

USER'S MANUAL
Model: *ITC-1600*
DATA ACQUISITION
SYSTEM



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/>

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Credits

Instrutech Corporation would like to thank the following individuals who have contributed their time and ideas to the development and testing of the *ITC-1600* data acquisition system:

Dr. Hubert Affolter, Heka elektronik
Dr. Arthur Sheiman

1 General Information

1.1 Product intended usage

The Instrutech *ITC-1600* 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-1600* and associated instruments.

The Instrutech *ITC-1600* is not intended for medical use. The Instrutech *ITC-1600* is not intended for use in life support situations, or in situations where improper operation or failure of the *ITC-1600* can result in personal injury.

Instrutech Corporation makes no representation that the design, implementation, testing, or manufacture of the *ITC-1600* 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-1600 Data Acquisition Interface*:

- 1 *PCI-1600* Host interface card (not supplied if I-1600 is ordered)
- 1 I-1600 Rack unit
- 2 Fiber-optic cables
- 1 Power cord, 110 volt or 220 volt type depending on application
- 1 *ITC-1600* 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-1600* 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.

1.5 Technical Specifications

I-1600 rack unit

Analog inputs:

| | |
|---------------------------|--|
| Number of channels | 8, 2 ADC, each multiplexed into 4 inputs MUX A channels 0-3, MUX B channels 4-7 |
| Input type | differential, optically isolated |
| Type of ADC | successive approximation |
| Input connector | BNC on front panel |
| Resolution | 16 bit, 1 in 65536 |
| Acquisition rate | 400 kHz aggregate, 200 kHz per ADC |
| Input range | -10.24 to +10.239 Volts |
| Aperture delay | 10 ns maximum |
| Aperture jitter | 50 ps rms maximum |
| Conversion speed | software selectable, minimum 5 μ s per ADC |
| Differential nonlinearity | $\pm 0.002\%$ of FSR |
| Drift | ± 2 ppm/ $^{\circ}$ C |
| Input impedance | 1M Ω |
| Signal-to-noise ratio | 86dB at DC to 160kHz, < 1mV PP |
| No missing codes | 16-bit |
| Crosstalk | between ADC: not measure able between MUX inputs: -110dB 20 Volt 1kHz sine |
| Maximum over voltage | ± 40 Volts |

Asynchronous "telegraphing" inputs:

| | |
|-------------------------|-------------------|
| Number of channels | 4, single-ended |
| Input connector | BNC on rear panel |
| Resolution | 12 bit |
| Acquisition rate | 5kHz aggregate |
| Input range | ± 10 Volts |
| Max. input over voltage | ± 40 Volts |

Digital inputs:

| | |
|----------------------|---|
| Digital inputs | 20, logic level, optically isolated |
| Input type | 3.3 and 5 Volt logic compatible |
| Operational mode | selectable, level or latching, active high or low |
| Minimum pulse width | 150 ns |
| Input connectors | 4 on front panel BNC, 16 on rear panel connector |
| Maximum over voltage | ± 30 Volts D.C. |

Trigger In:

| | |
|------------------|---|
| Number | 1, optically isolated |
| Input type | 3.3 and 5 Volt logic compatible |
| Operational mode | selectable, edge, level, active high or low |

| | |
|----------------------|--------------------|
| Minimum pulse width | 150 ns |
| Input connector | BNC on front panel |
| Maximum over voltage | ±30 Volts D.C. |

Analog outputs:

| | |
|-------------------------|--|
| Number of channels | 4, individual D/A converters |
| Output type | pseudo differential, optically isolated |
| Type of DAC | double buffered, multiplying |
| Output connector | BNC |
| Resolution | 24 bit converter, 16 bit data (1 in 65536) |
| Output range | -10.24 to +10.239 volts |
| Conversion speed | software selectable, minimum 5 μ s each |
| Settling time | <4 μ s to 0.001% |
| Gain error | 0.2% of FSR |
| Gain linearity | <2dB |
| Drift | ±4 ppm/ °C, after 10 minute warm up |
| Signal-to-noise ratio | 116dB |
| Output impedance | 10 Ω (for output overload protection) |
| Short circuit to ground | indefinite |
| Current output | ±20mA maximum |
| Capacitance drive | 200pF |

Digital outputs:

| | |
|-----------------------|--|
| Number | 36, optically isolated |
| Output driver | 3.3 Volt, TTL, LS, ACT, and HCT compatible |
| Output connectors | 4 on front panel BNC with LED indicators 32 on rear panel connector |
| Sink output current | 6.4 mA (front panel), 3.2 mA (rear panel) |
| Source output current | 6.4 mA (front panel), 3.2 mA (rear panel) |
| Power-on state | logic low |

Trigger Out:

| | |
|------------------|--|
| Number | 1, optically isolated |
| Output driver | 3.3 Volt, TTL, LS, ACT, and HCT compatible |
| Output connector | BNC on front panel |
| Output current | 6.4 mA sink or source |

Dimensions:

Width: 19" (47.5cm), Height: 1.75" (4.375cm), Depth: 6" (15 cm),
Weight: 8 pounds (3.6 kg)

Power requirements:

85-264VAC, 47-440 Hz, 25 Watts

Warranty:

Two years parts and labor

PCI-1600 computer interface

| | |
|-------------|--|
| Form factor | short, 32 bit, 33MHz |
| Type | Bus mastering, PCI 2.0 compliant |
| Cable | 1 pair 5 meter fiber optic cable for each I-1600 rack unit |
| Connectors | 2 pairs InstruLINK fiber optic transmitters/receivers, Unisolated Trigger In, Trigger Out, auxiliary digital output for optional expansion panel and for synchronization of multiple PCI-1600 interfaces |

Software support

| | |
|----------------------|---|
| MacOS | C/C++ Metrowerks libraries WaveMetrics IGOR Pro XOP Heka elektronik Pulse and PatchMaster |
| Linux | 32 bit C/C++ library |
| Windows 9x, NT, 2000 | 32 bit C/C++ library and VxD driver WaveMetrics IGOR Pro XOP National Instrument LabVIEW Mathworks MATLAB Heka elektronik Pulse and PatchMaster Instrutech ECELL |

MacOS / Windows are registered trademarks of their respective manufacture. Specifications are typical at 25°C unless otherwise noted and are subject to change without prior notice.

1.6 Description

Instrutech Corporation is proud to introduce the ITC-1600, expandable 16-bit data acquisition system. The ITC-1600 is not only a product of our historical commitment to designing high resolution, low-noise scientific data acquisition systems, but also a technological leap forward. The ITC-1600 utilizes the newest fiber optic and digital signal processing technologies, in addition to many of the exceptional features of its predecessors the ITC-16 and ITC-18. The ITC-1600 provides expandability and versatility that will satisfy both current and future needs.

The ITC-1600 system comprises of a PCI-1600 computer interface card, one or two I-1600 analog rack units connected by the InstruLINK fiber optic data cables. The fiber optics provide superb optical isolation, virtually eliminating ground loops, while increasing the distance between the computer and the recording setup to at least five meters. Fiber optic cables are small, flexible, and, unlike conventional electrical cables do not emit electromagnetic radiation.

The I-1600 rack unit has eight analog inputs, four analog outputs, twenty digital inputs and thirty-six digital output channels all sampling synchronously. In addition, four 12-bit

asynchronous “telegraphing” ADC channels are available for monitoring slow changing parameters.

The eight analog input channels are separated into two banks of four. Each bank is multiplexed into one 16-bit 200kHz A/D converter. Both A/D converters sample simultaneously and synchronously at the maximum conversion rate resulting in a total throughput of 400kHz. This unique arrangement allows pairs of channels to be digitized without phase-shift. If the bandwidth of the experiment calls for lower sampling rates, the DSP decimates and/or filters the data. An added benefit of filtering is the reduction of noise.

The PCI-1600 Bus mastering host interface card supports one or two I-1600 rack units. If two rack units are used, then all input and output channels are doubled and fully synchronized. For systems requiring even more channels, multiple PCI-1600 and I-1600 units are used. Multiple PCI-1600 cards installed in the same or in separate computers can be synchronized.

1.7 Explanation of symbols





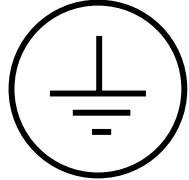
| Symbol | Description |
|---|--|
|  | Alternating current Curreant alternatif Wechselstrom Corriente alterna Corrente variabile |
|  | On (Supply) Allumé (alimentation) An (Netz) Encendido (suministro) Sotto tensione |
|  | Off (Supply) Éteint (alimentation) Aus (Netz) Apagado (suministro) Fuori tensione |
|  | 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.

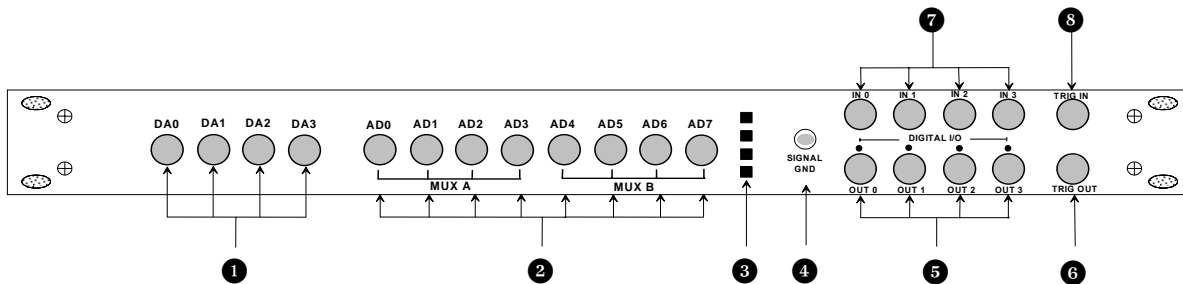


Figure 2: ITC-1600 Front Panel Controls

1 DAC Outputs:

Four BNC connectors provide access to the four individual deglitched 16 bit digital to analog converter outputs. Digital to analog converter output voltages / waveforms, and timings are controlled by the acquisition software. The DAC channels have an output range of -10.24 to +10.239 volts. These channels are optically isolated from the computer. All four channels can be used for simultaneous waveform generation. Use only high quality 75Ω BNC cables for optimal results.

2 ADC Inputs:

Eight BNC connectors provide access to the eight analog input channels. The eight analog inputs are divided into two sections of four, labeled “MUX A” and “MUX B”. Each “MUX” bank is comprised of a single A/D converter multiplexed into four analog inputs. Each bank has a maximum sampling rate of 200kHz with a combined aggregate rate of 400kHz. In addition inputs from each MUX can be simultaneously (co-phased) sampled. Input channel selection, sampling rate and decimation are specified by the acquisition software. The ADC channels have an input range of -10.24 to +10.239 volts. These channels are differential inputs and are optically isolated from the computer. If the BNC connector shield is left unconnected unexpected results can occur. Use only high quality 75Ω BNC cables for optimal results. The absolute maximum input range for these inputs is ± 40 volts. *Do not exceed this level or damage can result to the input circuitry.*

3 Status LED's

Power indicator:

The power indicator will be illuminated when the *ITC-1600* has been powered on.

Ready indicator:

This LED indicator will be illuminated when the *ITC-1600* is properly initialized by the acquisition software. If this indicator is not illuminated then the *ITC-1600* cannot function.

AD 8-15 indicator:

This LED indicator will be illuminated when two I-1600 rack units are installed. This indicates that this unit is considered by the acquisition software as the second set of channels D/A 4 – 7 and A/D 8 to 15.

Status2 indicator:

This LED indicator does not have a pre-assigned function. It is controlled by the acquisition software. Please refer to software user manual for usage description, if any.

4 Signal Ground connector:

A 4mm banana receptacle provides connection to the internal analog ground. This low noise ground is provided for connecting to the measuring device. This ground connection is not connected to the *ITC-1600* case or to the computer power supply ground. If desired, the user should provide an external connection between the case and the instrument rack.

5 Digital Outputs:

Four BNC connectors provide access to the high speed digital output channels. The state of the digital output channels are controlled by the acquisition software. LED indicators above each BNC connector are provided for monitoring the status of each output channel. These digital channels output standard 3.3 volt logic (3.3 volts and 0 volts). These channels are optically isolated from the computer. These channels are optimized to drive 75Ω BNC cables into an AC, HC, ACT, HCT or 8-TTL load.

6 Trigger Out:

A BNC connector provides access to a programmable output trigger. The default function of this output is a gate signal. In this mode the trigger will output a TTL high when acquisition is started and will remain high until acquisition is stopped. Please note that the true functionality of this output will depend on the application software. This output is optically isolated from the computer.

7 Digital Inputs:

Four BNC connectors provide access to the four high speed digital input channels. These digital inputs are controlled by the acquisition software. These digital input channels accept standard TTL levels (5 volts and 0 volts). These channels are optically isolated from the computer. The absolute maximum voltage range for these inputs is -0.5 volts to +5.5 volts. *Do not exceed this range or damage can result to the input circuitry.*

8 Trigger Input:

A BNC connector provides access to the external trigger input. A TTL trigger pulse can be given to start data acquisition. The *ITC-1600* will be triggered with a positive logic pulse with a minimum duration of 150ns. This input is optically isolated from the computer. The absolute maximum voltage range for this input is -0.5 volts to +5.5 volts. *Do not exceed this range or damage can result to the input circuitry.*

2.2 Rear Panel Controls

Circled numbers reference to the diagram of the front panel.

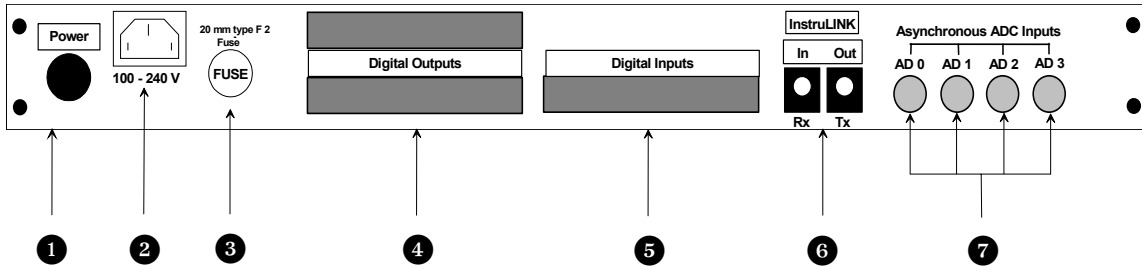


Figure 3: ITC-1600 Rear Panel Controls

1 Power Switch:

Push-button type. Press once to power on, press again to turn off.



2 Power Connector:

Accepts standard three wire IEC female type power cords. The appropriate power cord will be provided with the *ITC-1600*. The *ITC-1600* 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-1600* is fifteen watts. **WARNING: To avoid a shock hazard, the ITC-1600 must be plugged into a properly grounded receptacle.**

3 Fuse:

Replace fuse with a standard 20 mm type F 2A fuse only. Littelfuse #217002.

④ Digital Outputs:

Dual 37 pin stacked DB female connectors provide thirty-two 3.3 Volt logic digital outputs for triggering external devices. All digital outputs are fully synchronous with the analog I/O and are under software control. Top connector provides access for bits 0 to 15, bottom for 16 to 31. All digital outputs have an individual ground. Please refer to section 8 of this manual for pin-out assignments.

⑤ Digital Inputs:

Single 37 pin DB male connector provide sixteen (bits 0 to 15) 3.3 Volt logic digital inputs for monitoring external devices. All digital inputs have an individual ground. Please refer to section 8 of this manual for pin-out assignments.

⑥ InstruLINK:

Proprietary fiber-optic link between the I-1600 rack unit and the PCI-1600 host interface. The transmitter is labeled “**OUT Tx**” and the receiver is labeled “**IN Rx**”. When the unit is powered up the transmitters, on both the PCI-1600 and the I-1600 will be illuminated.

⑦ Asynchronous ADC Channels:

Four 12 bit asynchronous AD inputs running at approximately 1 millisecond sampling rate. Can be used for parameter monitoring such as telegraphing gain and filter settings from an amplifier. Channel selection is controlled by the acquisition software. Input range is between -10.24 to +10.23 volts. These channels are optically isolated from the computer. Use only high quality 75Ω BNC cables for optimal results. The absolute maximum input range for these inputs is ±40 volts. *Do not exceed this level or damage can result to the input circuitry.*

3 Installation

3.1 Driver installation:

MacOS:

For MacOS 9.x and lower a separate driver is not required. All of the hardware specific functions to control the ITC-1600 are embedded in the application software. For MacOS X please download the ITC-1600 MacOS X driver from our web site and follow the installation instructions.

Microsoft Windows:

- 1- Before installing the ITC-1600 / PCI-1600 please go to our web site and download the latest driver installer package.
- 2- Execute the self-extracting archive "ITCWinInstaller.exe". A dialog prompting for the folder to extract the files will be displayed. Select "OK" or hit the Enter key to use the default path "C:\ITC". To select another folder either type in the new name or use "Browse" to select an existing folder.
- 3- Follow directions and install the hardware.
- 4- For Windows NT 4, run the setup program from the ITC folder and follow the installation instructions. For Windows 95/98/ME, 2000 and XP the "add new hardware" wizard will automatically be executed once the new hardware has been detected. When prompted, browse to the ITC folder. The Instrutech.inf file will be found and the appropriate drivers will be installed.

3.2 Hardware installation:

1. Turn the computer OFF.
2. Disconnect the power cord to the computer.
3. Remove the cover from the computer to access the computer's PCI expansion slots. Please follow the instructions outlined in your computer user's manual for removing the cover of the computer. Locate an empty PCI bus slot and remove the cover over the case access opening. Use caution here to guard against static, as outlined in chapter one. Remove the *PCI-1600* card from the static shielding packaging. Line up the card-edge connector on the *PCI-1600* board with the female connector on the CPU board. Gently press the two together until fully seated. If any resistance is felt please check for any proper alignment of the connectors. Do not force the two boards together. It should take minimal pressure to mate the two connectors. If excessive force is used here, damage could result to the *PCI-1600* card and the computer mother board. If your model computer uses a screw to secure the expansion cards in place, install the screw and make sure that it is fastened securely.
4. Re-install the cover of the computer.
5. Install the *I-1600* interface into it's operating position. Make sure that the interface can reach the computer with the supplied 5 meter (16.5 feet) fiber-optic cable set.
6. Remove the protective plastic covers from the ends of the fiber-optic cables. Take the cable with the Blue label and connect one end to the back of the PCI-1600, also marked with a blue label and the other end to the connector labeled "OUT Tx" on the rear

panel of the I-1600 rack. Take the second cable, with the red marking, and connect one end to the back of the PCI-1600, also marked with a red label, and the other end to the connector labeled "IN Tx" on the I-1600. The connectors on either end of the cable are keyed and will only mate when properly inserted. Do not use any cable other than the Instrutech supplied cable. With the InstruLINK it is not necessary for the computer or I-1600 to be power off. *Note: If connecting a second I-1600 rack unit to the PCI-1600 then the colors connect the Green labeled cable to "IN Tx" and Yellow to "OUT Rx".*

7. Connect the power cord to the *I-1600*. The internal power supply used in the *I-1600* is an auto switching multi-voltage supply that will operate from 100 volts to 260 volts. *Make sure that the I-1600 power cord is plugged into a properly grounded AC receptacle. Improper grounding of the I-1600 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 sixty hertz noise to be induced into the acquired data.



8. Before powering up please recheck all connections. If all connections are proper then the power led will illuminate once the power switch is depressed.
9. You are now ready to install the acquisition software. Follow the installation instructions provided with the software.

4 Important considerations

4.1 Warm up:

The ITC-1600 digital to analog converter circuitry uses a sophisticated thermal stabilization technique to provide complete stability of the DAC outputs over time. For optimal stability of the DAC outputs the ITC-1600 requires 20 to 30 minutes of warm up time. During this initial 20 minutes after the ITC-1600 is turned on, DAC drift will occur. This drift can be as large as 6 mV during the initial warm up period. After this warm-up period the DAC outputs will be extremely stable.

4.2 Differential analog to digital inputs:

The ITC-1600 analog to digital converter inputs are true differential inputs. For proper operation of the A/D converter the cable connecting the A/D input to the signal source must have a complete shield. High quality 75 ohm BNC to BNC cables are recommended for optimum performance.

4.3 Grounding:

A connection should be made between the **SIGNAL GROUND** connector on the ITC-1600 front panel to the signal ground connector on the signal source. Most patch clamp amplifiers provide a suitable connection point for the signal ground.

To minimize ground-loops the ITC-1600 should be plugged into the same power strip as the host computer.

5 Troubleshooting

Most problems arise from incorrect installation of the hardware, and or incorrect use of the software. Following is a list of possible problems and solutions:

1- Power LED not illuminated.

First check that the power switch, located on the rear panel, is fully depressed.

Check to see that the AC line cord is plugged in correctly, if attached to a power strip check the power strip switch and circuit breaker.

Check the fuse, located on the rear panel. The fuse can be easily removed by using a flat blade screwdriver. If the fuse needs to be replaced please use the appropriate fuse as listed in section 2.2 of this manual.

2- Ready light not illuminated.

The ready light is illuminated once the application program has successfully initialized the ITC-1600 hardware. The ITC-1600 cannot be properly initialized if the device driver or the application software is not properly installed.

Check the cable connections between the PCI-1600 host interface and the I-1600.

Make sure both ends are plugged in securely and that the cable is not damaged. Also check that the color markings of the cables and connectors match as outlined in section 3.

Check if the driver was installed properly by running our ITCDemo program, supplied with driver installer.

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

6 Additional Software

6.1 Available Driver Software

Instrutech Corporation has available driver software for researchers and developers who wish to write custom applications using the *ITC-1600* 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-1600* driver disk of your choice.

6.2 Igor XOP's

Instrutech Corporation has available an XOP for WaveMetrics Igor Pro that will allow researchers and developers to write custom applications using the *ITC-1600* 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-1600* XOP diskette.

7 Product Registration

7.1 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.

7.2 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/>.

7.3 Product announcement mailing list

Instrutech Corporation has an Internet emailing list which 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.

8 Rear Panel and Internal Connector PIN Assignments

8.1 Rear Panel Digital Input connector

Below is a listing of the pin assignments of the digital input connector.

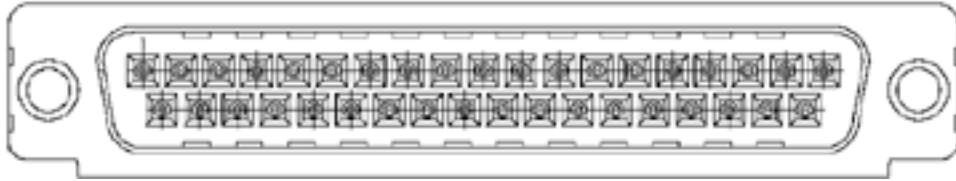


Figure 4: ITC-1600 rear panel digital input connector pins

| Pin | Signal | Pin | Signal |
|------------|---------------|------------|---------------|
| 1 | Ground | 20 | Ground |
| 2 | Ground | 21 | Bit 0 |
| 3 | Ground | 22 | Bit 1 |
| 4 | Ground | 23 | Bit 2 |
| 5 | Ground | 24 | Bit 3 |
| 6 | Ground | 25 | Bit 4 |
| 7 | Ground | 26 | Bit 5 |
| 8 | Ground | 27 | Bit 6 |
| 9 | Ground | 28 | Bit 7 |
| 10 | Ground | 29 | Bit 8 |
| 11 | Ground | 30 | Bit 9 |
| 12 | Ground | 31 | Bit 10 |
| 13 | Ground | 32 | Bit 11 |
| 14 | Ground | 33 | Bit 12 |
| 15 | Ground | 34 | Bit 13 |
| 16 | Ground | 35 | Bit 14 |
| 17 | Ground | 36 | Bit 15 |
| 18 | Ground | 37 | Ground |
| 19 | Ground | | |

8.2 Rear Panel Digital Output Connectors

Below is a listing of the pin assignments of the digital output connectors.

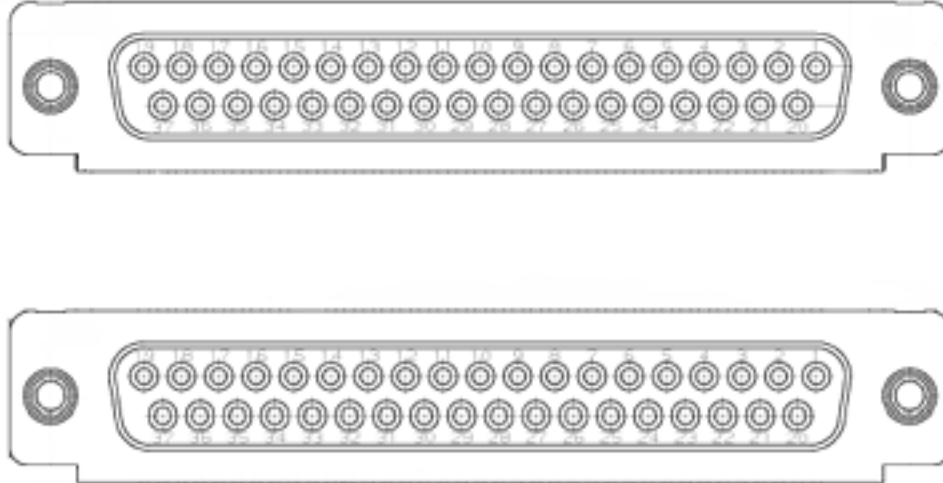


Figure 5: ITC-1600 rear panel digital output connector pins

| Pin | Signal Top and Bottom Connector | Pin | Signal Top Connector | Signal Bottom Connector |
|-----|---------------------------------|-----|----------------------|-------------------------|
| 1 | Ground | 20 | Ground | Ground |
| 2 | Ground | 21 | Bit 0 | Bit 16 |
| 3 | Ground | 22 | Bit 1 | Bit 17 |
| 4 | Ground | 23 | Bit 2 | Bit 18 |
| 5 | Ground | 24 | Bit 3 | Bit 19 |
| 6 | Ground | 25 | Bit 4 | Bit 20 |
| 7 | Ground | 26 | Bit 5 | Bit 21 |
| 8 | Ground | 27 | Bit 6 | Bit 22 |
| 9 | Ground | 28 | Bit 7 | Bit 23 |
| 10 | Ground | 29 | Bit 8 | Bit 24 |
| 11 | Ground | 30 | Bit 9 | Bit 25 |
| 12 | Ground | 31 | Bit 10 | Bit 26 |
| 13 | Ground | 32 | Bit 11 | Bit 27 |
| 14 | Ground | 33 | Bit 12 | Bit 28 |
| 15 | Ground | 34 | Bit 13 | Bit 29 |
| 16 | Ground | 35 | Bit 14 | Bit 30 |
| 17 | Ground | 36 | Bit 15 | Bit 31 |
| 18 | Ground | 37 | Ground | Ground |
| 19 | Ground | | | |

8.3 Internal Digital Output Connector

Below is a listing of the pin assignments of the internal digital output connector for bits 0 to 15. Connector is labeled P3001 on the main board. Note: This is for OEM applications only.

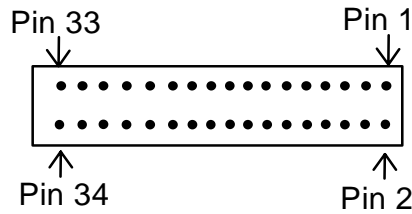


Figure 6: ITC-1600 internal digital output bits 0 – 15 connector pins

| Pin | Signal | Pin | Signal |
|-----|--------|-----|--------|
| 1 | Ground | 2 | Ground |
| 3 | Bit 0 | 4 | Ground |
| 5 | Bit 1 | 6 | Ground |
| 7 | Bit 2 | 8 | Ground |
| 9 | Bit 3 | 10 | Ground |
| 11 | Bit 4 | 12 | Ground |
| 13 | Bit 5 | 14 | Ground |
| 15 | Bit 6 | 16 | Ground |
| 17 | Bit 7 | 18 | Ground |
| 19 | Bit 8 | 20 | Ground |
| 21 | Bit 9 | 22 | Ground |
| 23 | Bit 10 | 24 | Ground |
| 25 | Bit 11 | 26 | Ground |
| 27 | Bit 12 | 28 | Ground |
| 29 | Bit 13 | 30 | Ground |
| 31 | Bit 14 | 32 | Ground |
| 33 | Bit 15 | 34 | Ground |

8.4 Internal Digital Input Connector

Below is a listing of the pin assignments of the internal digital input connector for bits 0 to 15. Connector is labeled P3002 on the main board. Note: This is for OEM applications only.

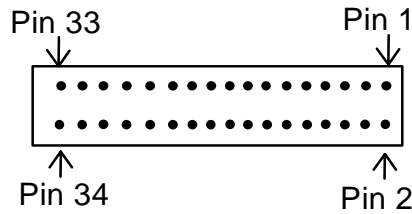


Figure 7: ITC-1600 internal digital input bits connector pins

| Pin | Signal | Pin | Signal |
|-----|--------|-----|--------|
| 1 | Ground | 2 | Ground |
| 3 | Bit 0 | 4 | Ground |
| 5 | Bit 1 | 6 | Ground |
| 7 | Bit 2 | 8 | Ground |
| 9 | Bit 3 | 10 | Ground |
| 11 | Bit 4 | 12 | Ground |
| 13 | Bit 5 | 14 | Ground |
| 15 | Bit 6 | 16 | Ground |
| 17 | Bit 7 | 18 | Ground |
| 19 | Bit 8 | 20 | Ground |
| 21 | Bit 9 | 22 | Ground |
| 23 | Bit 10 | 24 | Ground |
| 25 | Bit 11 | 26 | Ground |
| 27 | Bit 12 | 28 | Ground |
| 29 | Bit 13 | 30 | Ground |
| 31 | Bit 14 | 32 | Ground |
| 33 | Bit 15 | 34 | Ground |

8.5 Internal Digital Input Connector 2

Below is a listing of the pin assignments of the internal digital output connector for bits 16 to 19. Connector is labeled P3003 on the main board. Note: This is for OEM applications only.

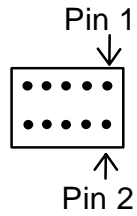


Figure 8: ITC-1600 internal digital input bits 16 – 19 connector pins

| Pin | Signal | Pin | Signal |
|-----|--------|-----|--------|
| 1 | Ground | 2 | Ground |
| 3 | Bit 19 | 4 | Ground |
| 5 | Bit 18 | 6 | Ground |
| 7 | Bit 17 | 8 | Ground |
| 9 | Bit 16 | 10 | Ground |

8.6 Internal Fast Digital I/O Connector

Below is a listing of the pin assignments of the internal fast digital input and output connector for bits 0 to 4 and external trigger in and out. Connector is labeled P3004 on the main board. Note: This is for OEM applications only.

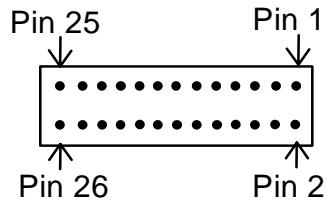


Figure 9: ITC-1600 front panel digital I/O bits connector pins

| Pin | Signal | Pin | Signal |
|-----|------------------------|-----|------------------|
| 1 | +3 volts digital | 2 | +3 volts digital |
| 3 | +3 volts digital | 4 | Ground |
| 5 | Fast Digital In Bit 0 | 6 | Ground |
| 7 | Fast Digital In Bit 1 | 8 | Ground |
| 9 | Fast Digital In Bit 2 | 10 | Ground |
| 11 | Fast Digital In Bit 3 | 12 | Ground |
| 13 | External Trigger In | 14 | Ground |
| 15 | Key – No connection | 16 | Ground |
| 17 | Fast Digital Out Bit 0 | 18 | Ground |
| 19 | Fast Digital Out Bit 0 | 20 | Ground |
| 21 | Fast Digital Out Bit 0 | 22 | Ground |
| 23 | Fast Digital Out Bit 0 | 24 | Ground |
| 25 | Trigger Out | 26 | Ground |

8.7 Internal Digital I/O Legacy Connector

Below is a listing of the pin assignments of the internal digital input and output connector that matches the original ITC-16. Connector is a dual row 20 pin header labeled P3005 on the main board. Note: This is for OEM applications only.

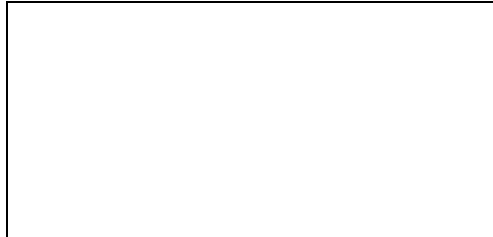


Figure 10: ITC-1600 internal ITC-16 digital I/O legacy connector pins

| Pin | Assignment | Pin | Assignment |
|-----|--------------------|-----|--------------------|
| 1 | Digital In Bit 0 | 2 | Digital Out Bit 30 |
| 3 | No connection | 4 | Digital Out Bit 31 |
| 5 | Digital In Bit 2 | 6 | Digital In Bit 10 |
| 7 | Digital In Bit 3 | 8 | Digital In Bit 11 |
| 9 | Digital In Bit 4 | 10 | Digital In Bit 12 |
| 11 | Digital In Bit 5 | 12 | Digital In Bit 13 |
| 13 | Digital In Bit 6 | 14 | Digital In Bit 14 |
| 15 | Digital In Bit 7 | 16 | Digital In Bit 9 |
| 17 | Digital In Bit 1 | 18 | No connection |
| 19 | Ground | 20 | Ground |
| 21 | Ground | 22 | Ground |
| 23 | No connection | 24 | Digital Out Bit 30 |
| 25 | Digital Out Bit 16 | 26 | Digital Out Bit 24 |
| 27 | Digital Out Bit 17 | 28 | Digital Out Bit 25 |
| 29 | Digital Out Bit 18 | 30 | Digital Out Bit 26 |
| 31 | Digital Out Bit 19 | 32 | Digital Out Bit 27 |
| 33 | Digital Out Bit 20 | 34 | Digital Out Bit 28 |
| 35 | Digital Out Bit 21 | 36 | Digital Out Bit 29 |
| 37 | Digital Out Bit 22 | 38 | Digital In Bit 8 |
| 39 | Digital Out Bit 23 | 40 | No connection |

8.8 Internal Power Connector

Below is a listing of the pin assignments of the main board power supply connector. Connector is labeled P000 on the main board. Note: This is for OEM applications only.

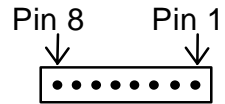


Figure 11: ITC-1600 Internal power supply connector pins

| Pin | Signal | Pin | Signal |
|-----|------------------|-----|----------------|
| 1 | No connection | 2 | Ground Digital |
| 3 | +15 Volts Analog | 4 | Ground Analog |
| 5 | -15 Volts Analog | 6 | No connection |
| 7 | +5 Volts Digital | 8 | No connection |

9 Warranty Information

9.1 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 a faster shipping service is desired by the customer, any additional special delivery expenses must be paid by the customer.

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 which 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.

9.2 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.

10 Other Products available from Instrutech Corporation

| | |
|-------------------------------|---|
| I-1600 | Additional analog rack unit to expand ITC-1600 data acquisition system. |
| ITC-18 | 16 bit data acquisition interface with 4 D/A, 8 simultaneous sampling A/D with individual programmable gain, 16 digital inputs and 32 digital outputs, 14 with current sink capabilities. |
| PCI-18 | Host Interface Card for the <i>ITC-18</i> and PCI bus computers. |
| 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. |
| 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 VideoProbe II Windows acquisition software. |
| EPC-10 series Patch Clamp | Computerized patch clamp amplifier. Available in either single, double or triple amplifier configuration. |
| TAC | Single channel analysis for MacOS or Windows. |
| PULSE/PULSEFIT | Data acquisition, stimulator and analysis for MacOS or Windows. |
| IGOR software | Graphing and data analysis for the MacOS or Windows. |
| ACQUIRE software | Continuous acquisition, event detection and data compression for MacOS or Windows. |
| PATCHMASTER software | Multi channel high speed acquisition and waveform generation for MacOS or Windows. |
| ECELL software | Turnkey software for electrophysiological and extracellular recordings. |

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.