

## USER'S MANUAL

*InstruTECH ITC-1600*

*InstruTECH ITC-1600/2*

*InstruTECH ITC-1600e*

*InstruTECH ITC-1600/2e*

**DATA ACQUISITION INTERFACE WITH PCI OR  
PCIEXPRESS HOST ADAPTER**



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# **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 *InstruTECH 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 *InstruTECH ITC-1600* can result in personal injury.

HEKA Instruments Incorporated makes no representation that the design, implementation, testing, or manufacture of the *InstruTECH ITC-1600* meet reasonable standards for use as a medical product.

As stated in the HEKA Instruments Incorporated Limited Warranty Statement, supplied with each product, "HEKA Instruments, Inc 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 *InstruTECH PCI-1600* or *InstruTECH PCI-1600e* Host interface card (not supplied if InstruTECH I-1600 is ordered)
- 1 *InstruTECH I-1600* Rack unit (2 for a dual system)
- 1 Duplex 5 meter Fiber-optic cable (2 for a dual system)
- 1 Power cord, 110 volt or 220 volt type depending on application (2 for a dual system)
- 1 *InstruTECH ITC-1600* User's manual

If any of these items are missing please contact HEKA Instruments Incorporated or your dealer immediately.

## **1.3 Unpacking**

After unpacking the *InstruTECH ITC-1600* and accessories from the shipping carton, please inspect each piece for any signs of shipping damage. Please contact the delivering carrier and HEKA Instruments Incorporated 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. HEKA Instruments Incorporated 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.

Use caution when removing the *InstruTECH PCI-1600* or *InstruTECH PCI-1600e* computer plug-in card from the special static shielding bag that it is packed in. This board is susceptible to damage and degradation by static discharges. Do not remove the board

from this static protection until you are ready to install it into the computer. Touch the computer chassis to equalize the static charge between yourself and the computer chassis before handling the computer board. *Following these steps is extremely important to prevent damage to the computer interface card.* HEKA Instruments Incorporated does not warranty the *InstruTECH PCI-1600* or *InstruTECH PCI-1600e* computer card from damage caused by improper handling.

**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: ..... \_\_\_\_\_

*InstruTECH I-1600* rack serial number: ..... \_\_\_\_\_

*InstruTECH I-1600* rack serial number: ..... \_\_\_\_\_

*InstruTECH PCI-1600* serial number: ..... \_\_\_\_\_

*InstruTECH PCI-1600e* serial number: ..... \_\_\_\_\_

Other notes:  
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## 1.5 Technical Specifications

### *InstruTECH 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 $\mu$ s per ADC
Differential nonlinearity	$\pm 0.002\%$ of FSR
Drift	$\pm 2$ ppm/ $^{\circ}$ C
Input impedance	1M $\Omega$
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	$\pm 40$ Volts

#### *Asynchronous "telegraphing" inputs:*

Number of channels	4, single-ended
Input connector	BNC on rear panel
Resolution	12-bit
Acquisition rate	5 kHz aggregate
Input range	$\pm 10$ Volts
Max. input over voltage	$\pm 40$ 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	$\pm 30$ 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  $\pm 30$  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  $\mu$ s each  
 Settling time <4  $\mu$ s to 0.001%  
 Gain error 0.2% of FSR  
 Gain linearity <2 dB  
 Drift  $\pm 4$  ppm/  $^{\circ}$ C, after 15 minute warm up  
 Signal-to-noise ratio 116 dB  
 Output impedance 10 $\Omega$  (for output overload protection)  
 Short circuit to ground indefinite  
 Current output  $\pm 20$  mA maximum  
 Capacitance drive 200 pF

***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 DB-37 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:***

Input voltage 85-264VAC

Input frequency	47-440 Hz
Maximum power	15 Watts

**Warranty:**

Duration	one-year parts and labor
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***InstruTECH PCI-1600 / InstruTECH PCI-1600e host interface***

Form factor	short, 32-bit, 33 MHz
Type: PCI-1600	5 or 3.3 Volt PCI bus mastering
PCI-1600e	PCI express 1X lane
Cable	1 - 5-meter fiber-optic per I-1600 rack unit
Connectors	2 pair InstruLINK fiber optic transmitters/receivers non-isolated Trigger In, Trigger Out, PLL Clock-IN and Clock-OUT

A note about Power Mac G5 computers: Apple has once again changed the PCI expansion slots on their G5 desktop computers. The latest release, as of November 2005, has PCI Express bus architecture. This is also true for the Intel-based Mac Pro desktop computers. The *InstruTECH PCI-1600* host interface IS NOT compatible with the PCI Express bus. For these computers, the *InstruTECH PCI-1600e* is used instead.

Power Mac G5 computers before November 2005 used PCI-X expansion slots. These systems are compatible with *InstruTECH PCI-1600*'s built after April 2004.

***Software support***

Mac OS X (PPC and Intel)	Driver and Framework Library WaveMetrics IGOR Pro XOP's PATCHMASTER, CHARTMASTER AxoGraphX InstruTECH AcquireT
2000, XP, Vista	Kernel Driver and DLL Library WaveMetrics IGOR Pro XOP's National Instruments LabVIEW PATCHMASTER, CHARTMASTER AcquireT and Ecell Strathclyde WinWCP AxoGraphX

*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

The *InstruTECH ITC-1600* is an expandable 16-bit data acquisition system designed by InstruTECH. The *InstruTECH ITC-1600* utilizes the latest 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.

### Main Features

#### *InstruTECH ITC-1600 system features*

- Expandable fully synchronized data acquisition system
- All synchronous analog and digital channels optically isolated
- Compatible with Windows (2000, XP, Vista), Mac OS X (PPC and Intel), LabVIEW for Windows, and MATLAB

#### *InstruTECH I-1600 rack features*

- Eight differential analog input channels
- Two 16-bit 200 kHz A/D converters multiplexed into two banks of four input channels
- Simultaneous sampling on two channels (one from each bank) at 200 kHz per channel
- Analog input / output range:  $\pm 10.24$ Volts
- Four pseudo-differential analog output channels
- Four 24-bit D/A converters (16-bit data)
- Sixteen synchronous digital input channels
- Thirty-two synchronous digital output channels
- Four 12-bit asynchronous A/D input channels

#### *InstruTECH PCI-1600 / InstruTECH PCI-1600e features*

- Each host interface supports two fully synchronized I-1600 rack units
- Bus Mastering PCI or PCI Express host interface
- *InstruTECH PCI-1600* - Universal PCI, 3.3 or 5 Volt bus
- *InstruTECH PCI-1600e* - PCI Express 1X lane
- Phase Lock Loop In / Out clock for multi-card synchronization

### Hardware Configuration

The *InstruTECH ITC-1600* system comprises of an *InstruTECH PCI-1600* or an *InstruTECH PCI-1600e* computer interface card and one or two *InstruTECH I-1600* analog rack units connected by the InstruLINK fiber optic data cables. Each *InstruTECH PCI-1600* or *InstruTECH PCI-1600e* bus mastering host interface card supports one or two *InstruTECH 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 *InstruTECH PCI-1600 / InstruTECH PCI-1600e* and *InstruTECH I-1600* units can be installed in the same or in separate computers and again fully synchronized.

This split configuration offers major advantages over traditional data acquisition designs. One advantage is noise performance. Another advantage is the capability to use the analog front end (I-1600 rack unit) with a variety of host interfaces as they become available. Moving the *InstruTECH I-1600* from one computer platform to another is a simple matter of using the appropriate host interface and installing compatible software.

## Optical Isolation

The analog electronics of the *InstruTECH I-1600* rack unit are optically isolated from the digital circuitry of the computer via the InstruLINK fiber optic circuitry. This circuitry provides superb optical isolation, virtually eliminating ground loops, while increasing the distance between the computer and the recording setup to at least five meters. The interconnecting fiber-optic cables are small, flexible, and, unlike conventional electrical cables, do not emit electromagnetic radiation.

Optical isolation provides complete electrical isolation between the computer and the measuring equipment. Computers contain digital electronics that switch at high speed, producing large electrical transients. The computer ground functions as the return path for these transients resulting in substantial high frequency ground noise. Each *InstruTECH I-1600* (rack unit) has a separate analog ground that is isolated from the computer ground.

Optical isolation is essential if low-noise analog outputs are desired.

## Analog I/O

Each *InstruTECH I-1600* rack unit provides eight differential analog input channels that are separated into two banks of four. Each bank uses one 16-bit 200 kHz A/D converter multiplexed into four inputs. Both A/D converters sample simultaneously and synchronously at the maximum conversion rate resulting in a total throughput of 400 kHz. 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.

Each *InstruTECH I-1600* rack unit provides four 24-bit D/A converters stripped to 16-bit data. This results to outputs that feature high accuracy. The D/A circuitry used in the *InstruTECH I-1600* rack unit is temperature stabilized and “De-glitched” for ideal performance.

In addition, each *InstruTECH I-1600* rack unit provides four 12-bit asynchronous “telegraphing” A/D channels, which can be used for monitoring slow changing parameters.

## Digital I/O

Each *InstruTECH I-1600* rack unit has twenty digital inputs and thirty-six digital output channels all sampling synchronously. The digital input channels feature level sensitive or latched modes. For maximum versatility the inputs can be inverted, allowing rising or falling edge triggering.

## 1.7 Explanation of symbols





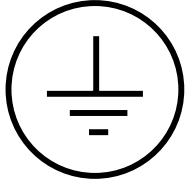
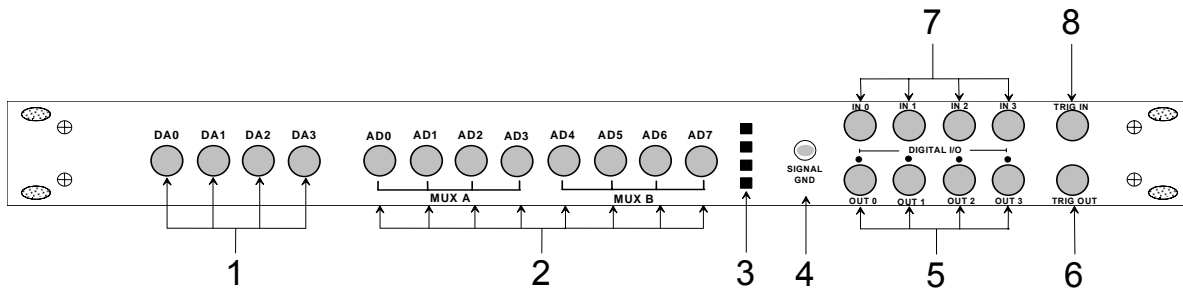
Symbol	Description
	Alternating current Curreant alternatif Wechselstrom Corriente alterna Corrente variabile
	On (Supply) Allumé (alimentation) An (Netz) Encendido (suministro) Sotto tensione
	Off (Supply) Éteint (alimentation) Aus (Netz) Apagado (suministro) Fuori tensione
	Caution Attention Vorsicht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

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 D/A 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.

Do not under any circumstances connect an output to any of the D/A channels. Otherwise the D/A circuitry can be damaged.

#### **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 200 kHz with a combined aggregate rate of 400 kHz. In addition inputs from each MUX can be simultaneously (co-phased) sampled. Input channel settings (i.e. sampling rate, decimation, etc.) are specified by the acquisition software. The A/D 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 InstruTECH ITC-1600 has been powered on.

**Ready indicator:**

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

**AD 8-15 indicator:**

This LED indicator will be illuminated when two *InstruTECH 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. The acquisition software strictly controls its functionality. Please refer to software user manual for usage description, if any.

**4 Signal Ground connector:**

A 4 mm 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 *InstruTECH 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 acquisition software controls the state of the digital output channels. 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 is HIGH while 0 Volts is LOW). 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 loads.

**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. The acquisition software controls these digital inputs. 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 *InstruTECH ITC-1600* will be triggered with a positive logic pulse with a minimum duration of 150 ns. 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

Numbers reference to the diagram of the front panel.

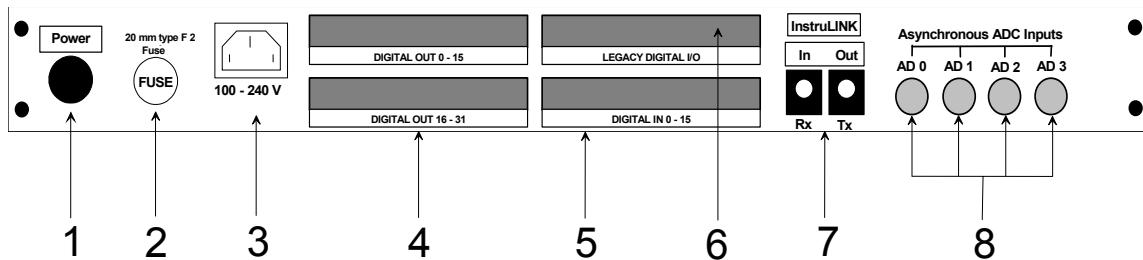


Figure 3: ITC-1600 Rear Panel Controls

### 1 Power Switch:

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

### 2 Fuse:

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



### 3 Power Connector:



Accepts standard three wire IEC female type power cords. The appropriate power cord will be provided with the *InstruTECH ITC-1600*. The *InstruTECH ITC-1600* will function with a line voltage from 88 to 264 Volts AC. Acceptable line frequencies are from 47 to 440 Hertz. The maximum power used by the *InstruTECH ITC-1600* is fifteen watts. **WARNING: To avoid a shock hazard, the *InstruTECH ITC-1600* must be plugged into a properly grounded receptacle.**

### 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. To mate to this connector use 3M electronics 8237-6000 series or equivalent. Pin-out assignments can be found in section 8 of this manual.

### 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. To mate to this connector use 3M electronics 8237-7003 series or equivalent. Pin-out assignments can be found in section 8 of this manual.

### 6 Legacy Digital I/O:

A 40-pin male connector combines the Digital Output (16 to 31) and Input lines of the *InstruTECH ITC-1600*. This specialized connector is required for interfacing with other HEKA devices such as the EPC 8 Patch Clamp Amplifier or the TIB 14S Trigger Interface. To mate to this connector use 3M electronics 3417 series or equivalent. Pin-out assignments can be found in section 8 of this manual.

### 7 InstruLINK:

Proprietary fiber-optic link between the *InstruTECH I-1600* rack unit and the *InstruTECH PCI-1600 / PCI-1600e* 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 *InstruTECH PCI-1600 / PCI-1600e* and the *InstruTECH I-1600* will be illuminated.

## **8 Asynchronous ADC Channels:**

Four 12-bit asynchronous AD inputs running at approximately 1 ms sampling rate. Can be used for parameter monitoring such as telegraphing gain and filter settings from an amplifier. The acquisition software controls channel selection. Input range is between -10.24 to +10.23 Volts. These channels are optically isolated from the computer. Use only high quality 75 $\Omega$  BNC cables for optimal results.

The absolute maximum input range for these inputs is  $\pm 40$  Volts. *Do not exceed this level or damage can result to the input circuitry.*

## **3 Installation**

### **3.1 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 or PCIexpress 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 *InstruTECH PCI-1600 / PCI-1600e* host adapter from the static shielding packaging. Line up the card-edge connector on the *InstruTECH PCI-1600 / PCI-1600e* 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 *InstruTECH PCI-1600 / PCI-1600e* card and the computer motherboard. 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 *InstruTECH 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 jacket and connect one end to the back of the *InstruTECH PCI-1600 / PCI-1600e*, also marked with a blue label and the other end to the connector labeled "OUT Tx" on the rear panel of the *InstruTECH I-1600* rack. Take the second cable, with the red jacket, and connect one end to the back of the *InstruTECH PCI-1600 / PCI-1600e*, also marked with a red label, and the other end to the connector labeled "IN Rx" on the *InstruTECH I-1600*. The connectors on either end of the cable are keyed and will only mate when properly inserted. Please do not use any other fiber-optic cable other than the one supplied with your interface.

*Note: If connecting a second I-1600 rack unit to the InstruTECH PCI-1600 / PCI-1600e then connect the red jacketed cable to the Green labeled connector on the InstruTECH PCI-1600 / PCI-1600e card and the blue jacketed cable to the Yellow labeled connector.*



7. Connect the power cord to the *InstruTECH I-1600*. Make sure that the *InstruTECH I-1600* power cord is plugged into a properly grounded AC receptacle. Improper grounding of the *InstruTECH I-1600* could result in an electrical shock hazard. It is advisable to plug all equipment into a common outlet power strip; this will minimize power line induced noise in the system. Equipment plugged into different outlets can cause excessive line frequency 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 power up the system and install the driver software. The InstruTECH ITC-1600 is supported on MacOS Classic, MacOS X (10.2 and above), Windows 9x, ME, NT, 2000, XP, Vista and Linux. Download the appropriate driver installer from our web site, <http://www.heka.com/>. Follow the installation instructions provided with the acquisition software that will be used with this *InstruTECH ITC-1600* interface.

## **4 Important considerations**

### **4.1 Warm up:**

The *InstruTECH 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 *InstruTECH ITC-1600* requires 20 to 30 minutes of warm up time. During this initial 20 minutes after the *InstruTECH 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 *InstruTECH 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. Use only high quality 75Ω BNC cables for optimal results.

### **4.3 Grounding:**

A connection should be made between the **SIGNAL GROUND** connector on the *InstruTECH 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 *InstruTECH 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 *InstruTECH ITC-1600* hardware. The *InstruTECH ITC-1600* cannot be properly initialized if the device driver or the application software is not properly installed.

Check the cable connections between the *InstruTECH PCI-1600 / PCI-1600e* host interface and the *InstruTECH 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 the ITCDemoG program, supplied with the 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**

HEKA Instruments Incorporated has available driver software for researchers and developers who wish to write custom applications using the *InstruTECH data acquisition systems*. These drivers and appropriate manuals are available in both MacOSX and Windows formats. They are available from HEKA Instruments Incorporated by request. By email send a message to [support@heka.com](mailto:support@heka.com) and request the *ITC* drivers for the operating system of your choice.

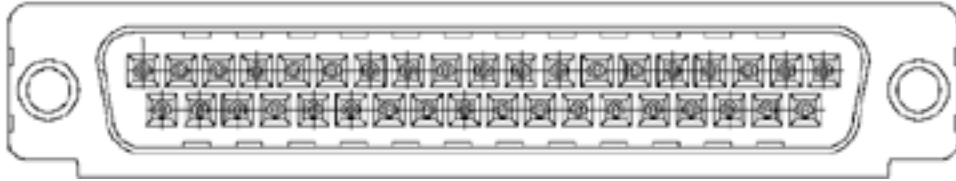
### **6.2 Igor XOP's**

HEKA Instruments Incorporated has available an XOP for WaveMetrics Igor Pro that will allow researchers and developers to write custom applications using the InstruTECH data acquisition systems and WaveMetrics Igor Pro software. These XOP's including the appropriate help file is available from <http://www.heka.com/>. By email send a message to [support@heka.com](mailto:support@heka.com) and request the *ITC* XOP's for the operating system of your choice.

## **7 Rear Panel and Internal Connector PIN Assignments**

### **7.1 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**

<b>Pin</b>	<b>Signal</b>	<b>Pin</b>	<b>Signal</b>
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		



## 7.2 Rear Panel Digital Output Connectors

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

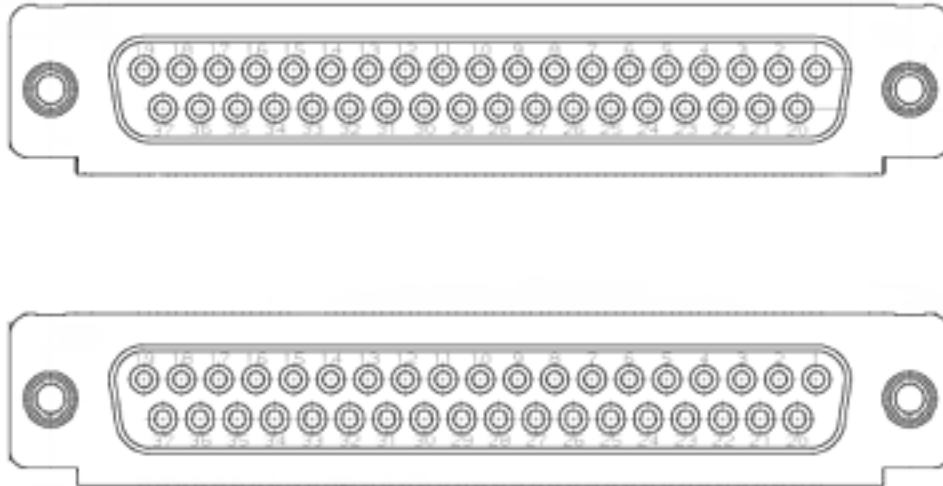


Figure 5: ITC-1600 rear panel digital output connector pins

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			

### 7.3 Rear Panel Digital I/O Legacy Connector

Below is a listing of the pin assignments of the legacy digital input and output connector that matches the original ITC-16. This connector is used for interfacing the EPC 8 Patch Clamp Amplifier or the TIB 14S Trigger Interface to the InstruTECH ITC-1600.

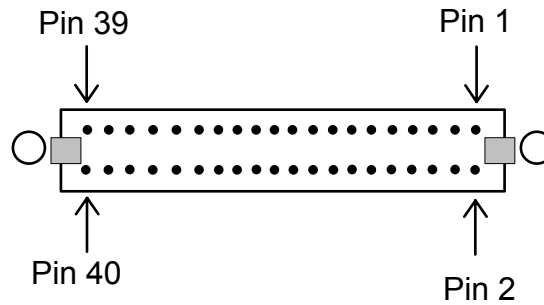


Figure 10: ITC-1600 rear panel ITC-16 digital I/O legacy connector

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

## 7.4 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.

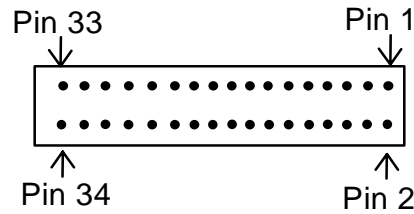


Figure 6: ITC-1600 internal digital output bits 0 – 15 connector pins

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

## 7.5 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.

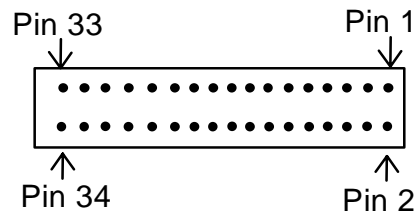


Figure 7: ITC-1600 internal digital input bits connector pins

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

## 7.6 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.

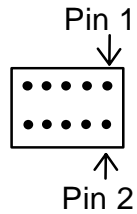


Figure 8: ITC-1600 internal digital input bits 16 – 19 connector pins

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

## 7.7 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.

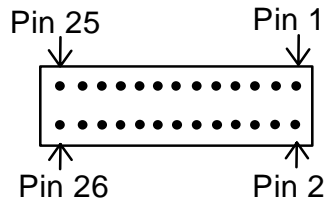


Figure 9: ITC-1600 front panel digital I/O bits connector pins

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

## 7.8 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.

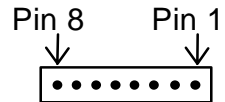


Figure 11: ITC-1600 Internal power supply connector pins

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

## **8 Warranty Information**

### **8.1 Limited Warranty**

HEKA Instruments Incorporated warrants to the first purchaser, for a period of one year from the date of purchase (invoice date), that this HEKA Instruments Incorporated product (hereafter referred to as the "Product") will be free from defects in 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 HEKA Instruments Incorporated properly packaged with a written explanation of the problem, with transportation charges prepaid and the shipment fully insured. The Customer is responsible for all duties, taxes, and freight charges, if applicable. HEKA Instruments Incorporated will return the Product, postpaid and insured, in the most appropriate method as determined by HEKA Instruments Incorporated. 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. HEKA Instruments Incorporated fully insures all shipments. Any claims of damage upon receipt must be filed with the carrier and HEKA Instruments Incorporated 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, without written approval from HEKA Instruments Incorporated.

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 available for free download on <http://www.heka.com/>.

No sales organizations, other than HEKA Instruments Incorporated 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 HEKA Instruments Incorporated. If HEKA Instruments Incorporated agrees to such a modification of this warranty, HEKA Instruments Incorporated will furnish a modified copy of this agreement, which must be presented if a claim is being made under these modified terms.

### **8.2 Limitation of Liability**

Title, risk of loss or damage, and other incidents of ownership shall pass to the customer upon due tender of goods.



HEKA Instruments Incorporated shall not be liable for delays in delivery or failure to perform due directly or indirectly to (i) causes beyond HEKA Instruments Incorporated reasonable control, (ii) acts of God, acts (including failure to act) of any governmental authority (de jure or de facto), wars (declared or undeclared), governmental priorities, port congestion, riots, terrorism, revolutions, fires, floods, sabotage, nuclear incidents, earthquakes, storms, epidemics, or (iii) inability, due to causes beyond HEKA Instruments Incorporated reasonable control, to obtain necessary labor, materials, components, facilities, energy, fuel, transportation, governmental authorizations or instructions, material or information required from the customer.

Notwithstanding any other provisions, the total limitations of HEKA Instruments Incorporated, including its subcontractors or suppliers, on any and all claims, whether in contract, warranty, or otherwise, arising out of, connected with, or resulting from the performance or non-performance of any agreement resulting here from or from the manufacture, sale, delivery, resale, repair, replacement or use of any equipment or the furnishing of any service, shall not exceed the price allocable to the Product or service which gives rise to the claim. Any such liability shall terminate upon the expiration of the warranty period (one year from the shipping date of invoice), except as to title.

Notwithstanding any other provisions, in no event, whether as a result of breach of contract, warranty, or otherwise, shall HEKA Instruments Incorporated, or its subcontractors or suppliers, be liable for any special consequential, incidental, indirect or exemplary damages, including, but not limited to, loss of profit or revenues, loss of use of the equipment or any associated equipment, cost of capital, cost of substitute goods, facilities, services or replacement power, downtime costs or claims of Customer's clients for such damages.

### **8.3 Obtaining Warranty Service**

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

### **8.4 Obtaining Out-of-Warranty Service**

HEKA Instruments Incorporated takes pride on its superb, long-standing repair and maintenance service of its products. In fact, support is still available for the HEKA produced EPC 7 - also known as List amplifier - which was introduced in 1982. If a unit requires service after the warranty period has expired, please contact HEKA Instruments Incorporated service department for consultation. If return of the unit is necessary, then shipping instructions will be provided. Once the unit has been received and diagnosed, a repair quote will be supplied for approval. Repairs are warranted for 90 days.

### **8.5 Technical Support**

HEKA Instruments Incorporated provides exceptional pre and post sales customer support from our trained international sales representatives. Customer support is free of charge for registered users of HEKA products.

Check the HEKA website, [www.heka.com](http://www.heka.com), for updated versions of driver and/or application software. There are also many tutorial documents available that may help resolve product-specific questions. If the problem is not resolved, please supply the following information when corresponding:

- Serial number of the InstruTECH ITC-18 interface
- Serial number of the host adapter (USB or PCI)
- Operating system version
- Driver software version number
- Application software version number
- Detailed information describing the problem