

**Trig-Tek™**  
**402PSI**  
**Microphone Calibrator**  
**User Manual**

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**THANK YOU FOR PURCHASING THIS  
ASTRONICS TEST SYSTEMS PRODUCT**

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## RETURN OF PRODUCT

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Authorization is required from Astronics Test Systems before you send us your product or sub-assembly for service or calibration. Call or contact Customer Support at 1-800-722-3262 or 1-949-859-8999 or via fax at 1-949-859-7139. We can also be reached at: [atshelpdesk@astronics.com](mailto:atshelpdesk@astronics.com).

If the original packing material is unavailable, ship the product or sub-assembly in an ESD shielding bag and use appropriate packing materials to surround and protect the product.

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# FOR YOUR SAFETY

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Before undertaking any troubleshooting, maintenance or exploratory procedure, read carefully the **WARNINGS** and **CAUTION** notices.



**CAUTION**  
RISK OF ELECTRICAL SHOCK  
DO NOT OPEN



This equipment contains voltage hazardous to human life and safety, and is capable of inflicting personal injury.



If this instrument is to be powered from the AC line (mains) through an autotransformer, ensure the common connector is connected to the neutral (earth pole) of the power supply.



Before operating the unit, ensure the conductor (green wire) is connected to the ground (earth) conductor of the power outlet. Do not use a two-conductor extension cord or a three-prong/two-prong adapter. This will defeat the protective feature of the third conductor in the power cord.



Maintenance and calibration procedures sometimes call for operation of the unit with power applied and protective covers removed. Read the procedures and heed warnings to avoid "live" circuit points.

Before operating this instrument:

1. Ensure the proper fuse is in place for the power source to operate.
2. Ensure all other devices connected to or in proximity to this instrument are properly grounded or connected to the protective third-wire earth ground.

If the instrument:

- fails to operate satisfactorily
- shows visible damage
- has been stored under unfavorable conditions
- has sustained stress

Do not operate until performance is checked by qualified personnel.

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## DOCUMENT CHANGE HISTORY

Revision	Date	Description of Change
A	09/01/2011	Document Control release

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# Chapter 1

## Introduction

### Description

The 402PSI Microphone Calibrator (**Figure 1**) is designed to provide calibration of high intensity microphones and pressure transducer. The 402PSI is housed in a portable carrying case (12"x12"x7.5").



**Figure 1-1, 402 PSI Microphone Calibrator**

The 402PSI Microphone Calibrator is capable of delivering sound pressure levels from 0.1 to 1.0 PSI in 0.1 PSI increments and is accurate to  $\pm 5\%$ . The test manifold, which interfaces both the UNKNOWN and REFERENCE (Known) microphones to the sound transducer, is designed so that both microphones share a common cavity. The output of the reference or "KNOWN" microphone is used in a closed loop control to maintain an accurate sound pressure level in the test manifold. Frequencies are crystal controlled from 20 to 1500 Hz in 1 Hz steps.

The 402PSI is completely self-contained and comes with the sound transducer, reference pressure transducer, test manifold, microphone adapter (of your choice), calibration plug and power cord.

## Dimensions

Case	12" x 12" wide x 7.5" high.
Sound Transducer	4.5" dia. x 5.5" high.

## Weight

	40 lbs. with sound transducer
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## Theory of Operation

The 402PSI has synthesized frequencies from 20 to 1500 Hz in 1 Hz steps. This frequency signal is sent to an AGC (Automatic Gain Control) circuit that controls the signal level of the transducer driver (See Chapter 4, **Figure 4-1**, 402PSI Frequencies).

The Reference microphone senses the sound pressure level in the test manifold at the output of the transducer. The output of the reference microphone is amplified and then rectified by the true RMS AC to DC converter and compared to a reference voltage.

Any error from the comparison causes the compressor, via the AGC circuit to increase or decrease the input to the drive circuit until the DC from the converter matches the reference, thus maintaining a known, fixed sound pressure level in the test manifold. Because of the nature of the driver transducer, the output can have up to 5% distortion. By using a true root means square conversion at the AC to DC converter, the distortion can only alter the level by the square root of the sum of the components squared; for instance, if the signal component is 1 and the distortion component is 10% or 0.1, the level change will be .05% change, so the distortion has a very small effect on the control level.

$$\sqrt{(1)^2 + (0.1)^2} = 1.004987$$

Because the 10 dB step will be controlled by gain changes, the sound pressure level for each 0.1 PSI step will be as accurate as the gain set for each step which can be held +1%, so the accuracy of the sound pressure level generated at the reference microphone is established by a preset reference voltage and the gain of the microphone amplifier. Both the reference voltage and the gain can be controlled very accurately. So the calibration accuracy of the system will ultimately be the precision of the KNOWN reference microphone.

## Chapter 2

# Operation

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### General Information

For proper operation, it is necessary that the microphone to be tested is installed in the test manifold with the appropriate microphone adapter. If there are any questions regarding proper microphone adapters, contact the manufacturer.

The 402PSI is equipped with a manifold which interfaces the KNOWN and UNKNOWN microphones to the sound transducer. In this manifold, the two microphones share a common cavity. The KNOWN microphone fits securely in the manifold with a metal hold down nut. The UNKNOWN microphone must be installed using an adapter made especially for the microphone being tested. For best results, an air tight seal is desired between the microphone to be tested and its adapter. These adapters can be purchased from Astronics Test Systems. Custom adapters can be supplied on request. The exact dimensions for the new microphone are required if a special adapter is ordered.

### Front Panel Controls and Indicators

**Figure 2-1** shows the controls and indicators on the front panel of the 402PSI.

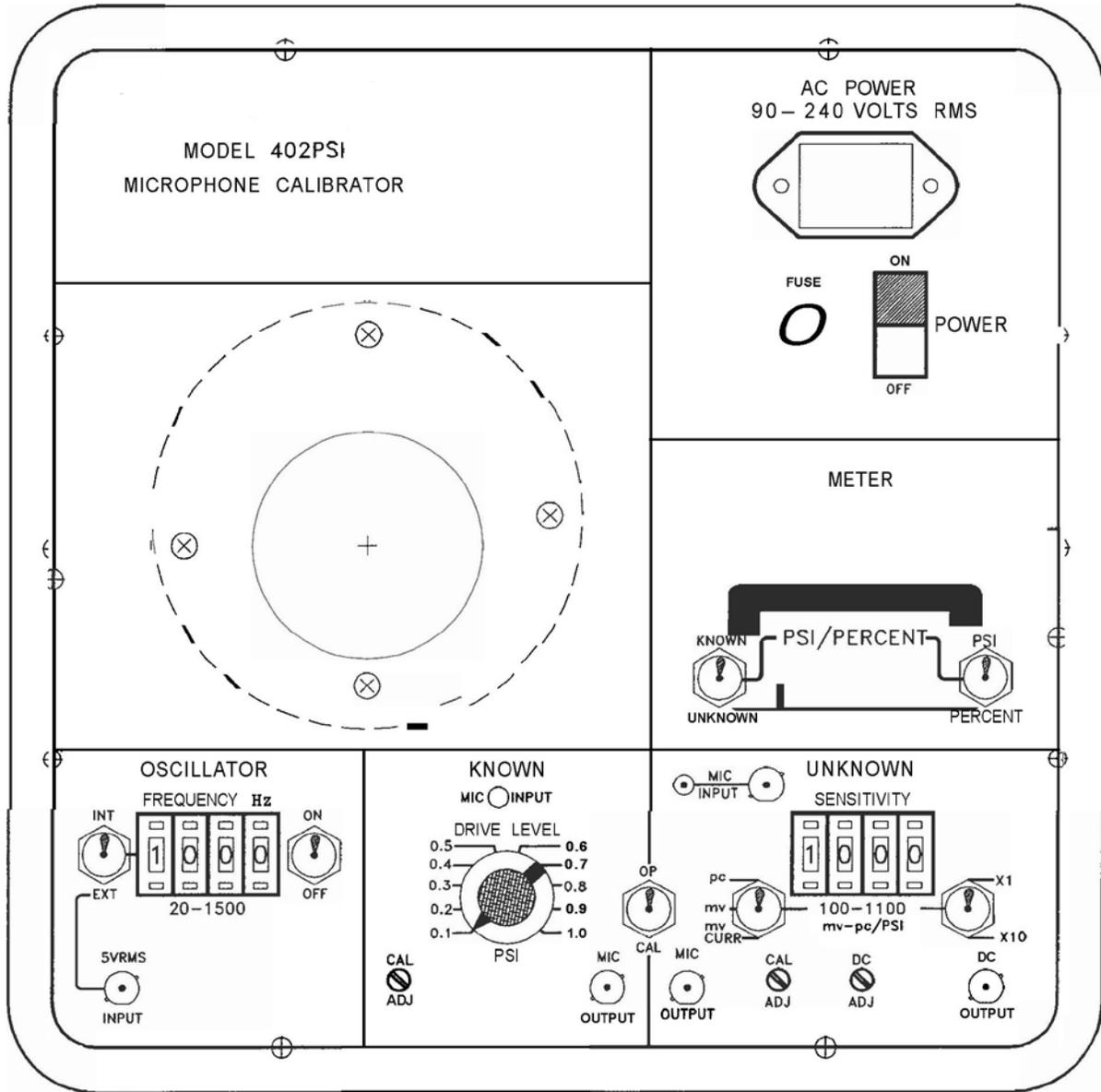


Figure 2-1, 402PSI Microphone Calibrator Front Panel

## Controls

Frequency Selector	This four-position thumb switch allows selection of 20 to 1500 Hz in 1 Hz step. The frequency response of the transducer is given in the usable frequency range chart.
Level Selector	Ten-position rotary switch with selection of 0.1 to 1.0 PSI in 0.1 PSI increments.
ON-OFF Power Switch	Energizes the circuitry when in the ON position.
ON-OFF Switch	Shuts off the drive (oscillator) to the Pressure transducer. <b>Note: This switch should be in the OFF position before turning the POWER switch ON.</b>
Sensitivity Selector Switch	Allows accommodating UNKNOWN microphones with sensitivities from 100 to 1100 mV-pC/PSI.
XI-XI0 Switch	Works in conjunction with the SENSITIVITY Selector to extend the range to 1000-11000 mV-pC/PSI. <b>NOTE: There is no STOP on the MSD and 1 or 0 are the only valid positions.</b>
PC-MV-MV CURR Switch	When at PC accommodates charge mode microphone; mV is a voltage input, and the MV CURR position accommodates MV (Integrated Circuit) type microphones.
UNKNOWN-KNOWN Switch	Selects which input microphone is being monitored.
PERCENT-PSI Switch	Units for the meter.

## Indicators

DIGITAL PANEL Meter-3-1/2 Digit meter to monitor the Sound Pressure Level in PSI units or percent different between the two microphones.

## Test Method

The REFERENCE microphone in this instrument called the KNOWN microphone is measured using a True RMS Detector. In order to get an accurate comparison, it is necessary to measure the UNKNOWN microphone with a

charge amplifier that also has True RMS Detection. The 402PSI has a built-in provision to compare either charge or MV (Integrated Circuit) type microphones against the KNOWN microphone.

## KNOWN Microphone

The Reference (KNOWN) microphone used in the 402PSI is a MIC62 (OEM from Dytran Instruments). For sensitivity refer to Chapter 4, **Figure 4-1**, 402 PSI Frequencies. The traceable accuracy variance of this microphone is 5% from 20 to 1500 Hz at 0.1 to 1.0 PSI. The calibration is RMS millivolts per PSI peak.

***NOTE: The sensitivity at the Reference (KNOWN) microphone must be known in order to accurately, run the Performance Test, Calibration Procedure or Operational Tests to find UNKNOWN sensitivities of other sensors. The recommended calibration period on the MIC62 is one year.***

## Chapter 3

# Performance Test

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The Performance Test Procedure should be run to verify that the unit is performing within the manufactured specifications. The unit uses integrated circuits and very stable parts and should not require calibration more than once every year, unless a part fails. In the event that a reading is out of tolerance the unit may require calibration (see **Chapter 4**).

### Initial Switch Settings

Prior to turning the 402PSI power ON, set the switches to the following:

- Oscillator ON-OFF switch to OFF
- INT-EXT to INT
- KNOWN Frequency Hz to 0500
- DRIVE LEVEL to 1.0 PSI
- OP-CAL to CAL
- METER Unknown-Known to KNOWN
- PERCENT-PSI to PSI
- Unknown PC-mV-mV CURR to mV
- XI-X10 and Sensitivity should be set for the mV/PSI sensitivity of the KNOWN (Reference) microphone

### Performance Test Procedure

**Note:** *Be sure the Oscillator ON-OFF switch is in the OFF position before the instrument is turned on.*

1. Connect the AC Voltmeter to the KNOWN MIC output.
2. Place the POWER Switch to ON.
3. Place the OSCILLATOR ON-OFF switch to ON.
4. Observe an indication of  $1.000 \pm 0.03$  PSI on the panel METER.
5. Place the Meter UNKNOWN-KNOWN Switch to UNKNOWN.
6. Observe an indication of  $1.000 \pm 0.03$  PSI on the panel METER.
7. Place the METER PERCENT-PSI Switch to PERCENT and observe an

indication of less than 3.0% on the panel METER.

8. Place the OSCILLATOR ON-OFF switch to OFF.

# Chapter 4

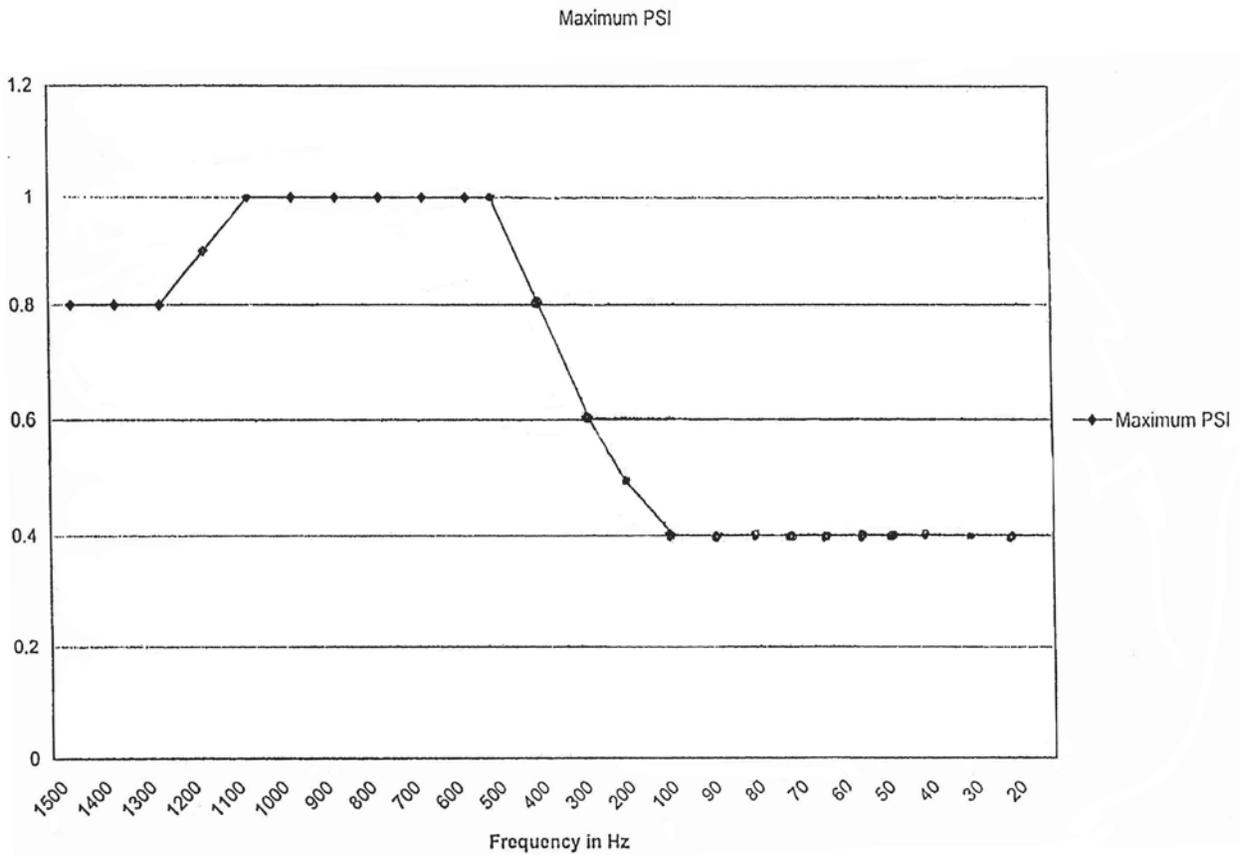
## Calibration Procedure

The calibration of the 402PSI is based on the traceability of the Reference Microphone. The MIC62 is traceable to secondary standards. The final calibration results are dependent on the accuracy of this Reference Microphone. The variance is measured to be less than 5% of the Sensitivity PSI.

### Test Equipment

**Note:** *Equivalent test equipment can be substituted.*

TRMS Meter	Keithley 179A
Digital Counter	Leader LDC-822



**Figure 4-1, 402PSI Frequencies**

## KNOWN Calibration

With the power OFF and the REFERENCE Microphone in place, insert the calibration plug or the UNKNOWN Microphone in the manifold. The UNKNOWN port must be closed.

### Initial Switch Settings

Prior to turning the 402PSI power ON, set the switches to the following:

- Oscillator ON-OFF switch to OFF
- INT-EXT to INT
- KNOWN DRIVE LEVEL to 1.0 PSI
- OP-CAL to CAL
- METER Unknown-Known to KNOWN
- Frequency Hz to 0500
- PERCENT-PSI to PSI
- Unknown PC-mV-mV Curr to MV
- XI-XI0 and Sensitivity should be set for the mV/PSI sensitivity of the KNOWN (Reference) microphone

### Calibration Procedure

**Note:** *Be sure the Oscillator ON-OFF switch is in the OFF position before the instrument is turned on.*

1. Connect the AC voltmeter to the KNOWN MIC Output.
2. Place the POWER Switch to ON.
3. Place the Oscillator ON-OFF switch to ON.
4. Set the KNOWN CAL ADJ for one PSI on the AC TRMS Voltmeter, for the KNOWN (reference) microphone  $\pm 0.5\%$  (TRMS value=sensitivity x .707).

**Note:** *Adjustments are made through the hole after removing the screw*

5. Set the DC ADJ for an indication of  $1.000 \pm 0.005$  PSI on the panel meter.
6. Connect the AC Voltmeter to the UNKNOWN MIC Output.
7. Observe the same level as seen on the KNOWN MIC Output.
8. Place the UNKNOWN-KNOWN Meter switch to UNKNOWN.
9. Set the UNKNOWN CAL ADJ for an indication of  $1000 \pm 0.005$  PSI on the Panel Meter.
10. Place the METER PERCENT-PSI switch to PERCENT and observe an

indication of less than 3.0 percent on the panel meter.

11. Place the OSCILLATOR ON-OFF switch to OFF.

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