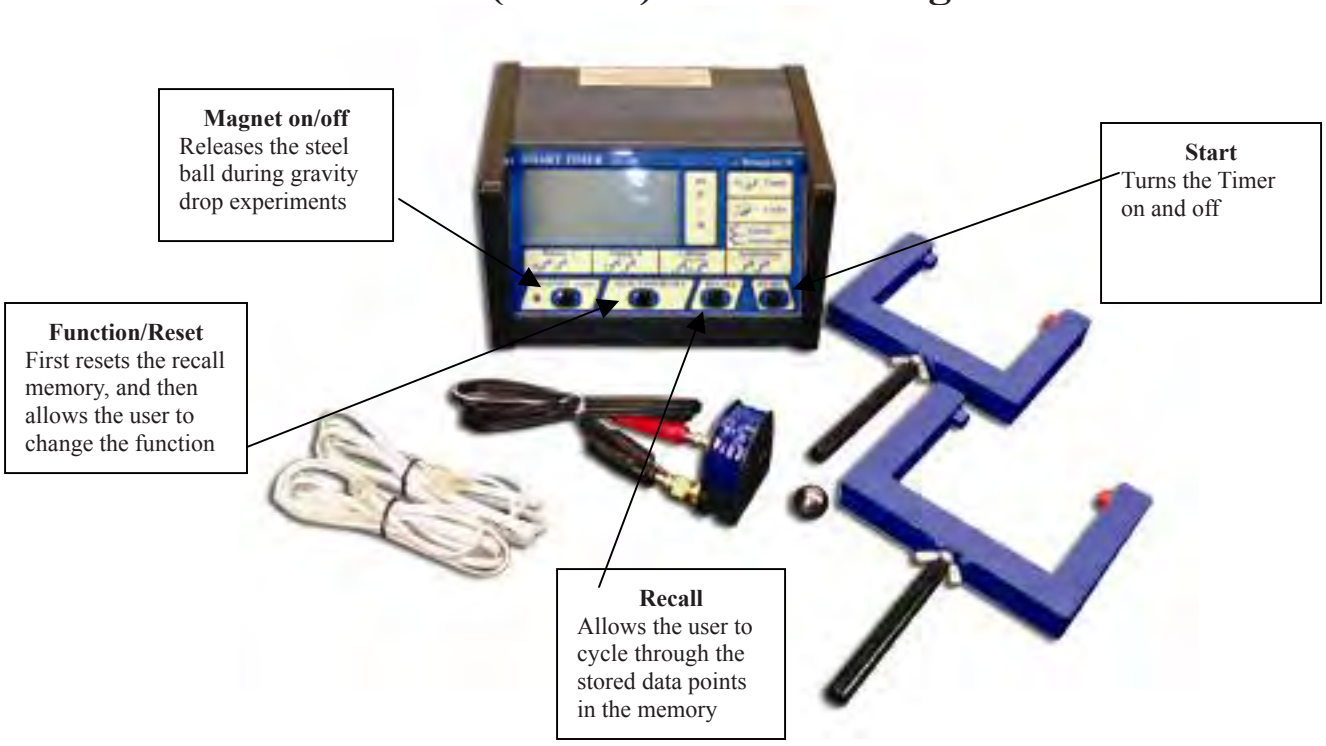
611-0103 (25-195) Smart Photogate Timer



Additional Materials (Optional)

- Ring Stand
- Halls Car with Picket Fence
- Air Track
- Free Fall Picket Fence
- Single and U-shaped triggers

Warranty, Replacement Parts:
We replace all defective or missing parts free of charge. Additional replacement parts may be ordered. We accept Mastercard, Visa, American Express, and school P.Os. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse, or normal wear and tear.

Introduction:
The purpose of this device is to allow precise timing of physics motion experiments.
The 25-195 Photogate Timer has seven separate functions and may be used to count time, measure acceleration, acceleration due to gravity, and cycles when used with air track and collision devices. The 25-195 uses a four digit LCD and has a timer range up to 1000 seconds, with an accuracy of .0001seconds. The timer conveniently displays its functions with a large graphical user interface.
The unit is rechargeable and may be used with or without the adaptor. The recharge time is about 12 hours.

Care and Storage:
The timer will need to be recharged from time to time. The unit should be charged periodically when not in use. If the time that the unit will stay charged is reduced, the battery may have developed a "memory" problem. Simply allow the unit to fully discharge, followed by a full 12 hour charge cycle.

How to use:
The Timer must be assembled prior to use. Begin by plugging the photogate cord into the back of the Timer. Plug the magnet release accessory into the back of the unit if you are performing the gravity acceleration experiment (5) on the next page, otherwise it does not need to be attached. Next, plug the power supply into the back of the Timer. Press the start button and you are ready to use your Timer.

See diagram at top..
The Timer has 4 control buttons:

The ***Magnet*** button is used to turn the electromagnet accessory on and off during experimentation. This allows the included steel ball to be released.
The ***Function/Reset*** button allows the user to clear the memory and then select which timer function they wish to use.
The ***Recall*** button will cycle through the stored memory of times of various events.
The ***Start*** button will turn the timer on and off.
The photogates used with this timer use an optical "beam" to trigger the timer to record an event. When an object passes through a photogate, it is referred to as the photogate being "interrupted". This interruption will be recorded in a manner determined by the function being used.
When performing experiments with the photogates, it is important that the object that is interrupting the photogate have straight smooth edges, and a length (width) that can be accurately measured. Ideally, the object that passes through the photogate will be a 1cm metal rectangle. These are commonly used with air tracks. It is also important that the photogates are "square" to the experiment being performed so that the timing is not distorted.

Smart Photogate Timer Functions:

1. Timing I

The Timing I function only uses photogate 1. Press the function button until Timing I is displayed. From this point on the timer is ready for photogate 1to be tripped. The Timing I function will store up to 10 data points in its memory. The data points will be the time in which the photogate was interrupted. To access the stored data points, press the recall button. This will cause the timer to display the series of time data points as ***P1.1***, then ***P1.2***, and so on until ***P1.10***.
With the time shown on the timer, and the length of the article passing the photogate, the velocity may be measured for each data point using V=L/T. Where V is the velocity, L is the length of the object breaking the photogate, and T is the time reading from the timer.
If a picket fence accelerating due to gravity is being passed through the photogate, the individual velocities calculated above may be graphed to show the acceleration due to gravity A=V/T. Where A is the acceleration, V is the velocity, and T is the time.
The Timing I function is especially useful when performing experiments with either a vertical drop picket fence like the Science First ***44-444 Picket Fence*** or a halls car mounted picket fence such as the Science First ***40-216 Halls Car with Picket Fence***.

2. Timing II

The Timing II function uses both photogate 1and photogate 2 in a series. The function will measure the time between photogate 1being tripped and photogate 2 being tripped. This function is useful for measuring the time of motion between two discrete points.

3. Collision

The Collision function uses both photogate 1and photogate 2 in a series. The function is designed to work with an air track, but may be used with dynamics cars as well. The function depends on two masses (air track carts), either equal or unequal in mass, being launched to impact at a point between the photogates. Each mass must launch from a given distance from impact, and pass through their respective photogates once before impact, and once after impact for elastic collisions.
The timer will display the data points with the following output:
P1.1 is the photogate interrupt time for the first (launching) pass through photogate 1.
P1.2 is the photogate interrupt time for the second (returning) pass through photogate 1.
P2.1 is the photogate interrupt time for the first (launching) pass through photogate 2.
P2.2 is the photogate interrupt time for the second (returning) pass through photogate 2.
If an inelastic collision takes place, and one of the masses passes through its opposite photogate (for a total of three passes through that gate), the timer will list a time of P1.3 instead of P2.2.
The velocity of each pass may be measured as V=L/T, here V is the velocity, L is the length of the object interrupting the photogate, and T is the time reading from the timer.

4. Acceleration

The Acceleration function uses both photogate 1and photogate 2 in a series. The accelleration function requires the use of a U-shaped trigger which will double trigger each gate. The function will display the following measurements as the photogates are interrupted:
1 is the time that photogate 1was interrupted.
2 is the time that photogate 2 was interrupted.
1-2 is the time in between the two photogates.
The velocities at the individual photogates may be calculated as before (see function 1. Timing I) using V=L/T.
The Acceleration may be calculated using A=(Vf-Vi)/T. Where A is the acceleration, Vf is the final (second) velocity, Vi is the initial (first) velocity, and T is the time between the two.

5. Gravity Acceleration

The Acceleration function uses photogate 1, photogate 2, and the ball release magnet. The function is designed to release a steel ball from the included electromagnet, and calculate the acceleration due to the earth's gravitational pull.
The photogates and ball release must be suspended in a way in which the following conditions are met:
The magnetic ball release and the photogates are plugged into the timer.

The ball release must be suspended at the top of a support rail so that ball, when released, will pass through the optical sensors of photogate 1and then photogate 2.
The magnetic ball release must be level. The magnetic point must aim towards the ground.
Press the Magnet button on the timer so that it is lit.
Suspend the 1/2 inch (12.5mm) steel ball from the bottom of the magnetic point so that it can spin freely from the point.
Press the Magnet button on the timer to release the ball, and thus interrupt the photogates. The timer will display the following output:
1 is the time from when the ball is released until it interrupts photogate 1.
2 is the time until the ball interrupts photogate 2.
Measure the distance from the lower level of the ball before it is released to each of the photogates. From the collected information, you may work out the value of G (acceleration due to gravity).
Two individual calculations may be worked out (one for each photogate) by using **G= 2H/T2**. Where G is the acceleration due to gravity, H is the vertical distance between the bottom of the ball and the given photogate, and T is the time recorded by the timer.

6. Cycles (Period)
The Cycles function uses photogate 1to record the time of 1-100 cycles in harmonic motion and spring bob experiments. After the first interruption the timer will begin to count complete cycles of harmonic motion. This means that the photogate will be interrupted two times for every cycle count.
The recall button will show the total time of the event, and will then display the time of the last 20 cycles. The cycles will display as follows: **E1**, **E2**, ...**E20**.

7. Count
The count function uses photogate 1to register a count on the timer every time the photogate is interrupted. The count range is 1 to 9999.

25-195 Smart Photogate Timer Curriculum
Content: Physical Science Standards
Grades 5-8: *Motions and forces*
Grades 9-12: *Motions and forces*