USER'S MANUAL

Model: *ITC-16i*
DATA ACQUISITION
INTERFACE

InstruTECH
Precision Instrumentation for Biological Research

**20 Vanderventer Avenue, Suite 101E
Port Washington, New York 11050-3752 U. S. A.
Tel: (516) 883-1300 Fax: (516) 883-1558
Internet: sales@instrutech.com
support@instrutech.com
http://www.instrutech.com/**

<u>Credits</u>

Instrutech Corporation would like to thank the following individuals who have contributed their time and ideas to the development and testing of the *ITC-16* computer interface:

Dr. Richard Bookman, University of Miami

Dr. Fred Sigworth, Yale University

Dan Brown, Bruxton Corporation

Dr. Hubert Affolter, Heka electronik GMBH

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1 General Information

1.1 Product intended usage

The Instrutech *ITC-16* is intended for research use only in a laboratory by persons trained in its use. Users are expected to be able to properly operate the *ITC-16* and associated instruments.

The Instrutech *ITC-16* is not intended for medical use. The Instrutech *ITC-16* is not intended for use in life support situations, or in situations were improper operation or failure of the *ITC-16* can result in personal injury.

Instrutech Corporation makes no representation that the design, implementation, testing, or manufacture of the *ITC-16* meet reasonable standards for use as a medical product.

As stated in the Instrutech Limited Warranty Statement, supplied with each product, "Instrutech Corporation expressly disclaims all warranties to buyer except the limited warranty set forth above, including without limitation to any and all implied warranties of merchantability and fitness for a particular purpose."

1.2 Accessories

The following items should have been packed with your *ITC-16 Computer Interface*:

1   Power cord, 110 volt or 220 volt type depending on application

1   *ITC-16* User's manual

1   Warranty card

If any of these items are missing please contact Instrutech Corporation immediately.

1.3 Unpacking

After unpacking the *ITC-16* and accessories from the shipping carton, please inspect each piece for any signs of shipping damage. Please contact the delivering carrier and Instrutech Corporation immediately if there is any damage. Do not dispose of the shipping carton. The carrier will want to examine the shipping carton to process a damage claim. Instrutech Corporation insures all shipments to cover shipping damage. It is also advisable to keep the shipping carton in the event that the instrument must be returned for service.

1.4 Purchase Information

Take the time now, while getting started, to record some purchase information here. This will make it easier to locate this information should this become necessary in the future.

Date of purchase: ...._____

Dealer:.._____

Dealer telephone number: ...._____

Dealer fax number: ...._____

Dealer email address:...................................._____

Contact name at dealer:................................._____

Serial number:..._____

Other notes:

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1.5 Technical Specifications

. **Analog Input Channels:**

Inputs:	16 bit 200 kHz (5us) analog to digital converter multiplexed to eight differential inputs. These outputs are available through eight BNC connectors on the front panel.
Input Range:	-10.24 volts to +10.23 volts.
Conversion Speed:	Programmable from 5 us to 65 ms in 1 us steps.
Resolution:	14 bit up to 10us (100 kHz) degrades to 12 bits at 5us.

. **Analog Output Channels:**

Outputs:	Four 16 bit digital to analog converters (1 for each channel) in a pseudo differential output configuration. These outputs are available through four BNC connectors on the front panel.
Input Range:	-10.24 volts to 10.23 volts. 15 Volts peak absolute maximum input voltage.
Conversion Speed:	Programmable from 5us to 65ms in 1 us steps.
Resolution:	16 bit.
Settling Time:	Less than 4 us to 0.001%.

. **Digital I/O Channels:**

Inputs:	16 TTL input lines. Four of these inputs are available through BNC connectors on front panel. All available through 40 pin rear panel connector. Do not exceed 20 mA maximum input current.
Outputs:	16 TTL output lines. Four of these outputs are available through BNC connectors on front panel. All available through 40 pin rear panel connector. 4 mA sink or source current maximum.
Trigger In	Start acquisition from an external unisolated TTL source. Input available through a BNC connector on the front panel. 20 mA maximum current input current.
Gate Out:	Unisolated busy output. This signal is available through a BNC connector on the front panel. 4 mA sink or source current maximum.
Special Purpose:	Compatible with Instrutech's VR-10/100 PCM Digital Data Recorders. Parallel input for direct digital transfer of data from tape to computer.

. **FIFO memory:**

16 kilosample A/D and 16 kilosample D/A FIFO memory.

. **Dimensions:**

Width:	19 inches
Height:	1.75 inches
Depth:	12 inches
Weight:	7 Lb.

. **Power requirements:**

Voltage:	115-240VAC 50/60 Hz
Power:	15 Watts.

All technical specifications are nominal conditions and are subject to change without notice.

1.6 Description

The *ITC-16* interface is a unique interface that will boost acquisition speeds and data reliability. All analog and digital I/O signals are optically isolated. Optical isolation eliminates ground loop problems and isolates the usually noisy computer power supply from the low noise recording amplifier setup.

The *ITC-16* employs a 16-bit analog to digital converter multiplexed into eight differential input channels. The analog to digital converter exhibits 14 bit linearity up to 100 kHz and 12 bit linearity from 100 kHz to 200 kHz. The input range is from +10.23 volts to -10.24 volts.

The analog outputs are generated by four individual 16 Bit digital to analog converter. The DAC outputs exhibit 16-bit resolution and are in a pseudo differential configuration. The output range of each digital to analog converter is from +10.23 volts to -10.24 volts.

In addition to analog inputs and outputs, the *ITC-16* has 16 digital input lines and 16 digital output lines. These channels provide or accept TTL (0 volt and +5 volt) pulses.

An internal timer controls sample interval timing. This timer has a range from 5 microseconds to 65 milliseconds in 1-microsecond steps.

The control of the analog to digital converter multiplexer, digital to analog converter output and the digital I/O lines is achieved by loading a control sequence into the channel sequence RAM. This unique arrangement allows for flexible multiplexing sequences.

The *ITC-16* has 16 kilosamples of A/D FIFO memory and 16 kilosamples of D/A FIFO memory. These FIFO memories along with the sampling interval timer eliminate the need for the computer to be continuously involved in the timing of the incoming and outgoing data. The computer downloads a sequence of sample values into the *ITC-16* and the interface runs independently of the computer from then on. This greatly simplifies the software necessary to control the interface.

1.7 Explanation of symbols

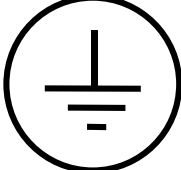| Symbol	Description
	Alternating current Currant alternatif Wechselstrom Corriente alterna Corrente variabile
	On (Supply) Allumé (alimentation) An (Netz) Encendido (suministro) Sotto tensione
	Off (Supply) Éteint (alimentation) Aus (Netz) Apagado (suministro) Fuori tensione
	Caution Attention Vorsicht Cuidado Cautela
	Protective conductor terminal Borne du conducteur de protection Schutzleiterpol Terminal de conductor protector Morsetto di filo di protezione

Figure 1. Explanation of symbols

2 Controls and Functions

2.1 Front Panel Controls

Circled numbers reference to the diagram of the front panel seen in figure 1 at the end of this section.

❶ **ANALOG GROUND** connector:
A 3 mm banana receptacle provides connection to the internal analog ground. This low noise ground is provided for connecting to the recording amplifier. This ground connection is not connected to the *ITC-16* case or to the computer power supply's ground. If desired, the user should provide an external connection between the case and the instrument rack. The mating plug for this connector is a Keystone Electronics Corporation part number 6077.

❷ **READY** indicator:
The ready indicator will be illuminated when the host computer and the acquisition software have properly initialized the *ITC-16*. If this indicator is not illuminated then the *ITC-16* can not function properly.

❸ **DAC** outputs:
Four BNC connectors provide access to the four individual 16-bit digital to analog converter outputs. The acquisition software controls the digital to analog converter voltages and timings. The DAC channels have an output range of $\pm$10.24 volts. These channels are optically isolated from the computer.

❹ **ADC** inputs:
Eight BNC connectors provide access to the multiplexed 16-bit analog to digital converter input channels. The acquisition software controls analog to digital converter channel selection and sampling interval timing. The ADC channels have an input range of $\pm$10.24 volts. These channels are optically isolated from the computer. These channels are differential inputs. Make sure that the cables that are used to connect to these channels have a very good shield, and that it is continuous to both ends of the cable. The shield of the BNC connector must have a reference connected to it. If the BNC connector shield is left unconnected unexpected results can occur. Do not under any circumstances exceed the maximum input allowed voltage of 15 volts peak.

❺ **POWER indicator**:
The power indicator will be illuminated when the *ITC-16* has been powered on. The *ITC-16* uses circuitry that will automatically switch the internal power supply when the computer is started or shutdown.

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❻ **TTL** digital outputs:

Four BNC connectors provide access to four out of the sixteen digital output channels. The acquisition software controls the statuses of the digital output channels. These digital channels output standard TTL levels (5 volts and 0 volts). These channels are optically isolated from the computer.

❼ **TTL** digital inputs:

Four BNC connectors provide access to four out of the sixteen digital input channels. The acquisition software controls the digital input channels. These digital input channels accept standard TTL levels (5 volts and 0 volts). Do not under any circumstances exceed 20 mA of current into these inputs. These channels are optically isolated from the computer.

❽ **GATE OUT**:

A BNC connector provides access to the acquisition sync pulse generated by the *ITC-16*. This output can be used for triggering a scope or other instrument when data acquisition has started. The TTL pulse will toggle from its normally low position to high. It will remain high as long as acquisition is taking place. This output is not optically isolated from the computer.

❾ **TRIG IN**:

A BNC connector provides access to the external trigger input. A TTL trigger pulse can be given to start data acquisition. The *ITC-16* will be triggered on the rising edge of the trigger pulse. This input is not optically isolated from the computer.). Do not under any circumstances exceed 20 mA of current into these inputs.
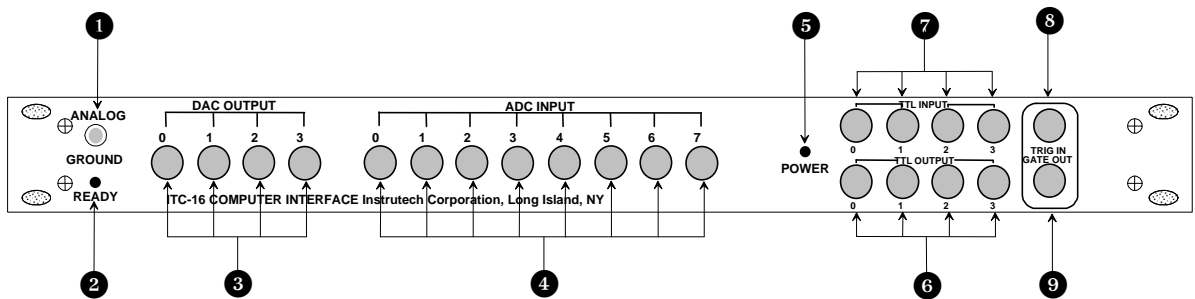

Figure 2. Front Panel

2.2 Rear Panel Controls

Circled numbers reference to the diagram of the rear panel seen in figure 3 at the end of this section.

❶ **FUSE**:
Replace fuse with a 20mm type F2A fuse only.

❷ **POWER CONNECTOR**:
Accepts standard three wire IEC female type power cords. The appropriate power cord has been provided with the *ITC-16.* The *ITC-16* will function with a line voltage of 100 volts AC to 120 volts AC or 200 volts AC to 240 volts AC. Acceptable line frequencies are from 47 hertz to 440 hertz. The maximum power used by the *ITC-16* is fifteen watts. *WARNING: To avoid a shock hazard, the ITC-16 must be plugged into a properly grounded receptacle.*

❸ **DIGITAL I/O**:
The *ITC-16* interface provides sixteen digital input and sixteen digital output lines. Four out of the sixteen input and output channels are brought out on the front panel. All of the digital channels are available on this connector. The mating connector for this port is a 3M part number 3318-0000 or equivalent. The pin connections for this connector are outlined later in this manual.

❹ **PCM DIGITAL RECORDER**:
The *ITC-16* can interface digitally with one of our *VR-10/100* series data recorders. This connector provides the link between the two units. Optional cable and software is required to utilize this capability. If this connection is installed between the *ITC-16* and a VR series data recorder, it is necessary to turn the computer power to the *ITC-16* interface on before or at the same time as turning on the data recorder. Damage can result to the *ITC-16* interface if the data recorder is turned on before the computer power to the *ITC-16* interface is turned on. No damage should result if the data recorder is on and the computer is off and remains off.

❺ **SERIAL**:
The Serial connector is used to connect to the host computers serial port when acquiring data using one of our *VR-10/100* series digital data recorders. Optional cable and software is required to utilize this capability.

❻ **COMPUTER CONNECTOR:**
Connection to host interface card. Host interface cards for NUBUS (MAC-23), PCI (PCI-16) or ISA (AT-16) are available.
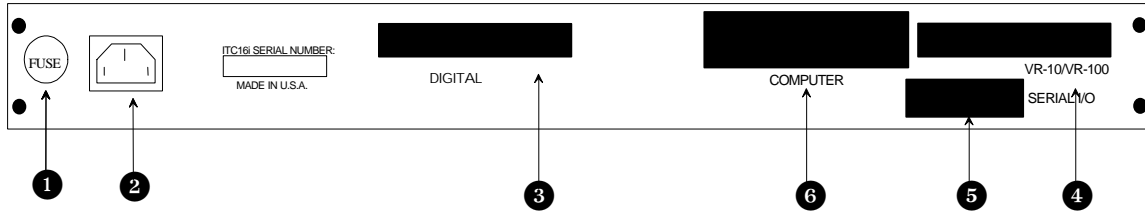
Figure 3. Back Panel

3 Installation

3.1 Hardware installation:

1. Install the host interface card as described in the host interface manual.

2. Install the *ITC-16* interface into the operating position. Make sure that the interface can reach the computer with the supplied cable. Do not extend this cable. Unreliable operation can result if this cable is extended.

3. Install the cable between the *ITC-16* interface and the host interface card.   The connectors on either end of the cable are keyed and will only mate when properly inserted. Attach the end of the cable with the 40 pin female connector to the back of the *ITC-16* marked "**Computer**". Insert the other end of the cable, with the DB-37 connector, into the connector on the host interface card. Fix the DB-37 connector in place with the screws attached to the connector. This is important to ensure a good electrical contact.

4. Connect the power cord to the *ITC-16*. The internal power supply used in the *ITC-16* is an auto switching multi-voltage supply that will operate from 100 volts to 260 volts. *Make sure that the ITC-16 power cord is plugged into a properly grounded AC receptacle. Improper grounding of the ITC-16 could result in an electrical shock hazard.* It is advisable to plug all equipment into a common outlet strip, this will minimize power line induced noise in the system. Equipment plugged into different outlets can cause excessive line hertz noise to be induced into the acquired data.

5. Before powering up please recheck all connections.

6. If you are using the optional **Acquire** software to transfer data from the VR-10 or VR-100 Data Recorders, connect the 40 pin ribbon cable (must be purchased separately) to the connector labeled "**PCM DIGITAL RECORDER**", located on the rear panel of the interface. Connect the opposite end of this cable to the connector labeled "**Computer Interface**" (on the *VR-100*) or "**Computer**" (on the *VR-10*) located on the rear panel of the digital data recorder. This cable should be labeled on each end "To Computer" and "To VR10/100". If these labels are missing, connect the end of the cable with the two additional wires coming from the connector and going to the shield of the cable to the digital data recorder.

7. You are now ready to power up the system and install the software. The *ITC-16* interface will turn on automatically when the host computer is turned on. Follow the installation instructions provided with the software that you will be using with the *ITC-16* interface.

4 Troubleshooting

Most problems arise from incorrect installation of the hardware, and or incorrect use of the software.

Check for proper installation of the hardware interface card.

Check the cable connecting the computer to the *ITC-16* interface. Make sure both ends are plugged in securely and that the cable is not damaged.

Check to see that the AC line cord is plugged in correctly.

Check that power light is illuminated. This indicator does not check all of the voltages, but is usually a good determination that there is power going to the interface.

If trying all of the above steps fail to resolve your problem then please contact your dealer for assistance.

5 Additional Software

5.1 Available Driver Software

Instrutech Corporation has available driver software for researchers and developers who wish to write custom applications using the *ITC-16* Interface. These drivers and appropriate manuals are available in both MacOS and Windows formats. They are available from Instrutech Corporation by request. They are also available from Instrutech Corporation by Internet WWW, FTP or email. For access to our WWW site our URL is http://www.instrutech.com/. For access by anonymous FTP use the URL: ftp://ftp.instrutech.com/. By email send an empty message to info@instrutech.com for a document that will describe how to access Instrutech files by email. If you do not have access to the Internet, call Instrutech and request the *ITC-16* driver disk of your choice.

5.2 Igor XOP's

Instrutech Corporation has available an XOP for Wavemetrics Igor that will allow researchers and developers to write custom applications using the *ITC-16* Interface and Wavemetrics Igor software. This XOP and the appropriate manual is available from Instrutech Corporation by request. It is also available from Instrutech Corporation by Internet WWW, FTP or email. For access to our WWW site our URL is http://www.instrutech.com/. For access by anonymous FTP use the URL: ftp://ftp.instrutech.com/. By email send an empty message to info@instrutech.com for a document that will describe how to access Instrutech files by email. If you do not have access to the Internet, call Instrutech and request the *ITC-16* XOP diskette.

6 Product Registration

6.1 Why Register your purchase?

Instrutech Corporation periodically offers enhancements and updates to our products. Without product registration, users of our products may miss out on announcements of important enhancements to the products that they are using.

Instrutech Corporation does not make our customer list available to anyone else. Any information that you provide to us is strictly confidential.

6.2 How to Register your purchase

Product registration can be accomplished in two ways. You may fill out and mail in the product registration/warranty card supplied with each Instrutech Corporation product. You may also register on-line at our World Wide Web site at http://www.instrutech.com/. By WWW select product warranty/product registration from the main menu.

6.3 Product announcement mailing list

Instrutech Corporation has an Internet emailing list that we use as our primary outlet for announcements of new products, product enhancements and product updates. We strongly recommend that all users of our products sign up for this emailing list. Email is kept to a minimum and list membership is kept in the strictest confidence. Only Instrutech Corporation can send mail to members of our emailing list.

You may join this mailing list through our World Wide Web site at http://www.instrutech.com/. To do this select Instrutech email lists from the main menu. You may also sign up for this list by sending email to listserv@instrutech.com. In the body of this message place the line: **JOIN instrutech-list** *your_email_address your_name*. If this subscribe message is sent from the account where you wish to receive your email, the *your_email_address* and *your_name* parameters are optional. This information will be extracted directly from the message.

7 40 Pin Digital I/O Connector

Below is a listing of the pin assignments of the digital port on the rear panel of the *ITC-16* interface. The connector on the *ITC-16* interface mates with a 3M part number 3318-0000 connector.

1	Inchannel 0		2	Outchannel 14
3	no connection		4	Outchannel 15
5	Inchannel 2		6	Inchannel 10
7	Inchannel 3		8	Inchannel 11
9	Inchannel 4		10	Inchannel 12
11	Inchannel 5		12	Inchannel 13
13	Inchannel 6		14	Inchannel 14
15	Inchannel 7		16	Inchannel 9
17	Inchannel 1		18	clipping
19	GND		20	GND
21	GND		22	GND
23	no connection		24	Strobe Out
25	Outchannel 0		26	Outchannel 8
27	Outchannel 1		28	Outchannel 9
29	Outchannel 2		30	Outchannel 10
31	Outchannel 3		32	Outchannel 11
33	Outchannel 4		34	Outchannel 12
35	Outchannel 5		36	Outchannel 13
37	Outchannel 6		38	Inchannel 8
39	Outchannel 7		40	no connection

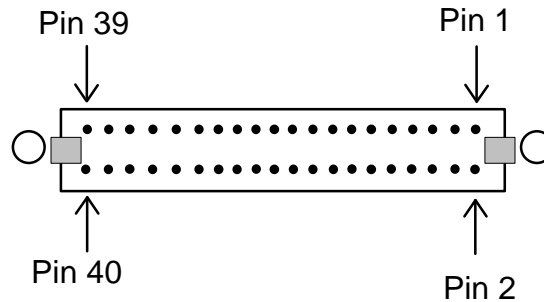Pin 39   Pin 1

Pin 40   Pin 2

Figure 4. *ITC-16* Digital I/O connector pins

8 Warranty Information

8.1 Limited Warranty

Instrutech Corporation warrants to the first purchaser, for a period of two years from the date of purchase, that this Instrutech Instrument (hereafter referred to as the "Product") will be free from defective workmanship and materials, and agrees that it will, at its option, either repair the defect or replace the defective Product or part thereof at no charge to the purchaser for parts and labor. The Product must be returned to Instrutech Corporation, postpaid and insured. Instrutech Corporation will return the Product, postpaid and insured, in the most appropriate method as determined by Instrutech Corporation. If the customer desires a faster shipping service, the customer must pay any additional special delivery expenses.

This warranty does not apply to shipping damage. Instrutech Corporation fully insures all shipments. Any claims of damage upon receipt must be filed with the carrier and Instrutech Corporation immediately.

This warranty does not apply to any exterior appearance item of the Product that has been damaged or defaced, which has been subjected to misuse and abuse, abnormal service or handling, or which has been altered or modified in design or construction.

This warranty does not apply to any interconnection cables supplied with the Product.

This warranty does not apply if any unauthorized repairs, modifications or alterations have been made to the Product.

This warranty applies to software products only to the extent of maintenance release software to correct improper operation of the Product. Software updates to increase the capabilities of the present product are not to be provided under the terms of this warranty. Updates will be sent at no cost to the customer by normal common carrier routes. If faster delivery is desired, the customer must assume any additional expenses for special delivery service.

No sales organizations, other than Instrutech Corporation itself, are authorized to make any warranties other than those described above, or to extend the duration of any warranties beyond the time period described above on the behalf of Instrutech Corporation. If Instrutech Corporation agrees to such a modification of this warranty, Instrutech will furnish a modified copy of this agreement, which must be presented if a claim is being made under these modified terms.

8.2 Obtaining Warranty Service

Warranty service of this Product can be obtained by returning the Product, post paid and insured, to Instrutech Corporation, or one of its sales agents. Prior authorization before shipping the product is advised for the most expedient service.

9 Other INSTRUTECH CORPORATION Products

PCI-16	Host Interface Card for the ITC-16 and PCI bus computers.
MAC-23	Host Interface Card for the ITC-16 and NUBUS computers.
AT-16	Host Interface Card for the ITC-16 and ISA bus computers.
VR-100B Digital Data Recorder	Eight channel VCR based digital data recorders.
VR-10B Digital Data Recorder	Two channel VCR based digital data recorder with built in programmable stimulator.
VR-111 Interface for VR10/100	IBM PC AT plug in card for direct digital transfer of data to the computer hard disk for video tape or in real time.
ITC-18 computer interface	True 16 bit interface with 4 D/A, 8 A/D, 32 digital output channels and 16 digital input channels. Available with interfaces for the ISA, PCI and NuBus computers.
DVP-32/PCI interface	Digital video processing system for PCI bus. 40 Mhz 12 bit A/D with multistage processing pipeline and 32 bit DSP. Includes acquisition software.
EPC-9 Patch Clamp	Computerized patch clamp amplifier.
TAC	Single channel analysis for MacOS and Windows.
PULSE/PULSEFIT	Data acquisition, stimulator and analysis software for MacOS and Windows.
IGOR	Graphing and data analysis software for the Macintosh.
ACQUIRE	Continuous acquisition software for the *ITC-16* under MacOS and Windows.
TAPEPLAY	Optional AxoTape based display software for the VR-111 interface board for the IBM PC AT.

Call Instrutech Corporation at (516) 883-1300 for more detailed information, new products and prices. You may also check our WWW pages at http://www.instrutech.com/ for our latest product announcements.