Part 80 - VHF Transceivers and Marine Radars

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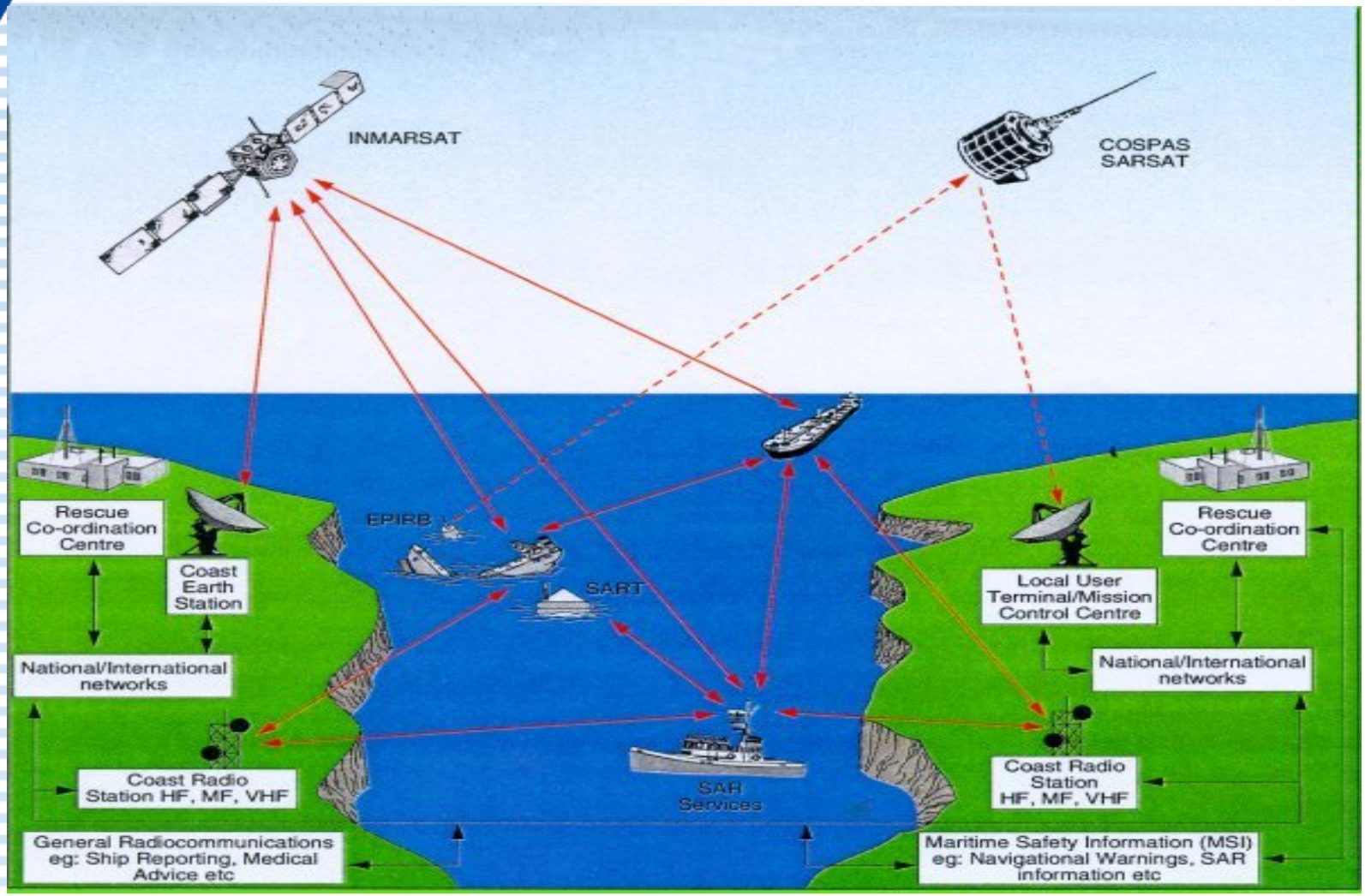
Scope B3 – Maritime Services
Maritime Presentation Scope

- **TCBs have been able to review these applications and may continue to do so**
- The US Coast Guard regularly reviews Granted applications and contacts the FCC if there are issues – this may result in an Audit
- Presentation intended to clarify Maritime issues and review process

Scope B3 – Maritime Services GMDSS Overview

- The Global Maritime Distress and Safety System (GMDSS) is an international system which uses terrestrial and satellite technology and ship-board radio-systems to ensure rapid, automated, alerting of shore based communication and rescue authorities, in addition to ships in the immediate vicinity, in the event of a marine distress.
- GMDSS is the general “umbrella” that cover many Maritime radio services

Scope B3 – Maritime Services
GMDSS Overview (Cont.)



Scope B3 – Maritime Services GMDSS – Radio Communications

- MF (including DSC) – 2 MHz Band
- HF (including DSC and telex) – 4, 6, 12,16, 18, 22, and 25 MHz Bands
- VHF (including DSC) – 156 to 162 MHz

Scope B3 – Maritime Services GMDSS Geographic Configuration

- Applies to cargo vessels >300 gross tons & passenger ships carrying more than 12 passengers when traveling on international waters or in the open sea.
- Depends on the sea area of which the ship will trade:

  http://www.navcen.uscg.gov/marcomms/gmdss/area.htm
- **Sea area A1** is within VHF range of a coast station
- **Sea area A2** is within MF range of a coast station
- **Sea area A3** is within Inmarsat Satellite System coverage
- **Sea area A4** is world-wide and within HF range of a coast station (Including the Polar Regions)

Scope B3 – Maritime Services
Digital Selective Calling (DSC) Overview

- Replacement for the radiotelephone and radiotelegraph (Morse) alarm signal
- Information transmitted:
  - the priority of the call - DISTRESS, URGENCY, SAFETY or ROUTINE;
  - the address - ie: all ships or a single ship/station
  - the identification of the ship in distress
  - the position of the ship in distress
  - the nature of the distress
- MF/HF DSC Distress and Safety Channels:

  2187.5, 4207.5, 6312.0, 8414.5, 12577.0, and 16804.5 kHz
- VHF DSC Distress and Safety Channel:

  Marine channel 70 (156.525 MHz)
- DSC Classifications:

  http://www.navcen.uscg.gov/marcomms/gmdss/dsc.htm

Scope B3 – Maritime Services MF & HF Channel Information

- Duplex Channels - single sideband radiotelephone channels used for communications between coast and ship stations
- Simplex Channels - single sideband radiotelephone channels for worldwide use by ships of all categories, for communications with coast stations or other ships
- Frequency Plan - Appendix 16 of the International Telecommunications Union (ITU) Radio Regulations, including revisions made by the 1987 Mobile World Administrative Radio Conference (Mob-87)

http://www.navcen.uscg.gov/marcomms/high_frequency/default.htm

Scope B3 – Maritime Services VHF Channel Information

- 156 to 162 MHz – channelized radio service (assigned channel frequencies)
  - A Channels: ship frequencies
  - B Channels: shore frequencies

  http://www.navcen.uscg.gov/marcomms/vhf.htm
- Channels 2, 4, 60, and 62 cannot be used for transmission in US waters
  - User's Manual must make this clear
- R&O (FCC 04-3) redesignates Channels 75 and 76 for communications related to port operations, and establish requirements for equipment to operate on the channels with reduced carrier power

  http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-04-3A1.pdf

Scope B3 – Maritime Services

VHF User's Manual - Frequency Table

Channel number			Frequency (MHz)	
USA	INT	CAN	Transmit	Receive
	01	01	156.050	160.650
01A			156.050	156.050
	02	02	156.100	160.700
	03	03	156.150	160.750
03A			156.150	156.150
	04		156.200	160.800
		04A	156.200	156.200
	05		156.250	160.850
05A		05A	156.250	156.250
06	06	06	156.300	156.300
	07		156.350	160.950
07A		07A	156.350	156.350
08	08	08	156.400	156.400
09	09	09	156.450	156.450
10	10	10	156.500	156.500
11	11	11	156.550	156.550
12	12	12	156.600	156.600
13*2	13	13*1	156.650	156.650
14	14	14	156.700	156.700
15*2	15*1	15*1	156.750	156.750
16	16	16	156.800	156.800
17*1	17	17*1	156.850	156.850
	18		156.900	161.500
18A		18A	156.900	156.900
	19		156.950	161.550

Channel number			Frequency (MHz)	
USA	INT	CAN	Transmit	Receive
19A		19A	156.950	156.950
20	20	20*1	157.000	161.600
20A			157.000	157.000
	21	21	157.050	161.650
21A		21A	157.050	157.050
		21b	Rx only	161.650
	22		157.100	161.700
22A		22A	157.100	157.100
	23	23	157.150	161.750
23A			157.150	157.150
24	24	24	157.200	161.800
25	25	25	157.250	161.850
		25b	Rx only	161.850
26	26	26	157.300	161.900
27	27	27	157.350	161.950
28	28	28	157.400	162.000
		28b	Rx only	162.000
	60	60	156.025	160.625
	61		156.075	160.675
61A		61A	156.075	156.075
	62		156.125	160.725
		62A	156.125	156.125
	63		156.175	160.775
63A			156.175	156.175
	64	64	156.225	160.825

Channel number			Frequency (MHz)	
USA	INT	CAN	Transmit	Receive
64A		64A	156.225	160.825
	65		156.275	160.875
65A	65A	65A	156.275	156.275
	66		156.325	160.925
66A	66A	66A*1	156.325	156.325
67*2	67	67	156.375	156.375
68	68	68	156.425	156.425
69	69	69	156.475	156.475
70*3	70*3	70*3	156.525	156.525
71	71	71	156.575	156.575
72	72	72	156.625	156.625
73	73	73	156.675	156.675
74	74	74	156.725	156.725
77*1	77	77*1	156.875	156.875
	78		156.925	161.525
78A		78A	156.925	156.925
	79		156.975	161.575
79A		79A	156.975	156.975
	80		157.025	161.625
80A		80A	157.025	157.025
	81		157.075	161.675
81A		81A	157.075	157.075
	82		157.125	161.725
82A		82A	157.125	157.125
	83	83	157.175	161.775

Channel number			Frequency (MHz)	
USA	INT	CAN	Transmit	Receive
83A		83A	157.175	157.175
		83b	Rx only	161.775
84	84	84	157.225	161.825
84A			157.225	157.225
85	85	85	157.275	161.875
85A			157.275	157.275
86	86	86	157.325	161.925
86A			157.325	157.325
87	87	87	157.375	161.975
87A			157.375	157.375
88	88	88	157.425	162.025
88A			157.425	157.425

WX channel	Frequency (MHz)	
	Transmit	Receive
1	RX only	162.550
2	RX only	162.400
3	RX only	162.475
4	RX only	162.425
5	RX only	162.450
6	RX only	162.500
7	RX only	162.525
8	RX only	161.650
9	RX only	161.775
10	RX only	163.275

*1Low power only. *2Momentary high power. *3DSC operation only

NOTE: Simplex channels, 3, 21, 23, 61, 64, 81, 82 and 83 **CANNOT** be lawfully used by the general public in U.S.A. waters.

Scope B3 – Maritime Services VHF Applicable Rules

- GMDSS – Part 80 Subpart W
- GMDSS Equipment must meet the requirements of 80.1101(c)(2)
- Non-Compulsory or voluntary equipment must meet the requirements of 80.225(a)
- **WARNING: DSC is permitted in VHF handheld radios but it must also meet** 80.225(a). Paragraph 80.225(a) requires that DSC equipment installed in coast or ship stations must meet either the requirements of ITU-R M.493 or RTCM Paper 56-95/SC101-STD. **Contact the FCC.**
- DSC typically not in handhelds since the requirements are hard to meet

Scope B3 – Maritime Services VHF Applicable Rules (Cont.)

- Section 80.1101(b)…must be tested in accordance with the applicable testing standards listed
- Section 80.1101(c)(2) – lists applicable standards
  - IMO Resolution A.803(19) Performance Standards for Shipborne VHF Radio Installations Capable of Voice Communication and Digital Selective Calling
  - ITU-R Recommendation M.493–10 Digital Selective-calling System for Use in the Maritime Mobile Service
  - ITU-R Recommendation M.541-8 Operational Procedures for the use of Digital Selective-Calling Equipment in the Maritime Mobile Service

Scope B3 – Maritime Services VHF Applicable Standards

- **RTCM Paper 56-95/SC101-STD**
  - RTCM Recommended Minimum Standards for DSC Equipment Providing Minimum Distress and Safety Capability, Version 1.0 – defines minimum functions for DSC transceivers used in the US
  - Paper Only ($10)

    https://ssl29.pair.com/dmarkle/puborder.php?show=2
- ITU-R M.541-9

  Operational procedures for the use of digital selective-calling equipment in the maritime mobile service

  http://www.gmdss.com.au/ITU%20DSC%20op%20spec.pdf
- ITU-R M.493-11

  Digital selective-calling system for use in the maritime mobile service

  http://www.gmdss.com.au/ITU%20DSC%20tech%20spec.pdf
- ITU Radiocommunication Sector – standards, updates & news

  Subscription Services (Electronic or paper)

  http://www.itu.int/ITU-R/

Scope B3 – Maritime Services VHF Technical Parameters

- DC Voltage & Current into Final Device 2.1033(C)(8)
- RF Output Power 2.1046 (Typically conducted power)
- Modulation Characteristics (Audio Roll-off) 2.1047 & 80.213
- Modulation Characteristics (Audio Frequency Response) 2.1047
- Modulation Characteristics (Modulation Limiting) 2.1047
- Occupied Bandwidth 2.1049(c)(1) & 80.211
- Spurious & Harmonic Emission at Antenna Terminal 2.1051
- Field Strength of Spurious & Harmonic Radiation 2.1053
- Frequency Stability (Temperature) 2.1055 & 80.209
- Frequency Stability (Voltage) 2.1055 & 80.209
- Receiver radiated spurious emissions 80.217(b)
- DC Voltage & Current into Final Device 2.1033(C)(8)

Scope B3 – Maritime Services VHF Equipment Authorization

- Equipment Class
  - GVH: Part 80 VHF Transmitter (GMDSS) Base Station
  - TNB (Base Station) or TNF (Handheld): Part 80 VHF transmitters without GMDSS/DSC
- For devices with DSC (Base Station)
  - CS “Transmitter meets technical requirements for ship stations”.
  - GM “This unit meets requirements for GMDSS as contained in Subpart W of Part 80”.
  - Handhelds - no Note Code required
- Modulations
  - VHF Marine: 16K0F3E and/or 16K0G3E
  - DSC: 16K0G2B (Requires separate line item)

Scope B3 – Maritime Services
VHF Equipment Authorization (Cont.)

- Modulation Characteristics (Audio Roll-off) 2.1047 & 80.213
  - FCC limits:
    - 3 kHz - 15 kHz: -40 log (F/3) dB
    - >20kHz : At least -28 dB
- Modulation Characteristics (Audio Frequency Response) 2.1047
  - FCC limits: 300 - 3000 Hz: 6dB/octave roll-off (+1/-3 dB)
- Modulation Characteristics (Modulation Limiting) 2.1047
  - FCC limits: +/-5 kHz deviation

Scope B3 – Maritime Services
VHF Equipment Authorization (Cont.)

- Occupied Bandwidth 2.1049(c)(1) & 80.211
  - a) -25dB (50 - 100% of assigned frequency)
  - b) -35dB (100 - 250% of assigned frequency)
  - c) 43 + 10log (RF output power in Watts) dB or 80dB, whichever is lesser attenuation for more than 250% of assigned frequency
- Spurious & Harmonic Emission at Antenna Terminal 2.1051
  - FCC limits: 43 + 10log (RF output power in Watts) dB
- Field Strength of Spurious & Harmonic Radiation 2.1053
  - FCC limit = 43 + 10log P(Watts) dB
  - P(dBm) = -30 + 10 log P(Watts) therefore Limit = -13 dBm

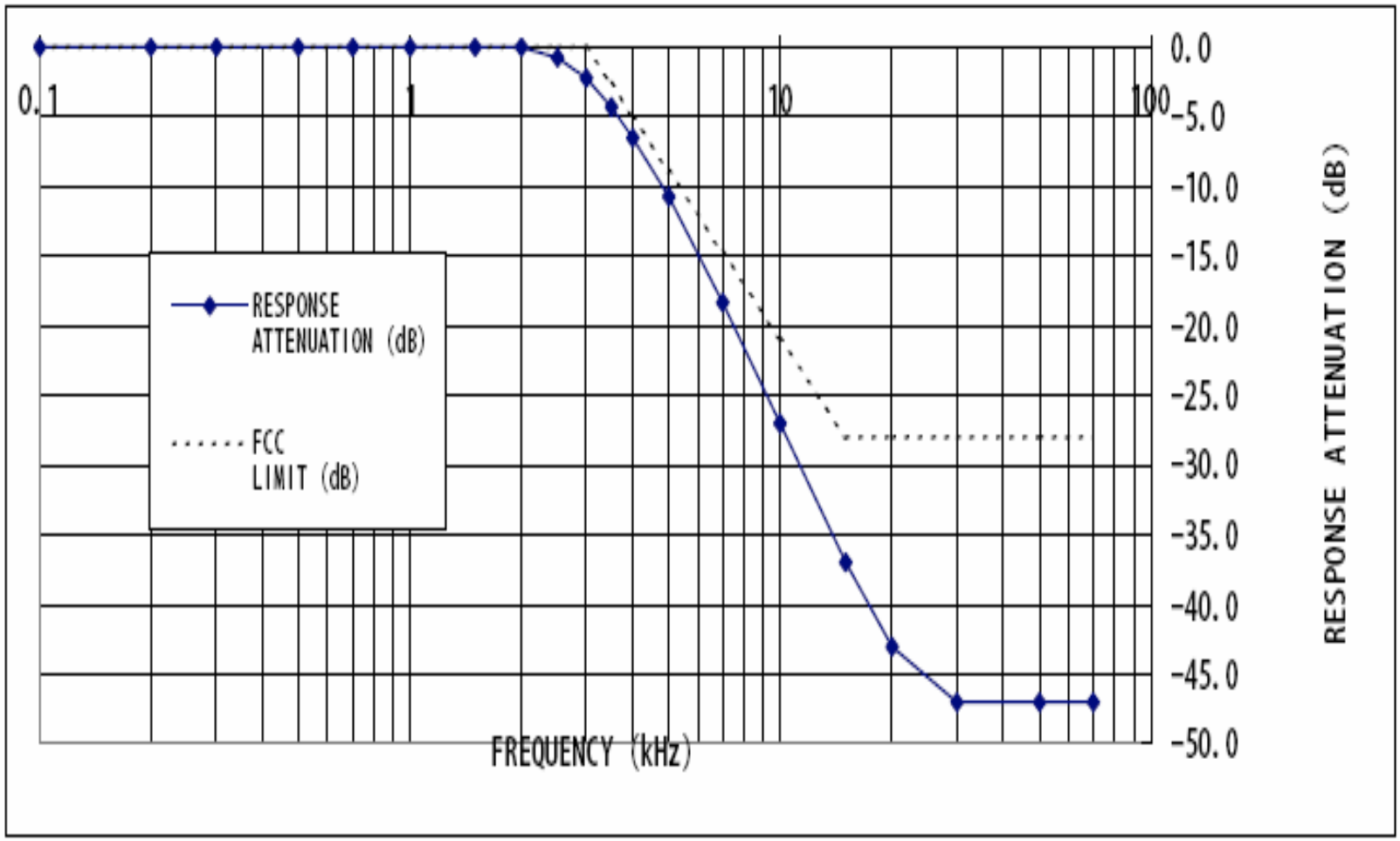
    X axis is dBm

Scope B3 – Maritime Services
VHF Equipment Authorization (Cont.)

- Frequency Stability (Temperature) 2.1055 & 80.209
  - From -20 °C to +50 °C at intervals of 10°C
  - FCC limits: +/-0.0005%
- Frequency Stability (Voltage) 2.1055 & 80.209
  - 85% to 115% of the nominal voltage
  - FCC limits: +/-0.0005%
- Typically test a low and high channel
- If the device has a switchable high/low power setting test at both high and low power. If the power is variable test at high power setting only.
- **US Coast Guard approval letter or MRA approval not required for VHF radios**

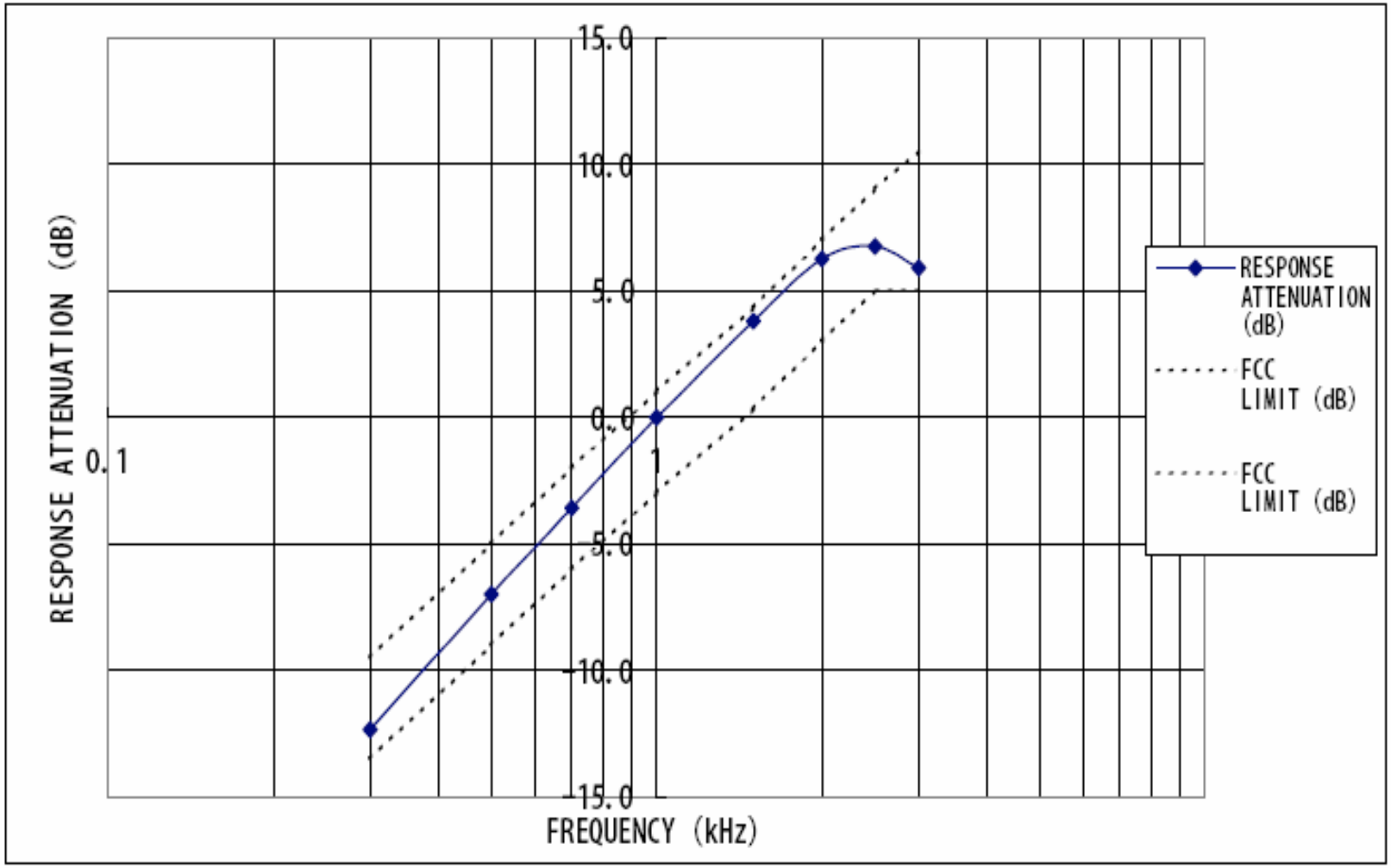
Scope B3 – Maritime Services

Modulation Characteristics (Audio Roll-off)



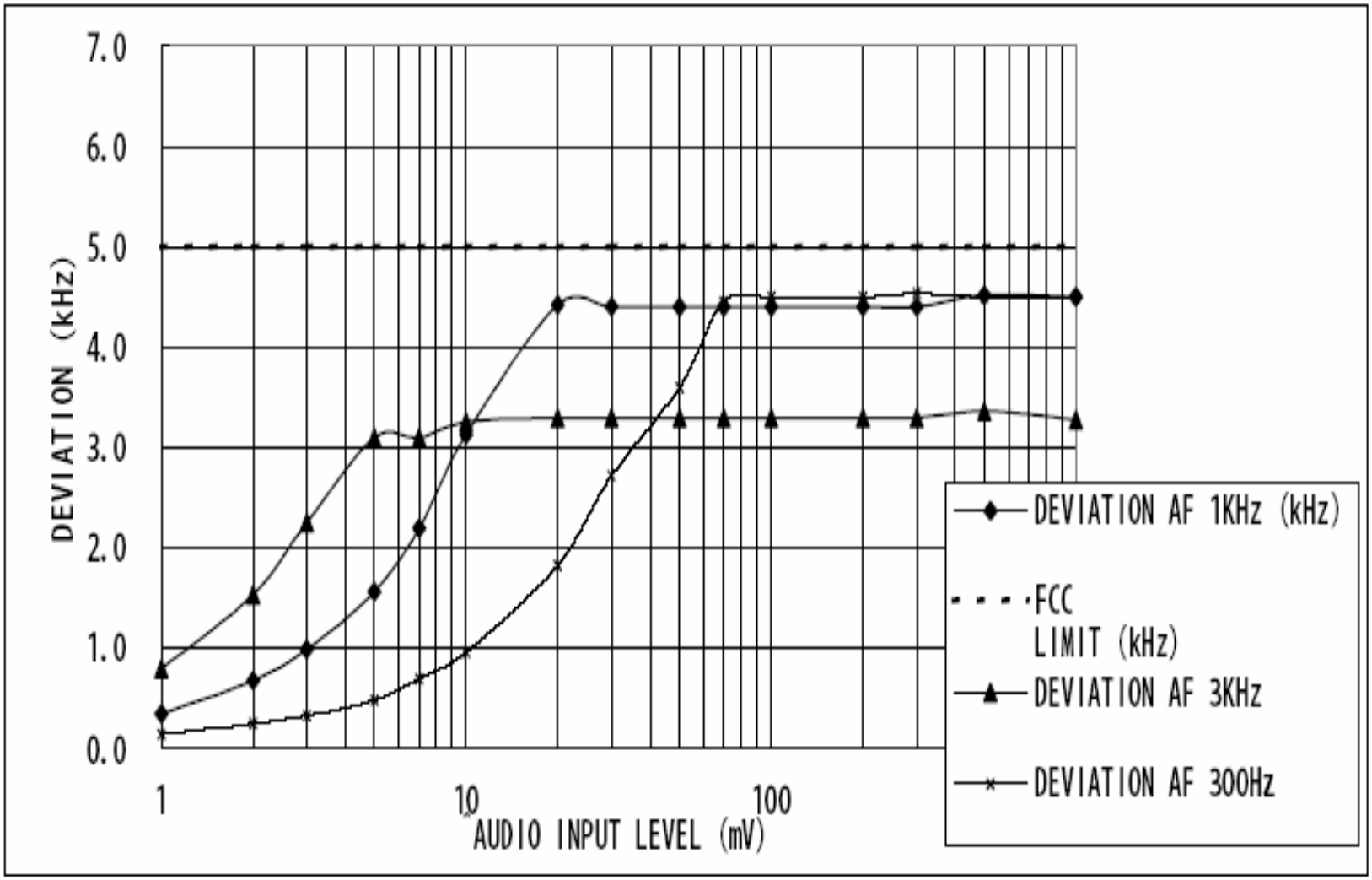
Scope B3 – Maritime Services

Modulation Characteristics (Audio Frequency Response)

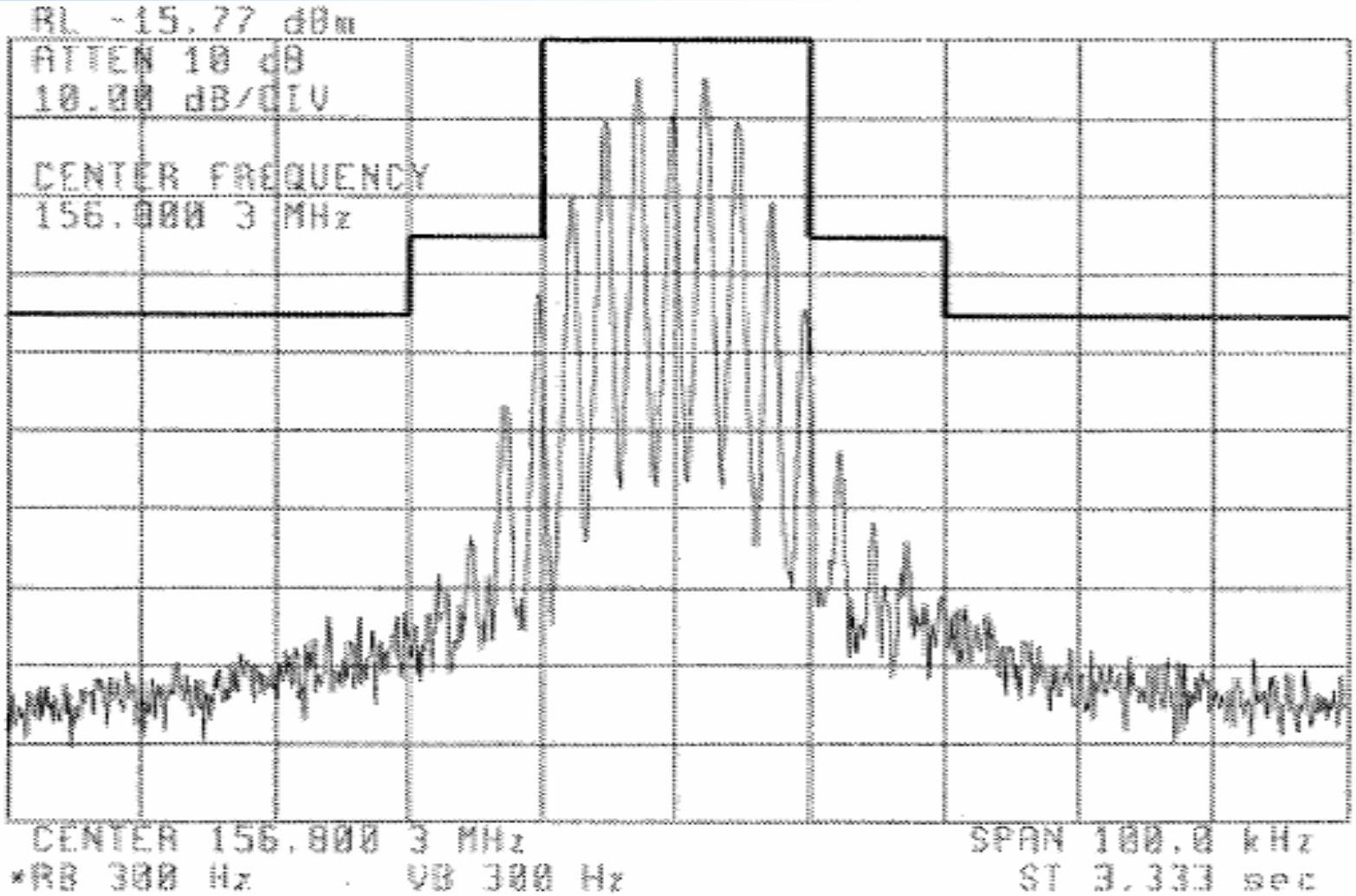


Scope B3 – Maritime Services

MODULATION CHARACTERISTICS (MODULATION LIMITING)

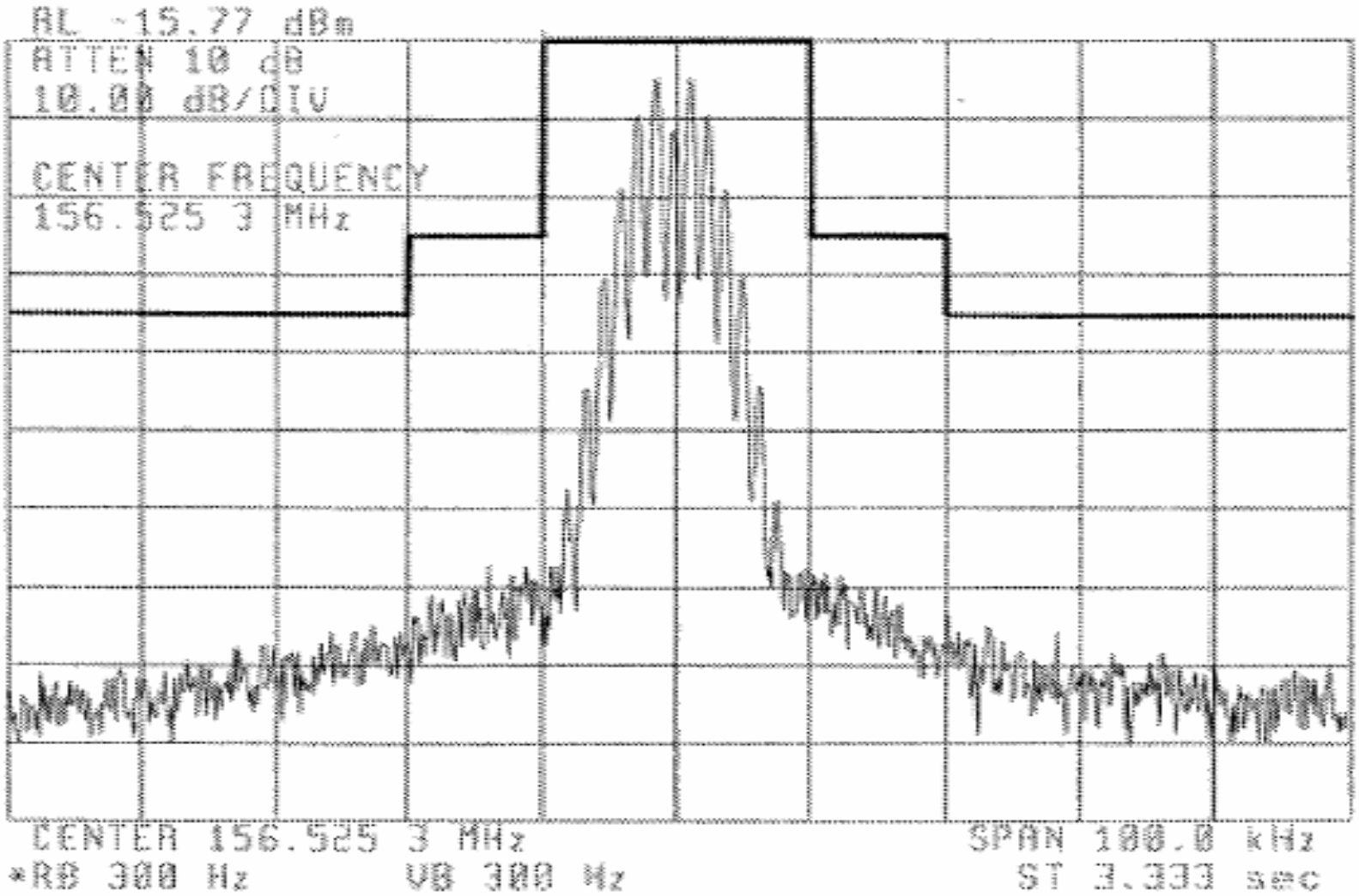


Scope B3 – Maritime Services F3E (Channel 16) Occupied BW



Scope B3 – Maritime Services

DSC (G2B Modulation, Channel 70) Occupied BW



Scope B3 – Maritime Services VHF Handheld PTT RF Exposure

- Categorically excluded: Section 1.1307(b)(2)
- Option 1 (Portables): Occupational Limits
  - Submit Occupational training material
  - Special exemption from the July 02 Exclusion List
  - SAR Report is not required
- Option 2 (Portables): General Population Limits
  - SAR Report required
- If Portable power > 7 Watts contact the FCC before proceeding for both Occupational and General Population limits

Scope B3 – Maritime Services
VHF Handheld PTT RF Exposure (Cont.)

- If applicant chooses to submit SAR - TCBs cannot review the application
  - Submitted to the FCC
  - No standard SAR procedures for 150 MHz devices
- RF exposure training instructions and labeling information is required for portables and mobiles
  - To determine mobile separation distance an MPE exhibit is required if separation distance not equal to 20 cm

Scope B3 – Maritime Services VHF Base Station RF Exposure

- Categorically excluded: Section 1.1307(b)(2)
- RF exposure training instructions and labeling information is required since these are mobiles
- To determine mobile separation distance an MPE exhibit is required

- For further details on RF Exposure Requirements for all Part 80 VHF devices, refer to February 05 TCB Workshop notes and March 04 KDB procedures

Scope B3 – Maritime Services VHF Example Grant

Equipment Class : Part 80 VHF Transmitter (GMDSS)
Notes: VHF FM Marine Transceiver

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
CS GM	80.1101(c)(4)	156.025 - 157.425	1	7 PPM	16K0G3E
CS GM	80.1101(c)(4)	156.025 - 157.425	25	7 PPM	16K0G3E
CS GM	80.1101(c)(4)	156.025 - 157.425	1	7 PPM	16K0G2B
CS GM	80.1101(c)(4)	156.025 - 157.425	25	7 PPM	16K0G2B

Power listed is conducted. This device must not exceed a maximum transmitting duty factor of 50%. All qualified end-users of this device must have the knowledge to control their exposure conditions and/or duration, and the exposure conditions and/or duration of their passengers and bystanders, to comply with the General Population/Controlled MPE limit and requirements. Users must be provided with the training information, antenna installation and transmitter operating conditions for satisfying RF exposure compliance. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 60cm from all persons and must not exceed an antenna gain of 0 dBi.
"Includes integral DSC modem in conformity with ITU-R M.493.8"

CS: Transmitter meets technical requirements only for use at ship stations.

GM: This unit meets requirements for GMDSS use as contained in Subpart W of Part 80.

Scope B3 – Maritime Services Radars – Frequency Bands

- Frequency Bands
  - 2450–2500 MHz
  - 2900–3100 MHz
  - 5460–5650 MHz
  - **9300–9500 MHz**
  - 14.00–14.05 GHz
- This presentation focuses on the 9300-9500 MHz band since the majority of new devices only use this band

Scope B3 – Maritime Services Radars – Applicable Rules

- R.F. Power Output
  - Sections 2.1046(a), 80.215 – “mean power”
  - Duty Cycle = P.R.F. x Pulse Width
  - Peak Power = Average Power/Duty Cycle
  - Note: high peak power & low average power
- Modulation Characteristics
  - Section 2.1047
  - P0N (Pulsed CW Radars)
  - Pulse widths (typically selectable for range)
  - PRF
- Occupied Bandwidth
  - Sections 2.1049(c)(1), 80.209(b), 80.211(f)

Scope B3 – Maritime Services Radars – Applicable Rules (Cont.)

- Spurious Emissions at Antenna Port
  - Sections 2.1051, 80.211(f)
- Radiated Spurious Emissions
  - Sections 2.1053, 80.211(f)
- Frequency Stability – temperature & voltage variation
  - Sections 2.1055, 80.209(b)
  - 1.5/T where T=Pulse Duration (microseconds)
  - Example for 9300-9500 MHz Band – frequency must be within
    - Upper Limit = 9500 – 1.5/T
    - Lower Limit = 9300 + 1.5/T

Scope B3 – Maritime Services Radars – International standards

- ***Section 80.273 Technical requirements for radar equipment – list of applicable standards***
- RTCM Paper 133–87–SC 103–33
  - RTCM Recommended Performance Specification for a General Purpose Navigational Radar Set for Oceangoing Ships of 500 Gross Tons and Upwards for New Radar Installations
- RTCM Special Committee No. 65 Final Report
  - Performance Specification for a General Purpose Navigational Radar Set for Oceangoing Ships of 1,600 Tons Gross Tonnage and Upwards for New Radar Installations
- International Standards are under review

Scope B3 – Maritime Services

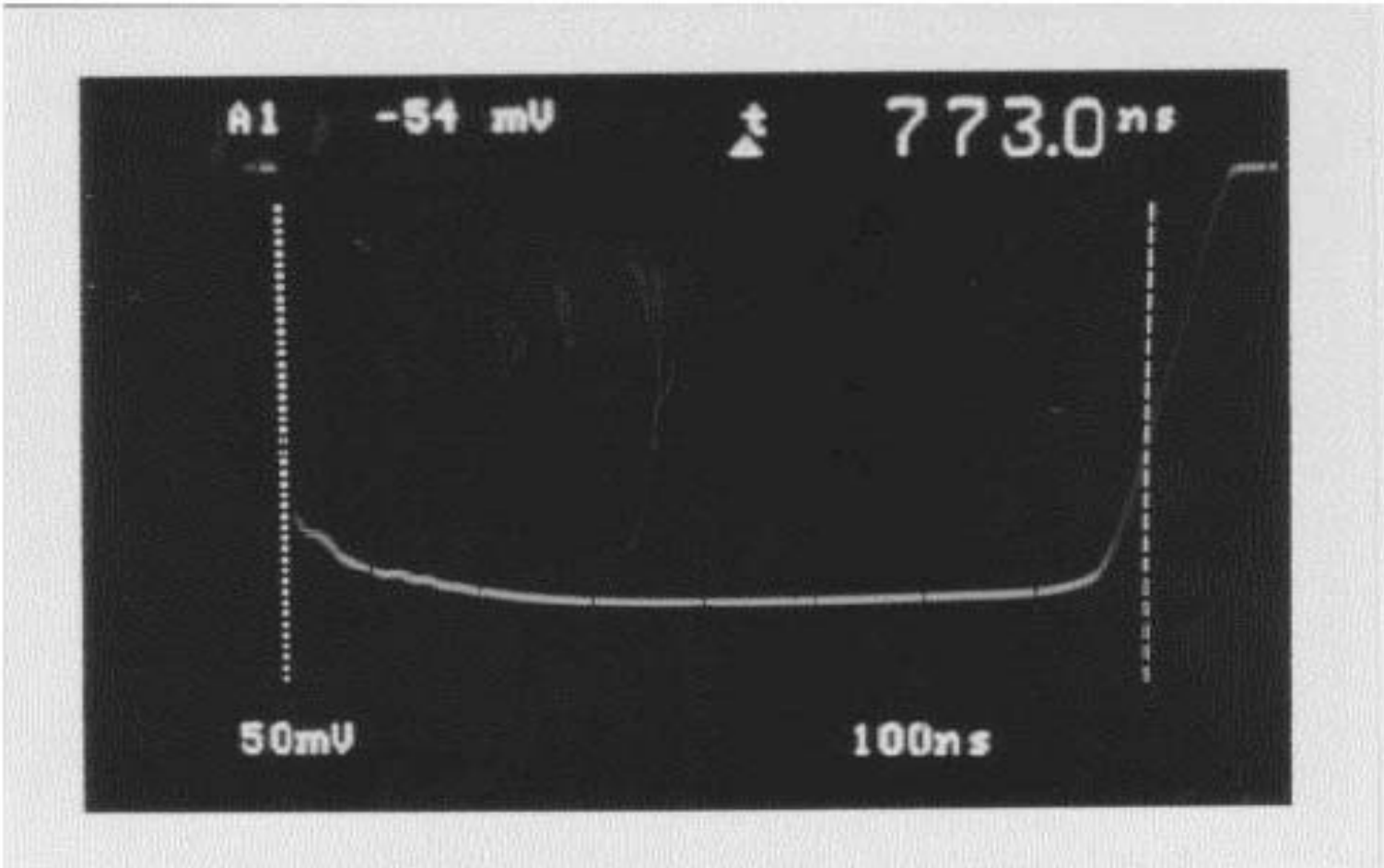
Radars – Typical Measurement Procedure

- The average power, pulse widths, pulse rise and decay times, and the interval between successive output pulses are measured (1/2 Voltage PW)
- The pulse repetition frequency (PRF) is then calculated from the reciprocal of the interval
- The duty cycle is calculated from the product of the P.F.R. and the pulse width
- The average power is corrected for attenuation
- The peak power is calculated by dividing the average power by the duty cycle
- The spurious and harmonic radiation characteristics, the occupied bandwidth and the receiver radiation are measured

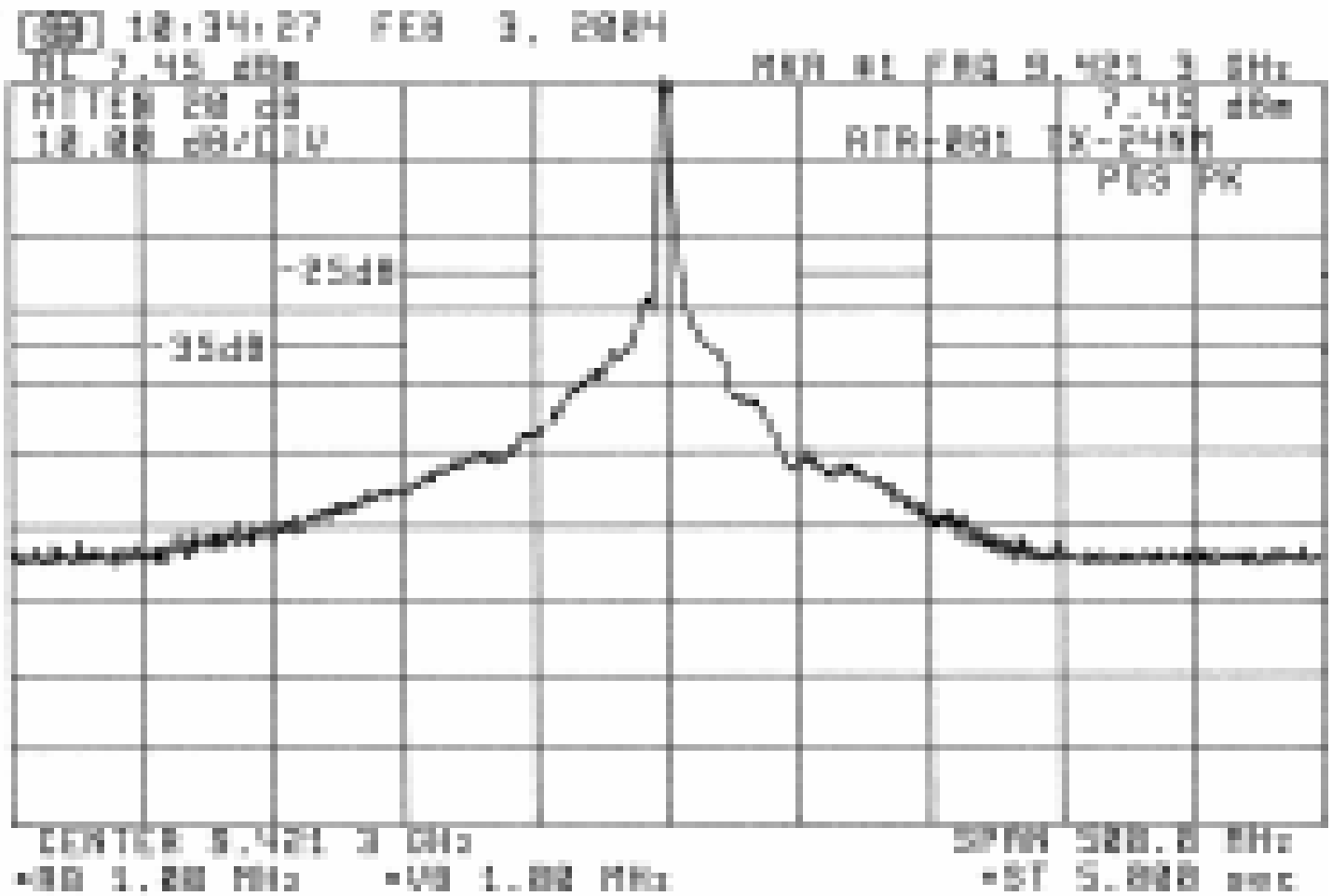
Scope B3 – Maritime Services Radars – Equipment Authorization

- Equipment Class – MRD (Marine Radar)
- Can list entire band on Grant but must have operational frequencies and frequencies parameters (Hopping, etc.) in the Operational Description
- Modulation P0N (Not PON)
- Necessary BW is typically several MHz
- Measure all PW and OBW – preferable to include plots in the Test Report
- Conducted spurious radiation
- Case radiated measurements
  - Antenna terminated
- No RF Exposure requirements

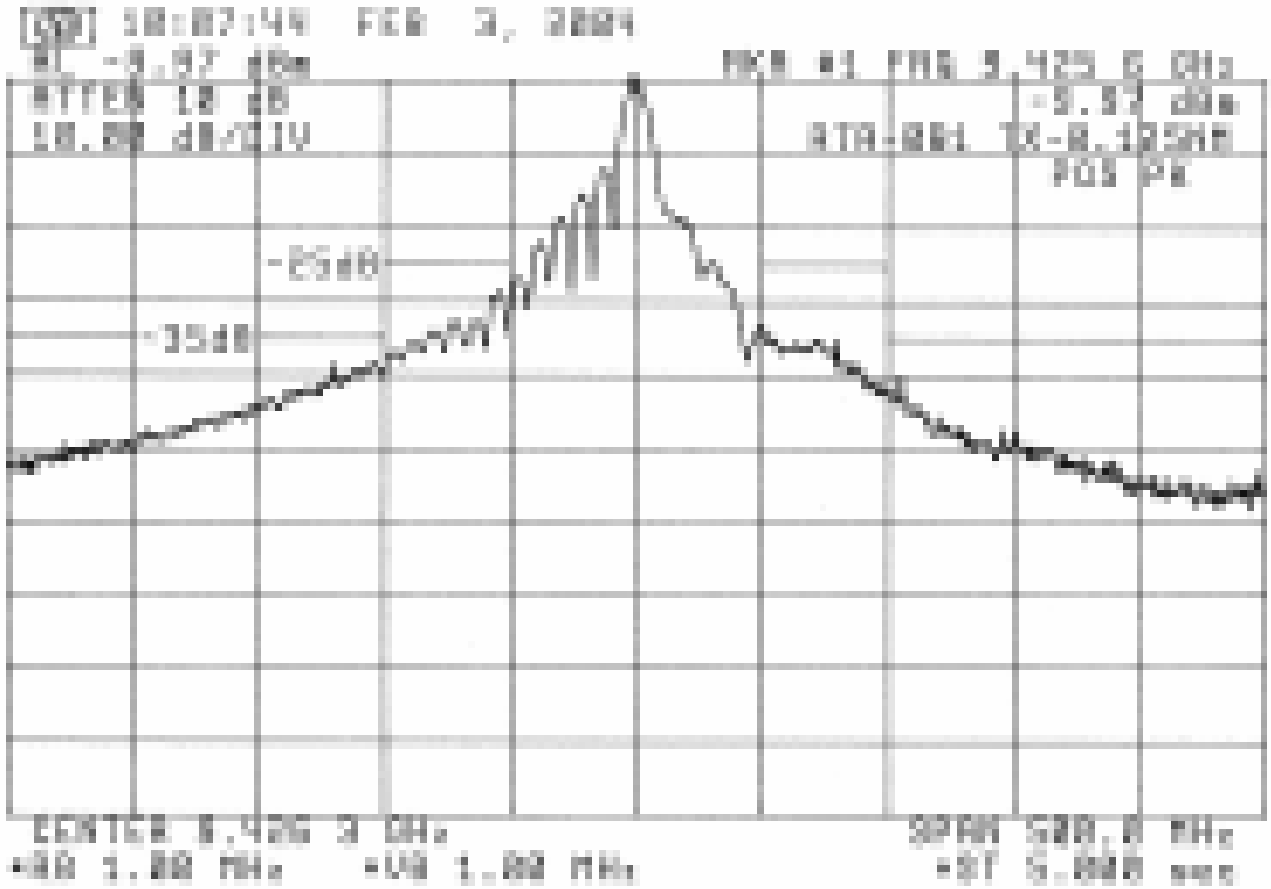
Scope B3 – Maritime Services Radars – Measured PW



Scope B3 – Maritime Services Radars – OBW RW #1



Scope B3 – Maritime Services Radars – OBW PW#2



Scope B3 – Maritime Services Radars – Grant Example

- Equipment Class – MRD
- List entire 9300-9500 MHz band
- Output Power – manufacturers rated peak power
- Frequency Tolerance – leave blank (must comply)
- No RF Exposure Conditional Requirements Necessary

Equipment Class : Marine Radar
Notes: Marine Radar RA41C

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	80	9300 - 9500	4000		54M4P0N

Questions and Answers

Thanks!