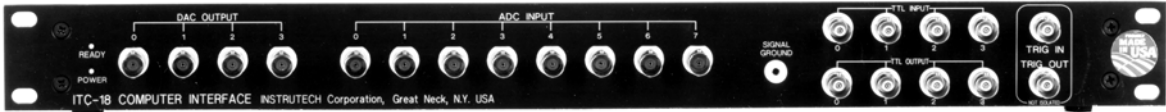# USER'S MANUAL

Model: *ITC-18/PCI* and *ITC-18/USB*

DATA ACQUISITION INTERFACE WITH PCI OR USB HOST ADAPTER

InstruTECH

Precision Instrumentation for Biological Research

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Table of Contents

Table of Figures

<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-18* computer interface:

Dr. Fred Sigworth, Yale University

Dan Brown, Bruxton Corporation

Dr. Hubert Affolter, Heka electronik

1 General Information

1.1 Product intended usage

The Instrutech *ITC-18/USB or ITC-18/PCI* 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-18/USB or ITC-18/PCI* and associated instruments.

The Instrutech *ITC-18/USB or ITC-18/PCI* is not intended for medical use. The Instrutech *ITC-18/USB or ITC-18/PCI* is not intended for use in life support situations, or in situations were improper operation or failure of the *ITC-18/USB or ITC-18/PCI* can result in personal injury.

Instrutech Corporation makes no representation that the design, implementation, testing, or manufacture of the *ITC-18/USB or ITC-18/PCI* 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-18/USB or ITC-18/PCI Computer Interface*:

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

    1 *ITC-18* Computer interface

    1 *USB-18* or *PCI-18* or *PCI-18V3* host interface adapter

    1 SC-18/12 Cable assembly (USB version only)

    1 SC-18 Cable assembly (PCI version only)

    1 four   foot USB Cable assembly (USB version only)

    1 *ITC-18* Warranty card

    1 *USB-18* or *PCI-18* or *PCI-18V3* Warranty card

    1 User's manual

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

1.3 Unpacking

After unpacking the *ITC-18* 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.

Use caution when removing the *PCI-18 or PCI-18V3* 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.* Instrutech Corporation does not warranty the *PCI-18 or PCI-18V3* 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: .... _____

ITC-18 Serial number: .... _____

USB-18 Serial number: .... _____

PCI-18 Serial number: .... _____

PCI-18V3 Serial number: .... _____

Other notes:

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1.5 Technical Specifications

Unless otherwise noted ambient temperature = 25 degrees Celsius

♦ **Analog Input Channels:**

Number of channels	8, differential, optically isolated
Type of ADC	successive approximation
Input connector	BNC on front panel
Resolution	18-bit converter, 16-bit data (1 in 3200)
Acquisition rate	200 kHz aggregate
Input range	-10.24 to +10.239 Volts
Aperture delay	10 ns
Aperture jitter	50 ps rms
Conversion speed	software selectable, 5 μs to 82 ms in 1.25 μs steps
Differential nonlinearity	$\pm$0.002% of FSR
Drift	$\pm$50 ppm/ °C
Input impedance	1MΩ
Signal-to-noise ratio	+90dB
Crosstalk	<1 LSB

♦ **Programmable Gain:**

Gain	software selectable, instrumentation grade 1, 2, 5,or 10V/V
Settling time	3.5 μs to 0.01% all gains
Nonlinearity	$\pm$0.0003% of FSR
Max. input voltage	$\pm$40 Volts
Input CMRR	100dB

♦ **Digital Inputs:**

Digital inputs	16, logic level, optically isolated
Input type	CMOS logic compatible
Operational mode	software selectable, level sense or latching. Latched mode will hold the value until read by the software. Level sensing will change with all level transitions.
	Active high or active low
Minimum pulse width	150 ns for either operational mode
Input connectors	bits (0 to3) on front panel BNC, 16 bits on rear panel multi-pin connector
Max. input voltage	$\pm$40 Volts

♦ **Triggers:**

Input

Number	1, hardware selectable isolated / non-isolated
Input type	CMOS logic compatible
Operational mode	software selectable, edge mode
	software selectable, inverted sense
Minimum pulse width	150 ns
Input connector	BNC on front panel
Max. input voltage	$\pm$40 Volts

Output

Number	1, hardware selectable isolated / non-isolated
Output driver	AC, HCT, ACT, HCT, VCT, or 8 TTL loads
Output connector	BNC on front panel
Max. output current	6 mA

♦ Analog Outputs:

Number of channels	4,pseduo-differential, optically isolated
Type of DAC	double buffered, multiplying
Output connector	BNC
Resolution	18-bit converter, 16-bit data (1 in 65536)
Output Range	-10.24 to +10.239 volts
Conversion speed	software selectable, 5 μs to 82 ms
Gain error	0.2% of FSR
Gain linearity	<2dB
Gain drift	$\pm$25 ppm of FSR/ °C
Signal-to-noise ratio	116dB
Output impedance	200Ω (for output overload protection)
Short circuit to ground	indefinite
Output load current	$\pm$8 mA typical

♦ Digital Outputs:

Standard

Number	32, optically isolated
Output driver	AC, HCT, ACT, HCT, VCT logic compatible, or 8 TTL loads
Output connector	bits (0 to 3) on front panel BNC 32 bits on rear panel multi-pin connector

High current drive

Number	14, optically isolated
Output driver	AC, HCT, ACT, HCT, VCT logic compatible or 8 TTL loads max
Output connector	14 bits on rear panel DB-25 multi-pin connector

Output sink current   350mA maximum for each bank of 7 outputs

Asynchronous outputs

Number   16, non-isolated

Output driver   HC logic compatible

Output connector   34 pin multi-pin connector

Sequencer outputs

Number   7, optically isolated

Output driver   AC, HCT, ACT, HCT, VCT logic compatible, or 8 TTL loads

Output connectors   7 bits on rear panel multi-pin connector

♦ USB host interface:

The *USB-18* host interface is a USB 2.0 Hi-speed adapter that interfaces the ITC-18 rack unit to a host computer that has USB 2.0 Hi-speed ports. The USB-18 will interface with slower USB ports but performance will be diminished.

♦ PCI host interface:

The *PCI-18* PCI interface card is a 5 volt, slave PCI host card that interfaces the ITC-18 rack unit to the host computer.

The *PCI-18V3* PCI interface card is a 3.3 volt, slave PCI host card that interfaces the ITC-18 rack unit to the host computer.

♦ FIFO memory:

Standard: 1024 kilosample FIFO

♦ External Clock:

Optional 12.8 megahertz external clock will synchronize multiple ITC-18 interfaces.

♦ Dimensions:

W: 19", H: 1.75", D: 10.5", Weight: 8 pounds
W: 47.5 cm, H: 4.375 cm, D: 26.25 cm, Weight: 3.6 kg

♦ Power requirements:

85-264VAC 47-440 Hz 15 Watts.

♦ Warranty:

Two years parts and labor.

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

1.6 Description

The ITC-18 is the second generation computer interface from Instrutech Corporation. The ITC-18 offers increased capability while retaining all of the exceptional features of it's predecessor, the ITC-16. The ITC-18 advances data acquisition to a new level!

Hardware Configuration:

The ITC-18 is a rack-mountable unit. It has BNC connectors for the analog inputs and outputs and ribbon-cable connectors for the digital lines.

The ITC-18 is connected to a host computer over a shielded cable to a host interface. Host interfaces are available for 3.3 and 5Volt PCI bus and USB 2.0. The PCI and USB host interfaces are compatible with both Macintosh and PC compatible computers. Moving the ITC-18 from one platform to another is a simple matter of installing the proper operating system drivers.

This configuration is unique to data acquisition units. Most data acquisition devices are printed circuit-boards installed directly in the computer itself. The interior of a computer is an electrically noisy environment. At the very high speeds of modern computers, even a short length of a conductive trace on a PC board acts as an antenna. Certain kinds of data acquisition devices are not affected by such noise (e.g. slow-speed integrating A/D converters), but high-speed high-resolution A/D and D/A converters like the ones used in the ITC-18 are affected by such noise. Mounting the electronics in an external box is the most effective way of reducing this noise.

Optical Isolation:

The analog electronics of the ITC-18 are optically isolated from the digital electronics and the computer. This provides complete electrical isolation between the computer and the measurement.

The optical isolation is provided to eliminate computer electrical noise from the analog measurements. 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. The ITC-18 has a completely separate analog ground that is isolated from the computer ground. Computer ground noise is not coupled into the measurement.

Optical isolation is almost essential if low-noise analog outputs are provided. If the analog outputs are not electrically isolated from the computer ground, the analog output ground will contain computer-generated noise. This is one of the major ways by which computer-generated noise is introduced into a measurement system.

The optical isolation of the ITC-18 brings with it another benefit that simplifies complex measurement systems. Since the analog inputs and outputs of the ITC-18 float with respect to ground, the ITC-18 and computer are not a source of ground loop problems.

Analog Circuitry:

The ITC-18 provides eight 18-bit A/D converters that feature individually programmable input range of ±1, ±2, ±5, or ±10 volts. Using separate A/D converters for each analog input channel eliminates crosstalk between channels and improves the frequency response of the analog inputs.

Typical data acquisition devices use a single A/D converter with a multiplexer to select between input channels. The multiplexer, usually an integrated circuit, is a single point where all analog input signals connect. Crosstalk, both from the multiplexer itself and from closely-spaced printed-circuit board traces, causes signals appearing at one analog input to appear at other inputs as well. The amount of crosstalk is usually frequency- dependent. High-frequency signals can be affected significantly.

The ITC-18 design is particularly important when making measurements using multiple high-frequency signal sources and analyzing the signals for correlation. An added benefit to the ITC-18 design is that all analog inputs can be sampled simultaneously. This simplifies analysis of high-frequency correlation between signals, since there is no time offset between sample points on the input channels.

The ITC-18 provides four 18-bit D/A converters that feature high accuracy with less than 1 bit (~300 microvolt) of noise.

The ITC-18 can access the A/D, D/A and digital I/O channels in any sequence. This provides the ability of different sampling rates for each channel.

Digital I/O

The ITC-18 provides sixteen digital inputs, thirty-two digital outputs, seven sequence RAM trigger outputs and fourteen asynchronous non-isolated digital outputs. The digital input channels feature level sensitive or latched modes. For maximum versatility the inputs can be inverted, allowing rising or falling edge triggering. Thirty-two digital output channels in two banks of sixteen, with fourteen channels paralleled with current sink circuitry for driving perfusion valves, solenoids, or other devices directly. Seven programmable trigger outputs for triggering from any location in the scanning sequence RAM and fourteen asynchronous auxiliary digital outputs that can be updated at any time regardless of the ITC-18's acquisition state are available.

FIFO Memory:

The ITC-18 is supplied with a large 1024 kilosample FIFO memory for input and output data. The ITC-18 allows data acquisition to be performed independent of the activity of the host computer. A large FIFO memory allows for increased acquisition speed while minimizing the use of computer resources.

Specialized Applications

The ITC-18 uses programmable gate arrays that allow the internal hardware to be altered for specialized applications. One available application is the *Artificial Synapse Dynamic Clamp*. The clamped cell is connected to an A/D input via a Voltage Clamp amplifier. The stimulus is computed, based on voltage measured from the cell, lookup tables for excitation, inhibition and conductance values and other parameters. This stimulus is applied to the cell via the current input of the Voltage Clamp amplifier.

The ITC-18 implements Dynamic Clamp in hardware rather than in software. In this Dynamic Clamp configuration the ITC-18 samples four co-phase A/D channels at 50 kHz (20 ms), performs the necessary calculations and drives the outputs. All calculations are done within one sample clock, resulting in an input to output delay of only 20 ms.

Software Support

The ITC-18 has extensive software support. Software drivers are available for Windows 3.x, Windows 95/98, Windows NT, Windows 2000, Windows XP, MacOS classic, MacOS X, Linux, National Instruments LabView, and for Wavemetrics IGOR Pro (XOP's). Software packages that support the ITC-18 are ECELL from Instrutech; PatchMaster, Pulse, X-Chart and TIDA from Heka Elektronik; Acquire and Device Access from Bruxton Corporation; AxoGraph from Axon Instruments; PulseControl XOP's from Dr. Bookman and Strathclyde WinWCP. Many custom applications have also been written for the ITC-18.

The ITC-18 costs more than low-cost data acquisition devices, which are built as printed circuit boards mounted in a computer, without electrical isolation and multiplexing a single A/D converter. For this extra cost, it provides a major improvement in the quality of acquired data, making measurements possible that would not otherwise be feasible.

1.7 Explanation of symbols
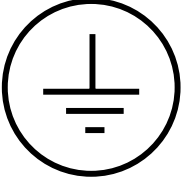
Symbol	Description
∿	Alternating current Currant alternatif Wechselstrom Corriente alterna Corrente variabile
▬	On (Supply) Allumé (alimentation) An (Netz) Encendido (suministro) Sotto tensione
▮	Off (Supply) Éteint (alimentation) Aus (Netz) Apagado (suministro) Fuori tensione
⚠	Caution Attention Vorsicht 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.

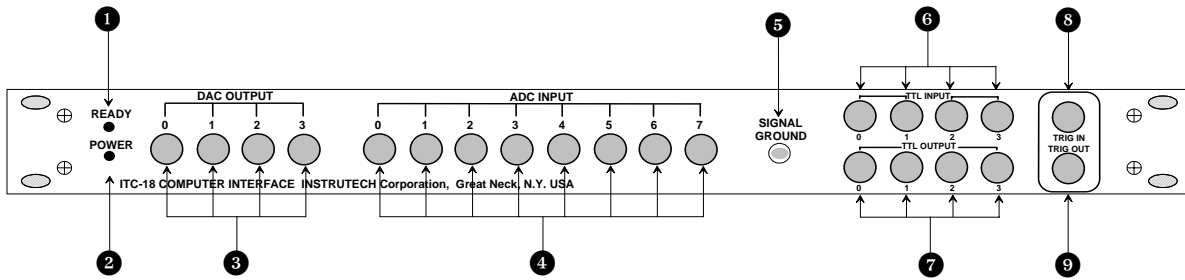**Figure 2: ITC-18 Front Panel Controls**

❶ **READY indicator**:
   The ready indicator will be illuminated when the *ITC-18* has been properly
   initialized by the host computer and the acquisition software. If this indicator is
   not illuminated then the *ITC-18* cannot function properly.

❷ **POWER indicator**:
   The power indicator will be illuminated when the *ITC-18* has been powered on.
   The *ITC-18* uses circuitry that will automatically switch the internal power
   supply when the computer is started or shutdown. Provided that the ITC-18 is
   connected to either the PCI or USB host adapter.

❸ **DAC** outputs:
   Four BNC connectors provide access to the four individual deglitched 18-bit
   (16-bit data) digital to analog converter outputs. All DAC outputs are
   thermally stabilized to reduce drift. The digital to analog converter output
   voltage and timing 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. Note: Allow a 20 to 30 minute warm-up
   time for proper thermal regulation after initial power-up.

❹ **ADC** inputs:
   Eight BNC connectors provide access to the eight individual 18-bit (16-bit
   data) analog to digital converter input channels. Each A/D channel uses a high
   speed programmable gain instrumentation amplifier to provide individually
   selectable gain. Analog to digital converter channel selection and sampling
   interval timing is controlled by the acquisition software. The ADC channels
   have an input range of -10.24 to +10.239 volts. These channels are optically
   isolated from the computer. These channels are differential inputs. If the BNC
   connector shield is left unconnected unexpected results can occur. Use only
   high quality 75 ohm 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.

❺ **SIGNAL 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-18* case or to the computer
   power supply 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.

❻ **TTL** digital inputs:
   Four BNC connectors provide access to four out of the sixteen digital input
   channels. The digital input channels 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.*

❼ **TTL** digital outputs:
   Four BNC connectors provide access to four out of the sixteen digital output
   channels. The status of the digital output channels are controlled by the
   acquisition software. These digital channels output standard TTL levels (5
   volts and 0 volts). These channels are optically isolated from the computer.
   These channels are optimized to drive 75 ohm BNC cables into an AC, HC,
   ACT, HCT or 8-TTL load.

❽ **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-18* will be triggered with a
   positive logic pulse with a minimum duration of 150ns. This input is not
   isolated. 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.*

❾ **TRIG OUT**:

A BNC connector provides access to the sequencer out data bit 0. This sequence bit will switch with each timer period and does not use a time slot. Can be used as a gate output signal for triggering a scope or other instrument when data acquisition has started. The true functionality of this output is software dependent. This output is not isolated.
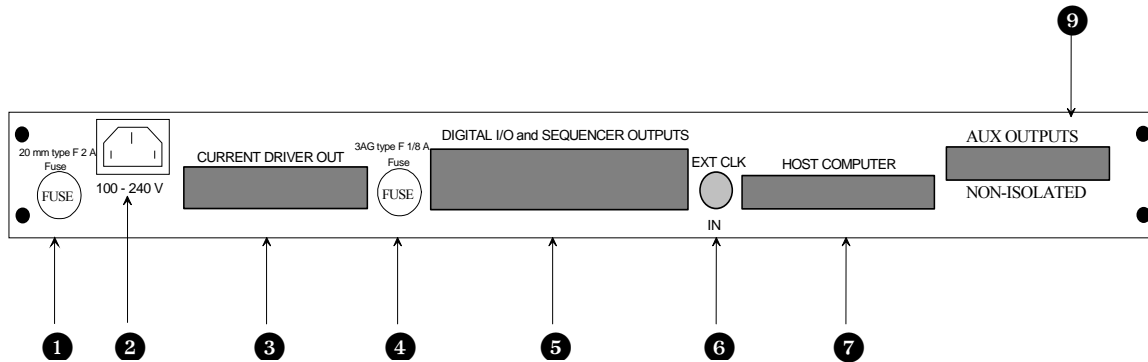
2.2 Rear Panel Controls

Figure 3: ITC-18 Rear Panel Controls

❶ **FUSE**:

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

❷ **POWER CONNECTOR**:

Accepts standard three wire IEC female type power cords. The appropriate power cord will be provided with the *ITC-18*. The *ITC-18* will function with a line voltage from 88 to 264 volts AC. Acceptable line frequencies are from 47 hertz to 440 hertz. The maximum power used by the *ITC-18* is fifteen watts. ***WARNING: To avoid a shock hazard, the ITC-18 must be plugged into a properly grounded receptacle.***

❸ **CURRENT DRIVER OUT**:

DB-25 female connector. The *ITC-18* provides 14 digital output channels that can be used either as standard TTL levels or as current sink. To use as current sink channels the connections to the external device is as follow:
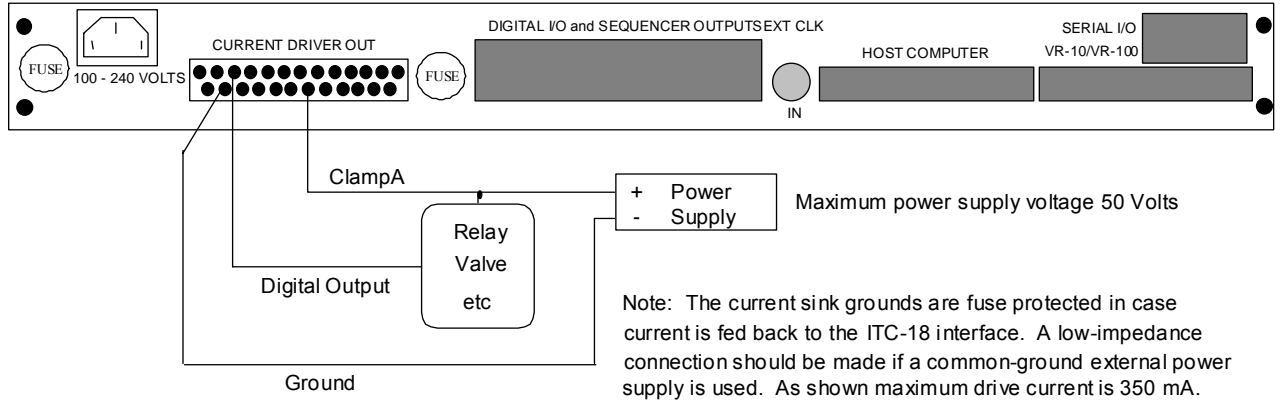
Figure 4: ITC-18 Current Driver Out external connections

❹ **FUSE**:

Current driver out ground fuse. This fuse will open when current is fed back into the *ITC-18*. Replace fuse with a standard 1.5 inch type F 1/8A fuse only.

❺ **DIGITAL I/O & SEQUENCE OUTPUTS**:

Dual 50 pin IDC connector. 16 Digital input lines with individual grounds, 16 Digital output lines with individual grounds (Channel 0), 16 Digital output lines with individual grounds (Channel 1) and 7 sequencer outputs with individual grounds. Please note that the absolute maximum voltage range for the digital inputs is -0.5 volts to +5.5 volts. *Do not exceed this range or damage can result to the input circuitry.*

❻ **EXT CLK: (optional)**

BNC connector. The external clock option allows multiple ITC-18 interfaces to be synchronized by an external master clock. Please contact Instrutech or your dealer for availability and specifications. If this option is installed, the absolute maximum voltage range for this input is ±4 volts peak. *Do not exceed this range or damage can result to the input circuitry.*

❼ **HOST COMPUTER:**

80 pin high density connector. Connection to one of the ITC-18 host interface adapters. Currently the PCI-18, PCI-18V3 or USB-18.

❾ **AUX. OUTPUTS**:

34 pin IDC connector. 16 auxiliary output lines with individual grounds. These signals are not isolated and must use the non-isolated ground provided on this connector for proper operation.

3 Installation

3.1 Hardware installation - USB version

1. Install the *ITC-18* 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.

2. Install the SC-12 cable between the *ITC-18* interface labeled **"HOST COMPUTER"** and the *USB-18 labeled* **"To ITC-18"**. The connectors on either end of the cable are keyed and will only mate when properly inserted. Fix the connectors in place with the screws attached to the connector. This is important to ensure a good electrical contact.

3. Install the USB cable to the *USB-18* labeled **"To USB"** and an available USB 2.0 Hi-speed port on the computer.

4. Connect the power cord to the *ITC-18*. The internal power supply used in the *ITC-18* is an auto switching multi-voltage supply that will operate from 100 volts to 260 volts. *Make sure that the ITC-18 power cord is plugged into a properly grounded AC receptacle. Improper grounding of the ITC-18 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.

5. Before powering up please recheck all connections. If all connections are proper then the power led will illuminate once the computer is started.

6. You are now ready to power up the system and install the driver software. The ITC-18/USB is supported on Apple MacOS X (10.2 and above) and Windows NT, 2000 and XP. Download the appropriate driver installer from our web site, www.instrutech.com. Follow the installation instructions provided with the acquisition software that will be used with this *ITC-18/USB* interface.

3.2 Hardware installation – PCI version

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-18 or PCI-18V3* card from the static shielding packaging. Line up the card-edge connector on the *PCI* 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* card and the computer main 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. ***Note:*** *On some model computers the rear bracket may not line up correctly against the inside of the computer case. For these computers, loosen the two screws on the PCI card that hold the rear bracket in place. Adjust the bracket for a better fit and re-tighten the screws.*

4. Re-install the cover of the computer.

5. Install the *ITC-18* 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.

6. Install the SC-18 cable between the *ITC-18* interface and the *PCI* computer board. The connectors on either end of the cable are keyed and will only mate when properly inserted. Fix the connectors in place with the screws attached to the connector. This is important to ensure a good electrical contact.

7. Connect the power cord to the *ITC-18*. The internal power supply used in the *ITC-18* is an auto switching multi-voltage supply that will operate from 100 volts to 260 volts. *Make sure that the ITC-18 power cord is plugged into a properly grounded AC receptacle. Improper grounding of the ITC-18 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 computer is started.

9. You are now ready to power up the system and install the driver software. The ITC-18/PCI is supported on MacOS Classic, MacOS X (10.2 and above), Windows 9x, ME, NT, 2000, XP and Linux. Download the appropriate driver installer from our web site, www.instrutech.com. Follow the installation instructions provided with the acquisition software that will be used with this *ITC-18/PCI* interface.

4 Important considerations

4.1 Warm up

The ITC-18 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-18 requires 20 to 30 minutes of warm up time. During this initial 20 minutes after the ITC-18 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-18 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.

A connection should be made between the **SIGNAL GROUND** connector on the ITC-18 front panel to the signal ground connector on the signal source. Most patch clamp amplifiers provide a suitable connection point for the signal ground.

5 Troubleshooting

Most problems arise from incorrect installation of the hardware, and/or incorrect use of the software. The first thing to check is for proper installation of the hardware interface.

Check the Instrutech website for a newer version of the driver. At times we make changes based on operating system changes, enhancements or bug fixes.

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

Check the fuses on the *ITC-18* interface rear panel.

Check the cable connecting the *PCI* card or the *USB* host to the *ITC-18* interface. Make sure both ends are plugged in securely and that the cable is not damaged.

Check the USB cable connecting the USB-18 and the host computer. Make sure both ends are plugged in securely and that the cable is not damaged.

Make sure that the computers USB port is USB 2.0 Hi-speed.

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-18* 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, or email. For access to our WWW site our URL is http://www.instrutech.com/. By email send a message to support@instrutech.com. If you do not have access to the Internet, call Instrutech and request the *ITC* driver disk for the operating system of your choice.

6.2 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-18* 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, or email. For access to our WWW site our URL is http://www.instrutech.com/. By email send a message to support@instrutech.com. If you do not have access to the Internet, call Instrutech and request the *ITC-18* XOP diskette.

7 Product Upgrades

7.1 USB-18 adaptability

The *USB-18* card is designed to be firmware upgradeable by users, should this ever become necessary to keep up with new developments in the specification for the USB bus. Do not attempt to do such an upgrade without the approval of Instrutech Corporation or one of its authorized agents. **If this upgrade is performed improperly, the *USB-18* card will malfunction and become unusable**.

First you must acquire the proper upgrade software from Instrutech Corporation or one of its representatives. These upgrades will be announced on our Web site. Update software will be made available in MacOS and Windows formats. After the software is run is should give you a successful completion message. The USB-18 should then be unplugged from the USB port and then reconnected. The update has now been completed.

7.2 PCI-18 adaptability

The *PCI-18/PCI-18V3* card is designed to be firmware upgradeable by the user, should this ever become necessary to keep up with new developments in the specification for the PCI bus. Do not attempt to do such an upgrade without the approval of Instrutech Corporation or one of its authorized agents. **If this upgrade is performed improperly, the *PCI-18 or PCI-18V3* card will malfunction and become unusable**.

First you must acquire the proper upgrade software from Instrutech Corporation or one of its representatives. These upgrades will be announced on the Instrutech Web site. The cover of the computer must be removed to access the *PCI* card in order to install a jumper. A programming jumper needs to be installed across the pins labeled "WE". Install this shunt with the computer powered off. After this shunt is installed power on the computer and run the software for your system. Update software will be made available in MacOS and Windows formats. After the software is run is should give you a successful completion message. The computer should then be powered down and the jumper removed from the "WE" pins. Close the computer and turn the power back on. The update has now been completed.

If there is any difficulty in this process, please contact your dealer.

8 Product Registration

8.1 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.

8.2 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/.

9 Rear Panel Connector PIN Assignments

9.1 VR-10/100 Digital Data Recorder Connector

Below is a listing of the pin assignments of the optional VR-10/VR-100 port on the rear panel of the *ITC-18* interface. This port is optional and is not provided on standard configuration *ITC-18* units.
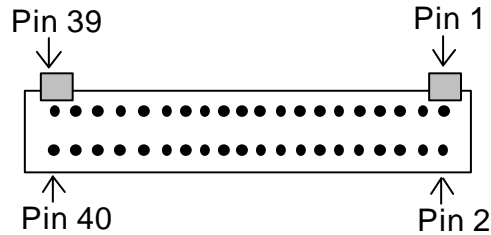
Pin 39   Pin 1

Pin 40   Pin 2

Figure 5: ITC-18 VR-10/VR-100 connector pins

Pin	Assignment	Pin	Assignment
1	PPMCM0 (channel mode)	2	PPMCM1 (channel mode)
3	PPMCM2 (channel mode)	4	PPMARS (analog reset)
5	* no connection	6	PPMCUE (CUE out)
7	* no connection	8	PPMCMP (FRAME out)
9	* no connection	10	Ground
11	* no connection	12	RSPCI (RS-232 TxD)
13	RSPC0 (RS-232 RxD)	14	Ground
15	Ground	16	Ground
17	PPMPLY(Play/Rec. mode)	18	Ground
19	no connection	20	Ground
21	Ground	22	PPMD0 (data bit 0)
23	PPMD1 (data bit 1)	24	PPMD2 (data bit 2)
25	PPMD3 (data bit 3)	26	PPMD4 (data bit 4)
27	PPMD5 (data bit 5)	28	PPMD6 (data bit 6)
29	PPMD7 (data bit 7)	30	PPMD8 (data bit 8)
31	PPMD9 (data bit 9)	32	PPMD10 (data bit 10)
33	PPMD1 (data bit 11)	34	PPMD12 (data bit 12
35	PPMD13 (data bit 13)	36	PPMERR (ERROR bit)
37	PPMSTR (valid data flag)	38	PPMTRG (TRIGGER bit)
39	Ground	40	Ground

* Do not ground these connections they are used by the VR-10/100.

9.2 Serial I/O Connector

Below is a listing of the pin assignments of the male serial port connector on the rear panel of the *ITC-18* interface. This port is optional and is not provided on standard configuration *ITC-18* units.
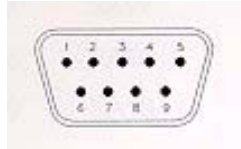

Figure 6: ITC-18 Serial Port connector pins

Pin	Assignment
1	RLSD: received line signal detect
2	RxD: receive data
3	TxD: transmit data
4	DTR: data terminal ready
5	Ground
6	DSR: data set ready
7	RTS: request to send
8	CTS: clear to send
9	RI: ring indicator

9.3 Current Driver Out Connector

Below is a listing of the pin assignments of the Current Driver Out connector on the rear panel of the *ITC-18* interface.
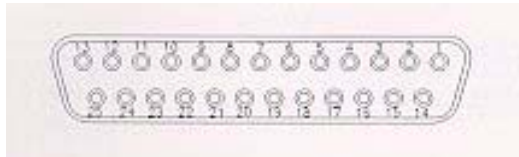
Figure 7: ITC-18 Current Driver Out connector pins

Pin	Assignment	Pin	Assignment
1	Clamp B (bank 2)	14	out channel 13 (bank 2)
2	out channel 12 (bank 2)	15	out channel 11 (bank 2)
3	Ground	16	out channel 10 (bank 2)
4	Ground	17	out channel 9 (bank 2)
5	Ground	18	out channel 8 (bank 2)
6	Ground	19	out channel 7 (bank 2)
7	Ground	20	clamp A (bank 1)
8	Ground	21	out channel 6 (bank 1)
9	Ground	22	out channel 5 (bank 1)
10	Ground	23	out channel 4 (bank 1)

11	Ground	24	out channel 3 (bank 1)
12	out channel 2 (bank 1)	25	out channel 1 (bank 1)
13	out channel 0 (bank 1)		

9.4 Digital I/O and Sequence Out Connector

Below is a listing of the pin assignments of the Digital I/O and Sequence Out port on the rear panel of the *ITC-18* interface.
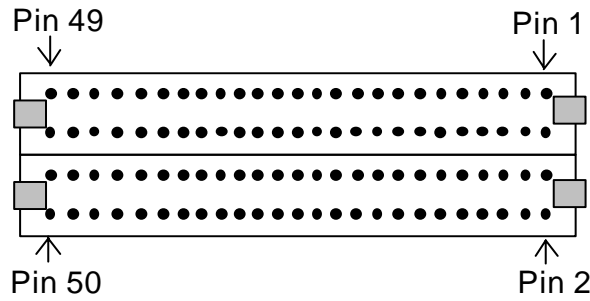
Pin 49   Pin 1

Pin 50   Pin 2

Figure 8: ITC-18 Digital I/O and Sequencer Out connector pins

Pin	Top Connector	Bottom Connector	Pin	Top &Bottom Connector
1	Ground	no connection	2	Ground
3	TTL input bit 8	TTL input bit 0	4	Ground
5	TTL input bit 9	TTL input bit 1	6	Ground
7	TTL input bit 10	TTL input bit 2	8	Ground
9	TTL input bit 11	TTL input bit 3	10	Ground
11	TTL input bit 12	TTL input bit 4	12	Ground
13	TTL input bit 13	TTL input bit 5	14	Ground
15	TTL input bit 14	TTL input bit 6	16	Ground
17	TTL input bit 15	TTL input bit 7	18	Ground
19	TTL channel 0 bit 12	TTL channel 0 bit 8	20	Ground
21	TTL channel 0 bit 13	TTL channel 0 bit 9	22	Ground
23	TTL channel 0 bit 14	TTL channel 0 bit 10	24	Ground
25	TTL channel 0 bit 15	TTL channel 0 bit 11	26	Ground
27	TTL channel 1 bit 8	TTL channel 1 bit 0	28	Ground
29	TTL channel 1 bit 9	TTL channel 1 bit 1	30	Ground
31	TTL channel 1 bit 10	TTL channel 1 bit 2	32	Ground
33	TTL channel 1 bit 11	TTL channel 1 bit 3	34	Ground
35	TTL channel 1 bit 12	TTL channel 1 bit 4	36	Ground
37	TTL channel 1 bit 13	TTL channel 1 bit 5	38	Ground
39	TTL channel 1 bit 14	TTL channel 1 bit 6	40	Ground
41	TTL channel 1 bit 15	TTL channel 1 bit 7	42	Ground
43	sequence out 4	sequence out 0	44	Ground
45	sequence out 5	sequence out 1	46	Ground
47	sequence out 6	sequence out 2	48	Ground
49	no connection	sequence out 3	50	Ground

9.5 Auxiliary Output Connector

Pin 33   Pin 1

Pin 34   Pin 2
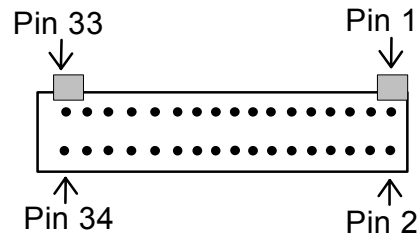
Figure 9: ITC-18 Auxiliary output connector pins

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

9.6 USB-18 Asynchronous Digital I/O Connector

Below is a listing of the pin assignments of the Digital I/O port on the *USB-18* host interface adapter. The Digital I/O port is a standard 68-pin mini DIN connector (same as SCSI cables).

Pin	Assignment	Pin	Assignment
1	Ground	35	Ground
2	Ground	36	Asynchronous TTL Out 0
3	Ground	37	Asynchronous TTL Out 1
4	Ground	38	Asynchronous TTL Out 2
5	Ground	39	Asynchronous TTL Out 3
6	Ground	40	Asynchronous TTL Out 4
7	Ground	41	Asynchronous TTL Out 5
8	Ground	42	Asynchronous TTL Out 6
9	Ground	43	Asynchronous TTL Out 7
10	Ground	44	Asynchronous TTL Out 8
11	Ground	45	Asynchronous TTL Out 9
12	User Out	46	Asynchronous TTL Out 10
13	Ground	47	Asynchronous TTL Out 11
14	Timer Out 2	48	Asynchronous TTL Out 12
15	Ground	49	Asynchronous TTL Out 13
16	Timer Out 1	50	Asynchronous TTL Out 14
17	Ground	51	Asynchronous TTL Out 15
18	Timer Out 0	52	Asynchronous TTL IN 15
19	Ground	53	Asynchronous TTL IN 14
20	Interrupt	54	Asynchronous TTL IN 13
21	Ground	55	Asynchronous TTL IN 12
22	Timer 2	56	Asynchronous TTL IN 11
23	Ground	57	Asynchronous TTL IN 10
24	Timer 1	58	Asynchronous TTL IN 9
25	Ground	59	Asynchronous TTL IN 8
26	Timer 0	60	Asynchronous TTL IN 7
27	Ground	61	Asynchronous TTL IN 6
28	Ground	62	Asynchronous TTL IN 5
29	Ground	63	Asynchronous TTL IN 4
30	Ground	64	Asynchronous TTL IN 3
31	Ground	65	Asynchronous TTL IN 2
32	Ground	66	Asynchronous TTL IN 1
33	Ground	67	Asynchronous TTL IN 0
34	Ground	68	Ground

10 Warranty Information

10.1 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.

10.2 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.