan="2">Time at Voltage Transient Level</th><th colspan="2">Oscilloscope Trace</th><th>Pass/Fail</th></tr>
<tr><td rowspan="4">Repetitive Transient</td><td></td><td>V_{DC}</td><td></td><td>V_{DC}</td><td></td><td>msec</td><td>Attach Trace</td><td>V_{DC} vs Time</td><td rowspan="4"></td></tr>
<tr><td colspan="2"></td><td></td><td>V_{DC}</td><td></td><td>msec</td><td colspan="2"></td></tr>
<tr><td colspan="2">Time Duration At Test Condition</td><td colspan="6" rowspan="2"></td></tr>
<tr><td></td><td>min</td></tr>
</table>

TABLE LDC105-V. Sample data sheet for LDC105 normal voltage transients for MIL-STD-704B, C, D, E, & F.

Test Condition	Parameters								Performance
	Steady State Voltage		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
AA		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
BB		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
CC		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
DD		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
EE		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
FF		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
GG		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
HH		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
II		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
JJ		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
KK		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
LL		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
MM		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
NN		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
OO		V_{DC}		V_{DC}		msec			
PP		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
QQ		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
				V_{DC}		msec			
RR		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
				V_{DC}		msec			

TABLE LDC105-V. Sample data sheet for LDC105 normal voltage transients for MIL-STD-704B, C, D, E, & F. - Continued

Test Condition	Parameters								Performance
	Steady State Voltage		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
Repetitive Transient		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
				V_{DC}		msec			
	Time Duration At Test Condition								
		min							

METHOD LDC201
Power Interrupt

POWER GROUP: 28 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Transfer Interrupt

PARAMETER: Power Interrupt

1. Scope.

1.1 Purpose. This test procedure is used to verify that 28 volt DC power utilization equipment operates and maintains specified performance when subjected to power interrupts as specified in the applicable editions(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for transfer aircraft electrical conditions when subjected to power interrupts as specified by the applicable editions(s) of MIL-STD-704 and as noted in table LDC201-I. The utilization equipment must maintain the specified performance during power interrupts. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE LDC201-I. MIL-STD-704 power transfer limits.

Limit	704A	704B	704C	704D	704E	704F
Power Interrupt	50 msec	50 msec	50 msec	50 msec	50 msec	50 msec
Voltage NLSS	24 Vdc	22 Vdc	22 Vdc	22 Vdc	22 Vdc	22 Vdc
Voltage NHSS	28.5 Vdc	29 Vdc	29 Vdc	29 Vdc	29 Vdc	29 Vdc

3. Apparatus. The test equipment should be as follows:

a. Programmable DC power supply
b. True RMS voltmeter
c. Oscilloscope
d. Resistive dummy load

4. Test setup. Configure the test setup as shown in figure LDC201-1. The dummy resistive load placed in parallel to the UUT should be sized to draw three times the steady state current of the UUT up to a maximum 25 kW dummy load. Note: This is done to ensure that the UUT test does

not lose stored energy to other aircraft loads during power interrupts. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

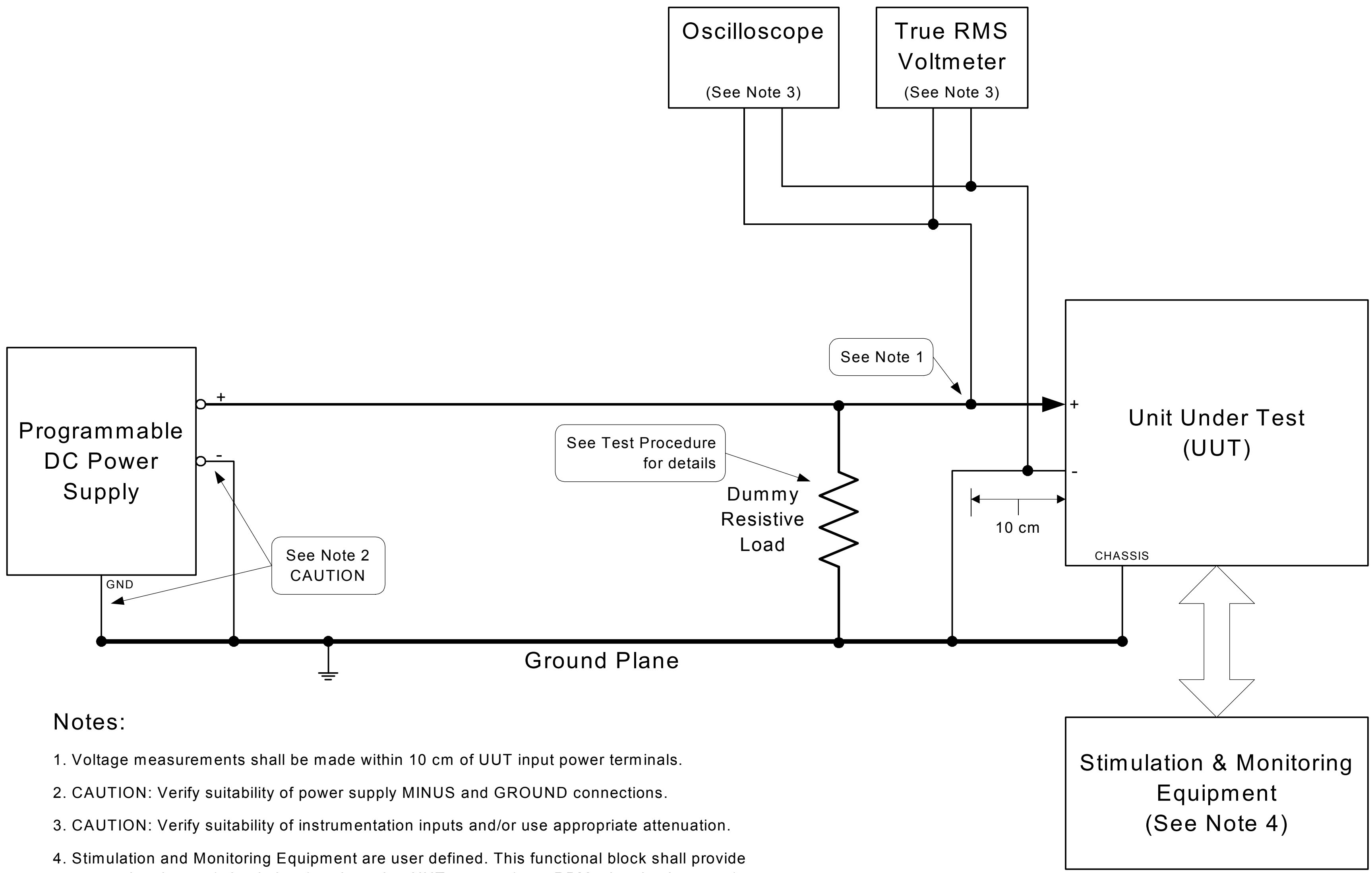
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure LDC201-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 28 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through K noted in table LDC201-II, adjust the voltage to the steady state voltage listed. Perform a power interrupt (0 V) of the duration listed. The voltage must decrease from the steady state voltage to 0 Volts within 0.25 milliseconds, remain at 0 Volts for the duration listed for the test condition, and return form 0 Volts to the steady state voltage within 0.25 milliseconds. For test condition J, three 50 millisecond power interrupts are performed, separated by 0.5 seconds. For test condition K a normal overvoltage transient follows the power interrupt. The normal voltage transient is 50 Vdc for 12.5 milliseconds and returns to nominal voltage over the next 70 milliseconds. For test condition L a normal undervoltage transient follows the power interrupt. The normal voltage transient is 18 Vdc for 15 milliseconds and returns to nominal voltage over the next 85 milliseconds. For each test condition, monitor the performance of the UUT according to the utilization equipment performance test procedures for power transfer operation to verify that the UUT is providing specified performance for transfer aircraft electrical conditions. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions. Record the steady state voltage, time duration of power interrupt, and the performance of the UUT for each test condition in the data sheet shown in table LDC201-III. Repeat each test condition 5 times. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 28 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE LDC201-II. Test conditions for transfer interrupt.

Test Condition	Steady State Voltage	Duration of Interrupt
A	Nominal Voltage	50 msec
B	NLSS Voltage	50 msec
C	NHSS Voltage	50 msec
D	Nominal Voltage	30 msec
E	NLSS Voltage	30 msec
F	NHSS Voltage	30 msec
G	Nominal Voltage	10 msec
H	NLSS Voltage	10 msec
I	NHSS Voltage	10 msec
J	Nominal Voltage	50 msec (repeated 3 times, separated by 0.5 sec)
K	Nominal Voltage	50 msec (followed by a normal voltage transient of 50 Vdc for 12.5 msec and return to steady state voltage in 70 msec)
L	Nominal Voltage	50 msec (followed by a normal voltage transient of 18 Vdc for 15 msec and return to steady state voltage in 85 msec)



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE LDC201-1. Transfer interrupt - power interrupt.

TABLE LDC201-III. Sample data sheet for LDC201 power interrupt.

Test Condition	Parameters				Performance
	Steady State Voltage		Time Duration of Power Interrupt		Pass/Fail
A		V_{DC}		msec	
B		V_{DC}		msec	
C		V_{DC}		msec	
D		V_{DC}		msec	
E		V_{DC}		msec	
F		V_{DC}		msec	
G		V_{DC}		msec	
H		V_{DC}		msec	
I		V_{DC}		msec	
J		V_{DC}		msec	
K		V_{DC}		msec	
	Overvoltage Transient				
	Voltage Transient		Voltage Transient		
		V_{DC}		msec	
L		V_{DC}		msec	
	Overvoltage Transient				
	Voltage Transient		Voltage Transient		
		V_{DC}		msec	

METHOD LDC301
Steady State Limits for Voltage

POWER GROUP: 28 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Abnormal

PARAMETER: Steady State Limits for Voltage

1. Scope.

1.1 Purpose. This test procedure is used to verify that 28 volt DC power utilization equipment operates and maintains specified performance when provided power with voltage at that the Abnormal Low Steady State (ALSS) limits and the Abnormal High Steady State (AHSS) limits as specified in the applicable editions(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when supplied input power of voltage at the specified abnormal steady state limits of the applicable editions(s) of MIL-STD-704 and as noted in table LDC301-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the abnormal steady state voltage limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE LDC301-I. MIL-STD-704 abnormal limits for steady state voltage.

Abnormal Limit	704A	704B	704C	704D	704E	704F
Voltage NLSS	22.5 Vdc	20.0 Vdc	20.0 Vdc	20.0 Vdc	20.0 Vdc	20.0 Vdc
Voltage NHSS	30.0 Vdc	31.5 Vdc	31.5 Vdc	31.5 Vdc	31.5 Vdc	31.5 Vdc

3. Apparatus. The test equipment should be as follows:

a. Adjustable DC power supply
b. True RMS voltmeter

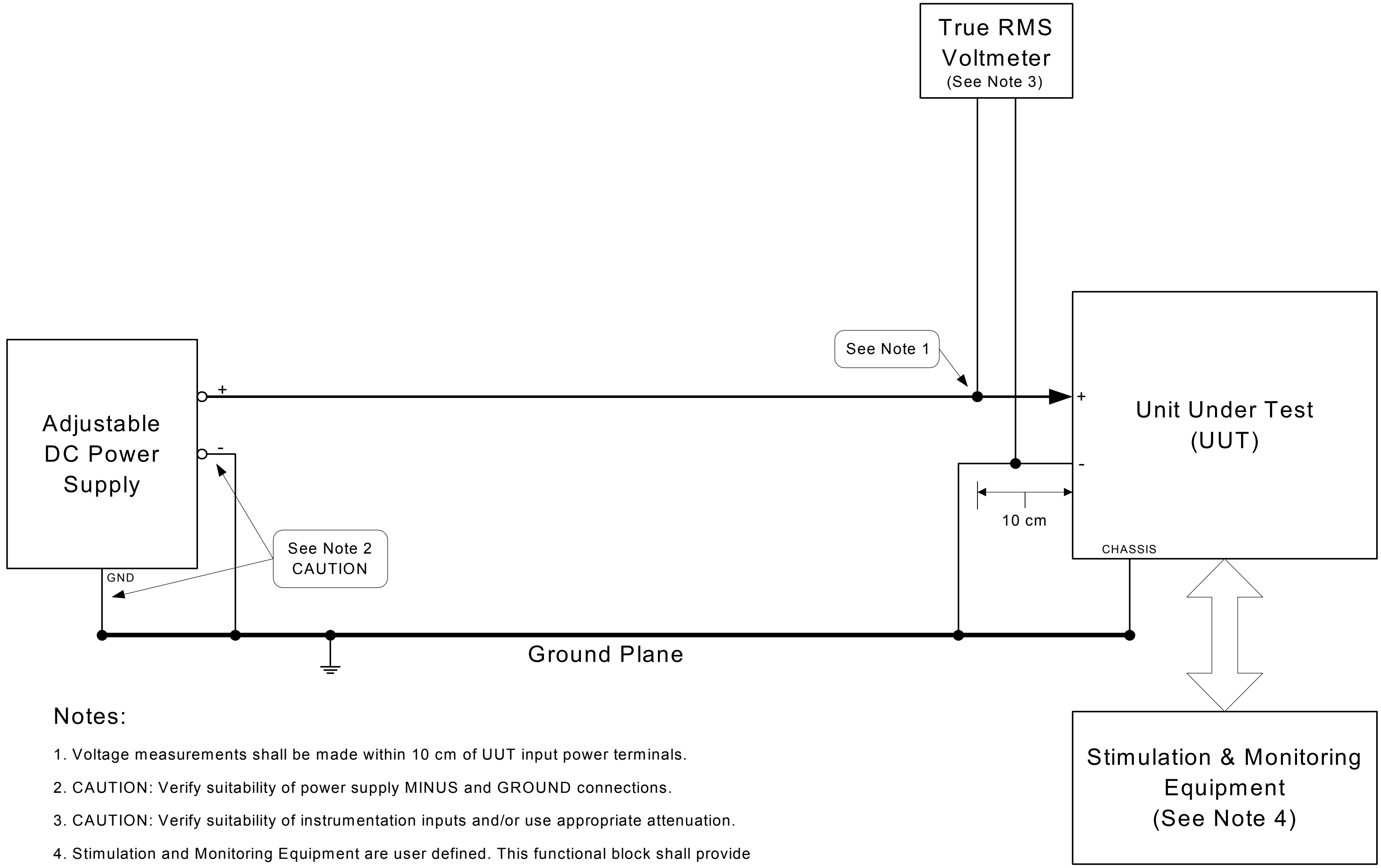
4. Test setup. Configure the test setup as shown in figure LDC301-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. <u>Compliance test</u>. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure LDC301-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 28 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A and B noted in table LDC301-II, the UUT must remain for a length of time that confirms the utilization equipment can perform as specified at the abnormal steady state voltage limits and should be not less than thirty (30) minutes. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. For each test condition shutdown the UUT and verify that the UUT can be re-started. After re-start conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Adjust the voltage to the nominal steady state voltage of 28 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the voltage, time duration at test condition, successful/unsuccessful re-start and the performance of the UUT for each test condition in the data sheet shown in table LDC301-III. Repeat for each mode of operation of the UUT.

TABLE LDC301-II. <u>Test conditions for abnormal steady state limits of DC voltage</u>.

Test Condition	Voltage
A	ALSS Voltage
B	AHSS Voltage



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE LDC301-1. Abnormal operation - steady state limits for voltage.

TABLE LDC301-III. Sample data sheet for LDC301 abnormal steady state limits for voltage.

Test Condition	Parameters					Performance
	Voltage		Time Duration at Test Condition		Re-Start (Yes/No)	Pass/Fail
A		V_{DC}		min		
B		V_{DC}		min		

METHOD LDC302
Abnormal Voltage Transients

POWER GROUP: 28 Volt DC

AIRCRAFT ELECTRICAL OPERATING CONDITION: Abnormal

PARAMETER: Abnormal Voltage Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that 28 volt DC power utilization equipment operates and maintains specified performance when subjected to abnormal voltage transients as specified in the applicable editions(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for abnormal aircraft electrical conditions when subjected to voltage transients within the abnormal limits of the applicable editions(s) of MIL-STD-704 and as noted in table LDC302-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE LDC302-I. MIL-STD-704 limits for abnormal voltage transients.

Limit	704A	704B	704C	704D	704E	704F
Abnormal Voltage Transients	Figure 9 MIL-STD-704A Locus of Equivalent Step Function Curves 1 and 4	Figure 8 MIL-STD-704B	Figure 12 MIL-STD-704C	Figure 12 MIL-STD-704D	Figure 11 MIL-STD-704E	Figure 14 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable DC power supply
b. True RMS voltmeter
c. Oscilloscope

4. Test setup. Configure the test setup as shown in figure LDC302-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure LDC302-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 28 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

5.1 Compliance test for MIL-STD-704A. The UUT must be subjected to the voltage transients for each test condition A through V noted in table LDC302-II. The voltage must increase or decrease from steady state voltage as noted in table LDC302-II to the voltage transient level within 1 milliseconds. The voltage must remain at the voltage transient level for the duration noted in table LDC302-II. The voltage must return to steady state over the time duration noted in table LDC302-II. For test condition E and J, three over-voltage transients of 80 Vdc for 12 milliseconds are performed, separated by 0.5 second. For test condition O and T, three under-voltage transients of 6 Vdc for 12 milliseconds are performed, separated by 0.5 second. For test condition U and V, an under-voltage transient of 6 Vdc for 10 milliseconds is immediately followed by an overvoltage transient of 80 Vdc for 50 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits. Record the steady state voltage, voltage transient (oscilloscope trace), and the performance of the UUT for each test condition in the data sheet shown in table LDC302-V. Repeat for each mode of operation of the UUT.

5.2 Compliance test for MIL-STD-704B, C, & D. The UUT must be subjected to the voltage transients for each test condition AA through NN noted in table LDC302-III. The voltage must increase or decrease from steady state voltage as noted in table LDC302-III to the voltage transient level within 1 milliseconds. The voltage must remain at the voltage transient level for the duration noted in table LDC302-III. The voltage must return to steady state over the time duration noted in table LDC302-III. For test condition CC and FF, three over-voltage transients of 50 Vdc for 45 milliseconds are performed, separated by 0.5 second. For test condition LDC302-II and LL, three under-voltage transients of 7 Vdc for 45 milliseconds are performed, separated by 0.5 second. For test condition MM and NN, an under-voltage transient of 7 Vdc for 10 milliseconds is immediately followed by an over-voltage transient of 50 Vdc for 45 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits. Record the steady state voltage, voltage transient (oscilloscope trace), and the performance of the UUT for each test condition in the data sheet shown in table VI. Repeat for each mode of operation of the UUT.

5.3 Compliance test for MIL-STD-704E & F. The UUT must be subjected to the voltage transients for each test condition AAA through NNN noted in table LDC302-IV. The voltage must increase or decrease from steady state voltage as noted in table LDC302-IV to the voltage transient level within 1 millisecond. The voltage must remain at the voltage transient level for the duration noted in table LDC302-IV. The voltage must return to steady state over the time duration noted in table LDC302-IV. For test condition CCC and FFF, three over-voltage transients of 50 Vdc for 50 milliseconds are performed, separated by 0.5 second. For test condition LDC302-III and LLL, three under-voltage transients of 7 Vdc for 50 milliseconds are performed, separated by 0.5 second. For test condition MMM and NNN, an under-voltage transient of 7 Vdc for 10 milliseconds is immediately followed by an over-voltage transient of 50 Vdc for 50 milliseconds and the voltage returns to steady state over the time duration noted. For each test condition, monitor the performance of the UUT during the voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for abnormal aircraft electrical conditions. Repeat each test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits. Record the steady state voltage, voltage transient (oscilloscope trace), and the performance of the UUT for each test condition in the data sheet shown in table VII. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 28 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE LDC302-II. Test conditions for MIL-STD-704A abnormal voltage transients.

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level	Time From Voltage Transient Level to Steady State Voltage milliseconds
Overvoltage Transients					
A	28.5 Vdc	< 1 msec	80 Vdc	50 msec	< 1 msec
B	28.5 Vdc	< 1 msec	80 Vdc	37.5 msec	24 msec
C	28.5 Vdc	< 1 msec	60 Vdc	550 msec	< 1 msec
D	28.5 Vdc	< 1 msec	60 Vdc	410 msec	280 msec
E	28.5 Vdc	< 1 msec	80 Vdc (3 times)	12 msec Every 0.5 sec	< 1 msec
F	24 Vdc	< 1 msec	80 Vdc	50 msec	< 1 msec
G	24 Vdc	< 1 msec	80 Vdc	37.5 msec	26 msec
H	24 Vdc	< 1 msec	60 Vdc	550 msec	< 1 msec
I	24 Vdc	< 1 msec	60 Vdc	410 msec	320 msec
J	24 Vdc	< 1 msec	80 Vdc (3 times)	12 msec Every 0.5 sec	< 1 msec
Undervoltage Transients					
K	28.5 Vdc	< 1 msec	6 Vdc	50 msec	< 1 msec
L	28.5 Vdc	< 1 msec	6 Vdc	37.5 msec	26 msec
M	28.5 Vdc	< 1 msec	12 Vdc	550 msec	< 1 msec
N	28.5 Vdc	< 1 msec	12 Vdc	410 msec	320 msec
O	28.5 Vdc	< 1 msec	6 Vdc (3 times)	12 msec Every 0.5 sec	< 1 msec
P	24 Vdc	< 1 msec	6 Vdc	50 msec	< 1 msec
Q	24 Vdc	< 1 msec	6 Vdc	37.5 msec	24 msec
R	24 Vdc	< 1 msec	12 Vdc	550 msec	< 1 msec
S	24 Vdc	< 1 msec	12 Vdc	410 msec	280 msec
T	24 Vdc	< 1 msec	6 Vdc (3 times)	12 msec Every 0.5 sec	< 1 msec
Combined Transient					
U	28.5 Vdc then	< 1 msec < 1 msec	6 Vdc 80 Vdc	10 msec 50 msec	< 1 msec 24 msec
V	24 Vdc then	< 1 msec < 1 msec	6 Vdc 80 Vdc	10 msec 50 msec	< 1 msec 24 msec

TABLE LDC302-III. Test conditions for MIL-STD-704B, C, and D abnormal voltage transients.

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Overvoltage Transients					
AA	29 Vdc	< 1 msec	50 Vdc	45 msec	< 1 msec
BB	29 Vdc	< 1 msec	50 Vdc	45 msec	15 msec
		then	45 Vdc	decreasing	30 msec
		then	40 Vdc	decreasing	60 msec
		then	35 Vdc	decreasing	4.85 sec
		then	30 Vdc	decreasing	1 sec
		then	29 Vdc		
CC	29 Vdc	< 1 msec	50 Vdc (3 times)	45 msec Every 0.5 sec	< 1 msec
DD	22 Vdc	< 1 msec	50 Vdc	45 msec	< 1 msec
EE	22 Vdc	< 1 msec	50 Vdc	45 msec	15 msec
		then	45 Vdc	decreasing	30 msec
		then	40 Vdc	decreasing	60 msec
		then	35 Vdc	decreasing	4.85 sec
		then	30 Vdc	decreasing	8 sec
		then	22 Vdc		
FF	22 Vdc	< 1 msec	50 Vdc (3 times)	45 msec Every 0.5 sec	< 1 msec
Undervoltage Transients					
GG	29 Vdc	< 1 msec	7 Vdc	45 msec	< 1 msec
HH	29 Vdc	< 1 msec	7 Vdc	45 msec	15 msec
		then	12 Vdc	increasing	30 msec
		then	17 Vdc	increasing	60 msec
		then	22 Vdc	increasing	4.85 sec
		then	28 Vdc	increasing	1 sec
		then	29 Vdc		
II	29 Vdc	< 1 msec	7 Vdc (3 times)	45 msec Every 0.5 sec	< 1 msec
JJ	22 Vdc	< 1 msec	7 Vdc	45 msec	< 1 msec
KK	22 Vdc	< 1 msec	7 Vdc	45 msec	15 msec
		then	12 Vdc	increasing	30 msec
		then	17 Vdc	increasing	60 msec
		then	22 Vdc		
LL	22 Vdc	< 1 msec	7 Vdc (3 times)	45 msec Every 0.5 sec	< 1 msec

TABLE LDC302-III. Test conditions for MIL-STD-704B, C, and D abnormal voltage transients. - Continued

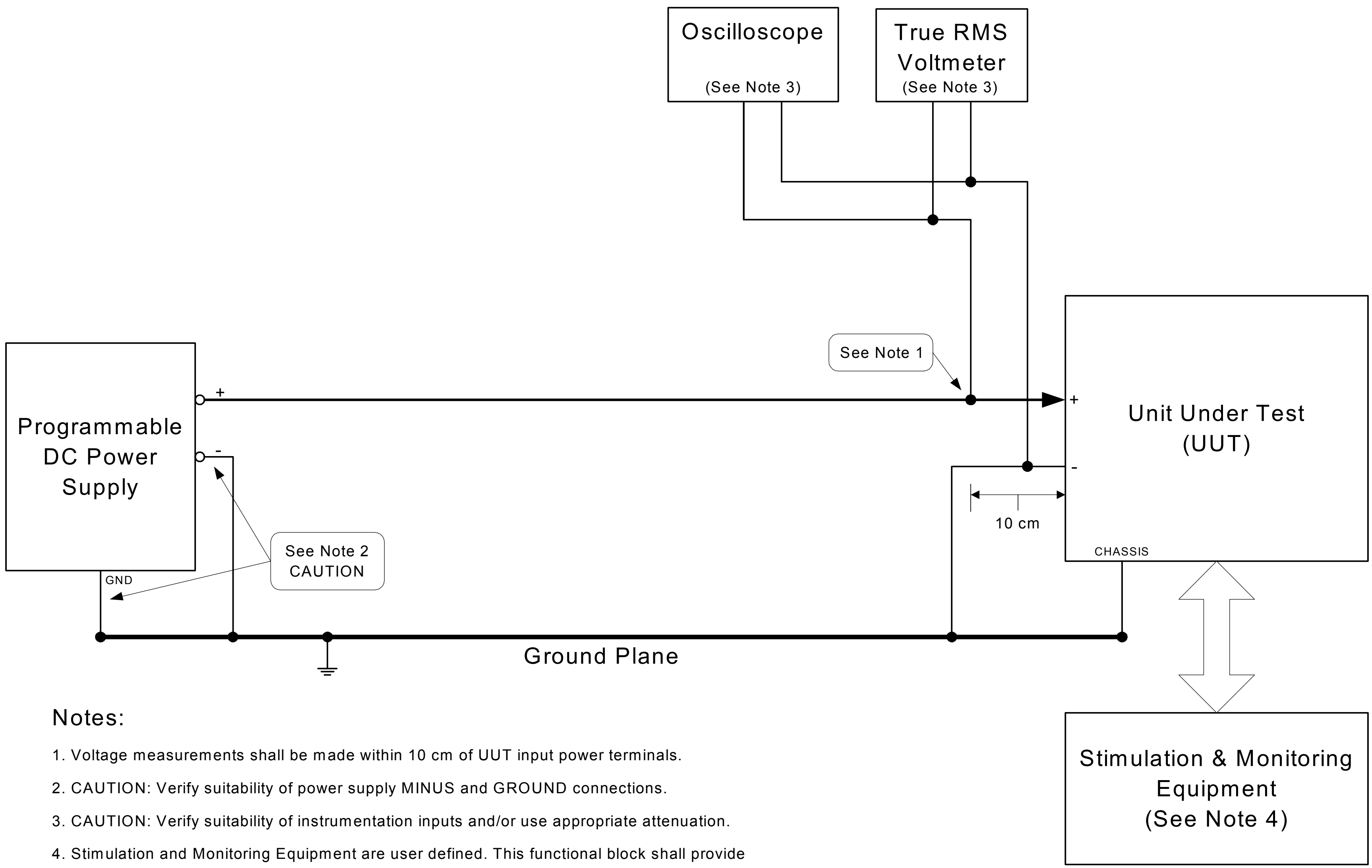
Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Combined Transient					
MM	29 Vdc	< 1 msec < 1 msec	7 Vdc then 50Vdc	10 msec 45 msec	< 1 msec 15 msec
		then	45 Vdc	decreasing	30 msec
		then	40 Vdc	decreasing	60 msec
		then	35 Vdc	decreasing	4.85 sec
		then	30 Vdc	decreasing	1 sec
		then	29 Vdc		
NN	22 Vdc	< 1 msec < 1 msec	7 Vdc then 50Vdc	10 msec 45 msec	< 1 msec 15 msec
		then	45 Vdc	decreasing	30 msec
		then	40 Vdc	decreasing	60 msec
		then	35 Vdc	decreasing	4.85 sec
		then	30 Vdc	decreasing	8 sec
		then	22 Vdc		

TABLE LDC302-IV. Test condition for MIL-STD-704E and F abnormal voltage transients.

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Overvoltage Transients					
AAA	29 Vdc	< 1 msec	50 Vdc	50 msec	< 1 msec
BBB	29 Vdc	< 1 msec	50 Vdc	50 msec	15 msec
		then	45 Vdc	decreasing	30 msec
		then	40 Vdc	decreasing	60 msec
		then	35 Vdc	decreasing	4.85 sec
		then	30 Vdc	decreasing	1 sec
		then	29 Vdc		
CCC	29 Vdc	< 1 msec	50 Vdc (3 times)	50 msec Every 0.5 sec	< 1 msec
DDD	22 Vdc	< 1 msec	50 Vdc	50 msec	< 1 msec
EEE	22 Vdc	< 1 msec	50 Vdc	50 msec	15 msec
		then	45 Vdc	decreasing	30 msec
		then	40 Vdc	decreasing	60 msec
		then	35 Vdc	decreasing	4.85 sec
		then	30 Vdc	decreasing	8 sec
		then	22 Vdc		
FFF	22 Vdc	< 1 msec	50 Vdc (3 times)	50 msec Every 0.5 sec	< 1 msec
Undervoltage Transients					
GGG	29 Vdc	< 1 msec	7 Vdc	50 msec	< 1 msec
HHH	29 Vdc	< 1 msec	7 Vdc	50 msec	15 msec
		then	12 Vdc	increasing	30 msec
		then	17 Vdc	increasing	60 msec
		then	22 Vdc	increasing	4.85 sec
		then	28 Vdc	increasing	1 sec
		then	29 Vdc		
III	29 Vdc	< 1 msec	7 Vdc (3 times)	50 msec Every 0.5 sec	< 1 msec
JJJ	22 Vdc	< 1 msec	7 Vdc	50 msec	< 1 msec
KKK	22 Vdc	< 1 msec	7 Vdc	50 msec	15 msec
		then	12 Vdc	increasing	30 msec
		then	17 Vdc	increasing	60 msec
		then	22 Vdc		
LLL	22 Vdc	< 1 msec	7 Vdc (3 times)	50 msec Every 0.5 sec	< 1 msec

TABLE LDC302-IV. Test conditions for ML-STD-704E & F abnormal voltage transients. - Continued

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Duration at Voltage Transient Level	Time From Voltage Transient Level to Steady State Voltage or Next Voltage Level
Combined Transient					
MMM	29 Vdc	< 1 msec < 1 msec	7 Vdc then 50Vdc	10 msec 50 msec	< 1 msec 15 msec
		then	45 Vdc	decreasing	30 msec
		then	40 Vdc	decreasing	60 msec
		then	35 Vdc	decreasing	4.85 sec
		then	30 Vdc	decreasing	1 sec
		then	29 Vdc		
NNN	22 Vdc	< 1 msec < 1 msec	7 Vdc then 50Vdc	10 msec 50 msec	< 1 msec 15 msec
		then	45 Vdc	decreasing	30 msec
		then	40 Vdc	decreasing	60 msec
		then	35 Vdc	decreasing	4.85 sec
		then	30 Vdc	decreasing	8 sec
		then	22 Vdc		



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE LDC302-1. Abnormal operation - abnormal voltage transients.

TABLE LDC302-V. Sample data sheet for LDC302 abnormal transients for MIL-STD-704A.

Test Condition	Parameters								Performance
	Steady State Voltage		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
A		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
B		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
C		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
D		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
E		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
F		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
G		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
H		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
I		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
J		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
K		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
L		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
M		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
N		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
O		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
P		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
Q		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
R		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
S		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
T		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
U		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
				V_{DC}		msec			
V		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
				V_{DC}		msec			

TABLE LDC302-VI. Sample data sheet for LDC302 abnormal voltage transients for MIL-STD-704B, C, & D.

Test Condition	Parameters								Performance
	Steady State Voltage		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
AA		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
BB		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
CC		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
DD		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
EE		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
FF		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
GG		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
HH		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
II		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
JJ		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
KK		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
LL		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
MM		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
				V_{DC}		msec			
NN		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
				V_{DC}		msec			

TABLE LDC302-VII. Sample data sheet for LDC302 abnormal voltage transients for MIL-STD-704E, & F.

Test Condition	Parameters								Performance
	Steady State Voltage		Voltage Transient		Time at Voltage Transient Level		Oscilloscope Trace		Pass/Fail
AAA		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
BBB		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
CCC		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
DDD		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
EEE		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
FFF		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
GGG		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
HHH		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
III		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
JJJ		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
KKK		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
LLL		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
MMM		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
				V_{DC}		msec			
NNN		V_{DC}		V_{DC}		msec	Attach Trace	V_{DC} vs Time	
				V_{DC}		msec			

METHOD LDC401
Steady State Limits for Voltage

POWER GROUP: 28 Volt DC

AIRCRAFT ELECTRICAL OPERATING CONDITION: Emergency

PARAMETER: Steady State Limits for Voltage

1. Scope.

1.1 Purpose. This test procedure is used to verify that 28 volt DC power utilization equipment operates and maintains specified performance when provided power with voltage at that the Emergency Low Steady State (ELSS) limits and the Emergency High Steady State (EHSS) limits as specified in the applicable editions(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for emergency aircraft electrical conditions when supplied input power of voltage at the specified emergency steady state limits of the applicable editions(s) of MIL-STD-704 and as noted in table LDC401-I. The utilization equipment must maintain specified performance for a length of time that confirms the utilization equipment can continuously operate at the steady state voltage and should be not less than thirty (30) minutes for each of the test conditions. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must demonstrate re-start at the emergency steady state voltage limits. Unless otherwise specified in the utilization equipment performance specification document, the utilization must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE LDC401-I. MIL-STD-704 emergency limits for steady state voltage.

Emergency Limit	704A	704B	704C	704D	704E	704F
Voltage ELSS	16.0 Vdc	18.0 Vdc	16.0 Vdc	16.0 Vdc	18.0 Vdc	18.0 Vdc
Voltage EHSS	24.0 Vdc	29.0 Vdc	30.0 Vdc	29.0 Vdc	29.0 Vdc	29.0 Vdc

3. Apparatus. The test equipment should be as follows:

a. Adjustable DC power supply
b. True RMS voltmeter

4. Test setup. Configure the test setup as shown in figure LDC401-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure LDC401-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 28 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A and B noted in table LDC401-II, the UUT must remain for a length of time that confirms the utilization equipment can perform as specified at the emergency steady state voltage limits and should be not less than thirty (30) minutes. At each test condition conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for emergency aircraft electrical conditions. For each test condition shutdown the UUT and verify that the UUT can be re-started. After re-start conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for emergency aircraft electrical conditions. Adjust the voltage to the nominal steady state voltage of 28 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the voltage, time duration at test condition, and the performance of the UUT for each test condition in the data sheet shown in table LDC401-III. Repeat for each mode of operation of the UUT.

TABLE LDC401-II. Test conditions for emergency steady state limits for DC voltage.

Test Condition	Voltage
A	ELSS Voltage
B	EHSS Voltage

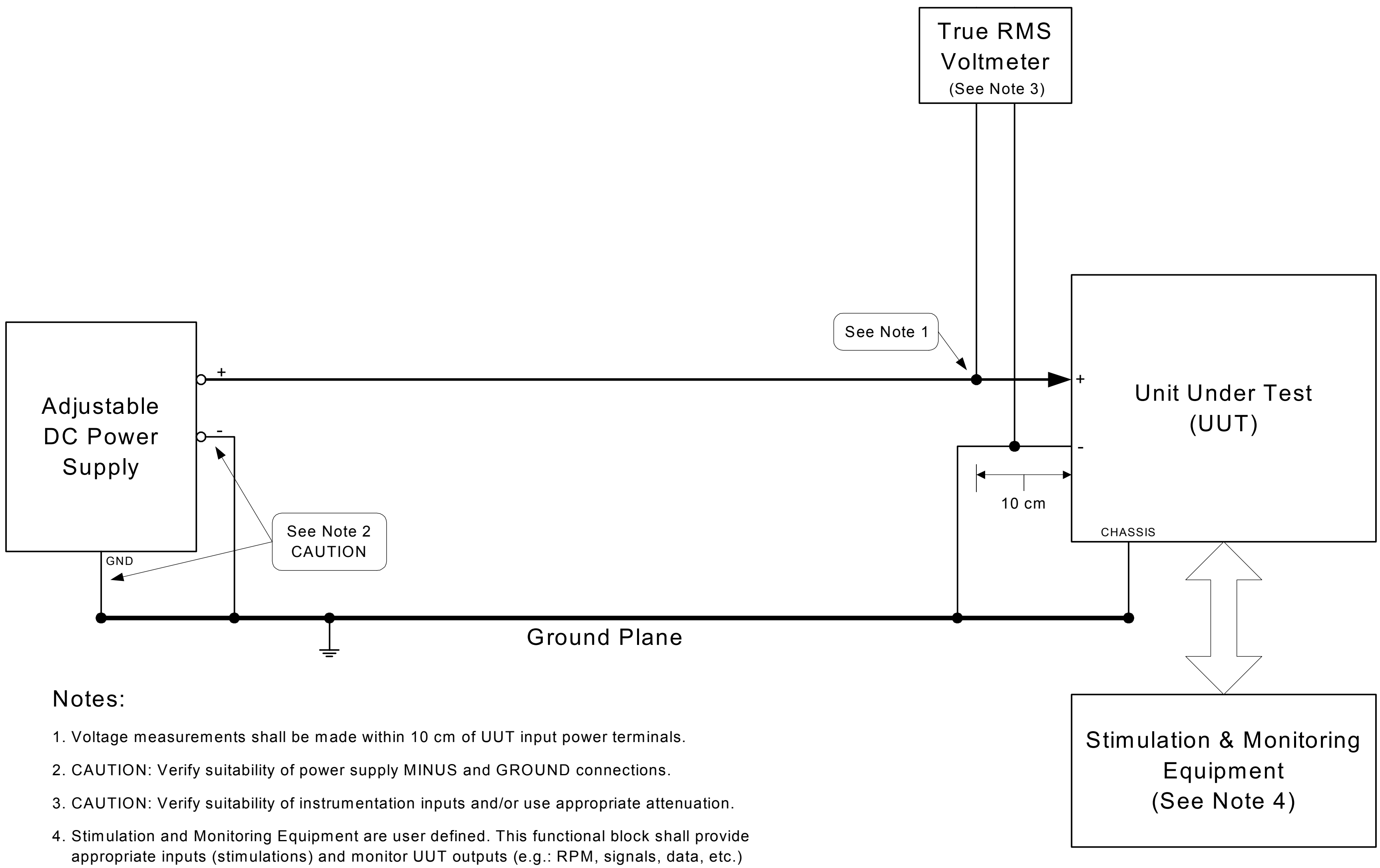


FIGURE LDC401-1. Emergency operation - steady state limits for voltage.

TABLE LDC401-III. Sample data sheet for LDC401 emergency steady state limits for voltage and frequency.

Test Condition	Parameters				Performance
	Voltage		Time Duration at Test Condition		Pass/Fail
A		V_{DC}		min	
B		V_{DC}		min	

METHOD LDC501
Starting Voltage Transients

POWER GROUP: 28 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Starting

PARAMETER: Starting Voltage Transients

1. Scope.

1.1 Purpose. This test procedure is used to verify that 28 volt DC power utilization equipment operates and maintains specified performance when subjected to starting voltage transients as specified in the applicable editions(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for starting aircraft electrical conditions when subjected to starting voltage transients for the applicable editions(s) of MIL-STD-704 and as noted in table LDC501-I. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE LDC501-I. MIL-STD-704 limits for starting voltage transients.

Limit	704A	704B	704C	704D	704E	704F
Starting Voltage Transients	16.0 Vdc to 28.5 Vdc	Use Limits of 704 C	16.0 Vdc to 30.0 Vdc	12.0 Vdc to 29.0 Vdc	12.0 Vdc to 29.0 Vdc	12.0 Vdc to 29.0 Vdc

3. Apparatus. The test equipment should be as follows:

a. Programmable DC power supply
b. True RMS voltmeter
c. Oscilloscope

4. Test setup. Configure the test setup as shown in figure 1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure LDC501-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 28 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

5.1 Compliance test for MIL-STD-704A, B and C. The UUT must be subjected to the starting voltage transients described in table LDC501-II (test condition A). The voltage must decrease from steady state voltage to the 16 Vdc within 1 millisecond. The voltage must return to steady state at a constant rate over 30 seconds. Monitor the performance of the UUT during the starting voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for starting aircraft electrical conditions. Repeat the test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits. Record the steady state voltage, voltage transient (oscilloscope trace), and the performance of the UUT in the data sheet shown in table LDC501-IV. Repeat for each mode of operation of the UUT.

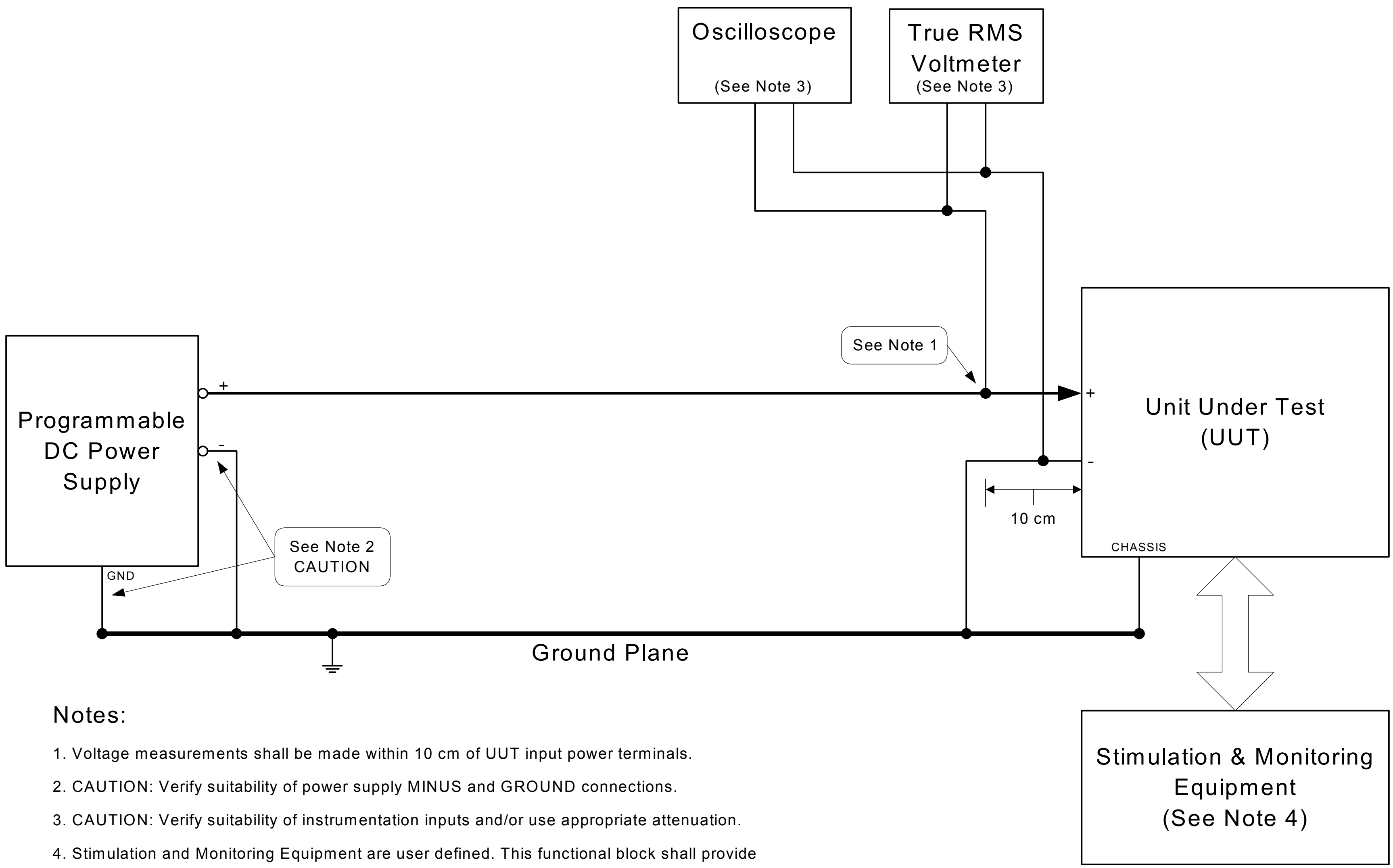
5.2 Compliance test for MIL-STD-704D, E, & F. The UUT must be subjected to the starting voltage transients described in table LDC501-III (test condition AA). The voltage must decrease from steady state voltage to the 12 Vdc within 1 millisecond. The voltage must return to steady state at a constant rate over 30 seconds. Monitor the performance of the UUT during the starting voltage transient according to the equipment performance test procedures to verify that the UUT is providing specified performance for starting aircraft electrical conditions. Repeat the test condition 5 times. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT automatically returns to specified performance for normal aircraft electrical conditions when the power returns to within normal limits. Record the steady state voltage, voltage transient (oscilloscope trace), and the performance of the UUT in the data sheet shown in table LDC501-IV. Repeat for each mode of operation of the UUT.

TABLE LDC501-II. Test conditions for MIL-STD-704A, B and C starting voltage transients.

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Time From Voltage Transient Level to Steady State Voltage
A	28.5 Vdc	< 1 msec	16 Vdc	30 sec

TABLE LDC501-III. Test conditions for MIL-STD-704D, E and F starting voltage transients.

Test Condition	Steady State Voltage Vdc	Time From Steady State Voltage to Voltage Transient Level milliseconds	Voltage Transient Level Vdc	Time From Voltage Transient Level to Steady State Voltage
AA	29 Vdc	< 1 msec	12 Vdc	30 sec



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE LDC501-1. Starting operation - starting voltage transients.

TABLE LDC501-IV. Sample data sheet for LDC501 starting voltage transients for MIL-STD-704A, B, C, D, E & F.

Test Condition	Parameters								Performance
	Steady State Voltage		Voltage Transient		Time to Return to Steady State Voltage		Oscilloscope Trace		Pass/Fail
		V_{DC}		V_{DC}		sec	Attach Trace	V_{DC} vs Time	

METHOD LDC601
Power Failure

POWER GROUP: 28 Volt DC

AIRCRAFT ELECTRICAL OPERATING CONDITION: Power Failure

PARAMETER: Power Failure

1. Scope.

1.1 Purpose. This test procedure is used to verify that 28 volt DC power utilization equipment operates and maintains specified performance when subjected to Power Failures as specified in the applicable editions(s) of MIL-STD-704.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment operates and maintains performance as specified in the utilization equipment performance specification document for power failure aircraft electrical conditions when subjected to power failures as specified by the applicable editions(s) of MIL-STD-704 and as noted in table LDC601-I. The utilization equipment must maintain the specified performance during power failures. Unless otherwise specified in the utilization equipment performance specification document, the utilization equipment must automatically return to the performance specified for normal aircraft electrical conditions when the power returns to within normal limits. The utilization equipment must not suffer damage or cause an unsafe condition.

TABLE LDC601-I. MIL-STD-704 power failure limits.

Limit	704A	704B	704C	704D	704E	704F
Power Failure	7 sec Figure 9 Curve 4 MIL-STD-704B	7 sec Figure 8 MIL-STD-704B	7 sec Figure 12 MIL-STD-704C	7 sec Figure 12 MIL-STD-704D	7 sec Figure 11 MIL-STD-704E	7 sec Figure 14 MIL-STD-704F

3. Apparatus. The test equipment should be as follows:

a. Programmable DC power supply
b. True RMS voltmeter
c. Oscilloscope

4. Test setup. Configure the test setup as shown in figure LDC601-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

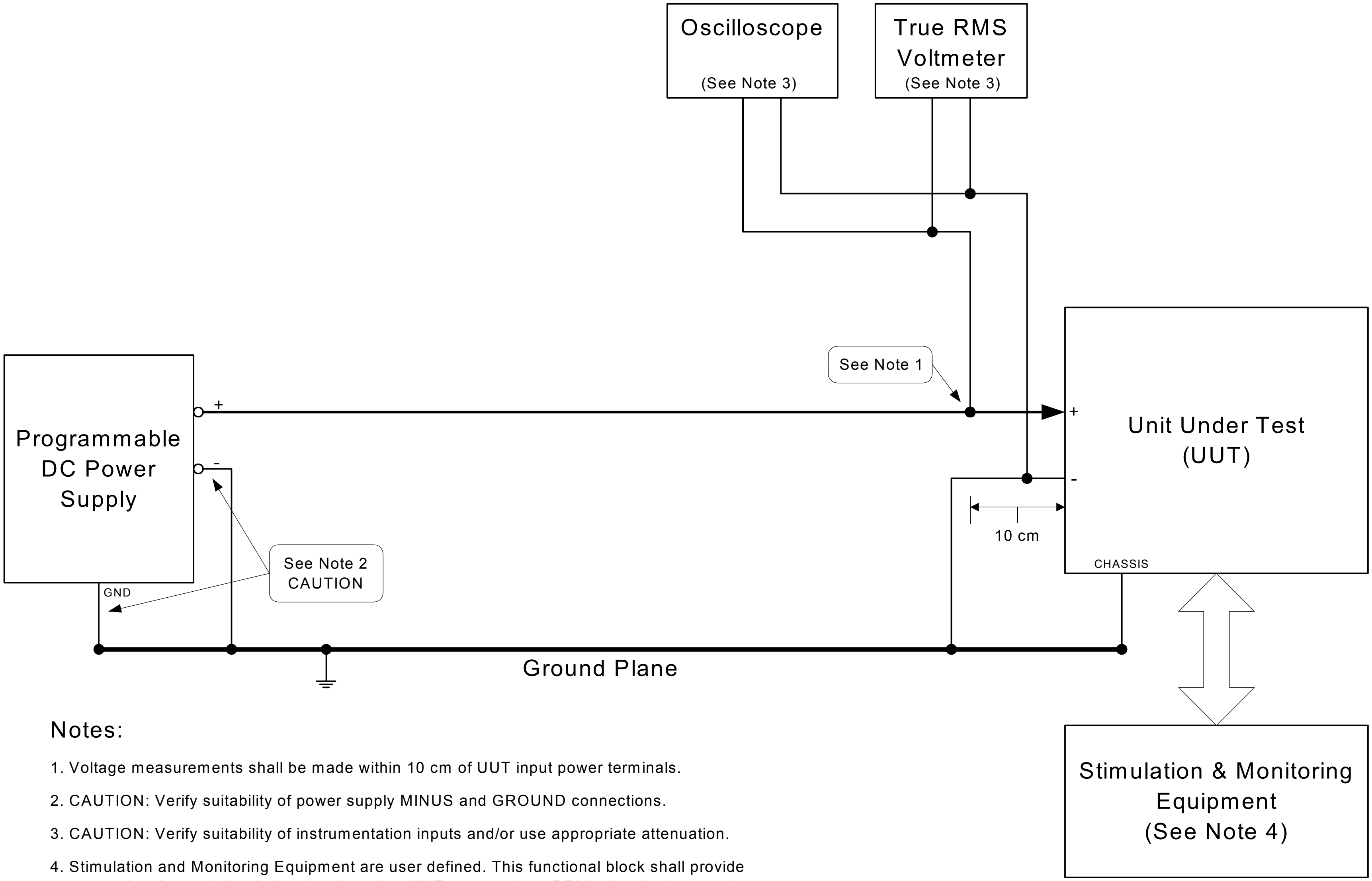
5. Compliance test. With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure LDC601-1. Turn on the power source and adjust the voltage to the nominal steady state voltage of 28 VDC. Energize the UUT. Allow sufficient time for the UUT to warm up. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to verify that the UUT is providing specified performance for normal aircraft electrical conditions.

For each test condition A through D noted in table LDC601-II, perform a power failure (0 V) of the duration listed. The voltage must decrease from the steady state voltage to 0 Volts within 0.25 milliseconds, remain at 0 volts for the duration listed for the test condition, and return from 0 Volts to the steady state voltage within 0.25 milliseconds. For each test condition, monitor the performance of the UUT according to the utilization equipment performance test procedures for power failure operation to verify that the UUT is providing specified performance for power failure aircraft electrical conditions. After the power returns to normal limits, conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has automatically returned to the performance specified for normal aircraft electrical conditions, and has not suffered damage. Record the steady state voltage, time duration of power failure, and the performance of the UUT for each test condition in the data sheet shown in table LDC601-III. Repeat each test condition 5 times. Repeat for each mode of operation of the UUT.

After all test conditions are complete, adjust the voltage to the nominal steady state voltage of 28 VDC. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has not suffered damage and is providing specified performance for normal aircraft electrical conditions.

TABLE LDC601-II. Test conditions for power failures.

Test Condition	Duration of Power Failure
A	100 msec
B	500 msec
C	3 seconds
D	7 seconds



Notes:

1. Voltage measurements shall be made within 10 cm of UUT input power terminals.
2. CAUTION: Verify suitability of power supply MINUS and GROUND connections.
3. CAUTION: Verify suitability of instrumentation inputs and/or use appropriate attenuation.
4. Stimulation and Monitoring Equipment are user defined. This functional block shall provide appropriate inputs (stimulations) and monitor UUT outputs (e.g.: RPM, signals, data, etc.)

FIGURE LDC601-1. Power failure - power failure.

TABLE LDC601-III. Sample data sheet for LDC601 power failure.

Test Condition	Parameters				Performance
	Voltage		Time Duration of Power Failure		Pass/Fail
A		V_{DC}		msec	
B		V_{DC}		msec	
C		V_{DC}		sec	
D		V_{DC}		sec	

METHOD LDC602
Phase Reversal

POWER GROUP: 28 Volt DC

AIRCRAFT ELECTRICAL
OPERATING CONDITION: Power Failure

PARAMETER: Phase Reversal

1. Scope.

1.1 Purpose. This test procedure is used to verify that 28 volt DC power utilization equipment is not damaged by phase reversal or a positive physical means is employed to prevent phase reversal.

2. Validation criteria. The utilization equipment is considered to have passed if the utilization equipment is not damaged and does not cause an unsafe condition when the positive and negative connection are reversed for the applicable editions(s) of MIL-STD-704 and as noted in table LDC602-I. A positive physical means to prevent phase reversal may be used to fulfill this requirement.

TABLE LDC602-I. MIL-STD-704 phase reversal requirement.

Limit	704A	704B	704C	704D	704E	704F
Phase Reversal	N/A	N/A	N/A	N/A	N/A	Phase Reversal Does not Cause Damage

3. Apparatus. The test equipment should be as follows:

a. Adjustable DC power supply
b. True RMS voltmeter

4. Test setup. Configure the test setup as shown in figure LDC602-1. Measurements, except current, must be made within 10 cm of the input power terminals of the UUT.

5. Compliance test. If a positive physical means is employed to prevent phase reversal, confirm that the positive and negative conductors cannot be reversed.

If the positive and negative conductors can be reversed, with the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure LDC602-1 (positive and negative conductors reversed). Turn on the power source and adjust the voltage to the nominal steady state voltage of 28 VDC. Energize the UUT. The UUT must remain for a length of time that confirms the utilization equipment is not damaged and does not cause an unsafe condition due to phase reversal and should be not less than thirty (30) minutes. Record the steady state voltage, time duration at phase reversal test condition, and the performance of the UUT in the data sheet shown in table LDC602-II. Repeat for each mode of operation of the UUT.

With the power source off, install the UUT and the stimulation and monitoring equipment into the test setup of figure LDC602-2 (positive and negative conductors connected properly). Turn on the power source and adjust the voltage to the nominal steady state voltage of 28 VDC. Energize the UUT. The UUT must remain for a length of time that confirms the utilization equipment was not damaged and does not cause an unsafe condition after the phase reversal and should be not less than thirty (30) minutes. Conduct a performance test of the UUT according to the utilization equipment performance test procedures to confirm that the UUT has returned to the performance specified for normal aircraft electrical conditions and has not suffered damage. Record the steady state voltage, time duration at test condition, and the performance of the UUT in the data sheet shown in table LDC602-II. Repeat for each mode of operation of the UUT.

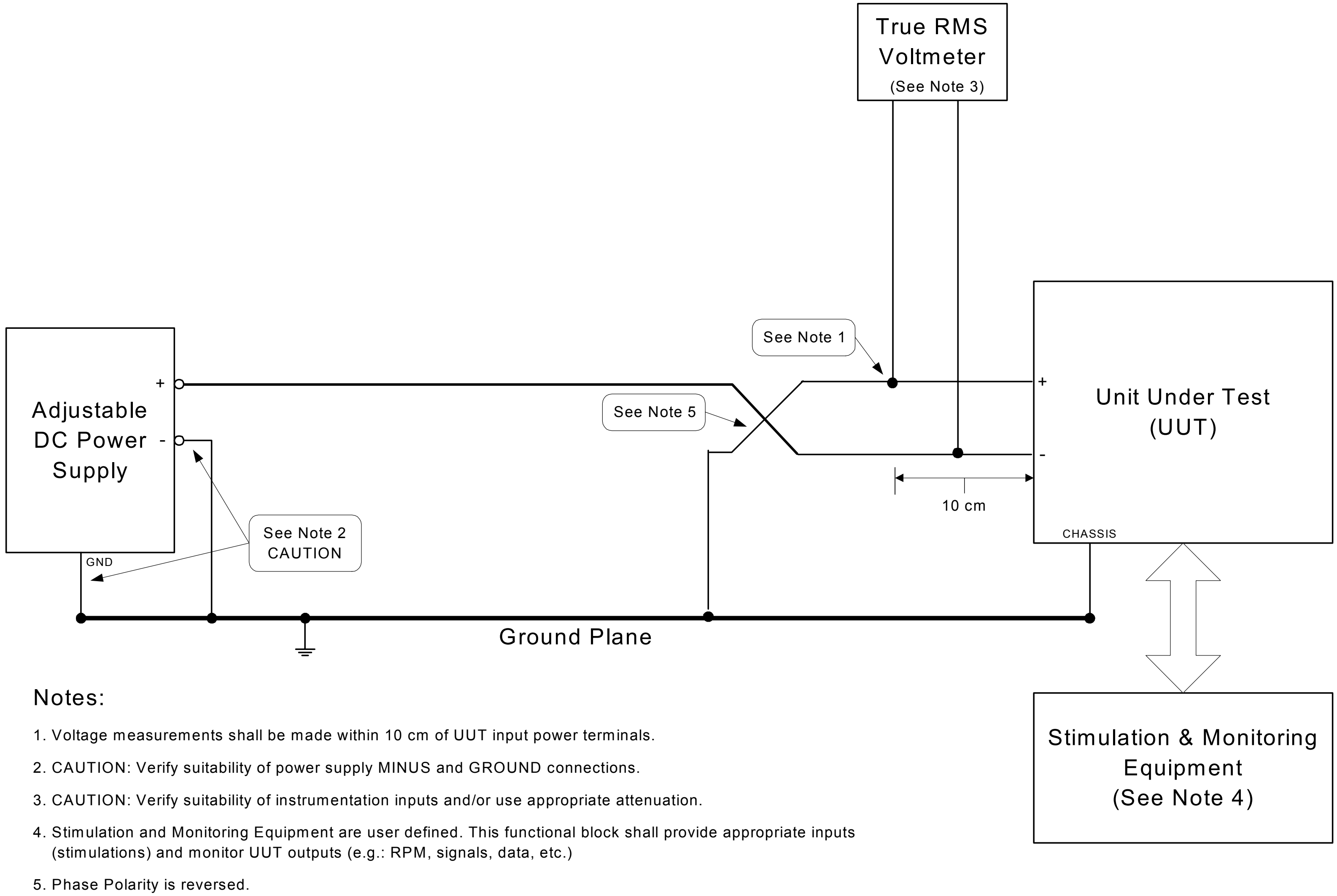


FIGURE LDC602-1. Phase reversal.

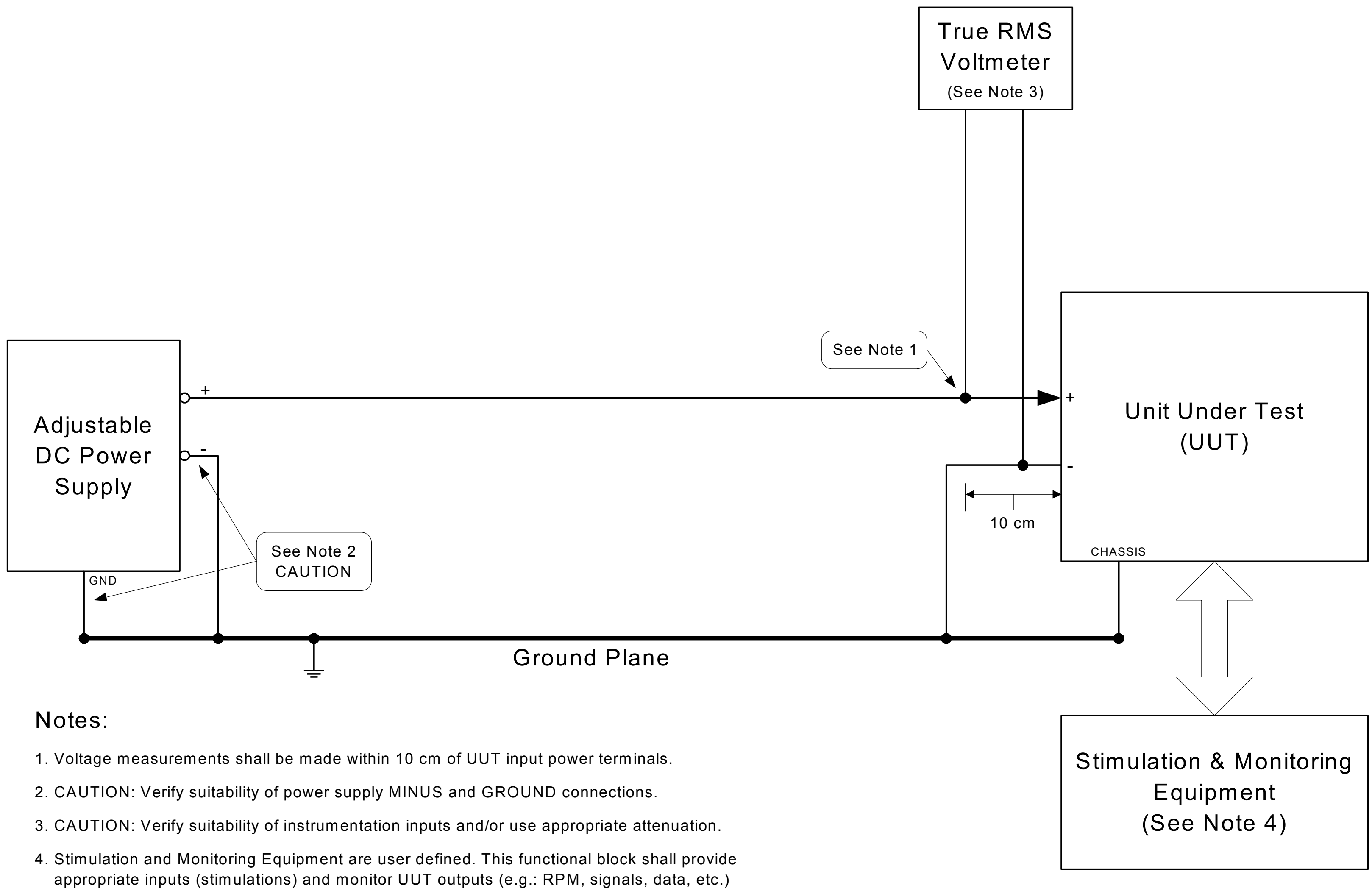


FIGURE LDC602-2. Correct phase connection.

TABLE LDC602-II. Sample data sheet for LDC602 phase reversal.

<table>
<tr><td rowspan="2">Test Condition</td><td colspan="4" rowspan="2">Parameters</td><td>Performance</td></tr>
<tr><td>Yes/No</td></tr>
<tr><td colspan="5">Phase Reversal Prevented by Positive Physical Means</td><td></td></tr>
<tr><td colspan="6">If No</td></tr>
<tr><td></td><td colspan="2">Voltage</td><td colspan="2">Time Duration at Condition</td><td>Pass/Fail</td></tr>
<tr><td>Phase Reversal</td><td></td><td>V_{dc}</td><td></td><td>min</td><td></td></tr>
<tr><td>Correct Phase Connection</td><td></td><td>V_{dc}</td><td></td><td>min</td><td></td></tr>
</table>

6. NOTES

6.1 Intended use. This handbook should be used as guidance when establishing test requirements, for inclusion in performance specifications developed for the procurement of utilization equipment, to ensure compliance with the aircraft electrical power characteristics as specified by MIL-STD-704.

6.2 Subject term (keyword) listing.

Aircraft, electrical power
Aircraft, electrical test
Electrical operating areas
Equipment, utilization
Power groups
Specification, utilization equipment

CONCLUDING MATERIAL

Custodians:
Army - AV
Navy - AS
Air Force - 11

Preparing Activity:
Navy - AS

(Project No. SESS-0054)

Review Activities:
Army - CR, MI, TE
Navy - EC, MC, SA, SH, YD

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at www.dodssp.daps.mil.