

◆ PRECISION INSTRUMENTS FOR TEST AND MEASUREMENT ◆

**1565-B SERIES**

**Sound-Level  
Meter**

**User and Service Manual**

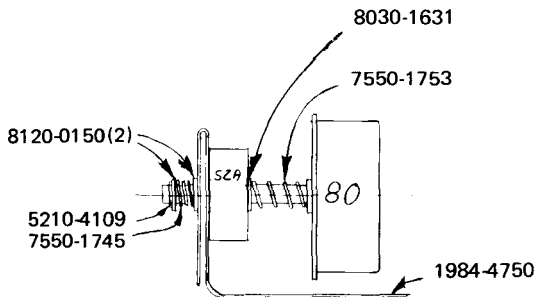
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1565-B im/January, 2002



Figure 1-1. Sound-Level Meter Controls and Indicators.

## CONDENSED OPERATING INSTRUCTIONS



- Remove and retain protective cap on microphone.
- Set LEVEL-RANGE control to the 110-120 dB Range.
- Slide power switch to right (ON).
- Depress and hold BAT CHECK button; meter should indicate in BATTERY portion of scale. If not, turn power off and squeeze ears of battery cover together to remove and replace batteries.
- Depress the appropriate weighting and meter-speed buttons (A, B, or C; up for fast, down for slow

### NOTE

The Occupational Safety and Health Act regulations require A weighting and SLOW meter response.

- Point the microphone at right angles to the direction of the noise path keeping your body out of the path, (see Figure 3-1).
- Adjust the LEVEL RANGE control for a reading. (For readings below 40 dB, read the meter below the low-end range mark and subtract the reading in dB from 40.)
- If the pointer fluctuates more than 3 dB, depress the SLOW button.

### CAUTION

If continuous noise exceeds 115 dB (A) slow, immediate use of protective ear muffs or plugs is indicated.

For best results, use the GR 1562 SLM Calibrator periodically (see para. 5.2.2).

III.

RESISTANCE IS IN OHMS, K =  $10^3$ , M =  $10^6$   
CAPACITANCE IS IN FARADS,  $\mu$  =  $10^{-6}$ , P =  $10^{-12}$   
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES  
PANEL CONTROL REAR CONTROL  
S - SCREWDRIVER CONTROL WT - WIRE TIE TP - TEST POINT  
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY  
LETTER, C.R., B.R., ETC.

## SPECIFICATIONS

**Sound Level:** 30 to 130 dB re 20  $\mu\text{N}/\text{m}^2$ , A weighted; 35 to 130 dB, B and C weighted.

**Weighting:** A, B, and C. Conforms to ANSI S1.4-1971 Type 2 and IEC 123,1961.

**Meter:** Rms response with fast and slow speeds.

**Input:** MICROPHONE: Lead-zirconate-titanate ceramic. 1560-P96 Adaptor converts input to 3-pin male A3 connector; for correct weighting, source impedance must be 380 pF  $\pm$  5%.  
**INPUT IMPEDANCE:**  $\approx$  13 M $\Omega$ /15 pF.

**Output:**  $\geq$  1.2 V rms behind 6200  $\Omega$  with meter at full scale; will drive Octave-Band Noise Analyzer, recorders, oscilloscopes, or low-impedance headphones. **HARMONIC DISTORTION:**  $\leq$  0.5% (0.1% typical) from 32 Hz to 8 kHz, C-weighted with meter at full scale.

**Calibration:** Can be pressure calibrated at 125, 250, 500, 1000, and 2000 Hz with 1562 Sound-Level Calibrator.

**Environmental:** **TEMPERATURE:** -10 to 50°C operating; -40 to +60°C storage, with batteries removed; coefficient of sensitivity  $\approx$  +0.02 dB/°C at 6 dB below full-scale meter reading. **HUMIDITY:** 90% RH. **MAGNETIC FIELD:** 1-Oersted (80 A/m) 50- or 60-Hz field causes  $\approx$  45 dB C-weighted indication when meter is oriented to maximum sensitivity to field.

**Supplied:** Carrying pouch, miniature phone plug to connect to output, and screwdriver for calibration adjustment. Also, hex wrench.

**Power:** Two 9-V batteries (Burgess 2U6 or equal) supplied, provide  $\approx$  50-h operation.

**Mechanical:** Shielded plastic case. **DIMENSIONS (w x h x d):** 3.63 x 6.5 x 2.09 in. (92 x 165 x 53 mm). **WEIGHT:** 13 oz (0.45 kg) net, 3 lb (1.4 kg) shipping.

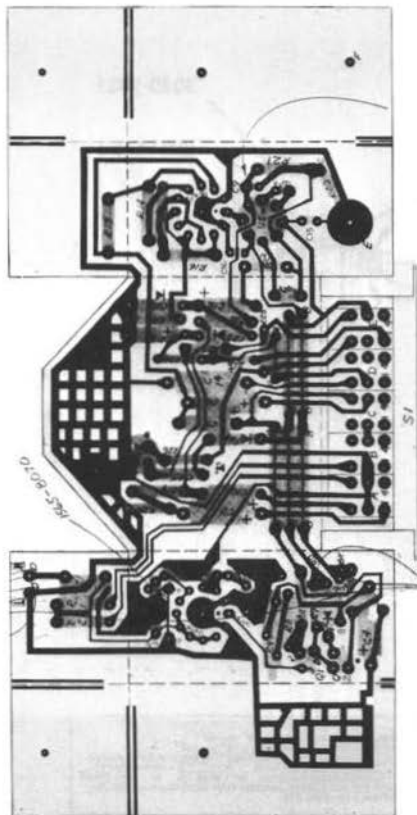


Figure 5-7. Main circuit etched-circuit board.

## SECTION 1

### INTRODUCTION

#### 1.1 GENERAL.

Sound (or noise) is basically a rapid variation in atmospheric pressure, and a sound-level meter (SLM) is an instrument that measures weighted sound pressure-level. A measurement of sound is accomplished by changing a noise into an electrical signal and displaying it on an indicator in terms of decibels (dB).

The apparent loudness that we attribute to a sound varies not only with the sound pressure but also with the frequency (or pitch) of the sound. How it varies with frequency depends on the sound pressure. This effect is taken into account to some extent for pure tones by "weighting" networks included in the SLM.

The above points are illustrated briefly in *A Primer of Noise Measurement*, a 34-page booklet free upon request from General Radio Co. For a more comprehensive work on noise, our *Handbook of Noise Measurement* for \$7.50 contains 328 pages of detailed information on how to solve your noise problems. Our *Primer of Plant-Noise Measurement and Hearing Testing* (free) explains conformance to the Federal Regulations of 1971.

#### 1.2 PURPOSE.

The basic instrument of the General Radio sound-measuring-equipment line is the sound-level meter (SLM). The unit (Figure 1-1), is a Type 2 (i.e. general purpose) SLM. A Type 2

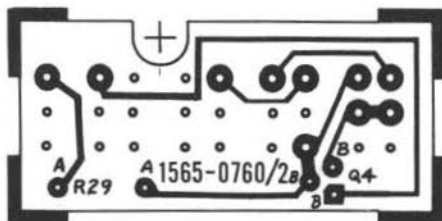


Figure 5-6. Meter switch etched-circuit board.

instrument has tolerances required by the American National Standards Institute (ANSI) standard specification S1.4-1971 for sound level meters. These tolerances are generally more stringent than those required for Type 3 instruments.

The chief use of the SLM is making noise measurements in a working or living environment such as: routine measurements of office-building ventilator systems, typewriters, machinery, traffic noise, and other noises of a reasonably constant character.

### 1.3 DESCRIPTION.

#### 1.3.1 General.

The instrument is housed in a high impact molded plastic case that is shaped for comfortable hand-held operation and tapered at the microphone end to minimize the effect of case diffraction. It consists of the following elements: a microphone to pick up sound; an amplifier, to raise the microphone output to useful levels; a calibrated attenuator, to adjust the amplification to a value appropriate to the sound level being measured; an indicating meter, to exhibit the measured sound level; networks, to adjust the frequency characteristic of the response (A, B, or C weighting); and an output connection, to accommodate additional measuring equipment. It covers the sound-level range from 30 to 130 dB above the standard reference level of  $20 \mu\text{N/m}^2$  (0.0002  $\mu\text{bar}$ ). Figure 1-2 shows a polar plot of the angle-of-incidence responses and Figure 1-3 shows the frequency response as a function of incidence of the SLM.

### FEDERAL MANUFACTURER'S CODE

From Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) as supplemented through August, 1968.

04713	Motorola, Phoenix, Ariz. 85008
07263	Fairchild Camera, Mountain View, Calif.
07999	Borg Inst., Delavan, Wisc. 53115
24446	G.E., Schenectady, N.Y. 12305
24655	General Radio Co, W. Concord, Mass. 01781
28959	Hoffman Electronics Corp, El Monte, Calif.
37942	P.R. Mallory & Co Inc, Indianapolis, Ind.
56289	Sprague Electric Co, N. Adams, Mass.
72982	Erie Technological Products Inc, Erie, Penn.
75042	IRC Inc, Philadelphia, Penn. 19108
76149	Mallory Electric Corp, Detroit, Mich. 48204
80183	Sprague Products Co, No. Adams, Mass.
82389	Switchcraft Inc, Chicago, Ill. 60630
58854	Sylvania Electric Products Inc.,
	Lighting Products Division, Salem, Mass., 01971

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.
TRANSISTORS				
Q1	E101	8210-1187	93916	2N1187
Q2	2N4250	8210-1135	93916	2N4250
Q3	2N4124	8210-1154	93916	2N4124
Q4	2N3391A	8210-1092	24454	2N3391A
Q5	E101 (330 $\mu$ A)	8215-0100	93916	E101

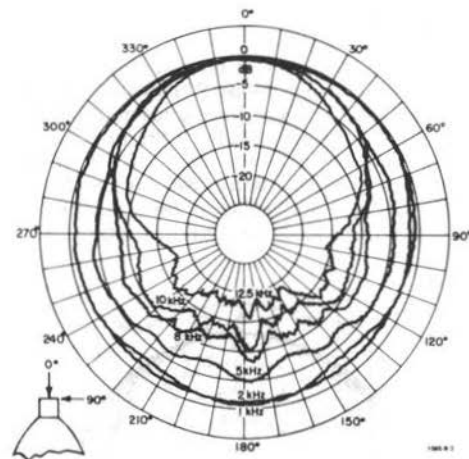


Figure 1-2. Directional patterns of the SLM.

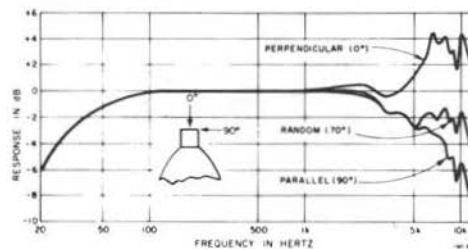


Figure 1-3. Typical response characteristics of the SLM with C weighting.

### 1.3.2 Microphone.

General Radio's lead-zirconate-titanate ceramic microphone cartridge (P/N 1560-2133) was developed as a measurement-grade microphone. With a diameter of 0.936 in., it fits into any fixture designed to accept the current industry standard Western Electric 640-AA Condenser Microphone. The following features make it excellent for sound-level measurements:

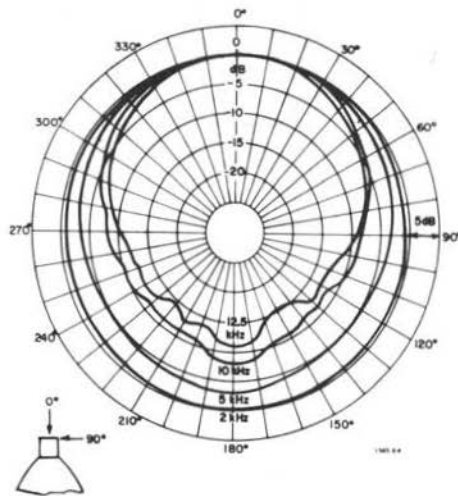


Figure 1-4. Directional patterns of the 1560-2133 Microphone.

#### ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Mfg Code	Mfg Part No.	Fed Stock No.
<b>RESISTORS (Cont.)</b>					
R16	Film, 715 $\Omega$ , $\pm 1\%$ , 1/8 W	6250-0715	75042	CEA, 715 $\Omega$ , $\pm 1\%$	5905-681-8757
R17	Film, 332 $\Omega$ , $\pm 1\%$ , 1/8 W	6250-0332	75042	CEA, 332 $\Omega$ , $\pm 1\%$	5905-827-3332
R18	Film, 205 $\Omega$ , $\pm 1\%$ , 1/8 W	6250-0205	75042	CEA, 205 $\Omega$ , $\pm 1\%$	
R19	Film, 61.9 $\Omega$ , $\pm 1\%$ , 1/8 W	6250-0619	75042	CEA, 61.9 $\Omega$ , $\pm 1\%$	5905-682-4103
R20	Comp., 51 k $\Omega$ , $\pm 5\%$ , 1/4 W	6099-3515	75042	BTS, 51 k $\Omega$ , $\pm 5\%$	
R21	Film, 200 k $\Omega$ , $\pm 1\%$ , 1/8 W	6250-3200	75042	CEA, 200 k $\Omega$ , $\pm 1\%$	5905-824-3077
R22	Film, 1.78 k $\Omega$ , $\pm 1\%$ , 1/8 W	6250-1178	75042	CEA, 1.78 k $\Omega$ , $\pm 1\%$	5905-682-4100
R23	Comp., 6.2 k $\Omega$ , $\pm 5\%$ , 1/4 W	6099-2625	75042	BTS, 6.2 k $\Omega$ , $\pm 5\%$	5905-815-3793
R24	Film, 7.15 k $\Omega$ , $\pm 1\%$ , 1/8 W	6250-1715	75042	CEA, 7.15 k $\Omega$ , $\pm 1\%$	
R25	Film, 105 k $\Omega$ , $\pm 1\%$ , 1/8 W	6250-3105	75042	CEA, 105 k $\Omega$ , $\pm 1\%$	5905-686-3385
R26	Film, 3.48 k $\Omega$ , $\pm 1\%$ , 1/8 W	6250-1348	75042	CEA, 3.48 k $\Omega$ , $\pm 1\%$	5905-279-4619
R27	Comp., 9.1 k $\Omega$ , $\pm 5\%$ , 1/4 W	6099-2915	75042	BTS, 9.1 k $\Omega$ , $\pm 5\%$	5905-815-3793
R28	Film, 7.15 k $\Omega$ , $\pm 1\%$ , 1/8 W	6250-1715	75042	CEA, 7.15 k $\Omega$ , $\pm 1\%$	
R29	*Film, 8.06 k $\Omega$ , $\pm 1\%$ , 1/8 W	6250-1806	75042	CEA, 8.06 k $\Omega$ , $\pm 1\%$	
	Comp., 68 k $\Omega$ , $\pm 5\%$ , 1/4 W	<del>6099-2685</del> 75042	75042	BTS, 68 k $\Omega$ , $\pm 5\%$	
<b>SWITCHES</b>					
S1	Push Button	7880-2120	71590	PB-10	
	1/2 Subminiature Oak Rotary	1565-0410	24655	1565-0410	
	Bat Con and SW Block Arm	1984-2200	24655	1984-2200	
	Slide DPDT	7910-1900	05568	23-021-114	

\*Used in units with meter stamped "1770" on rear of case.  
All others take the 7.15 k $\Omega$  resistor.



Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
INTEGRATED CIRCUITS					
U1	Type USB770939X	5432-7091	07263	USB770939X	
JACKS					
	Connector, Miniature	4260-1110	82389	TR-2A	
METERS					
M101	Meter Arm	5730-1435	80022	82T	
RESISTORS					
R1	Film, 3.24 M $\Omega$ , $\pm 1\%$ , 1/8 W	6250-4324	75042	CEA, 3.24 M $\Omega$ , $\pm 1\%$	
R2	Film, 5.62 M $\Omega$ , $\pm 1\%$ , 1/8 W	6250-4562	75042	CEA, 5.62 M $\Omega$ , $\pm 1\%$	
R3	Comp, 11.7 M $\Omega$ , $\pm 1\%$ , 1/4 W	6350-5117	75042	CEB, 11.7 M $\Omega$ , $\pm 1\%$	
R5	Film, 1.17 M $\Omega$ , $\pm 5\%$ , 1/8 W	6251-4117	03888	PME-00	
R6	Film, 130 k $\Omega$ , $\pm 1\%$ , 1/8 W	6250-3130	75042	CEA, 130 k $\Omega$ , $\pm 1\%$	5905-578-0876
R7	Comp, 6.2 k $\Omega$ , $\pm 5\%$ , 1/4 W	6099-2625	75042	BTS, 6.2 k $\Omega$ , $\pm 5\%$	5905-682-4100
R8	Film, 499 $\Omega$ , $\pm 1\%$ , 1/8 W	6250-0499	75042	CEA, 499 $\Omega$ , $\pm 1\%$	
R9	Poc., Wire Wound, Nectilinear, 2 k $\Omega$ , $\pm 10\%$	6051-2209	07999	2600 PC, 2 k $\Omega$ , $\pm 10\%$	
R11	Comp., 27 k $\Omega$ , $\pm 5\%$ , 1/4 W	6099-3275	75042	BTS, 27 k $\Omega$ , $\pm 5\%$	5905-683-3838
R12	Comp., 9.1 k $\Omega$ , $\pm 5\%$ , 1/4 W	6099-2915	75042	BTS, 9.1 k $\Omega$ , $\pm 5\%$	5905-279-4619
R13	Film, 22.6 k $\Omega$ , $\pm 1\%$ , 1/8 W	6250-2226	75042	CEA, 22.6 k $\Omega$ , $\pm 1\%$	5905-683-5747
R14	Film, 7.15 k $\Omega$ , $\pm 1\%$ , 1/8 W	6250-1715	75042	CEA, 7.15 k $\Omega$ , $\pm 1\%$	5905-815-3793
R15	Film, 2.26 k $\Omega$ , $\pm 1\%$ , 1/8 W	6250-1226	75042	CEA, 2.26 k $\Omega$ , $\pm 1\%$	

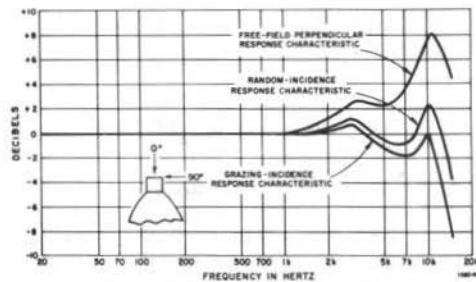


Figure 1-5. Typical response characteristics for the 1560-2133 Microphone.

1. A frequency characteristic (see Figure 1-5) carefully controlled in manufacture to give a flat response to sound waves of random incidence at frequencies from 5 Hz to 12.5 kHz.

2. Rugged dependable design capable of withstanding wide climate changes (from  $-40^{\circ}$  to  $95^{\circ}$  C, from 0 to 100% relative humidity).

3. Low temperature coefficient of sensitivity ( $+0.02$  dB/ $^{\circ}$  C) gives minimal change in output voltage from  $-10^{\circ}$  to  $50^{\circ}$  C.

4. Low temperature coefficient of internal impedance; cable correction is not affected by temperature at the microphone.

The nominal internal impedance of the microphone is 381 pF at  $23^{\circ}$  C with a temperature coefficient of  $2.2$  pF/ $^{\circ}$  C over the range of  $0^{\circ}$  to  $50^{\circ}$  C.

#### 1.4 ACCESSORIES SUPPLIED.

The following accessories are supplied with the Type 1565-B Sound-Level Meter:

Pouch

(P/N 1983-0400)

Screwdriver	(P/N 1565-0440)
Micro Plug	(Switchcraft 850-P2)
Two batteries	(Burgess 2U6 or equal)
Allen wrench	(P/N 7985-1680)
(.050-in.)	

### 1.5 ACCESSORIES AVAILABLE.

Following are some of the accessories that are available for use with the SLM (consult the GR catalog information for others):

1. Type 1562 Sound-Level Calibrator (P/N 1562-9701) for accurate field calibration of microphones and sound-measuring instruments.

2. Type 1560-P96 Adaptor (P/N 1560-9696) to adapt the input socket to mate with a standard, 3 terminal, male, and o connector (Switchcraft Type A3M) for connection to a vibration pickup or other transducer.

3. Type 1560-P52 Vibration Pickup (P/N 1560-9652) (refer to para. 2.2).

4. Type 1560-P83 Earphone Coupler (P/N 1560-9683) for connecting an audiometer earphone to the SLM.

5. Type 1560-P73 Extension Cable (P/N 1560-9673), for use between the microphone and instrument input (25 ft).

6. Adaptor cables: Type 1560-P77, Micro plug to 3/4-in. spaced banana plug pair (GR274) (P/N 1560-9677); Type 1560-P78, Micro plug to std. 1/4-in. phone plug (P/N 1560-9678); Type 1560-P79, Micro plug to BNC (P/N 1560-9679); Type 1560-P80, Micro plug to std. 1/4-in. phone jack (P/N 1560-9680).

7. Type 1560-9590 Tripod.

8. GR Microphone Windscreen (P/N 1560-9521) for reducing the effects of wind noise and protecting the diaphragm.

### ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
<b>CAPACITORS</b>					
C1	Ceramic, 0.1 $\mu$ F, +80-20%, 100 V	4400-2050	80183	5C13, .1 $\mu$ F, $\pm 20\%$	5910-080-9646
C3	Ceramic, 33 $\mu$ F, $\pm 5\%$ , 500 V	4404-0335	72982	831, 33 $\mu$ F, $\pm 5\%$	
C4	Tantalum, 47.0 $\mu$ F, $\pm 20\%$ , 6 V	4450-5500	56289	150D47XK0006B2	
C5	Tantalum, 15 $\mu$ F, $\pm 5\%$ , 15 V	4450-4303	12984	831, 15 $\mu$ F, $\pm 5\%$	5910-855-6343
C6	Tantalum, 10.0 $\mu$ F, $\pm 20\%$ , 20 V	4450-5100	56289	150D10XK0020B2	
C7	Ceramic, 82 $\mu$ F, $\pm 5\%$ , 500 V	4404-0825	72982	831, 82 $\mu$ F, $\pm 5\%$	
C8	Ceramic, 27 $\mu$ F, $\pm 5\%$ , 100 V	4410-1213	72982	8111-200-YSD-101J	
C9	Ceramic, 100 $\mu$ F, $\pm 5\%$ , 200 V	4400-6442	76149	831, 1 $\mu$ F, $\pm 5\%$	
C10	Tantalum, 1.0 $\mu$ F, $\pm 5\%$ , 35 V	4450-4302	37942	CG, 80 $\mu$ F, $\pm 20\%$	
C11	Tantalum, 80 $\mu$ F, $\pm 20\%$ , 15 V	4450-6300	56289	150D68XK0010A2	5910-936-1332
C12 and C13	Tantalum, 6.8 $\mu$ F, $\pm 20\%$ , 6 V	4450-4800	76149	56 MF $\pm 10\%$	
C14	Tantalum, 56 $\mu$ F, $\pm 10\%$ , 6 V	4450-5520	72982	8111-A100-YSS-102M	
C15 and C16	Ceramic, .001 $\mu$ F, $\pm 20\%$ , 100 V	4400-6422	15760	MTP, 300 $\mu$ F, $\pm 20\%$	
C101 and C102	Tantalum, 300 $\mu$ F, $\pm 20\%$ , 10 V	4450-5724	25440	IN4009	5910-727-3562
<b>DIODES</b>					
CR1	Type 1N4009	6082-1012	58854	IN34A(S)	5961-170-4430
CR2 thru CR4	Type 1N34A	6082-1003	28959	IN958B	
CR5	Type 1N958B (7.5 V)	6083-1057			



Figure 5-5. Mechanical parts — front view.

MECHANICAL PARTS LIST

Fig Ref	Qnt	Description	GR Part No.
1.	1	Knob, ON/off	1565-7310
2.	5	Pushbutton knob, A,B,C, SLOW, BAT CHECK	5511-0403
3.	1	Case, front	1565-1510
4.	1	Microphone, MK101	1560-2133
5.	1	Level-range-control knob	1565-1230
6.	1	Battery cover	1565-7430
	1	Case, rear	1565-5010

## SECTION 2

### INSTALLATION

#### 2.1 INSTALLATION

##### 2.1.1 General.

The sound-level meter should be stored in the vinyl pouch (supplied) when not in use. It can be carried conveniently at waist level by slipping your belt through the loop on the back of the pouch.

##### 2.1.2 Operating Environment.

The SLM operates over the range of environmental conditions that are normally encountered in industrial applications.

#### CAUTION

Remove the batteries before storing to avoid the corrosive effects of battery leakage.

##### 2.1.3 Tripod Mounting.

Any tripod that has a standard 1/4-20 thread will fit the insert on the back of the instrument case. To tripod mount the SLM, screw the threaded end of the pan head into the insert and hand tighten. GR has a tripod available, P/N 1560-9590.

##### 2.1.4 Microphone Windscreen.

To attenuate ambient wind noises use a GR Microphone Windscreen (P/N 1560-9521). The windscreen may also be used to cushion the microphone from accidental shocks and pro-

tect the microphone diaphragm from accumulations of oil, vapor and dust

The windscreen is a 3-in diameter sphere that fits snugly over the microphone. It is made of reticulated polyurethane foam and can be conveniently removed and washed, or replaced, if it becomes soiled. This is in addition to the obvious advantage of attenuating ambient wind noises, such as might emanate from a fan blowing cooling air across the site of the microphone (see Figure 2-1a).

Any attenuation of monitored noise resulting from use of the windscreen occurs over only a portion of the frequency spectrum being monitored. The loss of system sensitivity occasioned by use of the windscreen is shown in Figure 2-1b. For normally encountered noises, the influence of the windscreen on measured sound level is negligible.

### 2.1.5 Output Connector.

It may be desirable to drive other equipment with the SLM, such as a recorder or an oscilloscope. Therefore, a connector, near the level-range control, is available to supply voltages proportional to the meter response. A Switchcraft Type 850-P2 (Micro-plug) connector is supplied with the SLM to complete this end of a patch cord. The other end can be terminated with whatever connection is necessary. The output voltage is  $\approx 1.2$  V for a full-scale reading into an open circuit, with a 6200- $\Omega$  source impedance.

Table 5-5

#### TYPICAL INTERNAL SIGNAL-TO-NOISE RATIOS

Octave-Band Noise Levels in dB Below Full Scale

setting of level-range control

Center Freq (Hz)	Band	140	130	120	110	100	90	80	70	60
31.5	15	84	75	84	73	80	70	60	51	41
63	18	80	71	80	69.5	79	67.5	58	48.5	35.5
125	21	78	69	77.5	68	78	68	57.5	47.5	35.5
250	24	76.5	65	75	66	76.5	67	56.5	46.5	36.5
500	27	76	67.5	74.5	65	76.5	67.5	57	47	37.5
1000	30	75.5	67.5	72.5	64	76	68	58	48	37.5
2000	33	74	67	70.5	63.5	75	68	58.5	48.5	38.5
4000	36	72.5	66.5	68	59.5	74	69	60.5	50.5	40.5
8000	39	72.5	66.5	68	60	73.5	71	64	54.4	44.5

SLM set for C weighting, Gain for - 60 dB microphone (re 1 V/ $\mu$ bar).

Table 5-4

## DESIGN-CENTER AC VOLTAGES\*

Full Scale (dB)	Mike Output	Input Atten.	Input 1st Amp	Gain 1st Amp	Output 1st Amp†	2nd Atten.	Input 2nd Amp†	Gain 2nd Amp	Output 2nd Amp†
50	0.063 mV	÷1	0.063 mV	+26.4	1.67 mV	÷1	1.67 mV	750	1.25 V
60	0.2 mV	÷1	0.2 mV	+26.4	<b>5.28 mV</b>	÷3.16	1.67 mV	750	1.25 V
70	0.63 mV	÷1	0.63 mV	+26.4	16.7 mV	÷10	1.67 mV	750	1.25 V
80	2.0 mV	÷1	2.0 mV	+26.4	<b>52.8 mV</b>	÷31.6	1.67 mV	750	1.25 V
90	6.3 mV	÷1	6.3 mV	+26.4	167 mV	÷100	1.67 mV	750	1.25 V
100	0.02 V	÷10	2.0 mV	+26.4	<b>52.8 mV</b>	÷31.6	1.67 mV	750	1.25 V
110	0.063 V	÷10	6.3 mV	+26.4	167 mV	÷100	1.67 mV	750	1.25 V
120	0.2 V	÷100	2.0 mV	+26.4	<b>52.8 mV</b>	÷31.6	1.67 mV	750	1.25 V
130	0.63 V	÷100	6.3 mV	+26.4	167 mV	÷100	1.67 mV	750	1.25 V

\*Microphone-sensitivity level -60 dB (re 1 V/ $\mu$ bar), 1 kHz signal, and C weighting.

†Actual voltages may differ slightly due to gain variations of the amplifier.

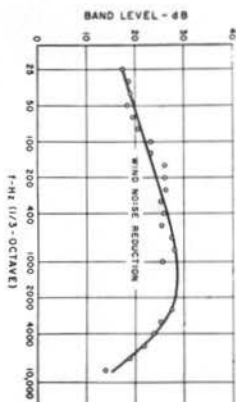


Figure 2-1a. Wind noise reductions caused by microphone windscreen, for wind velocity of 25 mph.

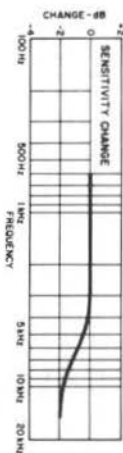


Figure 2-1b. Changes in SLM Sensitivity caused by use of the microphone windscreen.

Another means of connection is to use General Radio patch cords to convert the output connector to another type. For example, to convert the SLM to standard phone jack, use the GR 1560-9680 Patch Cord. Other patch cords are available to convert to standard phone plug, BNC, and double plug.

Figure 2-2. The sound-level meter fitted with the Type 1560-P96 Adaptor and the Type 1560-P52 Vibration Pickup.



## 2.2 USE A VIBRATION METER.

**Installation.** Figure 2-2 shows the Sound-Level Meter fitted with the Type 1560-P96 Adaptor and the Type 1560-P52 Vibration Pickup.\* The microphone is replaced with the adaptor, as in paragraph 3.6, but in this case the adaptor requires no modification. The vibration pickup includes a short cable fitted with a three-terminal microphone connector that mates with the adaptor.

**Calibration.** One method of calibrating the SLM uses the Type 1557-A Vibration Calibrator, as follows:

Remove one of the 50-gram disks from the calibrator and mount the pickup in its place.

\*Two other pickups are also available: the Type 1560-P53, with a greater frequency range than the Type 1560-P52, and the Type 1560-P54, with greater sensitivity.

## 5.7.4 Meter Window Care.

The clear acrylic meter window can become susceptible to electrostatic-charge build-up and can be scratched, if improperly cleaned.

If static-charge problems occur, possibly as the result of frequent cleaning, the window should be carefully polished with a soft dry cloth, such as cheesecloth or nylon chiffon. Then, a coating of Statnui\* should be applied with the polishing cloth.

### CAUTION

Do not use any kind of solvent. Kleenex or paper towels can scratch the window surface.

\*Available from Mancib Co., Burlington, MA 01803;

Table 5-3

TEST VOLTAGES (dc) $\pm 10\%$		
Component	Terminal	To Ground
Q1	D	7.8
	S	0.2-0.5
	G	*
Q2	E	8.4
	B	7.8
	C	1.3
Q3	E	0
	B	-1.4
	C	0
Q4	2	0
	B	0
	C	0.1 (MAX)
U1	2	0
	3	0
	4	-9
	6	0
	7	+9

\*Do not measure, high impedance.

ies. Replace them with fresh units if the check doesn't give an indication in the BATTERY region.

### 5.7.2 Electrical Check.

Next, isolate the problem to either the microphone or the rest of the instrument. To do this, replace the microphone with its equivalent impedance (para. 5.2.3) and drive the input with a 0.63 V, 1-kHz signal. Check the SLM indication to be  $130 \pm 3$  dB. If this indication is satisfactory, the microphone is defective and should be replaced. If it is not satisfactory, use the DVM to check the voltage at the output jack. It should be  $\geq 1.25$  V. If this voltage is incorrect, use Tables 5-3 and 5-4 to further isolate the problem.

### 5.7.3 Internal Noise.

Table 5-5 gives the typical internal noise levels measured in octave bands for each attenuator setting and is intended as a reference for making octave-band noise measurements. To reproduce this table, use the setup shown in Figure 5-1. Apply a 1-kHz calibration signal (2 V nominal) to the input of the SLM to give a full-scale reading on the 130-140 dB range. (The microphone is replaced with its equivalent impedance, see Figure 5-3.)

Calibrate the 1933 for a full-scale reading with the controls set for octave band response. Remove the equipment connected to the 1565B SLM input and then short the input as shown in Figure 5-3. Set the 1565 to the desired range and check the noise level for any of the bands given in the table.

(The cable must be free and unrestricted.) Set the calibrator on a level surface and turn it ON. Adjust the LEVEL control so that the meter indicates 100. Depress the SLOW button on the SLM and set the level-range control to the 110-120 dB range. Adjust the SLM indication to 112 dB by means of the CAL control. The meter will now indicate a level of 112 dB when the pickup is subjected to an acceleration of 1 g, rms (386 inches per second per second). Use Table 2-1 to convert indicated levels in dB to acceleration in g's, rms.

The SLM can also be calibrated by electrical means when the sensitivity of the Type 1560-P52 Vibration Pickup is known. Install the Type 1560-P96 Adaptor; then apply a voltage numerically equal to the pickup sensitivity in volts per g between terminals No. 1 and No. 3 of the adaptor input. (Terminal No.

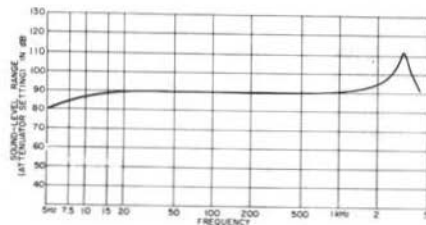


Figure 2-3. Frequency response of the Type 1560-P52 Vibration Pickup with the SLM.

Table 2-1

ACCELERATION IN g's CORRESPONDING  
TO VARIOUS INDICATED LEVELS

Level in dB	Accel in g's	Level in dB	Accel in g's	Level in dB	Accel in g's
34	.000126	66	.00501	98	.200
35	.00014*	67	.00562	99	.224
36	.000159	68	.00631	100	.251
37	.000178	69	.00708	101	.282
38	.000200	70	.00794	102	.316
39	.000224	71	.00891	103	.355
40	.000251	72	.0100	104	.398
41	.000282	73	.0112	105	.447
42	.000316	74	.0126	106	.501
43	.000355	75	.0141	107	.562
44	.000398	76	.0159	108	.631
45	.000447	77	.0178	109	.708
46	.000501	78	.0200	110	.794
47	.000562	79	.0224	111	.891
48	.000631	80	.0251	112	1.00
49	.000708	81	.0282	113	1.12
50	.000794	82	.0316	114	1.26
51	.000891	83	.0355	115	1.41
52	.00100	84	.0398	116	1.59
53	.00112	85	.0447	117	1.78
54	.00126	86	.0501	118	2.00
55	.00141	87	.0562	119	2.24
56	.00159	88	.0631	120	2.51
57	.00178	89	.0708	121	2.82
58	.00200	90	.0794	122	3.16
59	.00224	91	.0891	123	3.55
60	.00251	92	.100	124	3.98
61	.00282	93	.112	125	4.47
62	.00316	94	.126	126	5.01
63	.00355	95	.141	127	5.62
64	.00398	96	.159	128	6.31
65	.00447	97	.178	129	7.08
				130	7.94

b. Adjust the 1309 controls for a 0.1 V, 1-kHz output.

c. Connect the 1309 OUTPUT terminals to the SLM input.

d. Adjust the SLM controls for C weighting and 110-120 dB range.

e. Turn the SLM on and observe the meter indication.

The correct indication depends on the sensitivity of the microphone (refer to its calibration certificate) as given by Table 5-2. If the indication is incorrect adjust CAL control. If the correct indication cannot be obtained, refer to para. 5.7.

Table 5-2

## ELECTRICAL CALIBRATION DATA \*

Microphone Sensitivity		Meter Indication
re 1V/N/m <sup>2</sup>	dB re 20 $\mu$ N/m <sup>2</sup>	(110-120 dB range)
-37	-57	111
-38	-58	112
-39	-59	113
-40	-60	114
-41	-61	115
-42	-62	116
-43	-63	117

\* In SI units, 20  $\mu$ N/m<sup>2</sup> = 20  $\mu$ Pa (micropascal).

## 5.7 TROUBLE ANALYSIS.

## 5.7.1 Battery Check.

If the SLM cannot meet minimum performance standards (para. 5.2), the first step of trouble analysis should be to check the batter-



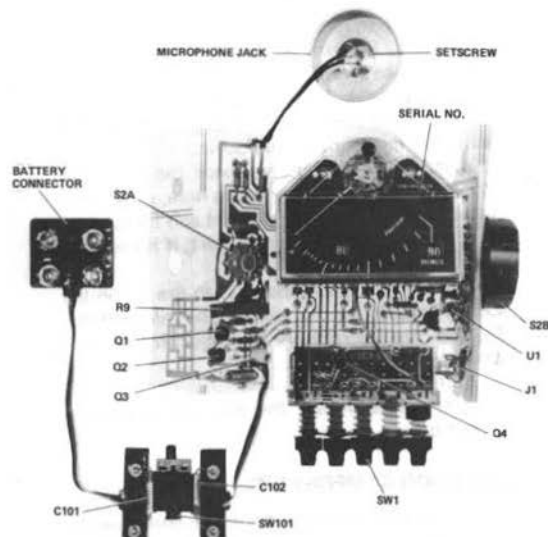


Figure 5-4. Circuitry removed from case.

If a part is obviously faulty or damaged, clip the leads close to the part and then remove the leads from the opposite side.

## 5.6 ELECTRICAL CALIBRATION.

An electrical calibration can be performed by the following procedure:

- a. Remove the microphone (para. 5.3) and connect a 390 pF capacitor to the microphone leads as shown in Figure 5-3.

1 is grounded to the instrument case.) Depress the SLOW button on the SLM and set the level-range control to the 110-120 dB range. The oscillator frequency should be between 100 and 1000 Hz. Adjust the CAL control for a meter indication of 112 dB. Install the pickup and use Table 2-1 to convert indicated dB levels to acceleration in g's, rms.

The technique for measuring vibration is given in the GR Handbook of Noise Measurement. The frequency response for the combination of the sound-level meter and the Type 1560-P52 Vibration Pickup is shown in Figure 2-3.

## 2.3 DETERMINATION OF NOISE EXPOSURE.

According to the Occupational Safety and Health Act of 1970, noise that measures above 115 dB(A) is automatically "too high" for any length of exposure over about 1 second. The SLM can be used to estimate the actual personnel exposure by measuring the noise level in various areas of the plant and measuring the time that personnel are present.

All noises between 90 dB(A) and 115 dB(A) should be recorded and combined to obtain equivalent continuous levels. Notice, in Table 2-2, that the permissible exposure for high-level noise is for much shorter periods than for low-level noise. An instrument that will automatically measure and compute the total exposure is the GR Type 1944 Noise Dosimeter. Its digital readout not only tells you the percentage of the exposure limit that has been accumulated but also indicates whether the in-

stantaneous 115-dB(A) and impact (140-dB peak) levels have been exceeded.

The SLM can be used in conjunction with the 1944. Refer to the 1944 Instruction Manual for operating instructions.

**Table 2-2**  
**PERMISSIBLE NOISE EXPOSURES<sup>†</sup>\***

Duration per day, hours	Sound level dB (A) Slow-Response
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or less	115

<sup>†</sup>At the time of printing, an added exposure of 16 hours at 85 dB(A) is under active consideration. Check regulations in force.

\*Under Part 1910.95 "Occupational Noise Exposure," (Dept. of Labor) of the Code of Federal Regulations, Chap. XVII of Title 29 (39 F.R. 7006).

See also: *Guidelines to the Dept. of Labor's Occupational Noise Standards*, Bulletin 334, GPO: 1971 O-484-782(3).

c. Check that the flex circuit lays properly in the case. Be sure it does not interfere with the front case screw holes.

d. Place the LEVEL RANGE lock in its groove in the lower case, with the locking tab facing the microphone and down.

e. After case assembly, check the alignment of CAL pot (R9) in the access hole, and operation of LEVEL RANGE control and lock.

f. Replace battery foam insert, if it becomes detached.

g. Remount microphone with the 'L' on the socket mating the 'L' pin on the microphone. Tighten the microphone by adjusting the set-screw *counterclockwise*.

h. Install batteries.

After disassembly, the SLM should be recalibrated.

## 5.4 MAJOR COMPONENTS.

Figure 5-4 identifies the major components of the SLM with their corresponding locations.

## 5.5 SERVICING ETCHED-CIRCUIT.

The SLM contains a single etched-circuit board, which is flexible and transparent. The electrical components are on one side and all solder connections are on the other.

### CAUTION

When removing or replacing parts, use a low-heat soldering iron and a small diameter rosin-core solder. Do not subject the parts or board to prolonged heat.

holds the etched-circuit in a folded configuration. (The LEVEL RANGE detent spring will pull out of the case with the circuitry. Reinstall it in the case.) Also make sure that the OUTPUT jack ground clip is still in place.

g. Remove the "c" ring ground contact springs and 2 washers from the left end of the level-range control shaft and pull the knob and shaft out of the assembly. (Be careful not to lose the spring and nylon washer on the shaft.) Figure 5-8 shows details.

All of the components are now easily accessible. See para. 5.5 for component replacement instructions.

To reassemble the instrument, reverse the above procedure. Before inserting the LEVEL RANGE shaft, position the tab on each switch (S2A and S2B, Figure 5-4) at 12 o'clock with the meter facing you. Notice that the knob has two mechanical stops on the inside surface. Turn the knob so that these stops are adjacent to the meter face, then insert the shaft through switch S2B. Place the right-hand drum (highest number = 130) on the shaft, with the number 90 appearing in the window. Place the other drum on the shaft with the number 80 appearing in the window. Place the spring and washer on the shaft and insert the end of the shaft into switch S2A. Continue with steps f through a of the above procedure in reverse order.

To Remount The Microphone;

a. Insert its socket in the lower half case with the setscrew facing access hole. Be sure tab of OUTPUT jack is mating with the ground clip in the lower case.

b. Insert the insulating strip in front of the ON/OFF switch post, then insert the switch.

## SECTION 3

### OPERATING PROCEDURE

#### 3.1 BATTERIES.

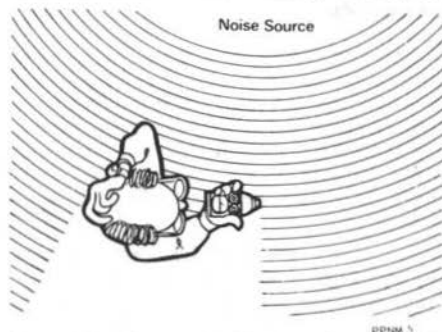
Two 9-V, carbon-zinc, transistor batteries are supplied and should be checked each time the instrument is used. To check the batteries slide the power switch to the right; depress and hold the BAT CHECK pushbutton. The meter should indicate in the region marked BATTERY. If it does not, the batteries must be replaced.

To replace the batteries, first turn the instrument off. Then, with a thumb and forefinger, grasp the knurled edges of the bottom cover, squeeze and remove. Pull the batteries out of the compartment and disconnect them from the clip. Replace with Burgess 2U6, Eveready 216, or equivalent.

#### 3.2 BASIC OPERATION.

Remove and retain the protective cap on the microphone. Slide the power switch to the ON position. Check the batteries by depressing the BAT CHECK button. (If the meter does not indicate in the BATTERY region, the batteries must be replaced.) Set the level-range control to the 110-120 dB range. If the control will not turn, use a pointed object, such as the end of a paper clip, to slide the level-range-control lock (see Figure 1-1) away from the knob.

Stand with the instrument in front of you, with the sound coming from the side. Point the microphone in a direction perpendicular to the noise path, keeping your body out of the path (See Figure 3-1). Depress one of the weighting buttons (see para. 3.3) and turn the level-range control until an on-scale reading is obtained.



**Figure 3-1. Proper positioning of meter with respect to noise source.**

The left window indicates the dB reading at the lower end of the scale while the right window indicates the full-scale reading for the range set by the level-range control. For example, if the level range control is set to the 60-70 dB range, the left window will indicate 60 and the right window 70. If the meter pointer is 4 divisions to the right of the first major meter-scale division, the indicated sound level is 64 dB for the particular weighting selected.

When using fast meter speed, an average level should be estimated if the meter pointer

b. Adjust the 334 A controls as follows:

FUNCTION sw. . . . . SET LEVEL  
METER RANGE sw. . . . . 100%  
FREQUENCY RANGE sw. . . . X100  
HIGH PASS FILTER sw. . . . . OUT

c. Adjust the 334 A SENSITIVITY controls for a full-scale reading.

d. Set the 334 A FUNCTION switch to DISTORTION.

e. Observe the 334 A meter indication — the distortion should be less than 0.5%.

### 5.3 DISASSEMBLY/ASSEMBLY.

#### CAUTION

This instrument should be serviced by skilled service personnel. The procedure outlined below is intended as a guide for skilled service personnel only.

a. Remove the batteries and retain the foam insert (see para. 3.1).

b. Using Allen wrench, turn setscrew (accessible through top rear of case) fully *clockwise* to release microphone, then pull it straight out.

c. Place the SLM face down and remove the four screws from the back half of the case.

d. Turn the instrument over and remove the front half of the case. (Be careful not to break microphone leads or lose the LEVEL RANGE control slide-bar lock.)

e. Grasp the ON-OFF switch assembly with a thumb and forefinger and pull straight up to dislodge it from the mounting post. Retain the insulating strip.

f. Carefully remove the circuitry from the back half of the case and remove the tape that

c. Connect the 2540 DVM to the oscillator output and the Type 1192 Counter to the attenuator input.

d. Connect a 600  $\Omega$ , 1% resistor across the OUTPUT terminals of the attenuator, then connect the attenuator OUTPUT to the input of the SLM.

e. Connect the HP 334A (with a 600  $\Omega$  load across the input) to the SLM output jack.

f. Adjust the SLM controls as follows:

Level-range control . . . . . 80-90 dB  
Weighting . . . . . C  
Power . . . . . ON

g. Adjust the 1309 controls as follows:

FREQUENCY . . . . . 1 kHz  
OUTPUT VOLTAGE . . . . . 1 V

h. Adjust the 334A controls as follows:

Function sw. . . . . VOLTMETER  
METER RANGE sw. . . . . 3 V

i. Adjust the 1450-TB so that the SLM reads full scale.

j. Observe the 334 A meter indication — it should be greater than 0.11 V (With the 600  $\Omega$  resistor removed from the 334 A input, the voltage should be greater than 1.2 V rms.)

#### 5.2.4 Output Distortion (Figure 5-1).

Following is a procedure that can be used to check the distortion of the output voltage:

a. Use the same equipment setup as explained in para. 5.2.3.

fluctuates by 3 dB or less. When the fluctuations are greater than 3 dB, depress the meter speed button (down for SLOW)

#### NOTE

The Occupational Safety and Health Act regulations require A weighting and slow meter response.

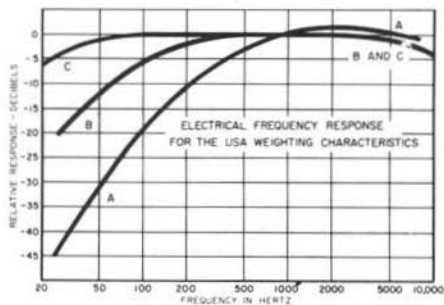
The same measurement procedure is used for A, B, or C weighting; the weighting characteristic should always be stated, otherwise, the measurement will be meaningless. Common practice is to assume A weighting unless otherwise stated (ANSI S1.4-1971).

### 3.3 WEIGHTING NETWORKS.

#### 3.3.1 Choosing the Proper Weighting.

Noise codes and acceptance-test procedures frequently specify the weighting characteristics to be used. For example, A-weighting is often used for the measurement of motor vehicle, appliance, office or plant noise.\* Except for impact noise, Federal Regulations, such as the Walsh-Healey Act and the Occupational Safety and Health Act require use of the A network (hence the symbol "dB(A)" for sound-level decibels on the A scale). When no standard test procedure is involved, measurements should be made with each of the three weighting characteristics. For a full discussion of weighting networks, refer to the General Radio *Handbook of Noise Measurement*.

\*R.W. Young, Journal of the Acoustical Society of America, Vol. 36, pp. 289-295 (1964). D.P. Loe, Noise Control, Vol. 5, pp. 230-235, July, 1959.



**Figure 3-2. A-, B-, and C-weighted responses of the SLM.**

The frequency response of the SLM for each weighting characteristic is shown in Figure 3-2. The C-weighting curve is nearly uniform over the frequency range from 32 Hz to 8 kHz, thus giving an indication of the over-all sound pressure. The A-weighting characteristic discriminates heavily against low-frequency sounds to give an indication closely correlated with subjective estimates of loudness, annoyance, and speech interference. The B-weighting characteristic, between the A and C curves, is sometimes used in place of A weighting when the subjective effects of noise are of interest.

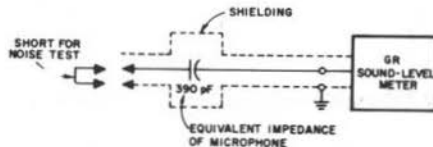
When a frequency analyzer is to be used with the SLM, set the weighting switch to C.

**Figure 5-2. Type 1562 Calibrator mounted over SLM Microphone.**



a. Remove the microphone (para 5.3, steps b and c) and replace it with the equivalent impedance (see Figure 5-3 and para. 3.6).

b. Connect the Type 1309 Oscillator OUTPUT to the input of the Type 1450-TB Attenuator.



**Figure 5-3. The microphone is removed and its equivalent impedance connected to the SLM input.**

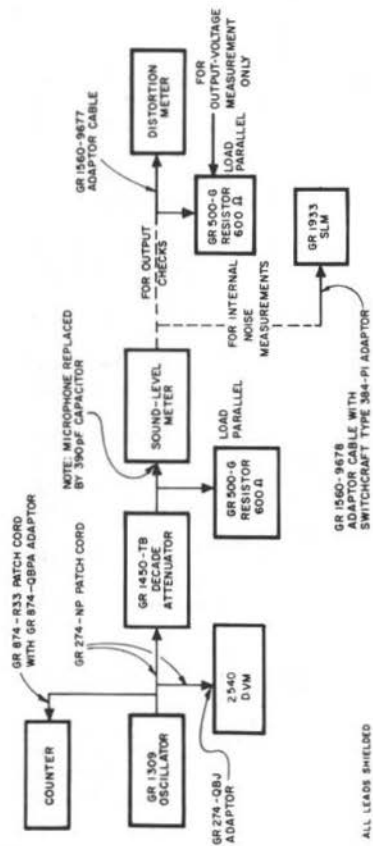


Figure 5-1. Test equipment setup.

### 3.3.2 Overload Prevention

An important possible source of error in SLM measurements arises from strong noise fields that overload the instrument, causing distortion in the meter-amplifier circuit. This circuit is capable of handling signals more than 11 dB above full-scale meter indication. Except for very high crest-factor ("spiked") signals, an on-scale meter indication will yield a valid reading.

Analysis of noise signals containing large low-frequency components may cause overload of circuits prior to the output amplifier, when these signals are weighted by the A and B networks. The SLM guards against this type of overload by partially weighting the signal before the active circuits can be overloaded. Figure 3-3 shows the maximum sinewave input before overload occurs for each weighting.

The curves may be used as follows:

- Measure the C-weighted sound level.
- Now measure the A- or B-weighted sound level.
- Compare the "C" weighted reading with the maximum input level for the level range selected in (b). If possible select the next higher level range. If the sound level drops 10 dB, the reading in (b) is valid.

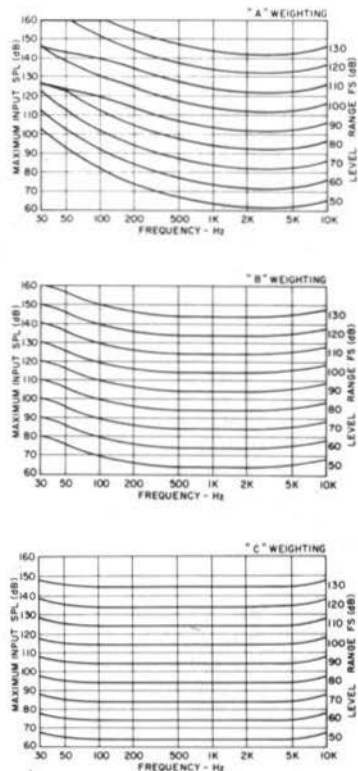


Figure 3-3. Relative maximum input-sound-pressure levels that can be measured in the various weighting modes.

### 5.2.2 Calibration.

A quick, reliable sound-pressure level calibration can be performed at specific frequencies by means of a Type 1562 Sound-Level Calibrator. The calibrator, like the SLM, is small, light, and battery operated, making it ideal for field use.

The procedure is as follows:

- Set the SLM level-range control to the 110-120 dB range.
- Slide the power switch to the ON position and depress the C-weighting-network button.
- Turn the calibrator on and set the desired calibrating frequency, 500 Hz for example.
- Place the calibrator, with the Type 1560-6100 Adaptor (15/16 in.) installed, over the microphone of the SLM (as in Figure 5-2).
- Observe the SLM meter indication to be  $114 \text{ dB} \pm 0.5 \text{ dB}$ . If the meter indication is incorrect by more than 0.5 dB, adjust the CAL control to obtain 114 dB. (Use the screwdriver supplied P/N 1565-0440.)
- Check the meter indication at the other calibrator frequencies. It should be  $114 \text{ dB} \pm 1 \text{ dB}$  at 125, 250, and 1000 Hz and  $\pm 2 \text{ dB}$  at 2000 Hz.

### 5.2.3 Output Voltage

(Figure 5-1).

The SLM will supply at least 1.2 V (ac) at the output jack when the meter is at full-scale deflection. This output is sufficient to drive an analyzer, recorder, oscilloscope, headphones, etc. Following is a procedure that can be used to check the amplitude:



**Table 5-1**  
**TEST EQUIPMENT**

Item	Requirements	Recommended* Type
Oscillator	Range: 20 Hz–8 kHz Output: 1 V	GR 1309
AC–DC DVM	Voltage: 0–10 V, rms Freq: 10 Hz–50 kHz Accuracy: $\pm 2\%$ Impedance: $> 100\text{ k}\Omega$	2540  (Data Precision)
Calibrator	OUTPUT: 1 V FREQUENCY: 125, 250, 500, 1 kHz and 2 kHz	GR 1562
Digital Counter	10 Hz–50 kHz	GR 1192
Attenuator	0–100 dB in 0.1 dB steps	GR 1450-TB
Distortion Meter	10 Hz–50 kHz	HP 334-A
Precision SLM and Octave-Band Noise Analyzer	Meets ANSI S1.4-1971, Type 1	GR 1933
Patch Cord	GR874 to banana plugs	GR874-R33
Patch Cord (2)	GR 274 to 274	GR 274-NP
Adaptor cable	Micro plug to Std. phone plugs	GR 1560-9678
Adaptor cable	Micro plug to GR274	GR 1560-9677
Adaptor cable	Micro plug to GR 1933 mast	GR 1933-9602
Resistor	600 $\Omega$ , 1% (2)	GR 500-G
Capacitor	390 pF $\pm 10\%$ (Mica)	—

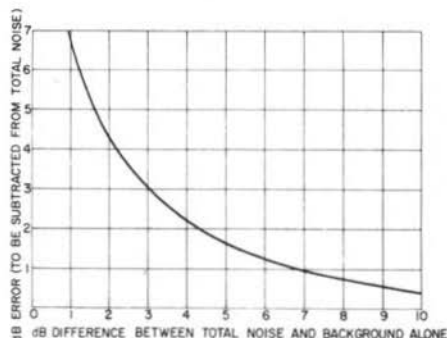
\*Or equivalent

### 3.4 EFFECT OF THE OPERATOR.

When the sound is coming mainly from one direction, the sound-level reading may be somewhat affected by the relative positions of instrument and observer. The SLM should not be held in front of the observer with the microphone pointed toward the source of the sound, although this is perhaps the most logical manner. This position gives a marked increase in the response at high frequencies. The observer, facing the sound from directly behind the instrument, acts as a reflector to produce errors of several dB in the frequency range above 100 Hz.

A more uniform frequency response is obtained with the meter in front of the observer, but with the sound grazing the microphone (coming from the side, rather than from the front). When out of doors, hold the instrument with the microphone pointing upward, (to avoid interference from reflected high frequencies) and as far from the body as is convenient. Do not point the microphone toward a source of background noise (any source other than the one being measured).

The sound-level meter can be mounted on a tripod (see para. 2.1.3) to reduce further the effects of the observer's presence. His position should be similar to that for hand-held operation; a line between the observer and the instrument should be approximately perpendicular to a line from the instrument to the sound source.



**Figure 3-4.** Effect of background noise on measurements.

### 3.5 BACKGROUND NOISE.

Measurements should be made with as little background noise as possible. For all weightings the background level should be at least 10 dB below the total measured level. When this cannot be done, apply the corrections given in Figure 3-4.

### 3.6 USE OF AN EXTENSION CABLE.

The sound-level meter can be operated at some distance from its microphone if a low noise extension cable, such as the Type 1560-P73, is used. In fact, this is a good practice when measuring high-intensity fields. However, several factors must be considered:

The use of the cable will change the source impedance as seen by the input terminals of the SLM, thereby changing the weighting characteristics. To compensate for this, a capacitor must be added in series with the input to the SLM.

## SECTION 5

## SERVICE AND MAINTENANCE

### 5.1 FIELD SERVICE

The General Radio warranty attests the quality of materials 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 use of the following service instructions, please contact 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 numbers of the instrument.

Before returning an instrument to General Radio for service, please contact our Service Department or nearest 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.

### 5.2 MINIMUM PERFORMANCE STANDARDS.

#### 5.2.1 General.

The equipment, methods, and criteria for verifying the specified performance of the SLM are presented in the following paragraphs. Table 5-1 lists the necessary equipment and Figure 5-1 shows an equipment setup for making performance tests.



GenRad

This product is warranted to be free from defects in material and workmanship and, when properly used, will perform in accordance with specifications. Any GR-manufactured instrument, module, or part found not to meet this standard within a period of one year after original shipment will be repaired or replaced at no charge when returned to a GR service facility.

GR policy is to maintain repair capability for a period of ten years after the original shipment and to make this capability available at the then prevailing schedule of charges for any product returned to a GR service facility. Changes in the product not approved by GR shall void this warranty. GR is not liable for consequential damages.

This warranty is in lieu of all other warranties, expressed or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose.

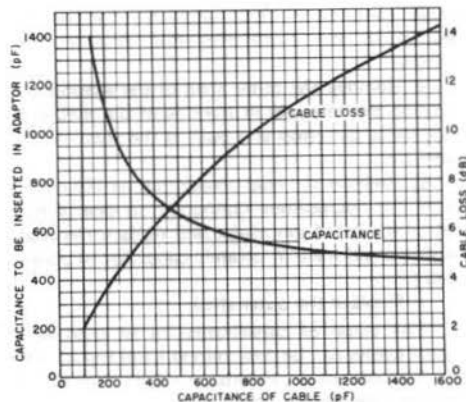


Figure 3-5. The chart shows the compensation required for the capacitance of various extension cables and the corresponding cable loss.

Also, cable losses will cause the meter to read low by an amount that varies with the cable length. Figure 3-5 shows the loss and the value of the compensating capacitor for cable capacitances between 150 and 1500 pF.

The Type 1560-P73 Extension Cable (P/N 1560-9673), for use with the SLM is a 25-foot cable, fitted with standard 3-terminal microphone connectors. A Type 1560-P96 Adaptor (P/N 1560-9696) and a Type 1560-3040 Microphone Base, P5 base, or P5 microphone complete, are needed to mate the SLM and the microphone with the connectors. The capacitance of the Type 1560-P73 Extension Cable is approximately 550 pF. Figure 3-5 shows that a series capacitor of 640 pF is required for this

cable capacitance. This capacitor can be installed in the Type 1560-P96 Adaptor, as follows:

- a. Remove the outer shell of the adaptor by turning the setscrew in the side of the shell in a clockwise direction and pulling the shell off the adaptor.

- b. Remove the lead connecting terminal No. 3 of the microphone connector to one of the teflon insulated pin plugs, and replace the lead with a small mica or ceramic capacitor of about 640 pF.

- c. Replace the outer shell.

The value of capacitance to be used with other cables can be determined from Figure 3-5.

To connect an extension cable, proceed as follows (see Figure 3-6):

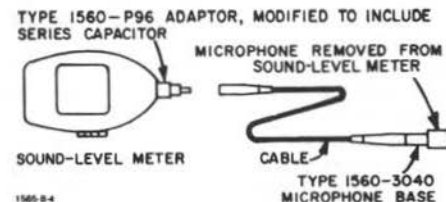


Figure 3-6. Installation of an extension cable between sound-level meter and the microphone.

- a. Insert the .050-in. Allen wrench, through the access hole at the top rear, and turn the screw *clockwise*.

- b. Pull the microphone straight out from the top. Note that the "L", molded inside the

potential is indicated by the meter, unless the negative battery is below  $-7.0$  V. If this lower negative-voltage limit is exceeded, Q3 turns on causing the meter to indicate that the negative-battery potential is low. Both batteries should be replaced at the same time.

Meter readings for "false" weightings (such as all buttons up, or 2 adjacent buttons down) are prevented by short circuiting the meter via Q4.

Since the microphone capacitance serves as part of the weighting network, the spectrum is partly weighted before it is introduced to the preamplifier, which reduces the likelihood of overloading the amplifier. The source capacitance cannot be changed, however, without affecting the weighting characteristic.

#### 4.3 POWER SUPPLY.

The power supply consists of two 9-V transistor-radio batteries, used to supply positive and negative voltages, and circuitry for checking the level of charge. Approximately 50 hours of operation are obtained when the instrument is operated for two hours per day.

## 4.2 MAIN CIRCUITRY.

Transistors Q1 and Q2 comprise the active elements of the preamplifier. Q1 is a low noise, N-channel, field-effect transistor and operates in conjunction with a high-gain, bipolar transistor (Q2) to stabilize the gain. R9, a potentiometer in the preamplifier feedback loop, is used to calibrate the instrument.

The main amplifier consists of one integrated circuit that provides low output impedance and high gain — gain is stabilized via the feedback loop. This amplifier drives both the meter detector circuit and the output terminals.

The attenuator is divided into two sections for best signal-to-noise ratio. One section precedes the input amplifier; the other is between the amplifier stages. The attenuation is adjustable in 10-dB steps.

Each coupling and feedback path in the SLM serves double duty by forming part of the weighting network. The main amplifier feedback loop shapes the 733-Hz and 8-kHz rolloff for A-weighting and A-, B-, and C-weighting, respectively. Rolloff at 107 Hz for A-weighting, 160 Hz for B-weighting and 32 Hz for C-weighting is accomplished by the combination of transducer capacitance and input load resistance. The 32-Hz rolloff for A- and B-weighting is formed by the preamplifier output coupling circuit and the second section of the attenuator.

The battery-check circuit utilizes the meter and a sensing circuit consisting of Q3, CR4, CR5, and associated resistors. When the BAT CHECK button is depressed the positive-battery

microphone and engraved on the SLM jack, indicates mating connectors.

c. Plug the modified -P96 Adaptor into the microphone connector. Make sure the adaptor pin marked "G" mates with the connector "L" pin and that the setscrew access holes line up. Turn the Allen setscrew *counterclockwise* to lock the adaptor in place.

d. Connect the microphone to the Type 1560-3040 Microphone Base (black lead to pin L on the microphone). Fasten the microphone base to the cartridge with the setscrews in the base.

e. Install the extension cable between the SLM and the microphone base (para. 3.6). The loss for the Type 1560-P73, 25-ft Extension Cable is found from Figure 3-5 to be 7.8 dB. This value must be added to the reading of the SLM to obtain the actual sound level. Or the correction can be determined with the Type 1562 Sound-Level Calibrator, set to produce a level of 114 dB at the microphone.

Using the 1560-2133 Microphone (with base) at the end of an extension cable allows sound-field intensity measurements up to 140 dB. To do this, calibrate the sound-level meter to read 104 dB (instead of 114 dB) with the 1562 Calibrator and add 10 dB to all readings.

### NOTE

When replacing the microphone on the SLM, make sure the "L" hole on the socket mates with the L terminal on the microphone cartridge.

### 3.7 PREFERRED ANGLE OF INCIDENCE.

When measurements are made on sounds in reverberant fields, the angle of incidence of sounds reaching the microphone is indeterminate. In this case, there is no preferred angle of incidence between the microphone and the sound source. When measurements are made on a source in a free field, an angle of incidence of 70 degrees between the axis of the microphone and the sound source will approximate random response.

### 3.8 USE AS A PREAMPLIFIER.

The SLM can be used as a preamplifier for the GR 1558 Octave-Band Noise Analyzer to make low level octave-band measurements (i.e. below the low end of the 1558 sound-level range). Following is a recommended procedure:

- Connect the SLM output to the 1558 INPUT (SLM) jack with the GR 1560-P78 (P/N 1560-9678) adaptor cable.
- Adjust the SLM controls as follows:  
Level-range control . . . . . 110/120  
Meter speed . . . . . SLOW  
Weighting . . . . . C  
Power sw. . . . . ON
- Adjust the 1558 controls as follows:  
Function sw. . . . . Fast  
Band CPS . . . . . ALL PASS  
BAND LEVEL dial . . . . . 12:00 o'clock  
BAND LEVEL knob . . . . . Fully cw
- Use the GR 1562 Calibrator to make the SLM read 114 dB; adjust the 1558 CAL control for a +4 meter indication. The setup is now calibrated so that a 1558 meter indication of 0

- equals the low end of the SLM range setting.
- Set the SLM level-range control for an on scale indication or the lowest range.
- Set the BAND CPS control to the desired band.
- Set the BAND LEVEL knob for an on scale reading. The band level in dB is the algebraic sum of the 1558 meter indication + the BAND LEVEL knob setting (red scale only) + the low end of the SLM range setting.

## SECTION 4

### PRINCIPLES OF OPERATION

#### 4.1 GENERAL.

The all solid-state circuit contains 2 transistors and 1 IC package and is carried by a single flexible etched-circuit board. The circuitry consists of two amplifiers, an attenuator, weighting networks, a meter circuit, and a power supply as depicted by Figures 4-1 and 5-8.

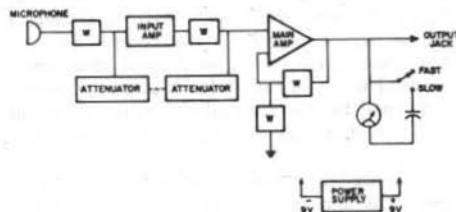


Figure 4-1. Block diagram of the Sound-Level Meter.

