



TOOLS THAT TEACH.



Timer & Photogates 2.0 P4-1450

Owners Manual



TOOLS THAT TEACH.

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Stopwatch	0.01 second resolution to 999999.99 seconds
Count	Dual channel (A or B) counters to 999999 each channel
FCC Compliance	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 rules are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. The equipment generates and uses radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.
Working Time (Battery)	> 40 hours
Power Consumption	0.015W without photogate, 0.25W with two photogates.

Technical Specifications

Time Reference	6.144 MHz quartz crystal, 0.65 micro-second internal resolution, 0.0001 second display resolution.
Input Voltage	9 V DC/500 mA Minimum (Center Tip positive).
Sensor Input	Two TTL falling edge triggered inputs using 1394 connectors.
Interval	Gate A, Gate B, and Interval A-to-B photogate timing with: <i>0.0001 second resolution from 0.0000 to 99.9999 seconds</i> <i>0.001 second resolution from 100.000 to 999.999seconds</i> <i>0.01 second resolution from 1000.00 to 9999.99 seconds</i> <i>0.1 second resolution from 10000.0 to 99999.9 seconds</i>
Frequency	Dual channel plus frequency differences (A, B, A-B, B-A) with: <i>0.0001 Hz resolution from 0.0000 to 99.9999 Hz</i> <i>0.001 Hz resolution from 100.000 to 999.999 Hz</i> <i>0.01 Hz resolution from 1000.00 to 9999.99 Hz</i> <i>0.1 Hz resolution from 10000.0 to 99999.9 Hz</i>
Period	Dual channel (A or B) period measurement with: <i>0.0001 second resolution from 0.0000 to 99.9999 seconds</i> <i>0.001 second resolution from 100.000 to 999.999seconds</i> <i>0.01 second resolution from 1000.00 to 9999.99 seconds</i> <i>0.1 second resolution from 10000.0 to 99999.9 seconds</i>

Timer and Photogate

P4-1450



BACKGROUND:

The new Arbor Scientific Timer and Photogate kit is a powerful, convenient and easy to use tool for making accurate measurements anywhere. We know that precision is key for analytical experiments. Our timer has a precision quartz crystal to make time measurements accurate to within 0.0001 seconds and frequency measurements accurate to 0.1 Hertz.

KIT CONTENTS:

- Timer
- Two Photogates with Firewire Data Cords
- Two Photogate Mounting Brackets w/ hardware
- AC Adapter
- Instructions
- Hard Carrying Case
- Recommended Items:**
- Ring Stand and Base (66-4220)
- Photogate Mounting Rod (PC-7502)
- Smart Pulley (PC-7501)

USING THE TIMER:

Caution: Use only the 9V power supply that came with your Arbor Scientific timer. Using another power supply may damage your timer and photogate system.

Connections

On the right side of the timer are input jacks “A” and “B”. These are used for connecting the two Photogates with the supplied cables. To the right of “A” and “B” is the jack for plugging in the included 9 volt AC adapter.

The power switch can be found on the left side of the timer. To turn on the timer, push the power switch to the “ON” position. It will run from here on either battery or AC power depending on if the AC adapter is being used or not.

The Power LED (See image 3) will light anytime the AC adapter is plugged into the timer. This light is not a reflection of if the timer is turned on or not. Anytime that the AC adapter is hooked up to the timer, the rechargeable battery will begin charging regardless of the position of the power switch.



Replacing the battery

To replace the rechargeable batteries, use a Phillips screwdriver and remove the four attachment screws from the back timer case cover. Remove the cover and disconnect the old battery and replace with the new one.

Replace the cover and tighten the screws.

Using the Timer with two Photogates can run down the battery quickly. Use the 9 V power supply whenever it is possible.

Measuring Period

The Timer can measure the period of signals which are connected to the inputs. The Photogates can provide the signals (such as with the Pendulum) or the Sound and Waves experiment can provide the signals.

The Timer measures period in seconds and can measure the period of the signal in input A or the period of the signal in input B.

Period Updates Every Other Cycle

You will notice that the period only updates every third time the Pendulum crosses the light beam. This is because the Timer averages over two periods before updating the display. The averaging technique corrects for errors that occur when the photogate is not placed at the exact center of the swing.

A Pendulum Crosses Twice Per Cycle

You will also notice that the Timer measures the half period of the Pendulum. This is because the pendulum breaks the light beam twice per cycle. The Timer does not know it is “seeing” a pendulum; all it knows is the period of the breaking of the light beam.

Using Count

The Timer has a counting feature that counts whenever anything breaks the light beam, or sends a signal. There are two independent counters: A and B. The counters can each count up to 19,999. The Reset button has a double action for count mode. Pressing Reset once causes the counter to stop counting and freezes the display. This is useful for counting things within a fixed time interval. Pressing Reset again will reset the counter back to zero.

Mode Selection

The reset button is used to clear all timer readings that have been stored in memory. The table on page 10 and 11 summarizes all features and functions of the timer.

Pressing the mode switching button will change the mode from one of the five modes to the next one, moving left to right and stepping once for each time the button is pressed. The order is: Interval-Frequency-Period-Stopwatch-Count. After Count, the mode cycles back to Interval.

Stopwatch Mode

The Stopwatch function is the simplest of the different modes. In Stopwatch mode the Timer measures in seconds and is accurate to one hundredth (0.01) of a second from 0.01 to 59.99 seconds. After one minute the display switches to *minutes: seconds* format and the display is accurate to whole seconds. The stopwatch can measure times up to 199 minutes and 59 seconds (199:59).

Interval Mode

In Interval mode, the Timer uses one or two Photogates to electronically collect times from up to 3 different locations. Photogate A, Photogate B and/or the time between the two.

Frequency

The Timer can measure the frequency of anything that breaks the light beams in the Photogates regularly, or the frequency of signals applied to the inputs, such as from the Sound and Waves machine. The highest frequency that can be measured is 19,999 Hz and the lowest is 0.1 Hz. For very low frequencies (<100 Hz) it is more accurate to use period mode, measure the period (T), and invert ($f = 1/T$).

Timer Console

The Arbor Scientific timer console is set up in an intuitive format that makes it easy to use. Select your desired mode, turn on which gates that you wish to use and everything is set to being recording accurate timings.



Enhance this picture with diagrams Image 2

The five timer modes are accessed by using the mode button. The corresponding LED below each timer mode will be lit when that mode is active. Pressing the mode switching button will change the mode from one of the five modes to the next one. The modes move from left to right and step forward one mode each time the button is pressed. The order is as follows: Interval-Frequency-Period-Stopwatch-Count. After Count, the mode cycles back to Interval. When a mode is active, the LED beneath its label will glow green.

The buttons labeled “A” and “B” toggle which Photogates are being used in the current mode. These buttons of course correspond to the photogate input jacks located on the right side of the timer. Photogate button ‘A’ corresponds to input jack “A”. When the LED above the photogate button glows green, this indicates that the connected photogate has been made active. The table below summarizes the states of this LED.

LED Color	Photogate Status
Red	Photogate is not present
Green	Photogate is active for the current mode
Clear	Photogate is connected but not active

The memory button is used to view any recorded data taken by the timer. The timer is capable of storing 10 separate timer readings. Pressing the memory button steps through the memory positions one at a time. Each time a measurement is recorded, it is stored in the current position and all previous stored times are pushed back one position. If there was already 10 readings in memory. The 10th piece of data (memory position 9) is discarded and replaced by what ever was in memory position 8.

Timer Buttons and Indicators

Feature	Function
Mode Button:	The mode button switches the Timer between its five different functions (or modes).
Mode Lights:	The five lights tell you which function the Timer is in.
“A” Button:	The “A” button switches the “A” light on and off, and starts and stops the stopwatch.
“A” Light:	The “A” light indicates what the Timer is displaying or doing relative to input A.
“B” Button:	The “B” button switches the “B” light on and off.
“B” Light:	The “B” light indicates what the Timer is displaying or doing relative to input B.
The Reset (0.0) Button:	The reset button initializes the Timer back to zero, or begins a new measurement. It also erases any value in memory.
The Memory (M) Button:	The memory button allows you to display the previous time interval measurements in interval mode.