



ScienceWorkshop[®] 750 Interface (USB)

Model No. CI-7599



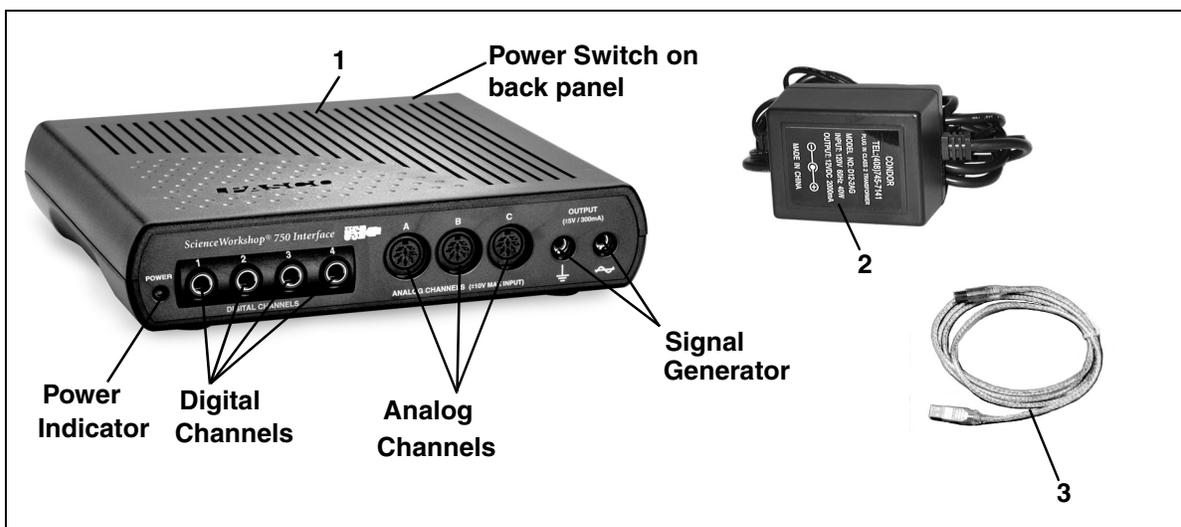
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ScienceWorkshop® 750 Interface (USB)

Model No. CI-7599

Equipment List



Included Equipment	Replacement Model Number*
1. ScienceWorkshop® 750 USB Interface box (1)	CI-7599
2. AC Adapter, 12 VDC, 60 Hz, 40 W (1)	540-034 or 540-035
3. USB cable (1)	514-016

*Use Replacement Model Numbers to expedite replacement orders.

Additional Equipment Required	
USB-compatible computer	
Any PASCO ScienceWorkshop® Sensor	A sensor with a CI-prefix*
DataStudio software, version 1.7 or later	CI-6870D or CI-6871D

* Either an analog or digital ScienceWorkshop® sensor is required for real-time data collection. Any photogate or photogate set beginning with the prefix “ME” can also be used with the interface.

Introduction

The PASCO 750 USB Interface, is a USB (Universal Serial Bus) data acquisition interface designed for use with any of PASCO's

ScienceWorkshop® Sensors. The 750 USB operates exactly the same as the 750 SCSI interface. The only functional difference between the 750 USB and SCSI interfaces is that the 750 USB plugs into a USB port on the back of your computer (the 750 SCSI interface interface connects to a SCSI port or RS-232 port). Users just plug the sensor into the interface, perform the necessary setup in DataStudio, and can immediately begin collecting data.

The PASCO 750 USB interface is designed for use with DataStudio, version 1.7 or later. The 750 USB interface is another option for customers who have computers with USB hardware (instead of older computers with SCSI cards and connectors) and want to use USB interfaces and connections.

Note: The 750 USB interface is compatible with PASCO *ScienceWorkshop* sensors. The 750 USB will not work with PASPORT™ sensors. Those customers wishing to use PASPORT products and sensors with DataStudio need to purchase USB Links or PASPORT Xplorers.

Computer Requirements for Using the Interface

Windows®-Based Computers: Pentium Processor with one or more USB ports, and Windows 98, ME, 2000, or XP. [The interface cannot be used with Windows 3.1, 95, or NT 4.0].

Macintosh® Computers: PowerPC processor with one or more USB ports, and OS 8.6 or higher

General Operation Requirements and Setup

A. Operation Requirements and Precautions

a) The interface must be used with PASCO's DataStudio software and *ScienceWorkshop* sensors. The interface will not work with PASPORT sensors or other sensors, software, or interface (i.e. Xplorer, etc.)

Also, you can use only one 750 USB interface per computer.

b) A power supply and USB cable are required for operation. Always plug the power supply into a standard three-pronged, grounded wall outlet.



WARNING: The interface is not water-proof. To avoid the risk of shock, keep the interface, AC adapter, and cable away from water and liquids. If conducting an experiment with liquids or water, place the liquid container at least one foot away from the interface. For maximum protection, keep liquids in closed containers with covers.

Also during operation, do not block the ventilating louvres on the top of the interface box. The louvres help prevent the interface from overheating during prolonged use.

B. Connecting the Interface to Your Computer

1. Install DataStudio (version 1.7 or later) on your computer.
2. Connect one end of the USB cable to the USB port on the back of your computer.
3. Connect the other end of the USB cable to the USB port on the back of the interface.
4. Connect the power supply to the jack on the back of your interface box and to a grounded wall outlet.
5. On the back of the interface, turn the power switch to the "1" (on position). When the green power light illuminates, the power is turned on.



Note: For more information about operational requirements, see Appendix C, "Frequently Asked Questions" in this manual.



To locate a USB port, look for the USB symbol.



C. Plugging a Sensor into the Interface

Analog sensors have DIN connectors and plug into channels A, B, and C on the interface. Digital sensors have stereo plugs and insert into channels 1, 2, 3, and 4 on the interface.



Figure 1: Connecting a Sensor to the Interface

D. Using the Interface with DataStudio Software

Note: Before using the interface with DataStudio software, you must have DataStudio (version 1.7 or later) loaded onto your computer, the interface connected to your computer, and the power supply turned on.

1. Connect a *ScienceWorkshop* sensor to any channel on the interface.
2. Open DataStudio and double click “Create Experiment.”

3. In the Sensors list, double-click the sensor to associate the sensor with the interface channel (See Figure 2) in the setup window.

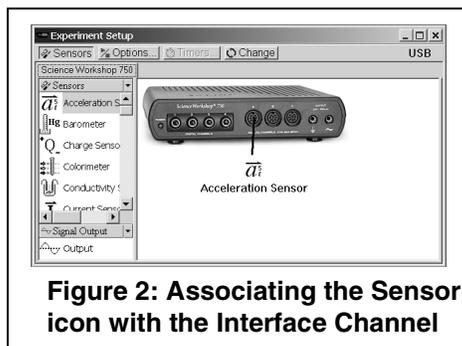


Figure 2: Associating the Sensor icon with the Interface Channel

4. In the Displays list, double-click on any of the displays to open a display.
5. To collect some data, click the **Start** button on the main toolbar.
Result: Data appears in real-time in the display.
6. To stop collecting data, go to the main toolbar and click the **Stop** button.

E. Changing Interfaces Between Experiments

If you have both the 750 USB interface and another type of interface connected to your computer simultaneously, you cannot use both simultaneously in DataStudio. To change interfaces in DataStudio, click the **Change** button in the Experiment Setup window, select the desired interface, and click OK.



Note: Both the 750 USB Interface and 750 SCSI interface use the same setup window in DataStudio. For more information on operating the interface with DataStudio, see Appendix C, “Frequently Asked Questions” in this manual or the DataStudio online help (ver. 1.7 or later).

Using the Interface as a Signal Generator (no amplifier required):

The 750 USB interface contains a built-in function generator for creating up to eight types of waveforms (sine, square, triangle, sawtooth, ramp up, ramp down, positive ramp up, positive ramp down, as well as DC voltages.) when the interface is used with DataStudio. No power amplifier is required for signal generation. The computer is used as an AC signal generator to power external circuits while it monitors its own output current as well as other inputs. Using the 750 interface, DataStudio can create an analog signal that ranges in frequency from DC to 50 KHz, with an amplitude of +/- 5 volts, and with a current of up to +/- 300mA. For specific frequency, range, and amplitude limits, see Appendices A (Specifications) and C (subsection "Built-In Function Generator/Amplifier") in this manual.

To use the Interface as a Signal Generator for a Circuit (or Other Device):

1. Insert a banana plug into the **Ground port** () on the interface, and connect the ground lead to the ground on the circuit board (or other device).
2. Insert a banana plug into the **Signal Generator port** () and connect the lead to the positive lead on the circuit board (or other device).
3. Below the Sensors list, click on the Signal Generator icon to open the Signal Generator dialog box.
4. In DataStudio, use the Signal Generator dialog box to choose the type of wave, and control the amplitude, frequency, and voltage output.
5. To create signals, click the **Start** button.



Note: Using DataStudio, you can also generate waves without a Power Amplifier connected to the interface. See "Using the Interface as a Signal Generator" in this manual.

Operating the Interface with a Power Amplifier

With a PASCO CI-6552A Power Amplifier II plugged into an analog channel of the *ScienceWorkshop* 750 USB interface, you can supply up to 1 A of external current at +/- 10 volts.

⚠ WARNING: To prevent power surges, always turn on the Power Amplifier *before* running DataStudio. Turning on the amplifier while DataStudio is opening may cause a power surge, resulting in damage to your computer.

To use the output of the Power Amplifier II, connect the load to the banana jacks on the front of the Power Amplifier II. There is a power switch on the back left hand corner of the Power Amplifier II.

When the Power Amplifier II is operating, a green power indicator light on the front panel illuminates. A red current overload light comes on whenever the maximum current of 1A is exceeded. If this warning light is on, the waveform is distorted and you should reduce the output voltage.

A. Set up the CI-6552A Power Amplifier with the Interface

1. Plug the DIN connector of a Power Amplifier into any analog channel on the 750 *ScienceWorkshop* interface.
2. Open DataStudio.
3. In the Experiment Setup window, click on the Power Amplifier icon in the Sensor list and drag it to any channel on the picture of the interface. **Result:** A Power Amplifier icon with a Signal Generator icon attached displays on the interface.

B. Generate Signals from within DataStudio (with the Power Amplifier Connected)

1. In DataStudio's Signal Generator dialog, select an AC waveform.
2. Adjust the amplitude and frequency with the **plus (+)** and **minus (-)** buttons (Figure 3) or type in a numerical value. Use the arrows for stepped progression.

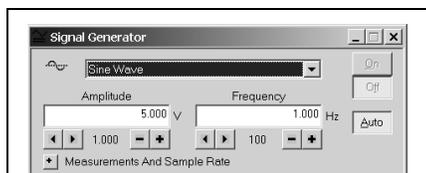


Figure 3: Signal Generator dialog in DataStudio

3. To generate signals, click the **Start** button.

For more information about signal generation, see the DataStudio online help.

C. View the Amplified Signals in DataStudio

From the Data list, drag the Output Voltage icon to a display (i.e. Graph, Scope, etc.), and click the **Start** button.

D. View the Voltage or Current in DataStudio

1. In the setup window, double click the Power Amplifier icon.
2. When the Sensor Properties dialog box opens, click on the Measurement tab. In the Measurement dialog box, check the Voltage and/or Current box.
3. To view the voltage: In the Data list, drag the Voltage icon to an open display (i.e. Graph, Digits, etc.).

Or

To view the current: In the Data list, drag the Current icon to an open display(i.e. Graph, Digits, etc.).

Troubleshooting

Problem	Recommendations
The interface does not turn on.	Ensure you have the power supply connected to the interface and a grounded outlet. Check to see that the power switch is turned on in the back of the interface. Ensure that the USB cable is inserted properly to both the interface and to the back of your computer.
My computer's operating system does not recognize the interface and asks for a driver.	<p>You must have DataStudio version 1.7 software loaded onto your computer. DataStudio 1.7 and later versions include a driver (set of software instructions) that allow your computer to communicate with the 750 USB interface. If you have an earlier version of DataStudio installed, your computer will not recognize the interface. Check "Computer Requirements" in this manual to ensure your operating system is compatible with USB devices.</p> <p>If you have DataStudio 1.7 installed and you still receive device error messages, contact PASCO's Technical Support Dept. (1-800-772-8700) or 916-786-3800.</p>
DataStudio does not allow me to collect data with the interface connected.	Recheck the USB cable and power connections. Also, check to ensure you have opened the proper setup window in DataStudio. In the Experiment Setup window, click the Change button and select "SW750" in the Please Choose a Data Source" box. When you click OK, the correct setup window opens.
I want to collect data with both a 750 USB interface and a PASPORT interface simultaneously.	DataStudio does not allow you to collect data from multiple <i>ScienceWorkshop</i> interfaces or PASPORT and <i>ScienceWorkshop</i> interfaces simultaneously. Instead, use the Change button in DataStudio's Experiment Setup window to alternate between interfaces.
I want to switch between the 750 USB and 750 SCSI interface in DataStudio.	Both the 750 (USB) and 750 (SCSI) <i>ScienceWorkshop</i> interfaces use the same Experiment Setup window in DataStudio. When you have the 750 USB interface connected, you will see a "USB" designator in the setup window header. Instead, use the Change button in DataStudio's Experiment Setup window to alternate between interfaces.
I am unable to operate the Power Amplifier with the interface.	Check to ensure you have connected the Power Amplifier to analog channel A,B, or C on the interface. Both devices must be turned on. Also, ensure you have associated the Power Amplifier icon on the same channel in DataStudio's Experiment Setup window. For more information, see DataStudio's online help.

Appendix A: Specifications

USB 750 Interface	Description
Power:	12 VDC to 20 VDC at 2 A, 2.1 mm jack
Computer Connection:	Universal Serial Bus (USB), 12 Mbps maximum data transfer rate
Digital Channels:	<ul style="list-style-type: none"> • 4 input/output channels • TTL compatible input/output levels with 8 mA maximum drive current • Maximum input logic transition time: 500 ns • Electrostatic Discharge (ESD) protected inputs, assuming the human body model standard, Mil-Std-3015.7 • Digital input: Edge sensitive and sampled at 10 KHz (100 μs), (1 μS resolution for the Motion Sensor)
Analog Channels:	<ul style="list-style-type: none"> • 3 identical channels with differential inputs and 1 M ohm impedance • +/- 10 V maximum usable input voltage range (+/- 12 V absolute maximum input voltage range) • ESD-protected input similar to that of the digital channels • 3 voltage gain settings on each analog channel (1,10, and 100) • Small signal bandwidth up to the ADC: 1 MHz for a gain of 1, 800 KHz for a gain of 10, and 120 KHz for a gain of 100; input amplifier slew rate: 1.2 V/μs (The actual bandwidth is determined by the sampling rate of the ADC).
Analog-to Digital Conversion:	<ul style="list-style-type: none"> • 5 input sources for the 12-bit ADC: channels A-C, signal generator analog output voltage and current • Voltage resolution at the ADC input: 4.88 mV (0.488 mV at a gain of 10; 0.049 mV at a gain of 100) • Current measurement resolution: 244 μA, where each volt measured represents 50 mA • Offset voltage accuracy < +/- 3 mV (For measuring full-scale voltages (or 1 V with a gain of 10, etc.), the total error will be less than +/- 15 mV, accounting for the gain error in the input amplifier. • Sample rate range: once every 3600 seconds - 250 KHz (The conversion time between consecutive channels in a burst is 2.9 μs) • 8x oversampling for improved accuracy for sample rates \leq100 Hz.

Appendix A - Specifications (Continued)

USB 750 Interface	Description
Analog Output:	<ul style="list-style-type: none">• DC value ranges: -4.9976 V to + 5.0000 V in steps of 2.44 mV• Accuracy at the DIN connector: (+/- 3.6 mV +/- 0.1% full scale)• Peak-to-Peak amplitude adjustment ranges for the AC waveform: 0 V to +/- 5 V in steps of 2.44 mV• AC waveform frequency ranges: 1 mHz (0.001 Hz) - 50 KHz, +/- 0.01%• Maximum amplified output at the banana jacks: about 300 mA at +/- 5 V, current limited at 300 mA +/- 12 mA

Appendix B: Electromagnetic Compliance

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

The PASCO Model CI-7599 *750 ScienceWorkshop* Computer Interface has been tested and complies with the essential protection requirements of Council Directive 89/336/EEC on the approximation of the laws of the Member States relating to electromagnetic compatibility. Assessment of compliance of the product with the requirements relating to electromagnetic compatibility was based on the following Directives and Standards:

- EN 50081-1 Electromagnetic compatibility generic emission standard
- EN 55022, CISPR 22 Class A Limits and methods of measurements of radio interference characteristics of information technology equipment.
- EN 50082-1 Electromagnetic compatibility generic immunity standard.
- IEC 801-2 Electrostatic discharge requirements
- IEC 801-3 Radiated electromagnetic field requirements
- IEC 801-4 Electrical fast transient/burst

Appendix C: Frequently Asked Questions

What is the 750 USB Interface?

The 750 USB interface was developed to meet the needs of those users who prefer the USB connection (or those whose computers do not support SCSI connections).

The PASCO 750 SCSI interface uses a SCSI (Small Computer System Interface) port to communicate with the PC or MacIntosh (Mac) computer to which it is connected. The SCSI-equipped interface is now known as the “750 SCSI interface.”

Are there other differences between the 750 SCSI and the 750 USB?

No. The 750 USB is identical to the 750 SCSI in all respects, except for the communications port. The 750 USB uses all the same sensors and performs the same functions as the 750 SCSI. The overall rate at which data is transmitted to the Mac or PC is essentially the same. The 750 USB Interface only works with DataStudio software; this differs from the 750 SCSI interface, which is compatible with the older *ScienceWorkshop* software.

How do I know if my computer has a USB port or a SCSI port?

If your computer has a USB port, you will see the USB symbol  embossed, engraved, or printed next to the port on the back of your computer. If you purchased a computer that was manufactured in 2001 or 2002, chances are you have a USB-compatible computer.

A SCSI port works with a serial 50-pin connector cable and often requires a SCSI card.

If you are still unsure about the type of port your computer has, check the documentation that came with your computer or call the manufacturer.

My computer has two USB ports. Can I connect and use two 750 USB Interfaces at the same time?

You can connect two 750 USB Interfaces, but only one interface will be recognized by DataStudio. The interface that is recognized first will

operate normally. There is no way to switch between the two 750 interfaces in DataStudio.

Is the 750 USB Interface compatible with PASCO's new PASPORT line of sensors?

No. The 750 USB is compatible with PASCO's line of "CI" sensors, which includes over 40 different sensor types.

Does the 750 USB Interface work with *ScienceWorkshop* software?

No. *ScienceWorkshop* software, which is available at no charge from PASCO, and works with all other PASCO interfaces (including the 750 SCSI), does not recognize the USB connections that come with newer computers and operating systems. DataStudio Lite, which is also available free from PASCO, supports all PASCO interfaces including the 750 USB.

I have a computer with USB connections. Does it matter whether I purchase the 750 SCSI or 750 USB?

Not really. The 750 USB will usually result in lower system cost, since a separate SCSI interface card is usually required for most systems using the 750 SCSI. Also, installation of the SCSI card within the computer and system configuration is more involved than the simple "Plug and Play" operation of USB. For newer computers and operating systems that support USB, the 750 USB interface is preferred.

I have an older computer that doesn't have USB. Is there any way I can still use the 750 USB Interface?

If you have a PC that is running Windows 98, 2000, ME, or XP (in other words, any system NOT running Windows 3.1, 95, or NT4), you can use the 750 USB as long as the required USB port can be installed in the computer. USB ports can be purchased from many electronic stores at low cost.

You can also upgrade some older Macs with USB ports if it is a PowerPC Mac with a PCI/PCMCIA bus running Mac OS v. 8.6 or better.

Does the 750 USB have a serial connection like the 750 SCSI?

No. The 750 USB Interface can connect to the computer only with the USB port.

If I have a 750 USB and a PASPORT Xplorer connected at the same time, which would be recognized first and have priority?

The interface you choose first in DataStudio is the one that has the priority. If you select the PASPORT data source in DataStudio (using the Please Choose Data Source box that appears when you click the **Change** button), DataStudio will connect to the Xplorer. If you select the 750 data source, DataStudio will connect to the 750. If the Xplorer has logged data runs, or it has a sensor plugged in, the PASPORTAL window will *automatically* launch DataStudio with the PASPORT data source selected.

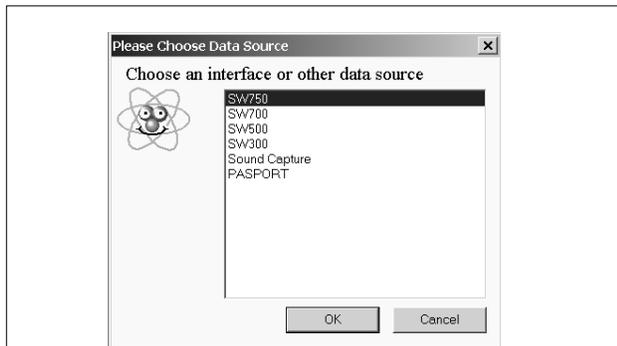


Figure 4: Data Source Window

Appendix D: Theory of Operation

Flash Memory

The 750 stores its operating system software and waveform patterns in flash memory. After turning on the power supply, the interface initializes the operating system without requiring user initiation in DataStudio. When a new revision of DataStudio is later loaded onto one's computer, the interface automatically upgrades the system software and waveforms in flash memory.

Analog Input Channels

All three analog input channels (A,B, and C) on the 750 interface are identical. Each has differential inputs; in other words, they are like the inputs to a voltmeter where neither lead is connected to ground. The voltage measured is the voltage difference between the inputs.

Each channel has three software accessible gain settings: 1, 10, and 100. When an analog sensor is plugged into the interface, the signal is applied to a device called a differential amplifier. As the name suggests, a differential amplifier amplifies the difference between two signals.

In this case, the output of the amplifier is the difference between the A+ input and the A- input, multiplied by a fixed gain that is selectable in DataStudio software at 1, 10 or 100. From this point, each analog signal (A, B, and C plus other internally-generated signals) is applied to a device called a multiplexer. The multiplexer, which acts like a switch, selects which input channel is to undergo analog-to-digital conversion.

There are other analog channels within the 750 interface. Two channels are dedicated to voltage and current measurements for the Function Generator, plus others for internal diagnostic purposes. Channels to be converted are selected by the 750 interface under the control of DataStudio. The analog-to-digital converter uses 12-bit conversion, so the maximum range of each analog input, +/- 10 volts can be converted to a range of digital numbers from 0 to 4095 (2^{12}). When the analog value is in digital form, it can be sent immediately to the host computer for further processing, or stored temporarily with the 750 interface internal memory.

Digital Input/Output Channels

When a digital sensor plugged into one or more of the 750 interface, the interface may perform several different tasks, with the task dependent on the type of sensor connected. It may time the interval between external events (i.e. a photogate), count external events (i.e. a nuclear sensor), or it may both trigger an external event and perform a timing function (i.e. Motion Sensor). When you choose a particular digital sensor in DataStudio, information is transmitted to the 750 interface, and the microprocessor within the interface knows what to do and when, and on which channel. The timing function is carried out within specialized digital devices within the 750 interface, called Field Programmable Gate Arrays. These devices are programmed to perform many digital functions and perform them at very high speeds.

Sampling Rate

The maximum samples rate depends on the channels the user selects for measurement. For higher sample rates, the interface samples a block of 2000 bytes and then transfers the block. Once transfer of bytes to the host begins, the interface starts sampling a new block. This is called *burst mode*, since there is a small time interval when data is not being sampled. The main use of this mode is for the virtual oscilloscope. Table 1 shows the sampling constraints while using a fast computer to record the data.

Table 1: Sample Rate Constraints

Sample Rate	No. of Channels	Comment
250 KHz	1 analog	Burst mode
100 KHz	3 analog	Burst mode
50 KHz	5 analog	Burst mode
20 KHz	1 or 5 analog	Continuous* (burst)
10 KHz	1 analog + 1 digital or 5 analog	Continuous* (Burst)
< 100 Hz	5 analog	Continous 8x oversample (improved accuracy at < 100 Hz)

* Continuous sampling with 5 channels selected is not possible to sustain for more than a few seconds.

There are five analog channels from which to choose: channels A-C, analog output voltage (at banana jacks), and the analog output current. Please note that for continuous sampling, the speed of the computer may slow down, especially if the interface is busy processing with many displays open in DataStudio.

Note: The sampling rate does not depend on the number of digital channels selected in DataStudio, as they are sampled separately and simultaneously at 10 KHz.

Built-In Function Generator/Amplifier

The USB 750 has a built-in function generator that is used to output analog signals. These can be either AC signals, such as sine and triangle waveforms, or a DC signal, ranging between +/- 5 volts. For the AC waveforms, of which there are eight waveforms resident in Flash, the frequency can range from 1 mHz (0.001 Hz) to 50 KHz and the peak-to-peak amplitude can be adjusted from 0 V to +/- 5 V with increments of 2.44 mV. The output voltage is calibrated at the factory to null the offset voltage and set the full scale voltage.

Accessing Analog Output

There are two different methods of accessing the analog output signal. The first is to connect the test leads to the 750 interface output banana jacks. The output current can be monitored along with the output voltage. The second is to use a CI-6552A Power Amplifier (which has a voltage gain of 2 and delivers 10 W) and connect its DIN plug to one of the analog channels, A-C.

Digital Event Sampling

The 750 can sample digital events for photogate timing. The 750 uses hardware edge detection so that it can capture either edge or both as events, a feature useful for setting trigger conditions. It can count digital events from devices, such as a Geiger tube or a Rotary Motion Sensor. Each channel has an independent 16-bit counter. For motion sensing, either single or dual, the internal counters and edge detectors provide improved performance with less noise in the measurement.

Appendix E: Technical Support

For assistance with the CI-7599 750 USB Interface or any other PASCO products, contact PASCO as follows:

Address: PASCO scientific
10101 Foothills Blvd.
Roseville, CA 95747-7100

Phone: (916) 786-3800

FAX: (916) 786-3292

Web: www.pasco.com

Email: techsupp@pasco.com

Appendix F: Copyright and Warranty Information

Copyright Notice

The PASCO scientific 012-08101A *ScienceWorkshop 750 Interface (USB) Manual* is copyrighted and all rights reserved. However, permission is granted to non-profit educational institutions for reproduction, of any part of the 012-08101A *ScienceWorkshop 750 Interface (USB) Manual*, providing the reproductions are used only for their laboratories and are not sold for profit. Reproduction under any other circumstances, without the written consent of PASCO scientific, is prohibited.

Limited Warranty

PASCO scientific warrants the product to be free from defects in materials and workmanship for a period of one year from the date of shipment to the customer. PASCO will repair, or replace, at its option, any part of the product which is deemed to be defective in material or workmanship. The warranty does not cover damage to the product caused by abuse or improper use. Determination of whether a product failure is the result of a manufacturing defect or improper use by the customer shall be made solely by PASCO scientific. Responsibility for the return of equipment for warranty repair belongs to the customer. Equipment must be properly packed to prevent damage and shipped postage or freight prepaid. (Damage caused by improper packing of the equipment for return shipment will not be covered by the warranty.) Shipping costs for returning the equipment after repair will be paid by PASCO scientific.