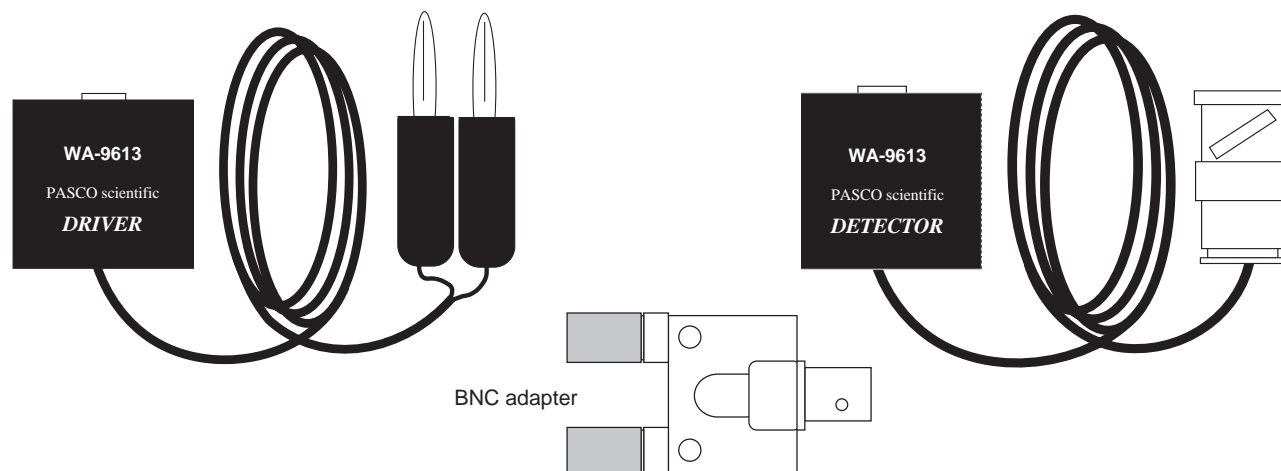


**Instruction Sheet
for the PASCO
Model WA-9613**

Driver/Detector Coils
(for use with the WA-9611 Sonometer)



Introduction

The PASCO Model WA-9613 Driver/Detector Coils are designed to be used with PASCO's Model WA-9611 Sonometer. The Driver Coil, when powered by a function generator (such as PASCO Models PI-9598 Student Function Generator or PI-9587B Digital Function Generator) capable of delivering up to 0.5 ampere, induces vibrations in the steel wires of the Sonometer. The amplitude and frequency of the vibrations are determined by the output of the function generator. The Detector Coil converts the wire vibrations into an electronic signal that can be viewed on an oscilloscope, producing a trace that shows the motion of the wire at the position of the Detector Coil.

You can use a PASCO Computer Interface such as the CI-6500 for DOS-compatible computers or the AI-6501 for Apple® II computers in place of the oscilloscope. You can use a PASCO Computer Interface such as the CI-6550 for Macintosh® computers or the CI-6565 for Windows™-compatible computers with a PASCO Power Amplifier in place of both the oscilloscope and the function generator.

Equipment

The Driver/Detector Coils come with a BNC adapter. You can use the BNC adapter and a CI-6503 Voltage Sensor to connect the Detector Coil to the CI-6550 or CI-6565 Computer Interface.

Additional Equipment

- WA-9611 Sonometer

Recommended Equipment

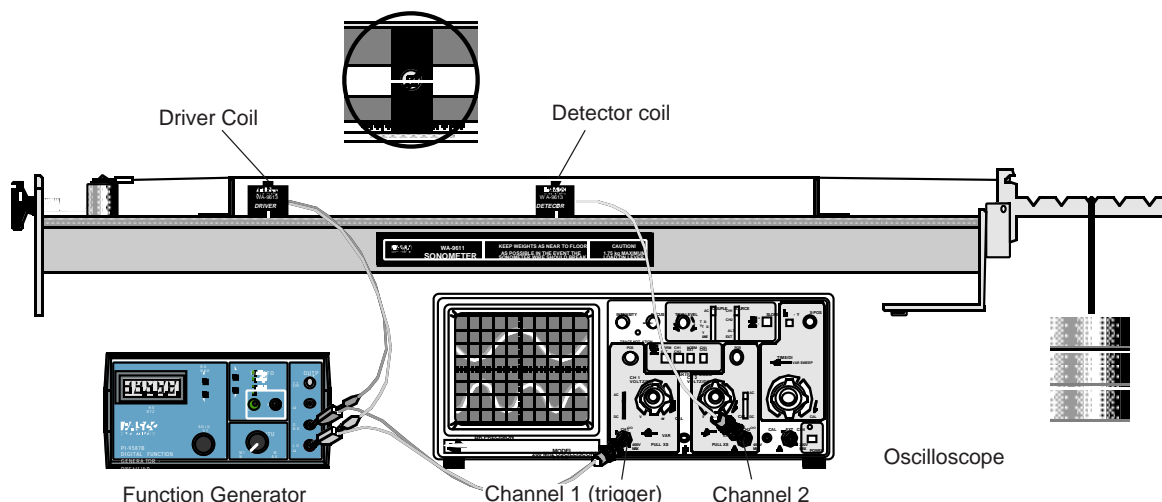
- CI-6550 or CI-6565 Computer Interface and a Power Amplifier (CI-6552)
- OR
- Series 6500 Computer Interface, CI-6508 Input Adapter Box, and a function generator capable of producing 0.5 A
- OR
- dual trace oscilloscope and a function generator capable of producing 0.5 A

Optional Equipment (for use with function generator)

- banana plug patch cords and BNC-to-dual banana adapter (for connecting the function generator to the BNC connector on an oscilloscope)

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This instruction sheet written/edited by: Dave Griffith



Operation

To connect the Driver/Detector Coils to a function generator and oscilloscope:

- ① Connect the Driver and Detector Coils to the function generator and oscilloscope as shown in the diagram. Connect the Driver Coil directly to the output of the PASCO PI-9587B Digital Function Generator. Connect the Detector Coil directly to channel two of an oscilloscope that has a BNC connector. You can use banana plug patch cords and a BNC-to-banana plug adapter to connect the output of the function generator to channel one of an oscilloscope that has a BNC connector.
- ② Set the gain on channel-one of the oscilloscope to 5 mV/div. Adjust the oscilloscope so it triggers on the signal from the function generator.
- ③ Position the Driver Coil approximately 5 cm from one of the bridges of the Sonometer.

Depending on the wave pattern you are trying to produce, you might want to place the driver at some other position. It will drive the string best if it is placed at an antinode of the wave pattern.

- ④ Position the Detector midway between the bridges initially, though for some patterns, you may want to reposition it to best pick up the signal. As with the Driver Coil, it works best when positioned near an antinode of the wave pattern.
- ⑤ Set the function generator to produce a sine wave. Set the frequency to a value between 100 and 200 Hz. Adjust the amplitude to about 5 V (approximately half of maximum). Slowly vary the frequency of the function generator output. When you reach a resonant frequency, you should see the motion of the string and the sound produced by the vibrating string should be a maximum. The wave pattern shown on the oscilloscope should become a clean sine wave. If you can't see or hear the string, raise the amplitude of the function generator output and try again.

Using the Driver/Detector Coils with a PASCO Computer Interface

There are several ways to use the Driver/Detector Coils with a PASCO Computer Interface. The method you use depends on the kind of computer, the interface (e.g., CI-6500, CI-6550, etc.), the device to control the driver coil, and whether you wish to do frequency analysis (Fast Fourier Transform or FFT) of the standing waves produced by the driver coil.

Computer	Interface	Device to drive coil	Software	FFT?
Apple II	AI-6501	Power Amplifier	<i>Power Amplifier (Apple II)</i>	no
Apple II	AI-6501	function generator	<i>Data Monitor (Apple II)</i>	no
DOS - PC	CI-6500	Power Amplifier	<i>Power Amplifier (MS-DOS)</i>	no
DOS - PC	CI-6500	function generator	<i>Data Monitor (MS-DOS)</i>	yes
Macintosh	CI-6550	Power Amplifier	<i>Science Workshop (Mac)</i>	yes
Macintosh	CI-6550	function generator	<i>Science Workshop (Mac)</i>	yes
Windows - PC	CI-6565	Power Amplifier	<i>Science Workshop (Windows)</i>	yes
Windows - PC	CI-6565	function generator	<i>Science Workshop (Windows)</i>	yes
Windows - PC	CI-6500	function generator	<i>Data Monitor (Windows)</i>	yes

To connect the Driver/Detector Coils to a Power Amplifier and PASCO Computer Interface:

- Connect the Power Amplifier DIN plug to channel C of the interface. Connect the Driver Coil to the output of the Power Amplifier.

► **CAUTION:** Do not turn on the power amplifier until you have set the output amplitude from within the program.

For the Series 6500 Computer Interface (e.g., CI-6500):

- Connect the BNC plug on the Detector Coil to the BNC jack on the CI-6508 Input Adapter Box, and the DIN plug on the Adapter Box to channel A of the interface. Turn the amplification select switch on the CI-6508 to 100X.

For the CI-6550 or CI-6565 Computer Interface

- Connect the BNC plug on the Detector Coil to the BNC adapter that is included with the Driver/Detector Coils. Connect the banana plugs of a CI-6503 Voltage Sensor to the BNC adapter. Connect the DIN plug of the Voltage Sensor to channel A of the interface.

To connect the Driver/Detector Coils to a Function Generator and PASCO Computer Interface:

- Connect the Driver Coil to the output of the function generator

For the Series 6500 Computer Interface (e.g., CI-6500):

- Connect the BNC plug on the Detector Coil to the BNC jack on the CI-6508 Input Adapter Box, and the DIN plug on the Adapter Box to channel A of the interface. Turn the amplification select switch on the CI-6508 to 100X.

For the CI-6550 or CI-6565 Computer Interface

- Connect the BNC plug on the Detector Coil to the BNC adapter that is included with the Driver/Detector Coils. Connect the banana plugs of a CI-6503 Voltage Sensor to the BNC adapter. Connect the DIN plug of the Voltage Sensor to channel A of the interface.

If you have another CI-6503 Voltage Sensor, use it to link the function generator to channel B of the interface. (This step is optional; it allows you to use the function generator for triggering, with slightly improved results.)

► NOTES

- ① For resonant wave patterns with an antinode in the center of the string (symmetrical patterns), you may occasionally see higher or lower harmonics superimposed on the driving frequency.
- ② If the driver and detector coils are too close together, the mutual inductance of the two coils may be great enough to induce a signal in the detector directly. The distance between the coils that is required to avoid this mutual inductance depends on the amplitude of the signal from the function generator to the driver coil, so you may need to experiment a bit to be sure your signal is coming only from the vibrating wire.
- ③ However, even if the signal to the detector is affected by mutual inductance, it should still be possible to locate the nodes and antinodes of a standing wave pattern. As you move the detector coil along the string nearer to the driver coil, the signal due to mutual inductance will rise steadily with decreasing distance. The nodes and antinodes of the wave pattern should still be detectable as relative maxima and minima within this steadily rising amplitude.

Limited Warranty

PASCO scientific warrants this product to be free from defects in materials and workmanship for a period of one year from the date of shipment to the customer. PASCO will repair or replace, at its option, any part of the product which is deemed to be defective in material or workmanship. This warranty does not cover damage to the product caused by abuse or improper use. Determination of whether a product failure is the result of a manufacturing defect or improper use by the customer shall be made solely by PASCO scientific. Responsibility for the return of equipment for warranty repair belongs to the customer. Equipment must be properly packed to prevent damage and shipped postage or freight prepaid. (Damage caused by improper packing of the equipment for return shipment will not be covered by the warranty.) Shipping costs for returning the equipment, after repair, will be paid by PASCO scientific.

Equipment Return

Should this product have to be returned to PASCO scientific, for whatever reason, notify PASCO scientific by letter or phone BEFORE returning the product. Upon notification, the return authorization and shipping instructions will be promptly issued.

►NOTE: NO EQUIPMENT WILL BE ACCEPTED FOR RETURN WITHOUT AN AUTHORIZATION.

When returning equipment for repair, the units must be packed properly. Carriers will not accept responsibility for damage caused by improper packing. To be certain the unit will not be damaged in shipment, observe the following rules:

- ① The carton must be strong enough for the item shipped.
- ② Make certain there is at least two inches of packing material between any point on the apparatus and the inside walls of the carton.
- ③ Make certain that the packing material can not shift in the box, or become compressed, thus letting the instrument come in contact with the edge of the box.