

Modular Circuits Generator

EM-3455

Introduction

The Modular Circuits Generator is a hand-crank generator accessory for PASCO Modular Circuits. When the crankshaft of the generator is turned, a circular holder containing a set of magnets rotates in response. When set up directly adjacent to a Modular Circuits coil, this rotation will induce a voltage in the coil. The device includes a photodetector which can monitor the rotation of the magnet holder, allowing students to track its angular speed in PASCO Capstone or SPARKvue data collection software. The generator can also act as a motor when alternating current is passed through the adjacent coil.

CAUTION: To avoid potential harm to fingers, do NOT touch the generator's gears while they are turning.

WARNING: This product contains small magnets. Swallowed magnets can stick together across intestines causing serious infections and death. Seek immediate medical attention if magnet(s) are swallowed or inhaled.

Components

Included equipment:

- Generator module, including magnet holder and gear shaft
- 8× coated neodymium magnets
- Photodetector cable
- 3× photodetector disks (8 segment, 4 segment, and 2 segment)
- Pulley wheel

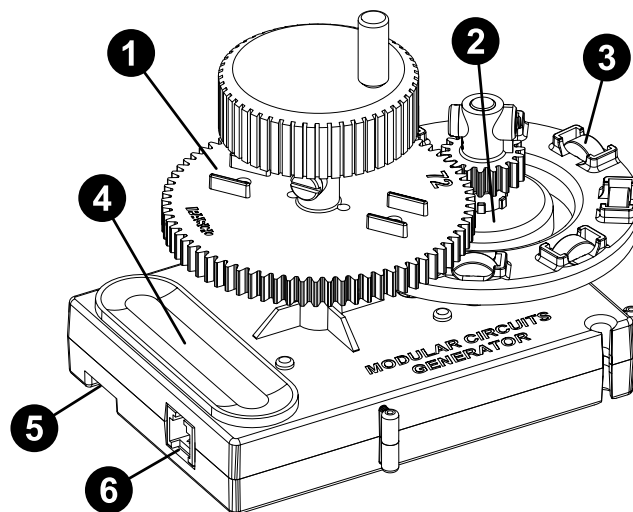
Required equipment:

- Any of the following coils:
 - Modular Circuits Coil, 1000 Turn (EM-3448)
 - Modular Circuits Coil, 500 Turn (EM-3457)
 - Modular Circuits Coil, 2000 Turn (EM-3458)

Recommended equipment:

- Either of the following Modular Circuits kits:
 - Basic Modular Circuits Kit (EM-3535)
 - Essential Physics Modular Circuits Kit (EM-3536)
- Wireless AC/DC Module (EM-3533)
- Wireless Voltage Sensor (PS-3211A)
- Super Pulley with Clamp (ME-9448B)
- Gear Set (ME-7021)
- Wireless Smart Gate (PS-3225) or PASCO interface with digital ports
- PASCO Capstone or SPARKvue data collection software

Features



1 Crankshaft with 72-tooth gear

Turn the handle on top of the crankshaft to power the generator.

2 Magnet holder with 18-tooth gear

Rotates in response to the motion of the crankshaft. The 18-tooth gear can be replaced with the pulley wheel when driving the magnet holder with a Super Pulley with Clamp. The photodetector is located on the base beneath the magnet holder. The photodetector disks need to be installed on the underside of the magnet holder.

3 Magnets

Insert into the eight slots on the magnet holder.

4 Handhold

Hold this point to secure the module in place while turning the crankshaft.

5 Pulley attachment point

Attach a Super Pulley with Clamp here to set up a system in which the magnet holder is driven by a falling mass.

6 Photodetector connection port

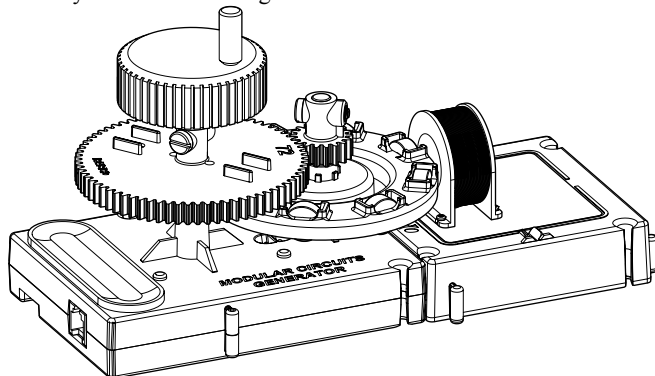
Use to connect the generator's photodetector to a Wireless Smart Gate or digital port on a PASCO interface using the included cable.

Usage

The Modular Circuits Generator can be used for a wide variety of Modular Circuits experiments. The following steps describe some of the more common uses for the generator.

Generate voltage

1. Install the crankshaft and magnet holder onto the Modular Circuits Generator, as shown below.
2. Insert the magnets into the slots in the magnet holder in alternating orientations.
3. Attach a coil module to the front of the generator so that the coil is directly in front of the magnet holder.



4. To measure voltage, attach the leads of a voltage sensor across the coil using jumper clips from a Modular Circuits set.
5. Press down on the handhold and begin turning the crankshaft.

Measure speed

The photodetector built into the base of the Modular Circuits Generator can be used to measure the angular speed of the magnet holder as it rotates. This procedure requires the included photodetector disks and a Wireless Smart Gate (PS-3225) or a PASCO interface, such as the 850 Universal Interface (UI-5000) or 550 Universal Interface (UI-5001).

1. Remove the crankshaft and magnet holder from the base of the Modular Circuits Generator.
2. Place one of the photodetector disks onto the underside of the magnet holder, with the black and white segments facing outward.
3. Return the crankshaft and magnet holder to the base.
4. Plug one end of the photodetector cable into the connection port on the base. Connect the other end to the digital input of a Wireless Smart Gate or a PASCO interface.
5. Connect the Smart Gate or interface to PASCO Capstone or SPARKvue.
6. Configure the Smart Gate or interface to recognize the photodetector:
 - **SPARKvue:** In the **Select measurements for templates** column, select the **Properties** icon next to the name of the digital channel to which the device is connected. Select **Modular Circuits Generator** from the list of device options, then select **OK**.

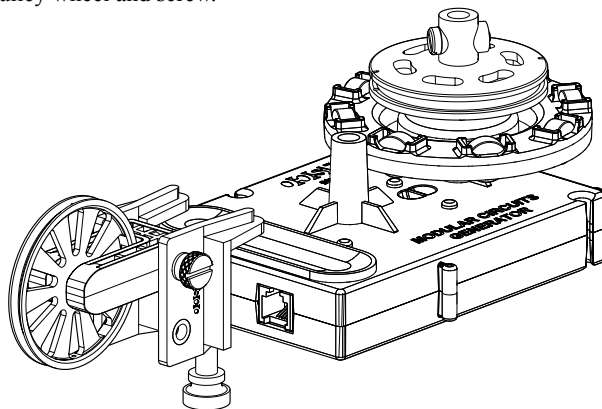
- **Capstone:** In the **Hardware Setup** tool, locate the image representing the Wireless Smart Gate or digital interface. Click the yellow circle over the port to which the Modular Circuits Generator is connected and select **Modular Circuits Generator** from the list of options.

7. Configure the Smart Gate or digital interface for the number of segments on the photodetector disk:
 - **SPARKvue:** Immediately after setting up the Modular Circuits Generator, you will be given the prompt to select a value for the **Number of Segments** parameter. Select the value matching the number of segments on your chosen disk, then select **OK**.
 - **Capstone:** In the **Hardware Setup** tool, select the **Properties** icon next to the Modular Circuits Generator's name. In the Properties window, select the appropriate option for **Number of Segments** and click **OK**.
8. Create a graph display of angular speed versus time.
9. Begin data collection, then begin turning the crankshaft on the generator.

Rotate magnet holder with the pulley

The magnet holder can be rotated by a falling mass hung over a Super Pulley by a thread.

1. Remove the crankshaft from the Modular Circuits Generator.
2. Clamp the Super Pulley to the base over the pulley mounting slot.
3. Unscrew the anti-backlash screw and remove the 18-tooth gear on top of the magnet holder. Replace the gear with the included pulley wheel and screw.



4. Tie a loop on one end of a thread and loop it around the notch on the pulley wheel. Tie the other end of the thread to the mass which will drive the magnet holder.
5. Hang the thread over the pulley, then wind the magnet holder clockwise to spool the thread until the mass is just below the pulley.
6. Release the mass and allow it to descend freely. The magnet holder will rotate as the mass falls.

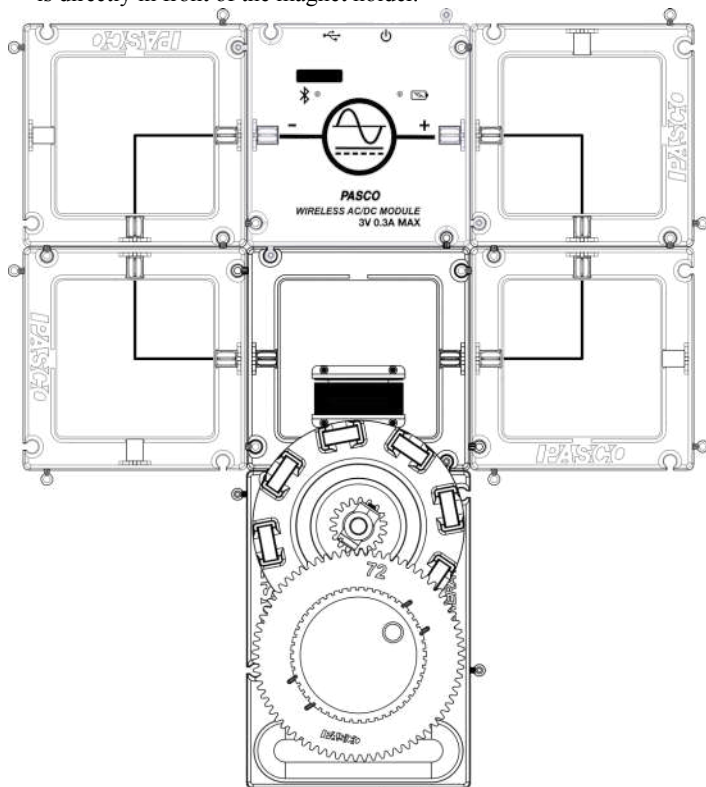
Use the generator as a motor

By passing an AC signal through a coil, the magnet holder on the Modular Circuits Generator can be made to function as a motor. This experiment requires a Wireless AC/DC Module (EM-3533) or other programmable power supply compatible with PASCO Capstone or SPARKvue.

In addition to a typical AC signal, the Modular Circuits Generator can also be made to act as a motor with Blockly code. The photodetector outputs a measurement called **State**, which has a value of 0 when one of the white segments of a photodetector disk is over the detector and a value of 1 when a black segment is over the detector. The value of this measurement can be used to output a positive voltage when one color is detected and a negative voltage when the other color is detected.

Use an AC signal

1. Remove the crankshaft from the Modular Circuits Generator base.
2. Using Modular Circuits components, construct a circuit including the programmable power supply and a coil module. The 500 Turn Coil (EM-3536) will produce the best results.
3. Attach the coil module to the front of the generator so that the coil is directly in front of the magnet holder.

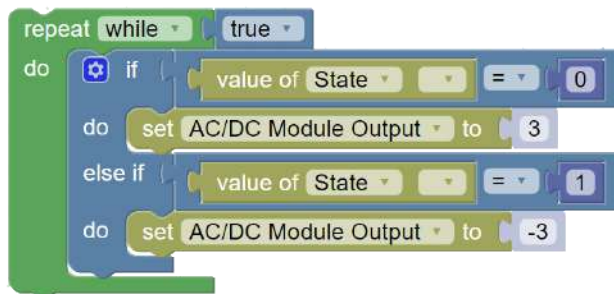


4. Insert the magnets into the magnet holder in alternating orientations.
5. Connect the power supply to SPARKvue or Capstone.
6. Open the signal generator controls:
 - **SPARKvue:** Select **Signal Generator and Scope** from the list of Quick Start Experiments.
 - **Capstone:** Select **Signal Generator** from the **Tools** palette on the left.

7. Set the power supply to output an AC signal. A square wave with a frequency of approximately 8 Hz will produce the most reliable results.
8. Begin outputting the signal, then give the magnet holder a gentle turn with your hand until it begins spinning independently. (This may take a few tries.)

Use Blockly code

1. Remove the crankshaft from the Modular Circuits Generator base.
2. Place one of the photodetector disks onto the underside of the magnet holder, with the black and white segments facing outward. The 8-segment disk will produce the best results.
3. Using Modular Circuits components, construct a circuit including the programmable power supply and a coil module. The 500 Turn Coil (EM-3536) will produce the best results.
4. Attach the coil module to the front of the generator so that the coil is directly in front of the magnet holder.
5. Insert a number of magnets into the magnet holder equal to the number of segments on the photodetector disk. Make sure that the magnets are evenly spaced around the magnet holder in alternating orientations, and that the center of each segment is aligned with a magnet.
6. Plug one end of the photodetector cable into the connection port on the base. Connect the other end to the digital input of a Wireless Smart Gate or a PASCO interface.
7. Start SPARKvue or PASCO Capstone and connect the power supply and the Smart Gate or interface to the program.
8. Configure the Smart Gate or interface to recognize the photodetector, as described in **Measure speed**.
9. In the Blockly code workspace, create code which will output a positive voltage from the power supply when the value of state is 0 and a negative voltage of the same magnitude when the value of state is 1, or vice versa.



10. Begin outputting the signal, then give the magnet holder a gentle turn with your hand until it begins spinning independently.

Software help

The SPARKvue, PASCO Capstone, and chemvue Help provide information on how to use this product with the software. You can access the help from within the software or online.

SPARKvue

Software: Main Menu  > Help

Online: help.pasco.com/sparkvue

PASCO Capstone

Software: Help > PASCO Capstone Help

Online: help.pasco.com/capstone

Specifications and accessories

Visit the product page at pasco.com/product/EM-3455 to view the specifications and explore accessories. You can also download experiment files and support documents from the product page.


Experiment files

Download one of several student-ready activities from the PASCO Experiment Library. Experiments include student handouts and teacher notes. Visit pasco.com/freelabs/EM-3455.

Technical support

Need more help? Our knowledgeable and friendly Technical Support staff is ready to answer your questions or walk you through any issues.

 Chat <https://ste.education/>

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Limited warranty

For a description of the product warranty, see the Warranty and Returns page at www.pasco.com/legal.

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Product end-of-life disposal



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CE statement

This device has been tested and found to comply with the essential requirements and other relevant provisions of the applicable EU Directives.