EM-09 Universal Spark Generator

Next-generation replacement for the EM-01 Basic Spark Generator and the EM-07 Precision Spark Generator

Description and General Use

The spark generator supplies the high voltage, short duration pulses for spark recording. These spark pulses are synchronized to the power line and make use of this inherently stable frequency reference. The generator delivers pulses at rates best suited to air table and air track experiments. The spark is controlled remotely using a foot switch or push button.

Spark recording is the most convenient way of obtaining a permanent record of the position of a moving object as a function of time. The sparks jumping from the body through the spark paper to the ground plane mark the paper with the path of the object. On the air table, the spark jumps from the electrode at the center of the first puck through the recording sheet to the special carbon paper to the second puck and back to the spark generator, marking the paper with the path of both pucks.

One caution must be observed when using this recording method. The spark requires that the experiment be wired for high voltage. This is not usually a problem, but a shock hazard does exist when the generator is operating.

All adjustments should be made with the spark turned off.

The operator of the spark generator should make the adjustments so that a co-worker doesn't accidentally turn on the unit while adjustments are being made. The push button, can be used as a safety lock connecting it before adjustments are made.

NOTE

Owing to these properties of spark recording, NO WARRANTY OF SHOCK SAFETY IS EXPRESSED OR IMPLIED. The shock delivered by the unit is very uncomfortable and should be avoided.

Spark recording does radiate a small amount of electromagnetic interference, which may affect other equipment in the laboratory. Digital equipment, such as computers or electronic counters, are often susceptible to this sort of interference. Normally, no damage is done, but use of the equipment is difficult during spark recording.

To minimize this interference, use the spark generator with a grounded outlet, so that the instrument case is well grounded. The case is internally connected to the ground lead in the power cord to eliminate most of the interference. Check with your laboratory neighbors before running the spark generators so that their work is not interrupted.

NOTE

The spark should not be triggered when no external gap is present or without verifying that the external gap used is less than 7mm. If the spark is heard firing across the safety gap inside the unit, the external gap is too large and should be adjusted.

The accuracy of the data points obtained from a spark recording depends primarily upon the wander of the spark between the spark wire and the ground plane. Anyone who has watched a lightning bolt during an electrical storm knows that the discharge does not travel in a straight line. What is true for lightning is also true for these small sparks. Several successive sparks do not strike the ground plane at the same point. The easiest way to minimize this spread is to make the spark very short. By using a short gap, there is little opportunity for the spark points to spread.

Experimental runs are generally on the order of a few seconds in duration. The unit is not designed to produce sustained spark for an extended period of time.

Do not trigger spark production for more than ~1 minute; overheating of componentry may occur.

Calibration

There are no user-serviceable internal adjustments in the Universal Spark Generator. Circuit operation is digital, using high reliability CMOS circuits. All internal settings and components, including the safety spark gap, are factory-set and should not be altered. Should you experience difficulties, do not attempt repair. Return the instrument to Daedalon with a description of the trouble and we will repair it safely for you.

For Use with Air Tables

Set up

1. Place the spark generator near the air table with clear access to the front panel.
2. Connect the two 4mm banana plugs from the hose manifold to the corresponding jacks on the rear panel of the spark generator.
3. Connect the foot switch to the spark generator using the phono jack in the rear of the case. Place the foot switch on the floor so that the user can press it conveniently after releasing the pucks.
4. Connect the spark generator to the proper power supply voltage. It is important that the ground pin in the line cord be attached to a good ground for reliable operation.

Operation

1. Place a sheet of the carbon paper provided on the glass table top of the air table with the black side up.

2. Place a sheet of white recording paper on top of it.
3. Turn on the air compressor and practice releasing the pucks so that they impact near the center of the table.
4. Turn on the spark generator and set the frequency at approximately 10Hz.
5. Practice releasing the pucks once again.
6. Release the pucks, pressing the foot switch only after they have left your hands. The spark will just be audible.
7. Keep the foot switch depressed until the pucks have collided and are headed for the walls. Release the switch before they hit the walls for a neat recording.

NOTE
The pucks are well insulated and, if held by the vertical tubes, can be released with the spark operating without shocking the operator. A painful shock may be received from the edges of the puck. For safety, step on the foot switch only after the pucks are released.

Single Puck Recording
There are a number of experiments in which the path of a single puck is all that is required. Motion on an inclined plane, trajectories, acceleration with a constant force, and angular motion with a central force are some examples. It is important to remember that the second puck must be resting on the carbon paper. This is necessary to provide the return path for the high voltage pulse. If the second puck is removed from the carbon paper, the spark generator will fire across its internal safety gap.

Do not operate the spark generator unless both pucks are on the carbon paper.

To keep the second puck from moving and getting in the way during recording, fold a small piece of paper and place under the edge of the puck. This will keep it from floating and moving about. Be sure that it is sitting over the carbon paper when it is immobilized.

For Use with Air Tracks
1. Place the spark generator near the air track with clear access to the front panel.
2. Connect the black wire of the output to the grounded side of the experiment. For an air track, connect this wire to the track end stop.
3. Connect the red wire of the output to the spark wire on the air track.
4. Insert the pushbutton trigger into the rear panel jack.
5. Connect the spark generator to the proper power supply voltage. It is important that the ground pin in the line cord be attached to a good ground for reliable operation.
6. Attach a strip of spark paper to the air track in the slot provided for it on the opposite side from the meter tape. The spark paper should have the black side facing the track surface. The polarity of the spark discharge affects the visibility of the mark made on the paper; for clearest recording, maintain the proper polarity.
7. Place a glider on the air track and adjust the glider wire so that it is close to the spark wire and the spark paper on the track. The manual for the Spark Wire Kit EA-14 describes the assembly of the spark wire on the glider in more detail. There should be a 2 mm gap between the wire at both ends.
8. Make sure no one is touching the spark wire; the track itself is at ground potential and represents no hazard. Turn on the front panel switch. Press the push button and observe the spark. It should make a clear mark on the spark paper.
9. When the spark is properly adjusted, set the switch to the desired frequency and proceed with the experiment.

The EM-09 Universal Spark Generator can be synchronized with the start of an air track experiment, if using the Daedalon EA-04 Electro Release to hold the glider. The release has an electromagnet that mounts on the air track end stop. When powered, the magnet holds the steel bumper spring of the glider. When connected by the EM-05 Patch Cable, the release box replaces the trigger push button. When the *RELEASE* button is pressed, the power is removed from the magnet coil and the spark generator is activated. The spark generator operates as long as the *RELEASE* button is depressed. In this way, the spark starts at the moment of release of the glider, giving a clear start to the recording, thus facilitating data reduction.

Specifications
Frequencies 5-60 Hz
Stability Typically ±0.1%
Spark Voltage Approximately 30 kV; Depends upon the gap length Spark normally jumps a 15 mm gap
Connections:
High Voltage Color-coded HV and ground leads, 1.2 m long w/alligator clips
Trigger Pushbutton, on 1 m cord
Power 120Vac 60Hz line power; 2A at line frequency; 0.08A idle
Dimensions 12.5"l x 4"h. x 5.75"w
Weight 3.3 kg (7.3 lbs) net.

NOTE: *No user serviceable parts inside unit. Please contact Science First for repair or replacement.

Warranty and Parts:

We replace all defective or missing parts free of charge. Additional replacement parts may be ordered. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse or normal wear and tear. Intended for children 13 years of age and up. This item is not a toy. It may contain small parts that can be choking hazards. Adult supervision is required.