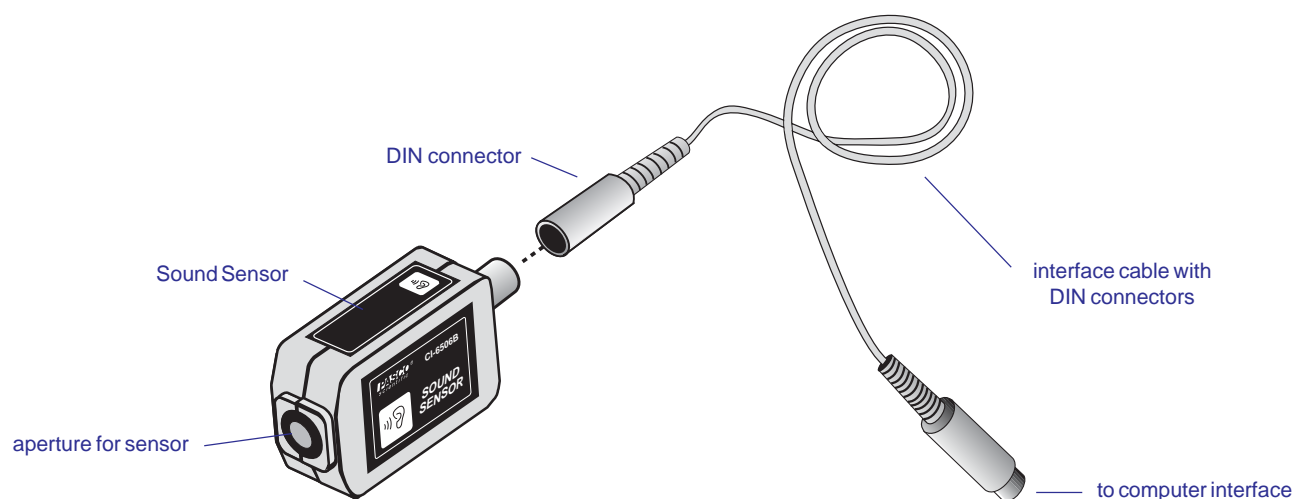


**Instruction Sheet  
for the PASCO  
Model CI-6506B**

## SOUND SENSOR



### Introduction

The PASCO CI-6506B Sound Sensor is designed to be used with a PASCO computer interface to make measurements of relative intensity of sound.

The sensing element of the Sound Sensor is an electret condenser microphone, which consists of an electret membrane, metal electrode, and field effect transistor that are in an efficient configuration yielding superior signal-to-noise ratios (>60 dB) and excellent frequency response (20 to 16,000 Hz).

Two stages of amplification are provided to condition the low-level signal from the microphone for input into the *ScienceWorkshop* computer interface. The output from the sensor is bipolar and ranges between  $\pm 10$  volts. When the sensitivity is raised to high in *ScienceWorkshop* (700 interface only), the Sound Sensor detects voltage levels as low as 0.0005 volts, corresponding to sound levels that are barely audible to the human ear. Sound levels ranging from classroom background noise (45 dB) to levels exceeding 100 dB are easily detected with the Sound Sensor.

The Oscilloscope and Fast Fourier Transform (FFT) functions of *ScienceWorkshop* may be used effectively

with the Sound Sensor: the Oscilloscope allows the student to view the Sound Sensor output directly, and the FFT function will transform the time domain signal from the sensor to a frequency domain display. These two functions allow the student to investigate the frequency composition of sound produced by the human voice, a tuning fork, or loud speaker driven by a complex waveform such as a square wave. Both the Oscilloscope and FFT functions may be used simultaneously.

The Sound Sensor can be plugged directly into any PASCO computer interface box or can be connected to the interface box using the supplied cable with 8-pin DIN connectors.

### Equipment Included:

- sound sensor in sensor box
- 6-foot cable with 8-pin DIN connectors

### Additional Equipment Required:

- Any PASCO *ScienceWorkshop*<sup>™</sup> computer interface (300, 500, or 700 series for Macintosh or Windows) or the 6500 series interface for DOS

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**Additional Equipment Suggested:**

- Tuning Forks (SE-9325 or SE-9326)
- Organ Pipe with Sliding Piston (SF-9328)
- Acoustics Demonstration Disk (SF-9410)

**Setup Procedure**

① Connect the Sound Sensor and any analog channel on the computer interface box with interface cable (Figure 1A),

or

insert the DIN plug of the Sound Sensor into the jack of any analog channel on the computer interface box (Figure 1B).

The sound level, which is measured in decibels can be calculated from amplitude of the voltage. The formula is.

$$B = 10 * \log(A^2/A(0)^2)$$

Where A is the amplitude of the voltage and A(0) is the theoretical amplitude for a sound level of 0 dB.

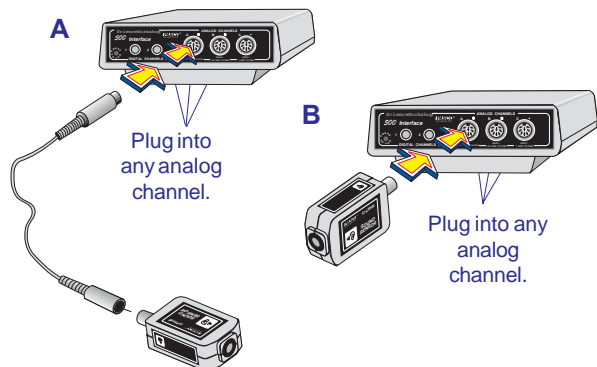
At a frequency of 440 Hz, A(0) = 10<sup>-4</sup> volts approximately.

To have Data Studio perform this calculation, click on the Calculate button and type the following equation:  
 sound level = 10 \* log(amplitude(10,10,001,v^2)/(10<sup>-8</sup>)).

In the Variables section of the Calculator, define v as Voltage, Ch A.

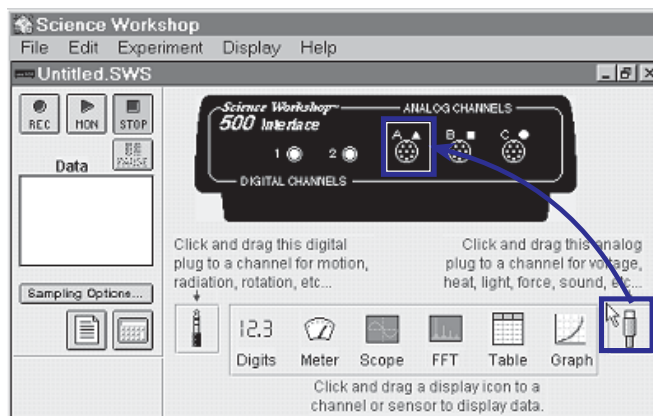
This equation is optimized for a sine wave at 440 Hz, so you may need to adjust the third argument of the amplitude function (it should be about equal to the period of the wave).

The value of 10<sup>-4</sup> volts is also optimized for 440 Hz. Since the response of the sound sensor varies with frequency, you may want to calibrate the equation for a different frequency. To do so, you would need a stand-alone sound level meter. Measure the sound level of as sound (B) with the meter, and the voltage amplitude (A) with the sound sensor. Use these values to solve for A(0) in the first equation above.



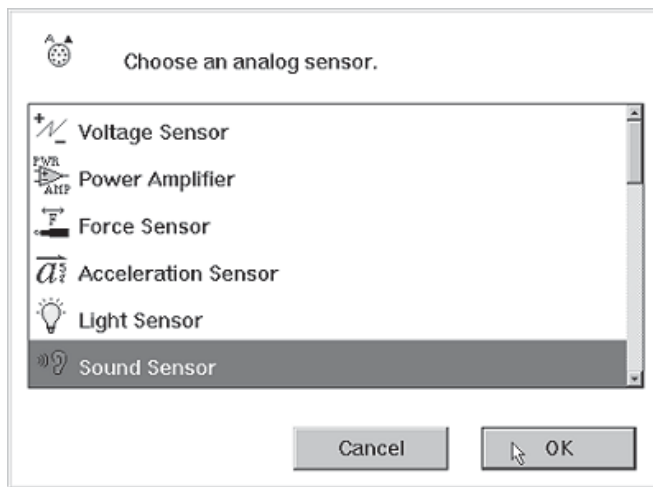
**Figure 1. Connecting the Sound Sensor into the computer interface.**

② Open the Experiment Setup window in *ScienceWorkshop*. Click and drag the analog plug icon to the analog channel icon that matches the analog port you are using for the Sound Sensor (Figure 2).



**Figure 2. Activating the analog channel in Science Workshop.**

③ Select "Sound Sensor" from the drop-down menu (Figure 3).



**Figure 3. Setting up the Sound Sensor in Science Workshop.**

④ Open a display window, such as the Oscilloscope display, by dragging and dropping the appropriate display icon to the Sound Sensor icon (Figure 4).

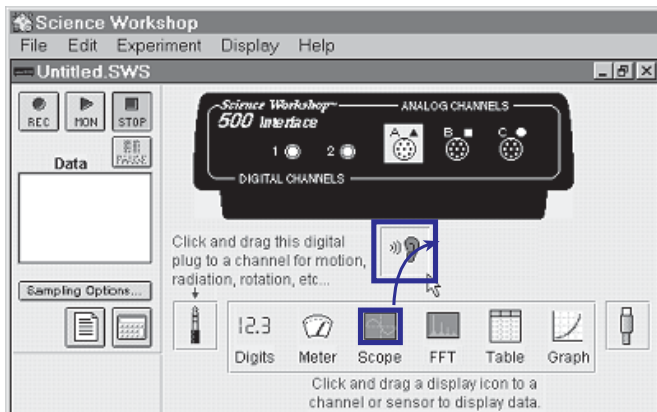


Figure 4. Opening a Display window in *ScienceWorkshop*.

- ⑤ Additional display windows can be opened by following the procedure in step 4.

### Calibration and Sensitivity Adjustment in *ScienceWorkshop*

- ① To open the Sound Sensor's calibration window, double-click on the Sound Sensor icon in the Experiment Setup window (see Figure 4).
- ② The sensitivity (gain) of channels A and B of the 300, 500, and 700 interfaces in *ScienceWorkshop* can be adjusted by selecting the appropriate level from the drop-down menu (Figure 5). If the Sound Sensor is producing voltage above 1 V, the sensitivity should be set to Low (1x). If the Sound Sensor is producing voltages between +1 V and -1 V, select Medium (10x). With the *ScienceWorkshop 700* interface, the sensitivity can be set to High (100x) if the voltage is very low (between +0.1 V and -0.1 V). Refer to the *User's Guide for ScienceWorkshop* for more details concerning calibration and adjusting the sensitivity setting.

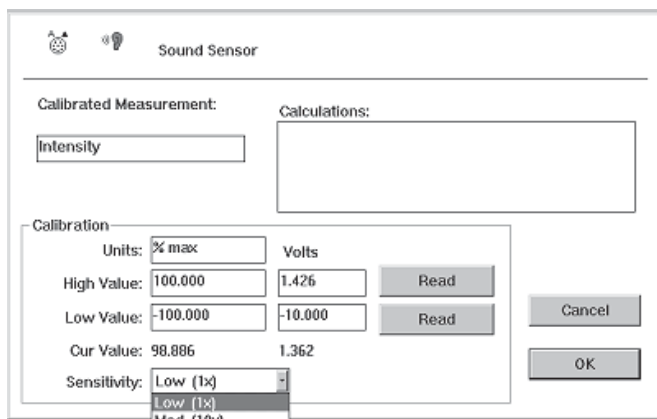


Figure 5. Dialog box for calibrating and adjusting the gain for the Sound Sensor in *ScienceWorkshop*.

### Mounting on an Experimental Apparatus

- ① Use the 1/4-20 screw connector located on the bottom of the sensor box to secure the Sound Sensor to an experimental apparatus (Figure 6). The alignment hole fits over an alignment pin included on some PASCO apparatuses.

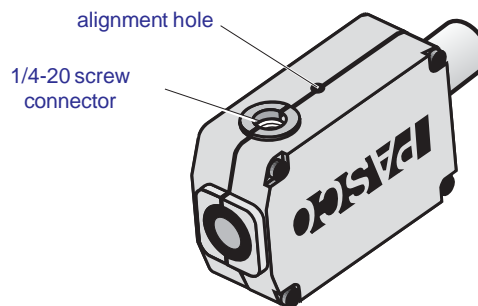
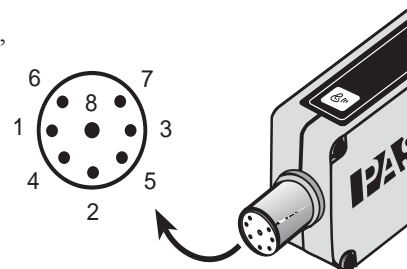


Figure 6. Mounting connector and alignment hole.

### DIN Connector Specifications

- 1: analog output (+), 0 to 10 V
- 2: analog output (-), signal ground
- 3: (no connection)
- 4: + 5 V DC power
- 5: power ground
- 6: +12 VDC power
- 7: -12 VDC power
- 8: (no connection)



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### **Equipment Return**

Should the product have to be returned to PASCO scientific for any reason, notify PASCO scientific by letter, phone, or fax 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 FROM PASCO.**

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 packing carton must be strong enough for the item shipped.
- ② Make certain there are 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, allowing the instrument come in contact with the edge of the packing carton.

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