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INSTRUCTION MANUAL

TYPE 1563

SOUND-LEVEL METER

This instrument is capable of making sound-level 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). Ref: Federal Register, Vol. 36, No. 105, May 29, 1971.

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CONCORD, MASSACHUSETTS 01742

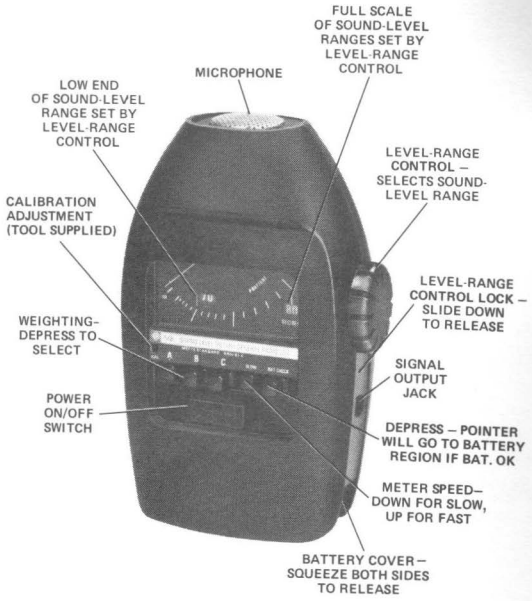

Figure 1-1. Type 1563 Sound-Level Meter.

CONDENSED OPERATING INSTRUCTIONS

- 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; SLOW – up for fast, down for slow).

NOTE

The Occupational Safety and Health Act regulations require A weighting and SLOW meresponse.*

- 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 an on-scale indication and read the meter. (The –10 mark is 40 dB and the meter should be read accordingly.)
- If the pointer fluctuates more than 3 dB, depress the SLOW button.
- CALIBRATION – Periodic acoustical calibration with the GR 1562 Sound-Level Calibrator is recommended (para. 5.2.2).

CAUTION

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

SPECIFICATIONS

Sound Level: 40 to 140 dB re 20 $\mu N/m^2$.

Weighting: A, B, and C. Conforms to ANSI S1.4-1971, Type 3.

Meter: Rms response with fast and slow speeds.

Input: MICROPHONE: Lead-zicronate-titanate ceramic. INPUT IMPEDANCE: $\approx$ 13 MΩ//15 pF.

Output: $\geqslant$ 1.2 V rms behind 620 Ω with meter at full scale; will drive GR 1556 Impact-Noise Analyzer, 1558 Octave-Band Noise Analyzer, 1521 or 1523 recorders, oscilloscopes, or low-impedance headphones. HARMONIC DISTORTION: $\leqslant$ 0.5% (0.1% typical) from 32 Hz to 8 kHz, C-weighted with meter at full scale.

Calibration: Can be calibrated at 114 dB sound pressure level at 1 kHz with the GR 1562.

Environmental: TEMPERATURE: −10 to 50° C operating: −40 to +60°C storage, with batteries removed; coefficient of sensitivity $\approx$ −0.01 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: Miniature phone plug to connect to output, screwdriver for calibration adjust, adaptor for coupling to the 1562 calibrator, and a carrying pouch.

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

Mechanical: Shielded plastic case. DIMENSIONS (wxhxd): 3.63x5.38x2.09 in. (92x137x53m). WEIGHT: 13 oz (0.37 kg) net, 3 lb (1.4 kg) shipping.

SECTION 1

INTRODUCTION

1.1 GENERAL.

Sound (or noise) is basically a rapid variation in atmospheric pressure. A measurement of sound pressure is accomplished by changing a noise into an electrical signal and displaying it on an indicator in terms of decibels (dB) relative to a reference pressure.

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. The 1563 is an instrument that measures sound level (i.e. weighted sound-pressure level); it is called a sound-level meter or 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 $2.00 contains 282 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 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. The 1563 (Figure 1-1) is a type -3 (survey) instrument, manufactured to meet tolerances specified by the American National Standards Institute (ANSI) standard for sound-level meters (S1.4-1971).

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 level-range control, 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 40 to 140 dB above the standard reference level of 20 $\mu N/m^2$ (0.0002 μbar).

Figures 1-2 and 1-3 show the directional characteristics of the 1563 SLM.

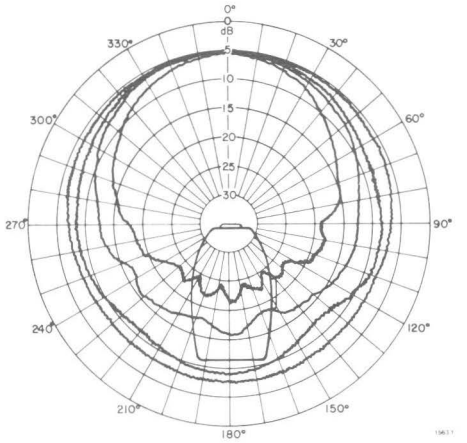

Figure 1-2. Polar plot of the angle-of-incidence response of the Type 1563 SLM.

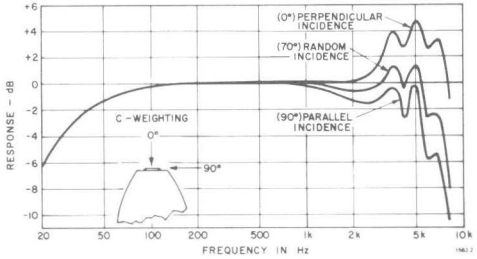

Figure 1-3. Frequency Response as a function of incidence of the Type 1563 SLM.

1.3.2 Microphone.

General Radio's 1563-0400 lead-zirconate-titanate ceramic microphone cartridge was developed specifically for use in the Type-3 SLM. The following features make it excellent for sound-level measurements:

1. A frequency characteristic carefully controlled in manufacture to give a flat response to sound waves of random incidence at frequencies from 20 Hz to 8 kHz.

2. Rugged dependable design capable of withstanding wide climate changes.

3. Low temperature coefficient of sensitivity gives minimal change in output voltage from −10° to 50° C.

4. Low temperature coefficient of internal impedance.

1.4 ACCESSORIES SUPPLIED.

The following accessories are supplied:

Pouch	(P/N 1565-0490)
Screwdriver	(P/N 1565-0440)
Micro Plug	(Switchcraft Type 850-P2)
Two batteries	(Burgess 2U6 or equivalent)
Adaptor	(P/N 1563-1100) to couple SLM to GR1562 Calibrator.

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. 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. ¼-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).

3. Type 1560-9580 Tripod.

SECTION 2

INSTALLATION

2.1 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.

2.2 OPERATING ENVIRONMENT.

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

CAUTION

Remove the batteries before long-term storage to avoid the corrosive effects of battery leakage.

2.3 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 tripod head into the insert and hand tighten.

The GR 1560-9580 Tripod is recommended.

2.4 OUTPUT CONNECTOR.

It may be desirable to drive other equipment with the SLM, such as a recorder or an oscilloscope. Therefore, a recessed Micro-jack

connector, next to the level-range control, is available to supply voltages proportional to the meter response. A Switchcraft Type 850-P2 Micro plug connector is supplied to complete this end of a patch cord. The other end can be terminated with whatever connection is necessary.

Another means of connection is to use General Radio adaptor cables to convert the output connector to another type. For example, to connect the GR 1556-B Impact Noise Analyzer to the sound-level meter, use the GR 1560-9680 (Micro plug to standard phone jack). Other adaptor cables are available to convert to standard phone plug, BNC, and double plug (para. 1.5).

The output voltage is approximately 1.2 V rms behind 620 Ω when the meter reads full scale. It can be monitored with an earphone of any impedance, although 600 Ω will provide the greatest sensitivity. An earphone discriminates against low frequency noises and allows the user to determine the approximate frequency of the noise being indicated by the SLM. This may be particularly useful when A weighting is used.

2.5 APPLICATIONS.

2.5.1 Impact Noise Analysis.

Under the regulations of the Walsh-Healey Public Contracts Act and the Occupational Safety and Health Act, the maximum permissible level of any single impact noise is 140 dB peak sound-pressure level.

The commonly accepted method for impact-noise measurements is to use an SLM with an impact-noise analyzer to collect data from a rapidly recurring noise and store or hold the information so that it can be conveniently read and studied. This system is both inexpensive and portable.

The GR 1556-B Impact-Noise Analyzer, is an amplifier-voltmeter system designed to measure the peak value of an impact noise. By means of electrical storage circuitry, the instrument will "hold" this peak level of the impact for subsequent reading. The SLM-analyzer combination is capable of peak sound-level measurements up to 145 dB. Above this level the microphone may become nonlinear.

Figure 2-1 shows the two instruments connected. A GR 1560-9680 Patch Cord is required to make the connection.

Figure 2-1. The GR 1563 Sound-level Meter with the GR 1556-B Impact-Noise Analyzer.

2.5.2 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.

All noises between 90 dB(A) and 115 dB(A) should be recorded and combined to obtain equivalent continuous levels. Notice, in Table 2-1 that the exposure for high-level noise is for much shorter periods than for low-level noise.

To determine the noise exposure in a location where the noise varies, each noise level and its duration must be measured. The noise exposure can be calculated from the measurement made with the 1563 SLM by following the procedures outlined in the GR ***Primer of Plant Noise Measurement and Hearing Testing.***

When the noise level fluctuates significantly and often during the workday, the manual computation technique becomes difficult and time consuming to perform reliably and accurately. Use of an instrument that ***automatically*** measures and computes the total exposure is a more economical method.

Such an instrument is General Radio's 1934 Noise-Exposure Monitor. The unattended 1934 automatically measures the noise exposure to the official criteria and continually calculates how much of the daily maximum legal exposure you've accumulated. Its digital readout not only tells you the percentage of the exposure limit that has been accumulated but also indicates whether the instantaneous 115-dB(A) and impact (140-dB peak) levels have been exceeded.

At the end of the test period, the instrument automatically stops measuring but retains the data until you can record the results. Because the 1934 measures noise exposure to the applicable portions of governmental, ANSI, and IEC standards, all data are legally defensible.

Figure 2-2. The Noise Exposure Monitor shown in an industrial application.

Table 2-1

PERMISSIBLE NOISE EXPOSURES*

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

*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). Ref: Federal Register, Vol. 36, No. 105, May 29, 1971.

SECTION 3

OPERATION

3.1 BATTERIES.

Two 9-V, carbon-zinc, transistor batteries are supplied and should always 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 battery 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.

Approximately 50 hours of operation can be obtained with new batteries when the instrument is operated for 2 hours per day.

3.2 BASIC OPERATION.

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 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 control lock (see Figure 1-1) away from the knob.

If it is desired to know whether or not a noise exceeds a certain level, and the actual level is unimportant, the level-range control can be locked in the desired range. To do so, slide the level-range control lock (Figure 1-1) toward the level-range control. Use a pointed object such as the end of a paper clip to slide the lock bar.

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 knob until an on-scale reading is obtained.

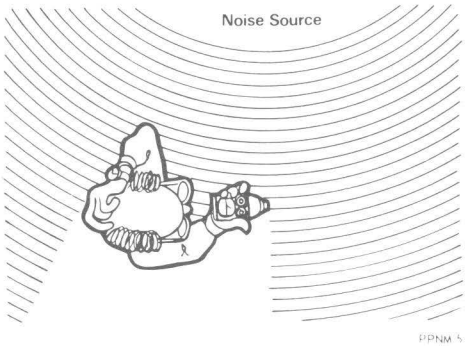

Figure 3-1. Proper positioning of meter with respect to noise source.

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 range-level control. For example, if the attenuator 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 the fast meter speed, an average level should be estimated if the meter pointer 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.

If the weighting is not specified, common practice is to assume A weighting.[1]

Measurements near hard walls should be avoided as readings are usually exaggerated.

[1] American National Standards Institute, S1.4,1971 pp. 8, para. 2.2.

3.3 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, community, office or plant noise.[1] 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.*

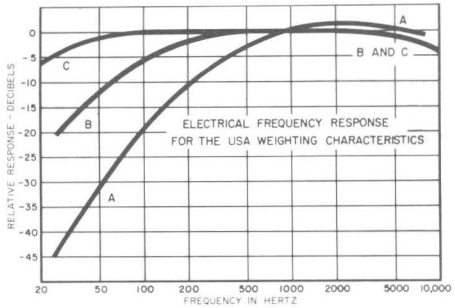

Figure 3-2. A-, B-, and C-weighted electrical responses of the SLM.

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

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.

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. 2.3) 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.

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 3-3.

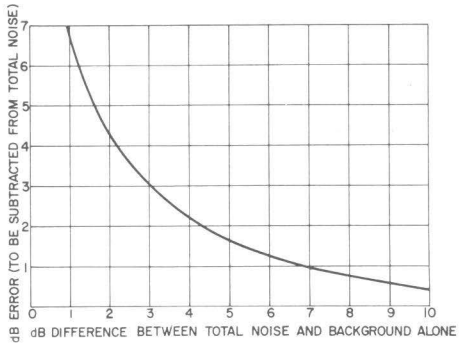

Figure 3-3. Effect of background noise on measurements.

3.6 PREFERRED ANGLE OF INCIDENCE.

When measurements are made on sounds in reverberant fields, the angle of incidence of sounds reaching the microphone is indeterminant. 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.

SECTION 4

THEORY

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.

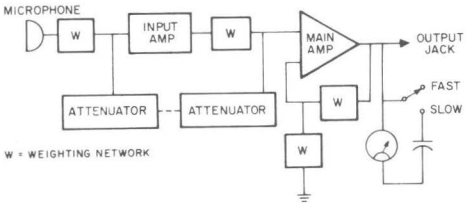

Figure 4-1. Block diagram.

4.2 MAIN CIRCUITRY. (Figure 5-8)

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 corresponding to level ranges.

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 rolloff for A-weighting and the 8-kHz rolloff for A-, B-, and C-weighting. 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 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.

Q4 is used in conjunction with transistor weighting switches to prevent meter readings for "false" weightings (i.e., all buttons up or 2 adjacent buttons down). The meter is electrically short circuited by Q4 for both conditions.

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. Use of two directly connected batteries allows fewer components in the circuit and eliminates losses in dc-dc converters.

SECTION 5

SERVICE AND MAINTENANCE

5.1 WARRANTY.

General Radio warrants that each new instrument sold by us is free from defects in material and workmanship, and that, properly used, it will perform in full accordance with applicable specifications for a period of two years after original shipment. Any instrument or part that is found within the two-year period not to meet these standards after examination by our factory, regional center, or authorized repair agency personnel, will be repaired, or, at our option, replaced without charge, except for batteries that have given normal service.

The two-year warranty stated above 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.

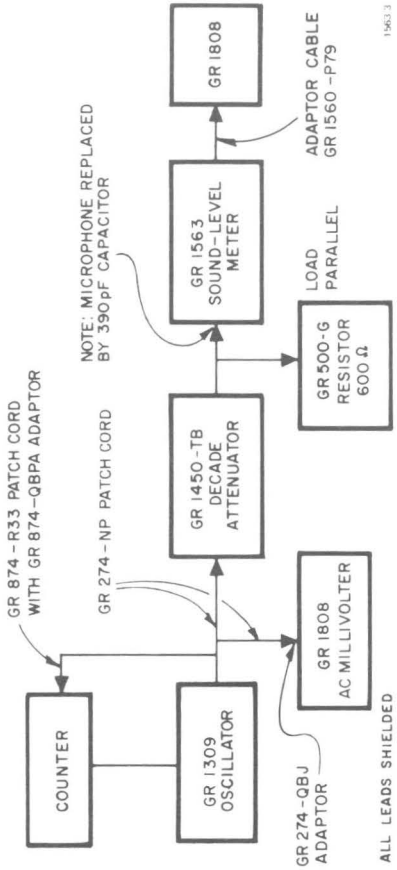

Figure 5-1. Test equipment setup

NOTE

The serial number is slightly obscured by instrument case and is located on the upper right-hand corner of the meter face.

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.

Table 5-1
TEST EQUIPMENT

Item	Requirements	Recommended Type*
Oscillator	Range: 20 Hz - 8 kHz Output: 1 V	GR 1309
AC Millivoltmeter	Voltage: 0-5 V, rms Frequency: 10 Hz - 50 kHz Accuracy: ±2% Impedance: 100 kΩ or greater	GR 1808
Calibrator:	OUTPUT: 114 dB sound pressure FREQUENCY: 1 kHz.	GR 1562
Digital Counter	10 Hz - 50 kHz	GR 1192

Table 5-1 (cont.)

Item	Requirements	Recommended Type*
Attenuator	0-100 dB in 0.1 dB steps	GR 1450-TB
Adaptor	Coupler 1562 to SLM	GR 1563-1100
Adaptor cable	Micro plug to BNC	GR 1560-9679
Patch cord	GR 274 to 274	GR274-NP
Patch cord	GR 874 to banana plugs	GR874-R33

*Or equivalent.

5.2.2 Calibration.

A quick, reliable sound-pressure level calibration can be performed at 1 kHz 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:

a. Set the SLM level-range control to the 110-120 dB range.

b. Slide the power switch to the ON position and depress the C-weighting-network button.

c. Stand the SLM on a flat surface or hold the two instruments as depicted by Figure 5-2.

d. Turn the calibrator on and adjust it for a 1-kHz calibrating signal.

e. Carefully place the calibrator, with the Type 1560-1100 Adaptor installed, over the microphone of the SLM.

f. Observe the SLM meter indication to be 114 dB ± 1 dB. If the meter indication is incorrect by more than 1 dB, adjust the CAL control to obtain 114 dB. (Use the screwdriver supplied P/N 1565-0440.) If the correct indication cannot be obtained, refer to para. 5.6.

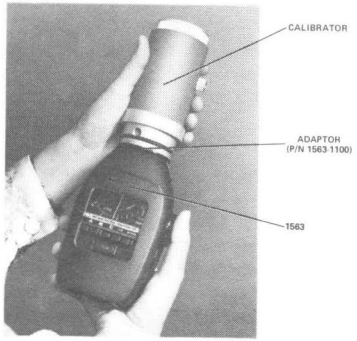

Figure 5-2. Type 1562 Calibrator mounted over 1563 Microphone.

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:

a. Perform steps a-f of para. 5.2.2.

b. Connect the Type 1808 AC Millivoltmeter to the SLM output jack and adjust the millivoltmeter for 1.5 V full scale.

c. Observe the 1808 meter indication – it should be 0.4-0.9 V (114 dB).

5.3 DISASSEMBLY/ASSEMBLY.

CAUTION

The procedure outlined below is intended as a guide for skilled service personnel only.

Refer to Figure 5-3 before attempting to disassemble the instrument. The following procedures are recommended:

a. Remove the batteries (see para. 3.1).

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

c. Turn the instrument over and remove the front half of the case. (Be careful not to damage the microphone.)

d. Carefully disconnect the microphone by removing the two leads from the base terminals.

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

f. Unsolder the ground wire at the output jack. (This wire is connected between the output jack and the back half of the case.)

g. Carefully remove the circuitry from the front half of the case and remove the tape that holds the etched circuit in a folded configuration. (Do not lose the level-range control lock bar.)

h. Pull the level-range control out of the assembly, being careful not to lose the spring and nylon washer on the left end of the shaft.

NOTE

Some instruments have a C-ring and washer installed over the end of the shaft. These must be removed before the level-range control can be withdrawn.

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 control shaft, position the tab on each switch (S2A and S2B, Figure 5-3) at 12 o'clock, with the meter facing you. Notice that the level-range-control knob has 2 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 = 140) on the shaft, with the number 100 appearing in the window. Place the other drum on the shaft with the number 90 appearing in the window. Place the spring and washer on the shaft and insert the end of the shaft into switch S2A. If used, replace the C-ring and washer and then continue with steps g through a of the above procedure in reverse order.

5.4 MAJOR COMPONENTS.

Figure 5-3 identifies the major components of the SLM with their corresponding locations.

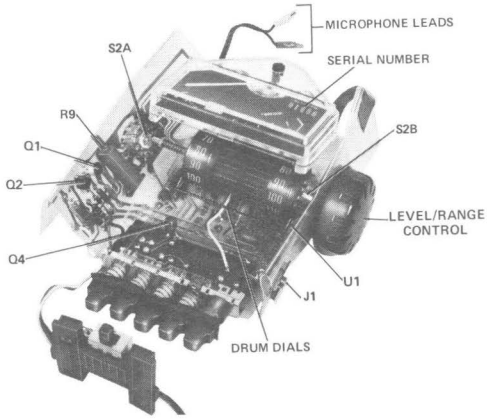

Figure 5-3. Circuitry removed from case.

5.5 SERVICING THE ETCHED BOARD.

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.

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 TROUBLE ANALYSIS.

If the SLM cannot meet minimum performance standards (para. 5.2), the first step of trouble analysis should be to check the batteries. Replace them with fresh units if the check doesn't give an indication in the BATTERY region.

Next, isolate the problem to either the microphone or the rest of the instrument. To do this, disassemble the instrument (para. 5.3) and replace the microphone with its equivalent impedance (Figure 5-4). Drive the input with a 1-V, 1-kHz signal. Check the SLM indication to be 131-137 dB. If this indication is satisfactory, the microphone is defective and should be replaced. If it is not satisfactory, use the GR 1808 to check the voltage at the output jack. It should be 0.4-0.9 V. If this voltage is incorrect, use Tables 5-2 and 5-3 to further isolate the problem.

Table 5-2
TEST VOLTAGES (dc) ±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
Ω4	E	0
	B	0
	C	0.1 (MAX)
IC1	2	0
	3	0
	4	−9
	6	0
	7	+9

*Do not measure, high impedance.

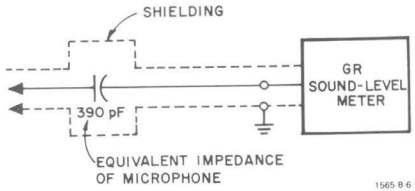

Figure 5-4. Microphone equivalent impedance connected to the SLM input.

Table 5-3
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†
60	0.2 mV	÷ 1	0.2 mV	X 7.9	1.57 mV	÷ 1	1.57 mV	X795	1.25
70	0.63 mV	÷ 1	0.63 mV	X 7.9	4.96 mV	÷ 3.16	1.57 mV	X795	1.25
80	2.0 mV	÷ 1	2.0 mV	X 7.9	15.7 mV	÷ 10	1.57 mV	X795	1.25
90	6.3 mV	÷ 1	6.3 mV	X 7.9	49.6 mV	÷ 31.6	1.57 mV	X795	1.25
100	0.0 2V	÷ 1	20 mV	X 7.9	157 mV	÷ 100	1.57 mV	X795	1.25
110	0.06 V	÷ 10	6.3 mV	X 7.9	49.6 mV	÷ 31.6	1.57 mV	X795	1.25
120	0.2 V	÷ 10	20 mV	X 7.9	157 mV	÷ 100	1.57 mV	X795	1.25
130	0.63 V	÷ 100	6.3 mV	X 7.9	49.6 mV	÷ 31.6	1.57 mV	X795	1.25
140	2.0 V	÷ 100	20 mV	X 7.9	157 mV	÷ 100	1.57 mV	X795	1.25

*Microphone-sensitivity level −60 dB, 1 kHz signal, and C weighting.
†Actual voltages may differ slightly due to gain variations of the amplifier.

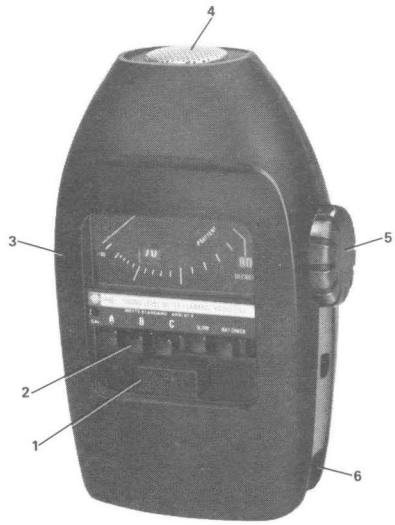

Figure 5-5. Mechanical parts – front view.

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 asm.	1563-1510
4	1	Microphone, MK101	1563-0400
5	1	Level-range-control knob	1565-1230
6	1	Battery cover	1565-7430

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
CAPACITORS					
C1	Cer., 0.1 µF +80-20% 100 V	4400-2050	80183	5C13, .1 µF +20%	5910-080-9646
C2	Cer., 1.8 pF ±5% 100 V	4400-6302	72982	8B1-025	
C3	Cer., 33 pF ±5% 500 V	4404-0335	72982	831, 33 pF ±5%	
C4	Tant., 47.0 µF ±20% 6 V	4450-5500	56289	150D476X0006B2	5910-752-4185
C5	Tant., .15 µF ±5% 15 V	4450-4303	12954	.15 µF ±5%	
C6	Tant., 10.0 µF ±20% 20 V	4450-5100	56289	150D106X0020B2	5910-855-6343
C7	Cer., 82 pF ±5% 500 V	4404-0825	72982	831, 82 pF ±5%	
C8	Cer., 27 pF ±5% 100 V NPO	4400-6303	72982	831, 27 pF ±5%	
C9	Cer., 100 pF ±5% 200 V	4400-6442	72982	8111-200-Y5D-101J	
C10	Tant., 1.0 µF ±5% 35 V	4450-4302	76149	1 µF ±5%	
C11	Tant., 80 µF +20% 15 V	4450-6300	37942	CG, 80 µF ±20%	
C12 and C13	Tant., 6.8 µF ±20% 6 V	4450-4800	56289	150D685X0010A2	5910-936-1332
C14	Tant., 56 µF ±10% 6 V	4450-5520	76149	56 MF ±10%	
C101 and C102	Tant., 120 µF ±20% 10 V	4450-6510	24655	4450-6510	
CONNECTORS					
	Miniature, Jack	4260-1110	82389	TR-2A	

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
DIODES					
CR1	1N4009	6082-1012	24446	1N4009	5961-892-8700
CR2 thru					
CR4	1N34A	6082-1003	58854	1N34A(S)	5961-170-4430
CR5	1N958B (7.5 V)	6083-1057	28959	1N958B	
INTEGRATED CIRCUITS					
U1	Integrated Circuit	5432-7091	07263	μ5B7709394	
RESISTORS					
R1	Film, 3.24 MΩ ±1% 1/8 W	6250-4324	75042	CEA, 3.24 MΩ ±1%	
R2	Film, 5.62 MΩ ±1% 1/8 W	6250-4562	75042	CEA, 5.62 MΩ ±1%	
R3	Comp., 11.7 MΩ ±1% 1/4 W	6350-5117	75042	CEB, 11.7 MΩ ±1%	
R5	Film, 1.17 MΩ ±.5% 1/8 W	6251-4117	75042	CEA-TO, 1.17 MΩ ±5%	
R6	Film, 130 kΩ ±1% 1/8 W	6250-3130	75042	CEA, 130 kΩ ±1%	5905-578-0876
R7	Comp., 6.2 kΩ ±5% 1/4 W	6099-2625	75042	BTS, 6.2 kΩ ±5%	5905-682-4100
R8	Film, 499 Ω ±1% 1/8 W	6250-0499	75042	CEA, 449 Ω ±1%	
R9	Pot., W.W., Rect. Linear, 2 kΩ ±10%	6051-2209	07999	2600PC, 2 kΩ ±10%	
R10	Comp., 24 kΩ ±5% 1/4 W	6099-3245	75042	BTS, 24 kΩ ±5%	
R11	Film, 10 kΩ ±1% 1/8 W	6250-2100	75042	CEA, 10 kΩ ±1%	5905-883-4847
R12	Comp., 9.1 kΩ ±5% 1/4 W	6099-2915	75042	BTS, 9.1 kΩ ±5%	5905-279-4619

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
R13	Film, 22.6 kΩ ±1% 1/8 W	6250-2226	75042	CEA, 22.6 kΩ ±1%	5905-683-5747
R14	Film, 7.15 kΩ ±1% 1/8 W	6250-1715	75042	CEA, 7.15 kΩ ±5%	5905-815-3793
R15	Film, 2.26 kΩ ±1% 1/8 W	6250-1226	75042	CEA, 2.26 kΩ ±1%	
R16	Film, 715 Ω ±1% 1/8 W	6250-0715	75042	CEA, 715 Ω ±1%	
R17	Film, 332 Ω ±1% 1/8 W	6250-0332	75042	CEA, 332 Ω ±5%	5905-681-8757
R18	Film, 205 Ω ±1% 1/8 W	6250-0205	75042	CEA, 205 Ω ±1%	
R19	Film, 61.9 Ω ±1% 1/8 W	6250-9619	75042	CEA, 61.9 Ω ±1%	
R20	Comp., 51 kΩ ±5% 1/4 W	6099-3515	75042	BTS, 51 kΩ ±5%	5905-482-4103
R21	Film, 200 kΩ ±1% 1/8 W	6250-3200	75042	CEA, 200 kΩ ±1%	
R22	Film, 1.78 kΩ ±1% 1/8 W	6250-1178	75042	CEA, 1.78 kΩ ±1%	5905-824-3077
R23	Comp., 620 Ω ±5% 1/4 W	6099-1625	75042	BTS, 620 Ω ±5%	5905-801-6998
R24	Film, 7.15 kΩ ±1% 1/8 W	6250-1715	75042	CEA, 7.15 kΩ ±5%	5905-815-3793
R25	Film, 105 kΩ ±1% 1/8 W	6250-3105	75042	CEA, 105 kΩ ±1%	
R26	Film, 3.48 kΩ ±1% 1/8 W	6250-1348	75042	CEA, 3.48 kΩ ±1%	5905-686-3385
R27	Comp., 9.1 kΩ ±5% 1/4 W	6099-2915	75042	BTS, 9.1 kΩ ±5%	5905-279-4619
R28	Film, 7.15 kΩ ±1% 1/8 W	6250-1715	75042	CEA, 7.15 kΩ ±5%	5905-815-3793
SWITCHES					
S101	Bat. Conn. + Sev. Block Asm.	1565-2200	24655	1565-2200	
S1	1/2" Subminiature Oak Rotary	1565-0410	24655	1565-0410	

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
TRANSISTORS					
Q1	E101	8210-1187	93916	2N1187	
Q2	2N4250	8210-1135	93916	2N4250	
Q3	2N4124	8210-1154	93916	2N4124	
Q4	2n3391A	8210-1192			
METERS					
M101	Meter Asm.	5730-1435	80022	82T	

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.

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

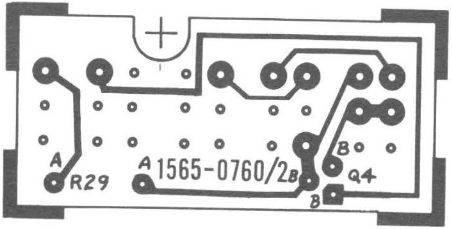

Figure 5-6. Meter switch etched-circuit board.

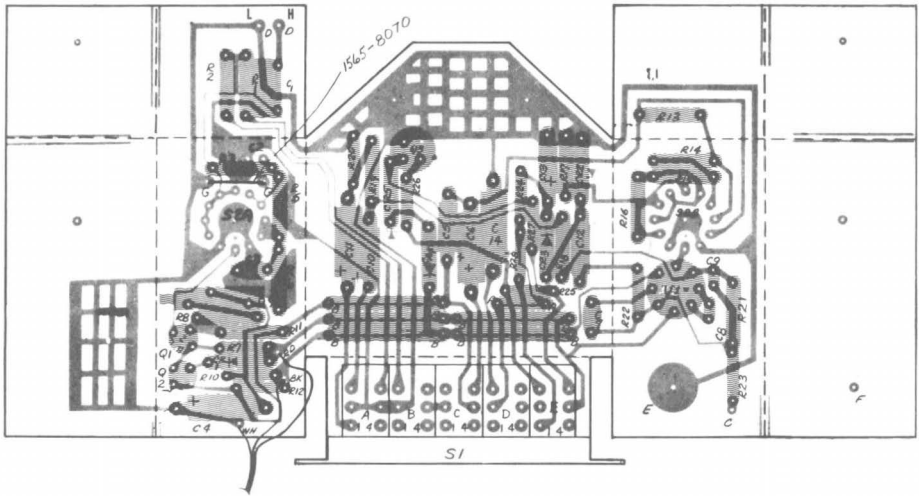

Figure 5-7. Main circuit etched-circuit board.

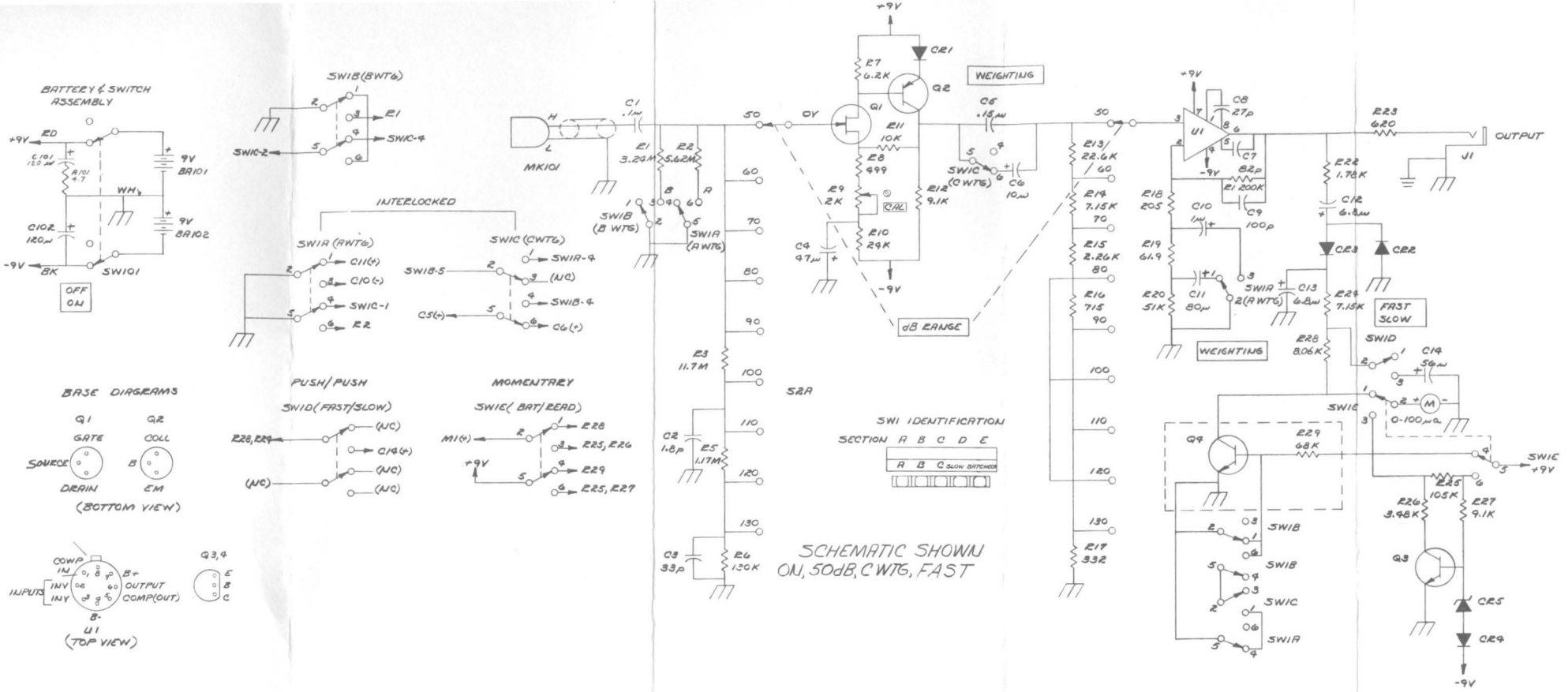

Figure 5-8. Schematic diagram of the Type 1563 Sound-Level Meter.