Timer and Photogates

P4-1450

INSTRUCTIONAL GUIDE

Contents

- Timer
- Two photogates with data cords
- Two photogate mounting brackets
- AC adapter
- Storage case
- Instructional Guide

Recommended for Activities:

- Ring Stand (66-4220)

Background

The Arbor Scientific Timer and Photogates 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.

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 will light anytime the AC adapter is plugged into the timer. This light is not representative of whether 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. The timer performs best when fully charged.

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

Timer Console

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

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 not 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 were already 10 readings in memory. The 10th piece of data (memory position 9) is discarded and replaced by whatever was in memory position 8.

Timer Buttons and Indicators:

Feature	Function
Mode Button	The mode button switches between the timer’s five different functions (modes).
Mode Lights	The five lights indicate 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 relative to input A.
“B” Button	The “B” button switches the “B” light on and off, and starts and stops the stopwatch.
“B” Light	The “B” light indicates what the timer is displaying relative to input B.
Reset (0.0) Button	The reset button zeros the timer or begins a new measurement. It also erases any value in memory.
Memory (M) Button	Displays the previous time interval measurements in interval mode.

Mode Selection
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 Timing allows the user to record the time it takes for a glider to pass through multiple photogates. This requires the initial velocity (relative to the first photogate) be greater than zero. Two photogates are required; activate both photogates by pressing “A” and “B”. The timer will begin timing once the photogate beam is broken and will finish the first measurement and begin the second measurement as it breaks the second beam. When photogate A is broken, the timer will start. When photogate B is triggered, the timer will record a datapoint. The timer will keep running from the time photogate A and record datapoints every time photogate B is tripped. The memory function will store the 10 most recent data points. Press “Reset” to clear the memory.

Frequency Mode: 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).

Period Mode: 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.

Count Mode: 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.

Technical Specifications

Time Reference	6.144 MHz quartz crystal, 0.65 microsecond 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: - 0.0001 s resolution from 0.0000 to 99.9999 s - 0.001 s resolution from 100.000 to 999.999 s - 0.01 s resolution from 1000.00 to 9999.99 s - 0.1 s resolution from 10000.0 to 99999.9 s
Frequency	Dual channel plus frequency differences (A, B, A-B, B-A) with: - 0.0001 Hz resolution from 0.0000 to 99.9999 Hz - 0.001 Hz resolution from 100.000 to 999.999 Hz - 0.01 Hz resolution from 1000.00 to 9999.99 Hz - 0.1 Hz resolution from 10000.0 to 99999.9 Hz
Period	Dual channel (A or B) period measurement with: - 0.0001 s resolution from 0.0000 to 99.9999 s - 0.001 s resolution from 100.000 to 999.999 s - 0.01 s resolution from 1000.00 to 9999.99 s - 0.1 s resolution from 10000.0 to 99999.9 s
Stopwatch	0.01 s resolution to 999999.99 s
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	0.015 W without photogate, 0.25 W with two photogates

Related Products

Physics Workshop Group The Physics Workshop is a complete solution for the lab equipment you need for physics and physical science students exploring force and motion concepts. Each Lab is supplied complete with curriculum materials.

PocketLab Voyager 2 (P4-1001) PocketLab connects with a single button to a smartphone, tablet, Chromebook or computer and instantly streams data that you can see and record. Using the FREE PocketLab app, you can easily analyze your data, create graphs and integrate your data with other software.

BeeSpi (P4-1490) The BeeSpi timer is a compact, battery powered photogate ready to use in one step! Two parallel photogates detect, measure, and display speeds of any objects that pass through, from zero to 99.99 km/h.