493-999-087

INSTRUCTION MANUAL

P/N 25164

GR1562

SOUND-LEVEL CALIBRATOR

Form 1562-0100-J

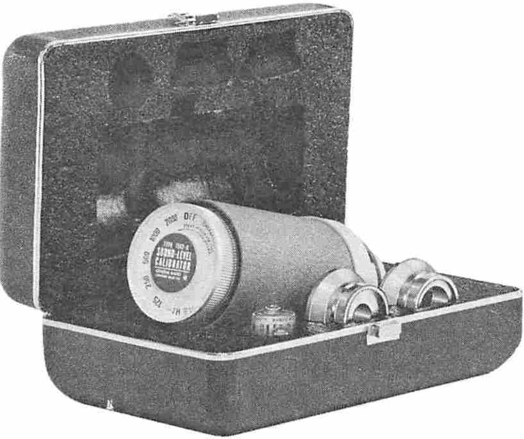
ID-6330

April 1978

This instrument is capable of calibrating sound-level meters used for measurements required under Part 1910.95 "Occupational Noise Exposure," (Dept. of Labor) of the Code of Federal Regulations, Chap. XVII of Title 29 (36 F. R. 7006).

This instrument carries U.S. Bureau of Mines, Mining Enforcement Safety Administration approval for use in methane-air mixture only. Approval Number 2G-2263.

Concord, Massachusetts, USA



SPECIFICATIONS

ACOUSTIC OUTPUT
Frequencies: 125, 250, 500, 1000, and 2000 Hz, ±3%.
Sound-Pressure Level: 114 dB re 20 μN/m^2
Accuracy (at 23°C and 760 mm Hg):

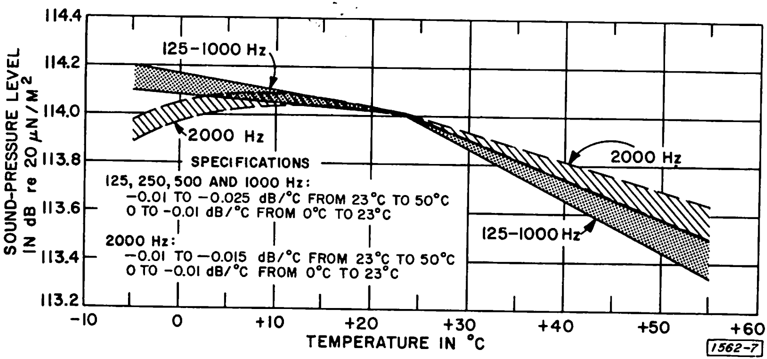
	at 500 Hz	other frequencies
WE 640AA or equivalent	±0.3 dB	±0.5 dB
other microphones	±0.5 dB	±0.7 dB

Temperature Coefficient: 0 to −.012 dB/°C. See chart facing.
Pressure Correction: Chart supplied.

ELECTRICAL OUTPUT
Voltage: 1.0 V ±20% behind 6000 Ω.
Frequency Characteristic: Output is flat ±2%.
Distortion: < 0.5%.
Connector: Jack to accept standard telephone plug.

GENERAL
Operating Environment: 0 to 40°C, 0 to 95% relative humidity.
Storage Temperature: −40 to +60°C with batteries removed.
Accessories Supplied: Carrying case, adaptors for 1-in and ½-in diameter microphones. (Fits 1⅛-in microphones without adaptor.) Battery included.
Battery: One 9 V Burgess PM6 or equal. 120 hours use.
Dimensions: Length, 5 in (130 mm); diameter, 2¼ in (55 mm).
Weight: Net, 1 lb (0.5 kg); **shipping** 4 lb (1.9 kg).

Output of Type 1562 Sound-Level Calibrator as a Function of Temperature (Typical Range)



NOTE: In SI units, the reference value is 20 micropascal (μ Pa).

Warranty — See page 32.

This book contains the instructions for the Type 1562 Sound-Level Calibrator. Detailed information on noise-measuring techniques and sound-measuring equipment associated with such a calibrator can be found in the General Radio "Handbook of Noise Measurement" ($7.50).

REPLACEMENT 9-V BATTERIES

Manufacturer	*Manufacturer's Part Number*
Bright Star	0918
Burgess	PM6 or P6
Eveready	226
Mallory	M-1600
Marathon	1600A
Neda	1600
Philco	P91
Ray-O-Vac	1600
RCA	VS300A
Sears	6418
Varta*	29
Wizard	7D7600
Zenith	Z226

*Instruments with ID2655 and greater will accept this battery.

TABLE OF CONTENTS

CONDENSED OPERATING INSTRUCTIONS

TO ACTIVATE THE INSTRUMENT:

a. Turn the dial counter-clockwise and hold one second.
b. Observe that bulb lights, indicating good battery.
c. Turn the dial clockwise to the desired frequency.

SELECTION OF ADAPTOR:

a. If microphone is 1 1/8-inch diameter, use instrument in the present configuration.
b. If microphone is 1-inch or ½-inch diammeter, select the proper adaptor.

TO CALIBRATE A SOUND-LEVEL METER:

a. Place calibrator slowly over the microphone.
b. Read the output on the Sound-Level Meter associated with the microphone. See appropriate table in text.
c. Adjust the instrument under test to read correctly or note error and apply correction to reading.

TO TURN INSTRUMENT OFF:

a. Turn the dial counter-clockwise to OFF.

NOTE

Batteries shipped uninstalled. See para. 2.1.1.

Section 1

INTRODUCTION

1.1 PURPOSE.

The Type 1562 Sound-Level Calibrator is a convenient and accurate self-contained device for checking the calibration of sound measuring instruments. Its intended use is for the field calibration of instruments that use as their input transducer the Type 1560-P5 or -P6 Piezoelectric Ceramic Microphones. These instruments include the Type 1551 and 1565 Sound-Level Meters, the Types 1558-A and 1558-BP Octave Band Noise Analyzers, plus the Type 1564 Sound and Vibration Analyzer, and the Type 1525 Data Recorder. Many other microphone-instrument systems can be calibrated if the microphones used are the Type 1560-P5 or -P6, the Type 1560-P3 or -P4, the Type 1551-P1L or -P1H, or the Western Electric 640-AA Laboratory Standard Microphone, or its equivalent.

1.2 DESCRIPTION.

1.2.1 GENERAL.

Figure 1-1 shows the Type 1562 with its adaptors, and Table 1-1 documents the type and function of the control and accessories.

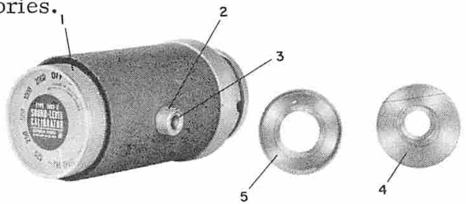


Figure 1-1. Type 1562 Sound-Level Calibrator.

Table 1-1

Controls and Accessories

Fig. 1-1 Ref.	*Name*	*Type*	*Function*
1	OFF-START-FREQUENCY	7-position selector switch	Turns instrument on. Checks battery. Selects frequency.
2	Knurled nut	Tubular	Holds shield on instrument.
3	Electrical Output	Phone Jack	Provides 1 volt ±20% sinewave output at each frequency.
4	Microphone Adaptor	(P/N 1562-6130)	Adapts instrument to 1/2 inch diameter microphone.
5	Microphone Adaptor	(P/N 1562-6100)	Adapts instrument to 1 inch diameter microphone.
—	Battery	9 V Burgess PM6 or equivalent	Power for instrument.
—	Case	——	Holds instrument and accessories.

As shown in the block diagram of Figure 1-2, the instrument consists of an oscillator which drives a loudspeaker to generate high-level acoustic calibrating signals in a coupler that fits over the measurement microphone. Figure 1-3 shows the coupling end of the instrument. Various diameter microphones will probably be involved at times, and Figures 1-4, 1-5, and 1-6 are provided to show mounting position of typical microphones.

1.2.2 THE OSCILLATOR.

The oscillator is a battery-operated Wien-bridge transistor oscillator that generates five ANSI-preferred frequencies, 125, 250, 500, 1000, and 2000 Hz. The oscillator operates from a 9-volt battery and is very stable, has low distortion, and low noise.

1.2.3 ACOUSTIC OUTPUT.

The oscillator drives a small controlled-reluctance magnetic loudspeaker. The loudspeaker drives one end of a small acoustic coupler. The other end of the coupler is closed by the microphone to be calibrated. A controlled leak to atmosphere in the wall of the coupler is adjusted so that constant voltage across the loudspeaker terminals generates essentially constant sound-pressure level in the coupler from below 100 Hz to 1000 Hz. Above 1000 Hz the response

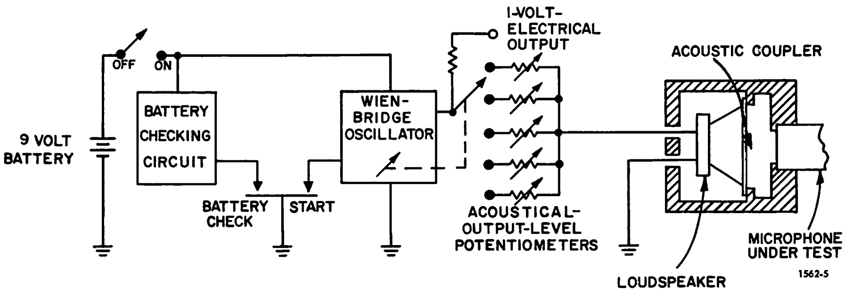


Figure 1-2. Functional block diagram of the Type 1562 Sound-Level Calibrator.

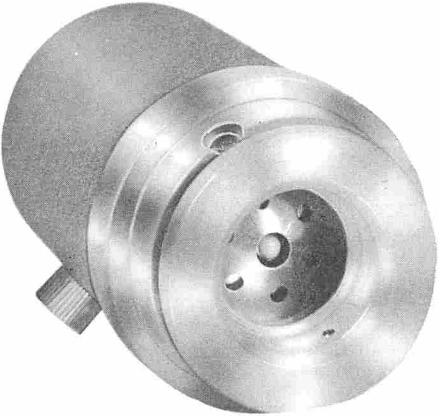


Figure 1-3. Acoustic coupler of Type 1562

falls off at approximately 12 dB per octave. The oscillator output voltage is the same at each frequency, so at each frequency a voltage divider is used to set the sound-pressure level in the coupler to 114 dB re 20 micronewtons per meter^{2*} as measured by a laboratory standard microphone (W. E. Type 640-AA).

1.2.4 OUTPUT ADAPTORS.

The coupler that makes up the output is designed to fit over the Types 1560-P3 and

---

**A newton per square meter is the unit of pressure and it is equal to 10 dynes per square centimeter; in the international system of units (SI), it is the Pascal (Pa).*

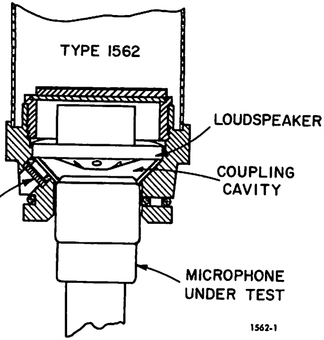


Figure 1-4. Calibration mounting position of GR Types 1560-P1, -P3, or -P4 microphones.

-P4 (1 1/8-inch diameter) microphones. These microphones were used for many years on sound-level meters and other sound-measuring equipment. There is still a large number in use throughout the industry. They also have the largest outside diameter of any widely used measurement microphone. Newly designed or special-measurement microphones are generally smaller in diameter, and it is usually much easier to design adaptors to reduce the diameter of the coupler fitting than it is to effect an increase in its diameter.

The most common smaller diameter microphones are the Types 1560-P5 and -P6 Piezoelectric Ceramic Sound-Level Meter Microphones currently supplied on General Radio sound-measuring instruments. The diameter of these microphones is 15/16 inch.

This is also the diameter of the USASI Type L Laboratory Standard Microphone embodied in the Western Electric Type 640-AA Microphone.

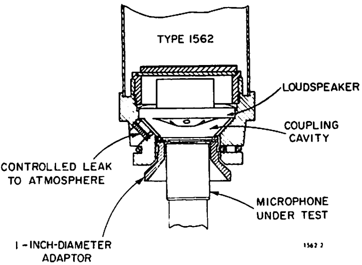


Figure 1-5. Calibration mounting position of GR Types 1560-P5, -P6 microphones with 1-inch diameter adaptor.

Smaller diameter microphones often associated with sound measurements are those in the Altec 21BR series supplied with the Type 1551-P1L and 1551-P1H Condenser Microphone Systems. These microphones have an outside diameter of 5/8 inch.

Snap-in adaptors for 1-in.-dia., and for 1/2-in.-dia. microphones are included with the Type 1562 calibrator so that most measurement microphones can be accurately and con-

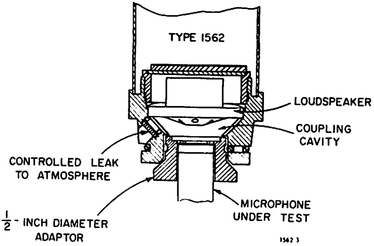


Figure 1-6. Calibration mounting position of GR microphones with ½-inch diameter adaptor.

veniently checked. Each adaptor is designed to maintain a constant volume in the coupler so that the sound level generated therein is always 114 dB when the barometric pressure is 760 mm of mercury.

1.2.5 ELECTRICAL OUTPUT.

The electrical output voltage of the oscillator is available at the phone jack on the side of the calibrator. The tubular knurled nut which secures the instrument cover, forms the shell of a standard telephone jack. The open-circuit output voltage at this point is nominally one volt in back of a source resistance of 6000 ohms. The actual value of this voltage for any calibrator is constant over the instruments frequency range and independent of normal environment conditions and battery voltages. The generated output is a sinewave with less than 0.5% distortion.

The tolerances on the characteristics of the thermistor (R133), which determines the operating level of the oscillator, permit operating levels among oscillators to differ by ±20%. Each oscillator will operate, however, at the constant level dictated by its thermistor.

1.2.6 BATTERY CHECKING CIRCUIT.

The operation of the calibrator oscillator is independent of the battery voltage as long as it remains at 6 volts or higher. The battery-checking circuit is included in the instrument so the operator can quickly determine if his battery is safely in the operating range. When the calibrator dial is turned to the spring return, counter-clockwise position, the lamp (P101) will light only if the battery voltage is 6 volts or higher. If the battery is below 6 volts the transistor switch remains open and the lamp will not light. Since the lamp load is much higher than the normal oscillator load on the battery, the battery must also be in good condition or its voltage will drop below the lamp ignition level during the battery check of one or two seconds, because of the excess load.

1.2.7 CONTROLS AND CONNECTORS.

MASTER CONTROL

The master control is the plastic combination knob, dial, and nameplate at the top of the instrument. This control is used to turn the instrument on, check the battery condition, and select the operating frequency. A red background area illuminates the transparent engraving to indicate the dial setting.

ACOUSTIC-OUTPUT COUPLING

The acoustic output from the calibrator is obtained at the bottom of the instrument, at the opposite end from the main control. The correct acoustic output is obtained when a 1 1/8-inch-diameter microphone, or smaller diameter microphone in a 1 1/8-inch-diameter adaptor is properly seated in the 1 1/8-inch-diameter recess at the bottom of the calibrator.

Section 2

OPERATING PROCEDURE

2.1 PRELIMINARY CHECKS.

2.1.1 BATTERY CHECK.

Install the battery in the instrument by removing the cover (paragraph 4-3) and connecting the battery between the battery clips. Replace the cover.

With the instrument upright on a desk or bench and the output phone jack connector facing the operator, the master control should be in the position shown in Figure 2-1. That is, the nameplate should be oriented for proper reading and OFF should be illuminated by the red backing area. To check the battery, turn the knob momentarily counter-clockwise against the spring return and observe that the small lamp at the 3:00 o'clock position lights. If the lamp doesn't light when the dial is turned against the spring return, repeat a second time. If there still isn't any light refer to Section 4 of this book.

Figure 2-1. Top view of calibrator with master control OFF.

2.1.2 OPERATIONAL CHECK.

Turn the Type 1562 on by rotating the master control counter-clockwise against the spring return, as when checking the battery, and holding it for approximately one second.

Turn the knob clockwise to the 2000-Hz position. A clear 2000-Hz tone should be easily audible. If a more raucous tone is heard it will be necessary to hold the knob in the START position a little longer before setting it to 2000 Hz. One second or so is usually long enough at normal room temperatures; however, at low temperatures the knob must be held in the start position somewhat longer to ensure proper starting of the oscillator.

When the clear 2000-Hz tone is heard, the calibrator is ready for use and can be set to any of its five frequencies without repeating the starting procedure.

2.2 CALIBRATION OF SOUND-MEASURING INSTRUMENTS.

The Type 1562 Sound-Level Calibrator is adjusted to develop a constant sound-pressure level of 114 dB re 20 micronewtons per meter^2 at each of five frequencies (125, 250, 500, 1000, and 2000 Hz), when its acoustic coupler is placed over a high (acoustic) impedance sound-measuring microphone. This level is established by adjusting the calibrator output to register a 114-dB sound-pressure level on a sound-measuring system using a carefully maintained laboratory standard microphone, such as the Western Electric 640-AA, with a pressure calibration determined by reciprocity and traceable to the National Bureau of Standards. This calibration is performed at a temperature of 23° C and an atmospheric pressure of 760 mm of Hg. Normal variation of temperature and atmospheric pressure will have negligible effect on the sound-pressure level developed. The specifications give the value of the temperature coefficient, and the curves in Figure 2-2 show the variation of sound-pressure level with atmospheric pressure.

So long as the volume enclosed by the coupler is kept constant, including the effective volume of the microphone to be calibrated, the sound-pressure level developed in the calibrator coupler is constant at 114 dB. The adaptors supplied with this calibrator are designed so that most of the commonly used measurement microphones are calibrated at the 114 dB sound-pressure level. Tables 2-1 and 2-2 list commonly used sound-measuring microphones. The appropriate calibrator adaptor, microphone adaptor if required, and the sound-pressure levels developed by the calibrator for each microphone are also tabulated. The levels listed in Tables 2-1 and 2-2 are sound-pressure levels and are the levels that would be indicated by a measuring system using a microphone with a flat pressure response, plus amplifiers and meters with flat frequency characteristics. Many sound-measuring systems (i.e., sound-level meters, see paragraph 2.3.1) are designed to have other than flat pressure response, so that the levels given in Tables 2-1 and 2-2 must be adjusted to account for the desired response of the measuring system. The procedure for calibrating sound-level meters will be explained in the following paragraphs.

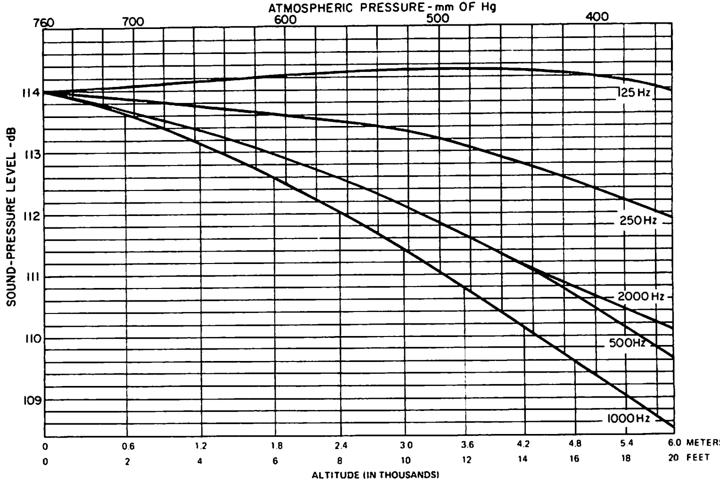


Figure 2-2. Variation of sound-pressure level in relation to changes in atmospheric pressure and altitude.

Table 2-1
SPL Deviations for Microphones Assuming Flat Pressure Response[1]

Microphone Mfg.	Microphone Type	Protective Grid	Adaptor No. 1562-	Adaptor Diameter Inches	Sound-Pressure Level (dB)/Frequency Hz 125	250	500	1000	2000
W. E.	640-AA	ON	6100	0.939	114.0	114.0	114.0	114.0	114.0
W. E.	640-AA	OFF	6100	0.939	114.0	114.0	113.8	113.7	113.5
B&K	4131/32	ON	6100	0.939	113.4	113.3	113.2	113.2	113.2
B&K	4131/32	OFF[2]	6100[3]	0.939	114.0	114.0	113.8	113.8	113.4
B&K	4131/32	OFF[2]	6100[4]	0.939	114.0	114.0	114.0	114.0	114.0
B&K	4133/34	ON	6100*	0.52	114.0	114.0	114.0	114.0	114.0
B&K	4135/36	ON	6100*	0.275	114.0	114.0	114.0	114.0	114.0
B&K	4138	ON	6100*	0.140	114.0	114.0	114.0	114.0	114.0
TOKYORIKO	MR103	ON	6100	0.939	114.0	114.0	114.0	114.0	114.0
TOKYORIKO	MR103	OFF	6100	0.939	114.0	114.0	113.8	113.7	113.5
ALTEC	BR series	ON	6110	0.628	114.1	113.9	113.9	114.0	113.5

1. Measurement conditions: Atmospheric Pressure – 760 mm of Hg; Temperature – 23°C.
2. Additional B & K coupler adaptor needed.
3. B & K coupler adaptor DB0111 used.
4. B & K coupler adaptor (with protective grid) DB0014 used.
* Require additional adaptors from GR Set 1560-9561.

Table 2-2
SPL Deviations for Microphones Assuming Flat Pressure Response[1]

Microphone Mfg.	Microphone Type	Protective Grid	Adaptor No. 1562-	Adaptor Diameter Inches	125	250	500	1000	2000
					Sound-Pressure Level (dB)/Frequency (Hz)				
GR	1560-9570	ON	6100	0.939	114.1	113.9	114.0	113.9	114.0
GR	1560-P5,-P6,-P7	ON	6100	0.939	114.1	113.9	114.0	113.9	114.0
GR	1560-P3[2]	ON	NONE	1.125	114.0	114.0	114.0	113.9	114.3
GR	1560-P4[2]	ON	NONE	1.125	114.0	114.0	114.0	113.9	114.3
GR	1560-P1[3]	ON	NONE	1.125	114.0	114.0	114.0	113.9	114.3
GR	1551-P1L	ON	6110	0.628	114.1	113.9	113.9	114.0	113.5
GR	1551-P1H	ON	6110	0.628	114.1	113.9	113.9	114.0	113.5
GR	1961	ON	6100	0.939	114.1	114.1	114.1	114.1	114.1
GR	1962	ON	9601	0.500	114.0	114.0	114.0	114.0	114.0
GR	1963	ON	9602	0.275	114.0	114.0	114.0	114.0	114.0
GR	1971	ON	6100	0.939	114.1	113.9	114.0	113.9	114.0
GR	1972	ON	9601	0.500	114.0	114.0	114.0	114.0	114.0

1. Conditions: Atmospheric Pressure – 760 mm of Hg; Temp – 23 °C. 2. Shure 98108 Microphone.
3. Shure 9898 Microphone.

2.3 CALIBRATION OF SOUND-LEVEL METERS.

2.3.1 GENERAL.

Sound-level-meter microphones manufactured in the United States are usually adjusted to have nominally flat response to sounds of random incidence in a free-field. The response of the amplifier in the sound-level meter is modified to obtain the required weighting characteristics. To determine what a sound-level meter should read when the Type 1562 is coupled to its microphone, one must correct for the difference between the microphone random-incidence, free-field response and its pressure response, and for the difference between a flat-amplifier response and the weighted-amplifier response.

Microphone-calibration response curves supplied by General Radio Company are for the free-field, random-incidence response. The Type 1559-B Reciprocity Microphone Calibrator also yields the free-field random incidence response of the microphone. Corrections of perpendicular-incidence and random-incidence responses to the pressure responses of General Radio microphones are given in Table 2-3. ANSI weighting characteristics for sound-level meters from the USA Standard Specification for Sound-Level Meters, S1.4, 1971, are listed in Table 2-4 for the five calibrator frequencies.

Table 2-3

Pressure Response Corrections for GR Microphones[1]

(dB to be added to perpendicular-incidence and random-incidence free-field responses)

Microphone Type / Incidence to Pressure	*1560-P5, -P6, 1961 1560-9570*		*1560-P3, -P4*		*1551-P1L, H*		*1962*	
	Frequency (Hz)		*Frequency (Hz)*		*Frequency (Hz)*		*Frequency (Hz)*	
	1000	2000	1000	2000	1000	2000	1000	2000
Perpendicular	-0.1	-1.1	-0.3	-1.7	0	-0.4	–0.2	–0.5
Random	0	-0.3	-0.1	-0.5	0	-0.1	–0.6	–0.2

1. Measurement conditions: Atmospheric pressure – 760 mm of Hg; Temperature – 23°C.

Table 2-4

Deviations in dB from Flat Response for Sound-Level Meter Weighting[1]

	Frequency (Hz)				
Weighting	125	250	500	1000	2000
C	-0.2	0	0	0	-0.2
B	-4.3	-1.4	-0.3	0	-0.2
A	-16.2	-8.6	-3.3	0	+1.2

1. Measurement conditions:
Atmospheric pressure – 760 mm of Hg
Temperature – 23 °C

2.3.2 CALIBRATION OF TYPE 1551-C OR TYPE 1565 SOUND-LEVEL METERS WITH TYPE 1560-P5, -P6 MICROPHONE OR TYPE 1560-2131 MICROPHONE CARTRIDGE.

For detailed calibration procedures on individual GenRad instruments, refer to the instruction manual for the particular instrument.

Table 2-5

Design-Center Readings in dB for Sound-Level Meters using 1 inch Diameter Microphones[1] (Type 1560-P5, -P6, -P7 or 1560-9570 Cartridge)

	Frequency (Hz)				
Weighting	125	250	500	1000	2000
C	113.8	113.9	114.0	113.9	113.5
B	109.7	112.4	113.7	113.9	113.5
A	97.8	105.3	110.7	113.9	114.9

1. Measurement conditions:
Atmospheric Pressure – 760 mm of Hg
Temperature – 23 °C

NOTE

Tables 2-5 and 2-6 list Design-Center Readings for sound-level meters using GR microphones. For sound-level meters adjusted to read correctly at 500 Hz, the allowable variations from the values given in Tables 2-5 and 2-6 for a meter meeting the ANSI Standard Specifications for Sound-Level Meters, S1.4, 1971, are ±2 dB (±1.5 dB from the specification tolerances and ±0.5 dB from the calibrator tolerances) at 1000 Hz and ±3 dB (±2.5 dB from the specification tolerances and ±0.5 dB from the calibrator tolerances) at 2000 Hz. For the GR Type 1560-P5 and -P6 Microphones, these variations from the values of Table 2-5 should not exceed ±1.3 dB (±0.8 dB ±0.5 dB) at 1000 Hz and ±1.8 dB (±1.3 dB ±0.5 dB) at 2000 Hz. For the GR Type 1560-P7 Microphone, these variations should not exceed ±1.3 dB (±0.8 dB ±0.5 dB) at 1000 Hz and 2000 Hz.

In Table 2-6 the GR Type 1560-P3 and -P4 Microphone variations should not exceed ±1.5 dB (±1.0 dB ±0.5 dB) at 1000 Hz and ±2.0 dB (±1.5 dB ±0.5 dB) at 2000 Hz.

Table 2-6

Design-Center Readings in dB for Sound-Level Meters using 1 1/8 Inch Diameter Microphones[1]
(Type 1560-P1, -P3, -P4, Shure 9898, or Shure 98108)

	Frequency (Hz)				
Weighting	125	250	500	1000	2000
C	113.8	114.0	114.0	113.8	113.6
B	109.7	112.5	113.7	113.8	113.6
A	97.8	105.4	110.7	113.8	115.0

1. Measurement conditions:
Atmospheric Pressure – 760 mm of Hg
Temperature – 23°C

2.3.3 CALIBRATION OF TYPE 1551 SOUND-LEVEL METERS WITH 1560-P1 OR -P3 MICROPHONES.

Refer to SLM manual for details.

2.3.4 CALIBRATION CHECKS ON TYPE 1563.

Refer to SLM manual for details.

2.3.5 CONDENSER MICROPHONE SETS.

A special set of adaptors (P/N 1560-9561) is available as an accessory to permit calibration of five combination microphone/preamplifier sets utilizing small diameter condenser microphones. They are sets P/N 1560-9532 through -9536, ranging in size from 1/2 to 1/8 inch. The adaptors nest into one another to get down to the smaller sizes and ultimately mate with calibrator through the 1-inch adaptor, P/N 1562-6100. Operation is otherwise the same as for ceramic microphones.

CAUTION

Don't confuse the slight resistance of an internal O-ring in the smaller adaptors for true bottoming.

2.4 ALTITUDE AND PRESSURE CORRECTIONS.

The Type 1562 is subject to altitude and atmospheric pressure changes in relation to its acoustical output. A graph has been plotted (Figure 2-2) to show the change in sound-pressure level with a change in altitude and atmospheric pressure. Each frequency has its own curve to be used when determining the output level at a specific altitude or pressure. The pressures given by the United States Weather Bureau and by various flight facilities are corrected pressures, i.e., pressures referred to sea level. Most barometers are similarly calibrated to read pressures corrected to sea level. The actual barometric pressure can be specifically requested of your local weather station, or you can correct the published barometric reading for your own location. This correction is a function of altitude, temperature, and pressure, but the principal factor is the altitude correction of one inch of mercury per 1000 feet above sea level. The Appendix includes an altitude correction chart and a conversion nomograph for inches of mercury to millibars, along with a table of altitudes above sea level for selected cities in the U.S. and Canada.

NOTE

> When the curves of Figure 2-2 are used to determine the acoustical output of the calibrator at high altitudes, an additional tolerance of ±0.1 dB per 4000 feet of elevation must be added to the existing specification tolerance.

Two examples of how to use the graph are:

a. Conditions of measurement:
Frequency, 250 Hz
Altitude, 8000 feet
Microphone, Western Electric 640-AA

Solution by graph:
Instrument tolerance from specification, ±0.5 dB
Graph sound-pressure level and tolerance, 113.5 ±0.2 dB
Final acoustical output, 113.5 ±0.7 dB

b. Conditions of measurement:
Frequency, 500 Hz
Altitude, 18000 feet
Microphone, Western Electric 640-AA

Solution by graph:
Instrument tolerance from specification, ±0.3 dB
Graph sound-pressure level and tolerance, 110.2 ±0.45 dB
Final acoustical output, 110.2 ±0.75 dB

This final acoustical output is the value of sound-pressure level that will be generated by the calibrator under the stated measurement conditions.

Section 3

PRINCIPLES OF OPERATION

3.1 THE WIEN-BRIDGE OSCILLATOR.

3.1.1 GENERAL.

The Wien-bridge circuit (Figure 3-1) used in this oscillator performs two functions. Two of the bridge arms (C105, R_{F1} and C104, R_{F2}) form a frequency determining impedance divider which provides positive feedback to sustain oscillation. The remaining two arms (R133 and R108), form a resistive divider which provides negative feedback to stabilize the amplitude.[1]

1. For a detailed discussion of this design feature, see Fulks, R.G., "Novel Feedback Loop Stabilizes Audio Oscillator", Electronics, Vol. 36 No. 5 February, 1963. Available as General Radio reprint A-107.

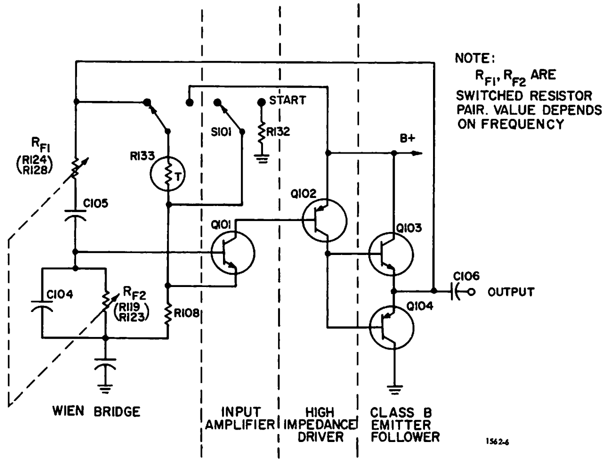


Figure 3-1. Simplified schematic diagram of oscillator in Type 1562 Sound-Level Calibrator.

3.1.2 FREQUENCY AND STABILITY.

The operating frequency of a Wien-bridge oscillator depends on the values of the components in the impedance divider. In the Type 1562, capacitors C104 and C105 (Figure 3-1) are equal and remain at a constant value. Resistors R_{F1} and R_{F2} are also equal, but are switched in value to establish the frequency of oscillation. This frequency-determining network has a transfer function:

$$\frac{e_{OUT}}{e_{IN}} = \frac{RCS}{1+3RCS+R^2C^2S^2}$$

where $S = j2\pi F$

$R = R_{F1} = R_{F2}$

$C = C105 = C104$

At the oscillator frequency $(f_o = \frac{1}{2\pi CR})$ this function equals +1/3. The net loop gain should be +1 for proper and stable operation, so the resistive divider consisting of R133 and R108 is used to set the associated amplifier gain to +3. This gives a net loop gain of +1 and the circuit oscillates at the desired frequency. R133, a thermistor, automatically adjusts its resistance to the value needed to maintain oscillations. Its time constant is short enough to provide rapid correction for amplitude variations, yet long enough to cause little distortion at the lower frequencies. It operates at a high temperature, in an evacuated bulb, to minimize the effects of ambient temperature. The effects of ambient temperature are further reduced by winding R108 with wire having a high positive temperature coefficient.

3.1.3 AMPLIFIER.

The amplifier uses four transistors in a single, direct-coupled feedback loop. The input amplifier circuit is chosen for low-noise performance. Transistor Q102 provides a high-impedance drive for the class-B output stage, and achieves a minimum of crossover distortion, yet does not require complicated, temperature-sensitive biasing networks. Negative dc feedback is used in addition to the negative ac feedback to obtain a transfer characteristic which is substantially independent of transistor characteristics, resulting in excellent stability, low distortion, and long-term reliability.

3.2 ACOUSTICAL OUTPUT CIRCUIT.

The output voltage obtained from the oscillator is the same at each frequency. To correct for any variation in establishing the 114 dB sound-pressure level, a potentiometer has been placed in series between the oscillator output and the speaker for each frequency. C107, added at 2000 Hz, forms a series resonant boost circuit with the speaker inductance to insure that all units will develop the required 114 dB sound-pressure level. This is necessary because the output of the transducer used falls off in response above 1000 Hz.

3.3 ELECTRICAL OUTPUT CIRCUIT.

The oscillator output voltage is also fed to a telephone jack through a resistive divider network (R129, R130, R131, Figure 4-5) which makes available a sinewave of 1 V, rms, ±20%, with a source impedance of 6000 Ω.

3.4 BATTERY CHECK CIRCUIT.

The battery checking circuit (Figure 4-5) is a transistor switch. The two transistors, Q106 and Q105, are in the ON state when the battery is above 6 volts. When this condition exists the bulb, P101, will light if the master control is held in the START - BATTERY CHECK position.

CAUTION

Do not hold the switch in the START-CHECK BATTERY position any longer than necessary because the battery will run down very fast.

If the battery voltage drops below 6 volts, the emitter and base voltages of Q106 drop, causing a change in the collector voltage. This change is in the upward direction which will raise the base voltage of Q105, causing Q105 to go to the OFF state and extinguish P101.

3.5 STARTING CIRCUIT.

Under normal room conditions (23°C and 760 mm of Hg) the oscillator will start and operate properly when the battery connection is made. However, since the output of the oscillator is always connected to the loudspeaker, an annoying, raucous sound will be heard as the thermistor comes up to its proper operating temperature.

At low ambient temperatures the normal oscillator current through the thermistor is not sufficient to warm the thermistor to its proper operating temperature, and the raucous sound will persist, indicating improper operation of the oscillator. To avoid the raucous sound and insure proper starting of the oscillator even at low temperatures, a spring return oscillator START position on the master control is provided. This connects the thermistor in series with the battery and a protective resistor (R132) causing extra warm-up current to be momentarily forced through the thermistor. The warm up takes approximately one second.

Section 4

SERVICE AND MAINTENANCE

4.1 WARRANTY.

GenRad

WARRANTY

We warrant that this product is free from defects in material and workmanship and, when properly used, will perform in accordance with applicable GenRad specifications. If within one year after original shipment it is found not to meet this standard, it will be repaired or, at the option of GenRad, replaced at no charge when returned to a GenRad service facility. Changes in the product not approved by GenRad shall void this warranty. GenRad shall not be liable for any indirect, special, or consequential damages, even if notice has been given of the possibility of such damages.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

GenRad policy is to maintain product repair capability for a period of ten years after original shipment and to make this capability available at the then prevailing schedule of charges.

4.2 SERVICE.

The warranty stated above attests the quality of material and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible. If the difficulty cannot be eliminated by the use of the following service instructions, please write or phone our Service Department (see rear cover), giving full information of the trouble and of steps taken to remedy it. Be sure to mention the serial and type number of the instrument.

Before returning an instrument to General Radio for service, please write to our Service Department or nearest Sales Engineering Office, requesting a Returned Material Tag. Use of this tag will ensure proper handling and identification. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay.

4.3 REMOVAL OF THE INSTRUMENT COVER.

To remove the cover:

a. Remove the round knurled nut (marked OPEN – 1 V 6 kΩ OUT) located approximately half way up the side of the cover.

b. Slide the cylindrical cover off over the master control.

4.4. MINIMUM PERFORMANCE STANDARDS.

To check the general performance of the Type 1562 Sound-Level Calibrator, proceed as follows:

a. Remove the cover as above and install a good nine volt battery. (See Figure 4-1 for position).

b. Replace the cover and secure it with the knurled nut.

c. Turn the master control dial to START-CHECK BATTERY and observe that the dial light lights, indicating that the battery is good. Release the control and it will return to OFF.

CAUTION

Do not hold the switch in the START – CHECK BATTERY position any longer than necessary because the battery will run down very fast in this switch position.

d. Turn the master control dial to START-CHECK BATTERY and hold for about one second and then turn it to 2000 Hz. After a slight pause a signal of 2000 Hz should be heard from the acoustic coupler end of the instrument.

e. Turn the dial to each of the four remaining frequencies and listen for a tone. This indicates that there is an acoustical output present.

f. Check the electrical output at each frequency by connecting a VTVM, such as the GR Type 1806, through a telephone plug into the output jack (knurled nut marked OPEN – 1 V 6 kΩ OUT) on the side of the instrument. The voltage should be 1.0 V, rms, ±20%.

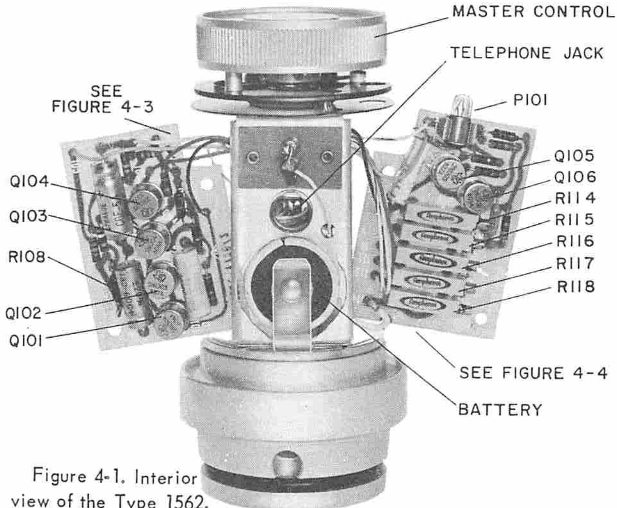


Figure 4-1. Interior view of the Type 1562.

g. Check the accuracy of the output frequency by connecting a digital counter (Type 1192) into the output jack through a telephone plug. The value should be within ±3% of the desired frequency.

h. Insert the 1/2-inch microphone adaptor into the acoustic coupler and see that the ball detents hold it firmly.

i. Repeat step h for the 1-inch adaptor.

4.5 TROUBLE-ANALYSIS.

The following is a list of trouble symptoms and probable solutions:

a. Bulb fails to light in BATTERY CHECK position.

1) Low battery.

2) Bulb failure.

3) Failure of Q105 or Q106 (Table 4-1, Figure 4-1).

b. No acoustical or electrical output at any frequency (BATTERY CHECK working):

1) R108 open (Figure 4-1).

c. No acoustical or electrical output at any frequency (BATTERY CHECK working):

1) Failure of Q101, Q102, Q103, or Q104 (Table 4-1, Figure 4-1).

d. Acoustical output not "clean" signal at all frequencies, electrical output high (about 3 volts, rms) (BATTERY CHECK working):

1) Thermistor (R133) open.

ALTITUDES ABOVE SEA LEVEL FOR SELECTED CITIES IN U.S. AND CANADA

City	*Feet Above Sea Level*
Akron, Ohio	950
Albany, New York	20
Allentown, Pennsylvania	320
Ashland, Kentucky	530
Atlanta, Georgia	1105
Augusta, Georgia	141
Baltimore, Maryland	81
Bangor, Maine	21
Bay City, Michigan	593
Binghamton, New York	865
Birmingham, Alabama	598
Boise, Idaho	2717
Boston, Massachusetts	45
Brandon, Man.	1204
Buffalo, New York	590
Burlington, Vermont	190
Bridgeport, Connecticut	12
Calgary, Alta.	3439
Cambridge, Massachusetts	80
Camden, New Jersey	30
Campbellton, N.B.	42
Charleston, South Carolina	13
Charlotte, North Carolina	734
Charlottetown, P.E.I.	8
Chicago, Illinois	604
Cleveland, Ohio	600
Colorado Springs, Colorado	6012
Columbus, Georgia	261
Columbus, Ohio	759
Council Bluffs, Iowa	989
Dallas, Texas	437

City	*Feet Above Sea Level*
Dartmouth, N.S.	14
Davenport, Iowa	571
Dayton, Ohio	743
Denver, Colorado	5227
Des Moines, Iowa	626
Duluth, Minnesota	626
Edmonton, Alta.	2183
Elizabeth, New Jersey	28
Erie, Pennsylvania	709
Evansville, Indiana	380
Flint, Michigan	716
Fort Smith, Arkansas	445
Fort Wayne, Indiana	780
Fort Worth, Texas	600
Fredericton, N.B.	32
Galveston, Texas	28
Grand Rapids, Michigan	628
Great Falls, Montana	3309
Halifax, N.S.	59
Hamilton, Ontario	300
Harrisburg, Pennsylvania	355
Hartford, Connecticut	36
Houston, Texas	48
Huntington, West Virginia	565
Indianapolis, Indiana	749
Jackson, Mississippi	286
Jacksonville, Florida	25
Jersey City, New Jersey	44
Kansas City, Missouri	750
Knoxville, Tennessee	895
Lansing, Michigan	842
Lexington, Kentucky	966
Lincoln, Nebraska	1169
Little Rock, Arkansas	286

City	*Feet Above Sea Level*
London, Ontario	804
Los Angeles, California	292
Loisville, Kentucky	454
Manchester, New Hampshire	210
Memphis, Tennessee	238
Miami, Florida	15
Milwaukee, Wisconsin	609
Minneapolis, Minnesota	826
Mobile, Alabama	15
Moncton, N.B.	50
Montgomery, Alabama	191
Montreal, P.Q.	110
Nashville, Tennessee	498
Newark, New Jersey	43
New Haven, Connecticut	21
New London, Connecticut	27
New Orleans, Louisiana	5
New York, New York	35
Norfolk, Virginia	38
Oakland, California	18
Omaha, Nebraska	1040
Ottawa, Ontario	200
Paterson, New Jersey	117
Peoria, Illinois	465
Philadelphia, Pennsylvania	150
Phoenix, Arizona	1085
Pittsburg, Pennsylvania	742
Portland, Maine	34
Portland, Oregon	69
Providence, Rhode Island	43
Quebec, P.Q.	20
Racine, Wisconsin	619
Regina, Sask.	1414
Reno, Nevada	4487

City	*Feet Above Sea Level*
Richmond, Virginia	84
Rochester, New York	509
Saint John, N.B.	21
Saint Louis, Missouri	460
Saint Paul, Minnesota	754
Salt Lake City, Utah	4300
Sacramento, California	30
San Antonio, Texas	657
San Francisco, California	50
Saskatoon, Sask.	1596
Savanah, Georgia	42
Scranton, Pennsylvania	757
Seattle, Washington	51
Shreveport, Louisiana	217
Sioux Falls, South Dakota	1405
South Bend, Indiana	718
Spokane, Washington	1905
Springfield, Massachusetts	101
Sydney, N.S.	10
Syracuse, New York	410
Tacoma, Washington	87
Toledo, Ohio	594
Toronto, Ontario	250
Topeka, Kansas	909
Tuscon, Arizona	2382
Tulsa, Oklahoma	700
Utica, New York	448
Vancouver, B.C.	18
Washington, D.C.	100
Wichita, Kansas	1285
Windsor, Ontario	580
Winnipeg, Man.	727
Youngstown, Ohio	832

APPENDIX

USE OF THE NOMOGRAPH

CORRECTION OF BAROMETRIC PRESSURE TO STATION ALTITUDE.

To obtain a corrected barometric pressure for a station:

a. Determine the station's altitude above sea level (see chart later in Appendix).

b. Obtain a barometric pressure reading corrected to sea level from a barometer. (If the barometer reads only values in millimeters, find the corresponding value of millibars from the right-hand scales.

c. Place a straight-edge across the proper points on the center and left-hand scales of the nomograph, and read the actual pressure at the station, on the right-hand scales.

CONVERSION FROM MILLIMETERS OF MERCURY TO INCHES OF MERCURY.

To convert from millimeters of mercury to inches of mercury proceed as follows:

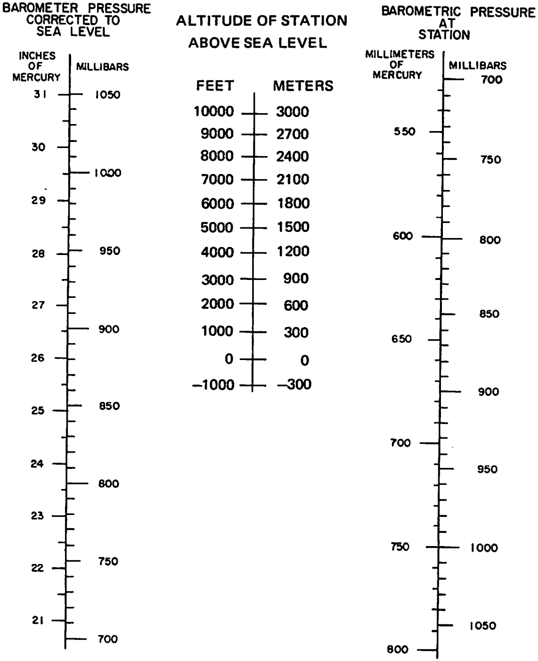
a. Find the barometric pressures value in millimeters of mercury on the right-hand scales.

b. Obtain the corresponding value in millibars from the same scales.

c. Move to the left-hand scales and find the millibar value obtained in step b.

d. Read the corresponding value of barometric pressure in inches of mercury from the left-hand scales.

NOMOGRAPH FOR APPLYING ALTITUDE CORRECTION TO BAROMETRIC PRESSURE



ALTITUDES ABOVE SEA LEVEL FOR SELECTED FOREIGN CITIES

City	Altitude Above Sea Level Meters	Feet
Adelaide, Australia	11	35
Amman, Jordan	665	2400
Amsterdam, Netherlands	50	16
Ankara, Turkey	640	2250
Athens, Greece	92	300
Belgrade, Yugoslavia	138	450
Berlin, Germany	35	115
Bombay, India	8	25
Brussels, Belgium	58	190
Buenos Aires, Argentina	14	45
Cairo, Egypt	30	98
Canberra, Australia	900	2000
Copenhagen, Denmark	76	25
Johannesburg, U.S. Africa	1750	5689
Lahore, Pakistan	210	706
La Paz, Bolivia	3700	12200
London, England	74	245
Manila, Philippines	8	25
Melbourne, Australia	10	30
Mexico City, Mexico	2200	7349
Munich, Germany	510	1700
Paris, France	42	300
Prague, Czech.	175	575
Rome, Italy	28	95
Santiago, Chile	550	1800
San Paulo, Brazil	820	2700
Seoul, Korea	78	250
Stockholm, Sweden	11	35
Tokyo, Japan	10	30
Warsaw, Poland	73	240
Zurich, Switzerland	400	1360

FEDERAL SUPPLY CODE FOR MANUFACTURERS
UNITED STATES AND CANADA

DEFENSE LOGISTICS AGENCY MICROFICHE
H4-1 SB 708-41 GSA-FSSH4-1

FMC	MANUFACTURER
01295	TEXAS INSTRUMENTS., DALLAS, TX 75222
09823	BURGESS INC., FREEPORT, IL 61032
14433	ITT SEMICONDUCTORS., W. PALM BEACH, FL 33402
15801	FENWAL ELECTRONICS., FRAMINGHAM, MA 01701
24655	GENRAD., CONCORD, MA 01742
56289	SPRAGUE ELECTRIC., NORTH ADAMS, MA 01247
71744	CHICAGO MINIATURE LAMP., CHICAGO, IL 60640
75042	IRC., BURLINGTON, IA 52601
80294	BOURNS LABORATORIES., RIVERSIDE, CA 92506
81349	MILITARY SPECIFICATIONS
83259	PARKER SEAL., CULVER CITY, CA 90231
94322	TEL LABS., MANCHESTER, NH 03102

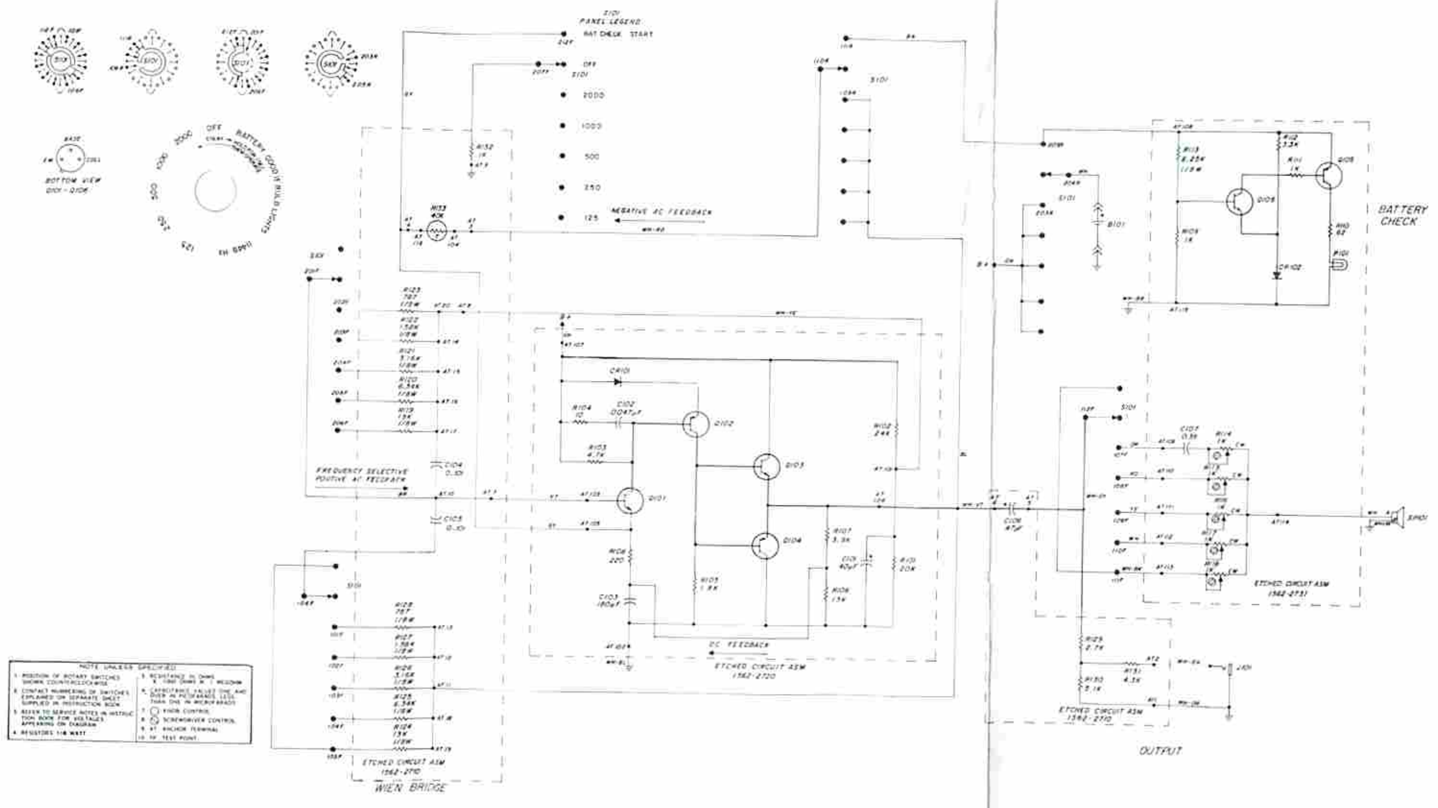


Figure 4-5. Schematic diagram for Type 1562-A Sound-Level Calibrator.

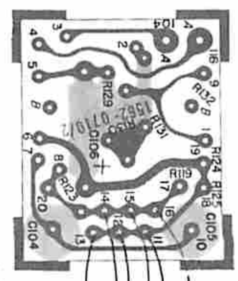


Figure 4-2. Wien-Bridge and Electrical-Output etched-circuit assembly. (For complete etched-circuit board assembly, order Part Number 1562-2710.)

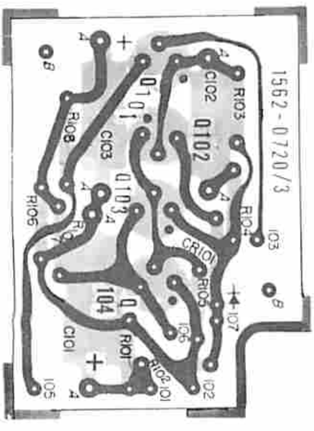


Figure 4-3. Amplifier etched-circuit assembly. (For complete etched-circuit assembly, order Part Number 1562-2720.)

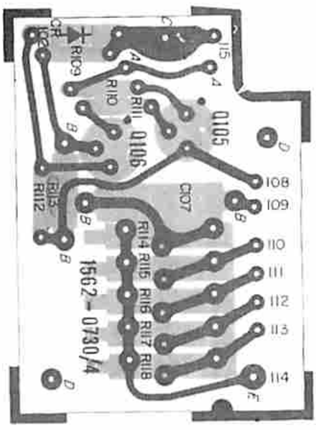


Figure 4-4. Acoustical-Output and Battery-Check etched-circuit assembly. (For complete etched-circuit assembly, order Part Number 1562-2731.)

NOTE: The number on the foil side is not the part number for the complete assembly. The dot on the foil at the transistor socket indicates the collector lead.

ELECTRICAL PARTS LIST

REFDES		DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
		WEIN-BRIDGE & ELECTRICAL-OUTPUT PC BOARD P/N 1562-2710			
C	104	CAP MYLAR .101UF 1 PCT 100V	4860-7932	56289	410P 0.101 UF 1PCT
C	105	CAP MYLAR .101UF 1 PCT 100V	4860-7932	56289	410P 0.101 UF 1PCT
C	106	CAP TANT 47 UF 20PCT 6V	4450-5500	56289	150D476X000682
R	119	RES FLM 13.0K 1 PCT 1/8W	6250-2130	81349	RN55D1302F
R	120	RES FLM 6.34K 1 PCT 1/8W	6250-1634	81349	RN55D6341F
R	121	RES FLM 3.16K 1 PCT 1/8W	6250-1316	81349	RN55D3161F
R	122	RES FLM 1.58K 1 PCT 1/8W	6250-1158	81349	RN55D1581F
R	123	RES FLM 787 OHM 1 PCT 1/8W	6250-0787	81349	RN55D7870F
R	124	RES FLM 13.0K 1 PCT 1/8W	6250-2130	81349	RN55D1302F
R	125	RES FLM 6.34K 1 PCT 1/8W	6250-1634	81349	RN55D6341F
R	126	RES FLM 3.16K 1 PCT 1/8W	6250-1316	81349	RN55D3161F
R	127	RES FLM 1.58K 1 PCT 1/8W	6250-1158	81349	RN55D1581F
R	128	RES FLM 787 OHM 1 PCT 1/8W	6250-0787	81349	RN55D7870F
R	129	RES COMP 2.7 K 5PCT 1/4W	6099-2275	81349	RCR07G272J
R	130	RES COMP 5.1 K OHM 5PCT 1/4W	6099-2515	81349	RCR07G512J
R	131	RES COMP 4.3 K OHM 5PCT 1/4W	6099-2435	81349	RCR07G432J
R	132	RES COMP 1.0 K 5PCT 1/4W	6099-2105	81349	RCR07G102J
		AMPLIFIER PC BOARD P/N 1562-2720			
C	101	CAP ALUM 40 UF 6V	4450-3600	56289	30D406G006
C	102	CAP MYLAR .0047UF 10 PCT 600V	4860-7400	75042	663UW .0047 UF 10PCT
C	103	CAP TANT 180 UF 20PCT 6V	4450-5617	56289	150D187X0006R2
CR	101	DIODE RECTIFIER 1N645	6082-1016	14433	1N645
Q	101	TRANSISTOR 2N1304	8210-1304	01295	2N1304
Q	102	TRANSISTOR 2N1305	8210-1305	01295	2N1305
Q	103	TRANSISTOR 2N1304	8210-1304	01295	2N1304
Q	104	TRANSISTOR 2N1305	8210-1305	01295	2N1305
R	101	RES COMP 20 K OHM 5PCT 1/4W	6099-3205	81349	RCR07G203J
R	102	RES COMP 24 K OHM 5PCT 1/4W	6099-3245	81349	RCR07G243J
R	103	RES COMP 4.7 K 5PCT 1/4W	6099-2475	81349	RCR07G472J
R	104	RES COMP 10 OHM 5PCT 1/4W	6099-0105	81349	RCR07G100J
R	105	RES COMP 1.8 K 5PCT 1/4W	6099-2185	81349	RCR07G182J
R	106	RES COMP 13 K OHM 5PCT 1/4W	6099-3135	81349	RCR07G133J
R	107	RES COMP 3.9 K 5PCT 1/4W	6099-2395	81349	RCR07G392J
R	109	RES WW 220 OHM 3 PCT +3500 TC	6620-1040	94322	SA-21 220 OHM 3PCT
		ACOUSTICAL-OUTPUT & BATTERY-CHECK PC BOARD P/N 1562-2731			
C	107	CAP MYLAR MTLZD 0.39UF 10PCT 50V	4860-9702	56289	431P3949R5
CR	102	DIODE RECTIFIER 1N645	6082-1016	14433	1N645
Q	105	TRANSISTOR 2N1305	8210-1305	01295	2N1305
Q	106	TRANSISTOR 2N1304	8210-1304	01295	2N1304
R	109	RES COMP 1.0 K 5PCT 1/4W	6099-2105	81349	RCR07G102J
R	110	RES COMP 62 OHM 5PCT 1/4W	6099-0625	81349	RCR07G620J
R	111	RES COMP 1.0 K 5PCT 1/4W	6099-2105	81349	RCR07G102J
R	112	RES COMP 3.3 K 5PCT 1/4W	6099-2335	81349	RCR07G332J
R	113	RES FLM 8.25K 1 PCT 1/8W	6250-1825	81349	RN55D8251F
R	114	POT WW TRM 1K OHM 10 PCT 20T	6051-2109	80294	3005P-1-102
R	115	POT WW TRM 1K OHM 10 PCT 20T	6051-2109	80294	3005P-1-102
R	116	POT WW TRM 1K OHM 10 PCT 20T	6051-2109	80294	3005P-1-102
R	117	POT WW TRM 1K OHM 10 PCT 20T	6051-2109	80294	3005P-1-102
R	118	POT WW TRM 1K OHM 10 PCT 20T	6051-2109	80294	3005P-1-102
		CHASSIS MOUNTED PARTS P/N 1562-3000			
B	101	BATTERY 9V CARBON ZINC 1600	8410-3000	09823	P6
P	101	LAMP FLANGE BASE 6V .04A 10000H	5600-0316	71744	CM-345
R	133	THERMISTOR 40K OHM 20PCT	6740-1400	15801	BA-44V3
S	101	SWITCH ROTARY ASM	7890-4330	24655	7890-4330
SP	101	CONTROLLED MAGNETIC TRANSDUCER	1562-0410	24655	1562-0410

MECHANICAL PARTS LIST

QNT	DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
1	DIAL ASM	1562-2030	24655	1562-2030
1	COVER	1562-6080	24655	1562-6080
1	BUSHING	1562-6091	24655	1562-6091
1	O RING	5855-1437	83289	2-221
1	CARRYING CASE	1562-0430	24655	1562-0430