What follows is a compilation of the owner's manuals for the following Radio Shack SPL (Sound Pressure Level) meters and modifications for them.

The Models are:

33-2050 Analog
33-2055 Digital
33-4050 Analog (two versions of the manual)
42-3019 Analog

Also included are schematics for the units.

There is a significant collection of meter modifications created by Eric Wallin and others as noted on Eric's web site. A special thank you goes out to Eric for allowing the material to be included with the archive.

Eric's Web site may be found here:

http://mysite.verizon.net/tammie_eric/ericindex.html

Enjoy!

SHR
20-June-2011

RadioShack®
www.radioshack.com℠

Sound Level Meter

Owner's Manual
Please read before using this equipment.

❒ Contents

❒ Introduction

Your RadioShack Sound Level Meter is an extremely versatile device for measuring sound intensity in just about an acoustic environment — loud or soft; high-pitched, low-pitched, or broad-band; intermittent or continuous. Your meter features a large, easy-to-read indicator for taking quick measurements. The meter uses a 9V battery (not supplied) which allows you to use it anywhere.

Note: This meter should be used for home/hobbyist use only. This meter does not meet the requirements set forth by the American National Standards Institute (ANSI), Standard S1.4.

The meter's other features include:

Seven Sound-level Ranges — allow measurements form 50–126 dB (referenced to 0.0002 µbar).

A And C Weightings — lets you check compliance with safety regulations and make an acoustic analysis.

Slow And Fast Response Settings — let you check peak and average noise levels.

Built-in Battery Condition Indicator — lets you check the battery condition.

Phono-type Output Jack — for connection to home theater or test equipment.

Threaded Insert — lets you attach the meter to a camera tripod for increased accuracy.

❒ Specifications

Range:

Switch Setting	Range of Measurement
60 dB	50–66 dB
70 dB	60–76 dB
80 dB	70–86 dB
90 dB	80–96 dB
100 dB	90–106 dB
110 dB	100–116 dB
120 dB	110–126 dB

Accuracy ..... ± 2 dB @ 114 dB

Standard ..... 0 dB = 0.0002 µbar

Weighting ..... A and C

Response ..... Fast and Slow

Signal Output ..... 1.0V (peak) minimum into open circuit, with full-scale meter, deflection at 1 kHz

Load Impedance .....10k Ohm minimum

Distortion ..... Less than 2% at 1 kHz, 0.5V

Microphone ..... Electret condenser omnidirectional becoming slightly directional with increase in frequency

Battery ..... One 9V

Battery Check ..... Tests “good” from 7.0 to 10.5V

Expected Battery Life ..... 110 working hours (alkaline battery)

Size (HWD) ..... $5\frac{1}{16} \times 2\frac{5}{8} \times 1\frac{3}{8}$ Inches ($130 \times 68 \times 36$ mm)

Weight ..... 4.23 oz (120 g)

Specifications are typical; individual units might vary. Specifications are subject to change and improvement without notice.

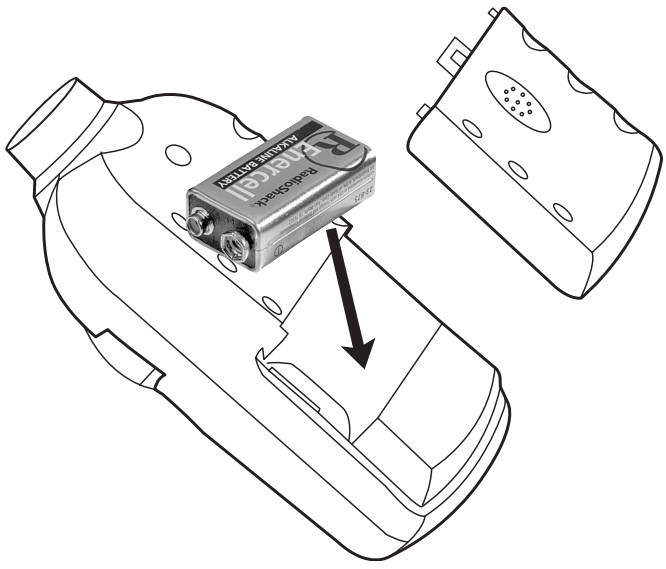
❒ *Installing a Battery*

Your meter requires one 9V battery (not supplied) for power. For the best performance and longest life, we recommend a RadioShack alkaline battery.

Caution: Use only a fresh battery of the required size and recommended type.

Follow these steps to install the battery.

1. Press both sides of the battery compartment cover and lift it.



2. Place the battery in the compartment as indicated by the polarity symbols (+ and –) marked inside.

3. Close the cover.

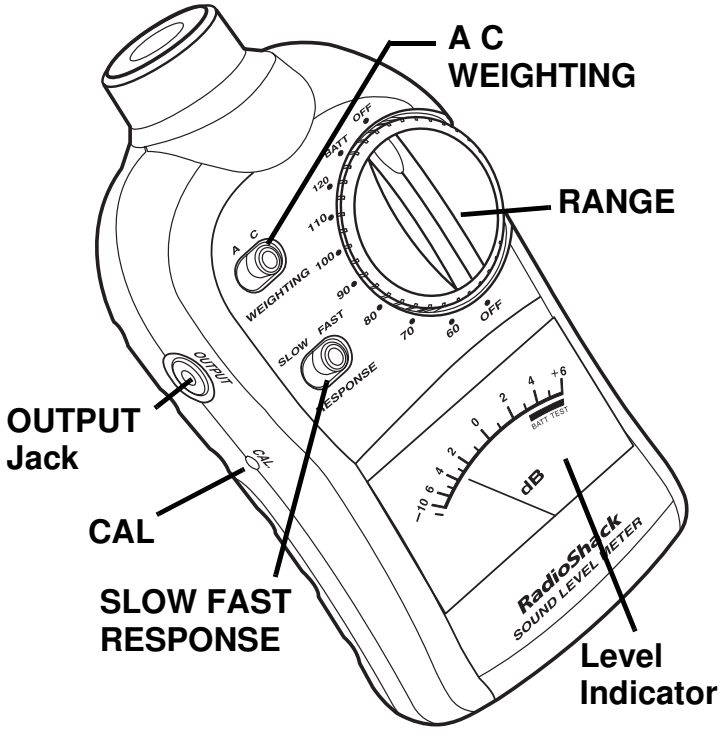
To test the battery, set **RANGE** to **BATT**. If the meter shows a reading in the red **BATT TEST** region, the battery is still good. Replace the batteries when the reading is in any other region or the meter stops operating.

Warning: Dispose of old batteries promptly and properly. Do not burn or bury them.

Caution: If you do not plan to use the meter for a week or more, remove the batteries. Batteries can leak chemicals that can destroy electronic parts.

Note: Leave **RANGE** in the **OFF** position when the meter is not in use to conserve battery power.

❒ Controls



RANGE

The **RANGE** selector lets you select one of seven sound level ranges, each spanning 16 dB. The **RANGE** numbers refer to the center points of the seven ranges. The needle level indicator shows the actual sound level as a displacement from the center point. For example, if **RANGE** is set to **80** and the meter scale reads **–3**, the actual sound level is 77 dB (80–3). If the meter scale reads **0** (same as the value where **RANGE** is set), the actual sound level is 80 dB (80+0).

OUTPUT

The phono-type **OUTPUT** jack lets you connect the meter to recording or other measurement equipment. For example, you might use an audio patch cord to connect the meter to the AUX or high-level input of a recorder.

Note: The meter response will not be flat, due to the A- and C-weighting networks.

Set **RANGE** so the maximum needle deflection is never greater than +4, to prevent the built-in amplifier from clipping. Use A-weighting for voice recordings, or C-weighting for full-range musical material. The **OUTPUT** jack can also be connected to high-impedance headphones, or an oscilloscope, a frequency analyzer, or other test equipment.

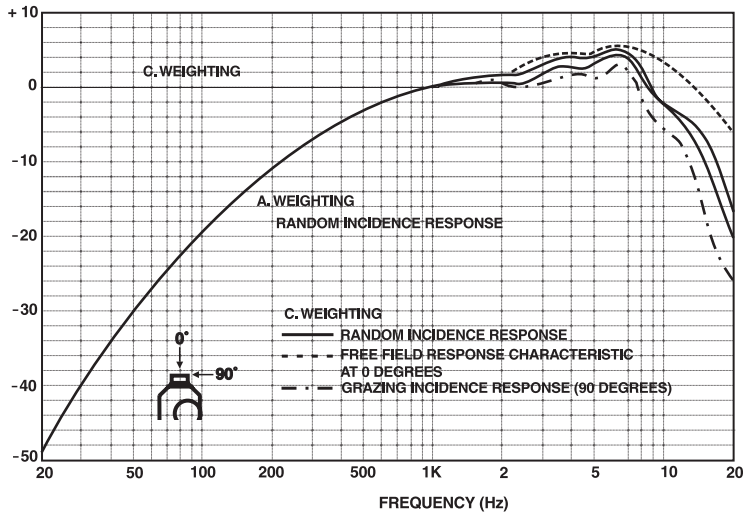
RESPONSE

The **RESPONSE** selector has two settings: **FAST** and **SLOW**. In the **FAST** position, the meter reacts quickly to changes in the sound level, showing you the peak sound levels present in the environment. In the **SLOW** position, the meter is damped and indicates an average-value sound level.

The effect of brief sound peaks is minimized in the **SLOW** position.

WEIGHTING

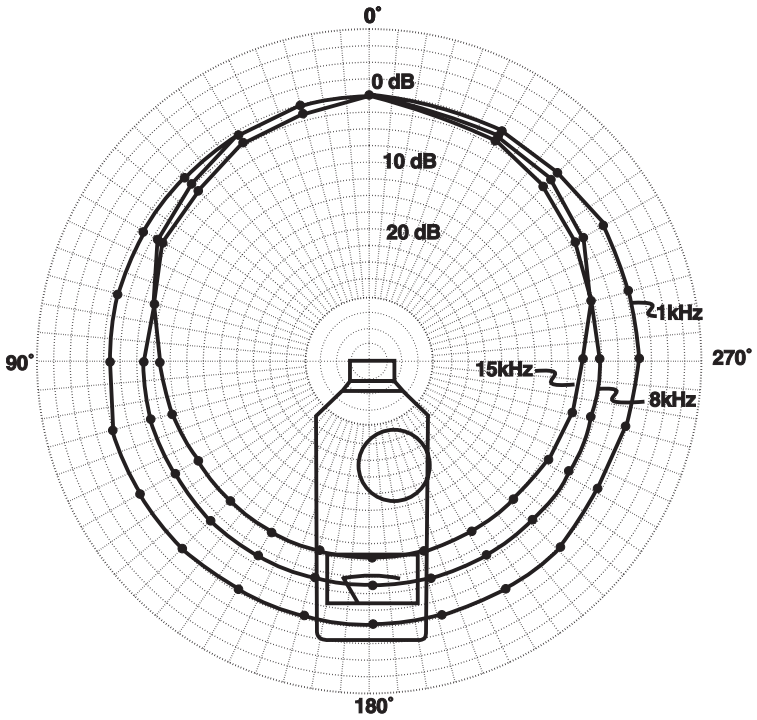
Set **WEIGHTING** to weight the sound measurement for a particular frequency range. When set to **A**, the meter primarily measures frequencies in the 500–10,000 Hz range, which is the area of greatest sensitivity to the human ear. When set to **C**, the meter measures uniformly over the frequency range from 32–10,000 Hz, giving an indication of the overall sound level.



Typical A- and C-weighted response curves (A-weighted with random-incidence)

MICROPHONE

The meter's built-in microphone works best when you point it directly at a sound source.



TRIPOD ADAPTER

You can mount the meter on a camera tripod (standard 1/4–20 thread) to eliminate hand noise and minimize the effects of sound reflected from your body. This makes it easy to use the meter with auxiliary recording or test equipment.

CAL (CALIBRATION)

Your meter has been accurately calibrated and normally will not require further adjustment. If adjustment is necessary, we recommend you take the sound meter to an audio professional for proper calibration via the **CAL** recess.

MEASUREMENTS

Important:

- Do not hold the meter directly between you and the sound source, as this might produce an error of several decibels in the frequency range above 100 Hz. Position the meter so an imaginary line between you and the meter is perpendicular to a line between the meter and the sound source.

- Handle the meter carefully. The microphone and meter movement are fragile and might be damaged if the instrument is dropped. Do not operate the meter at a range setting that causes pegging of the needle. This could damage the movement.

Follow these steps to select the desired response, weighting, and range.

1. Set **RESPONSE** to **FAST** if the sound source you want to measure consists of short bursts or if you want to measure only peak values. Or, set **RESPONSE** to **SLOW** if you want to measure average sound levels.

2. Set **WEIGHTING** to **A** if you want to measure noise level or **C** if you want to measure sound levels of musical material.

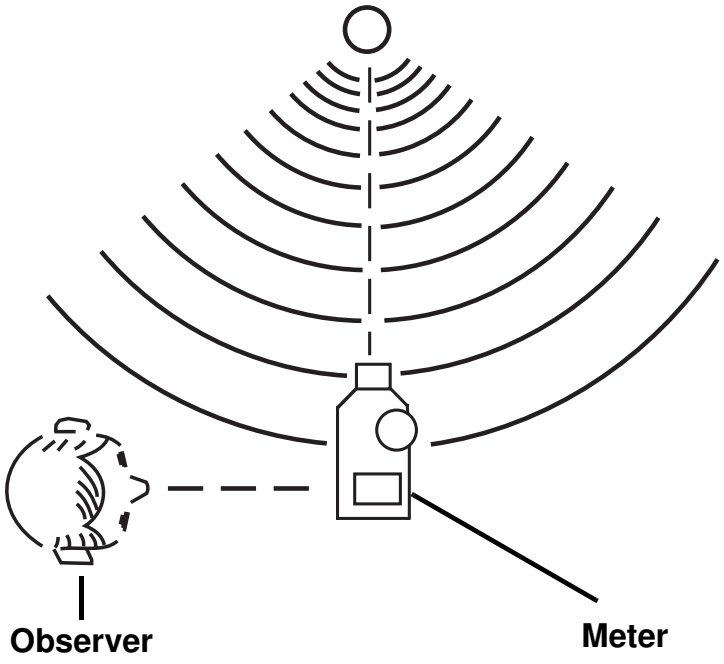
3. Set **RANGE** to the highest setting (**120 dB**) then adjust it downward until there is significant deflection of the needle. For the greatest accuracy, always use the lower of any two possible settings.

   For example, if **RANGE** is set to **80 dB** and the meter reads **–5**, reset **RANGE** to **70 dB** so the meter reads **+3**, for an actual sound level of 73 dB.

   Important: For meaningful readings, any particular sound to be measured must be at least 10 dB louder than the background noise level.

While taking measurements, minimize the effect of your body's presence. When the sound is coming mainly from one direction, the level reading might be significantly affected by reflections from your body.

For the most accurate readings and the best polar response, point the meter's microphone toward the sound source when possible.



CHECKING NOISE LEVELS

This chart, gathered from Federal, State, and local agencies, shows standards for acceptable noise levels.

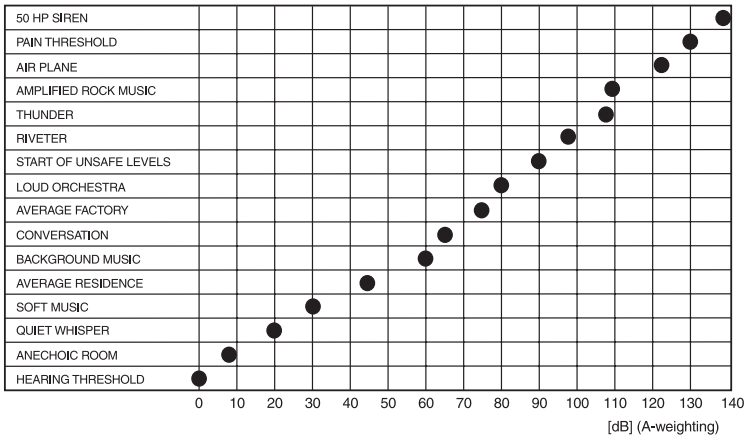
Sound Level (dB) (A-weighting, SLOW response)	Maximum Duration per Day (hours)
90	8
92	6
95	4
97	3
100	2
102	1 1/2
105	1
110	1/2
115	1/2 or less

Permissible noise exposures. Extracted from U.S. Department of Labor Noise Regulations.

Noise is inevitable in almost any environment. Depending on the level and duration, noise can be a minor irritant, a definite disturbance, or even a threat to your hearing.

To use your meter to check noise levels, set **WEIGHTING** to **A** and **RESPONSE** to **SLOW**. Take measurements at several points in the test area, with the meter positioned properly.

Average dB levels of some common activities.



CHECKING ROOM ACOUSTICS

The size, shape, and furnishings of a room can have a tremendous effect on a home theater system's performance. A "hard" room with bare surfaces tends to exaggerate treble response, sometimes giving the music a strident quality. A "soft" room with curtains, overstuffed furniture, carpet, and so on, might reduce high-frequency response. This may result a dominant bass sound.

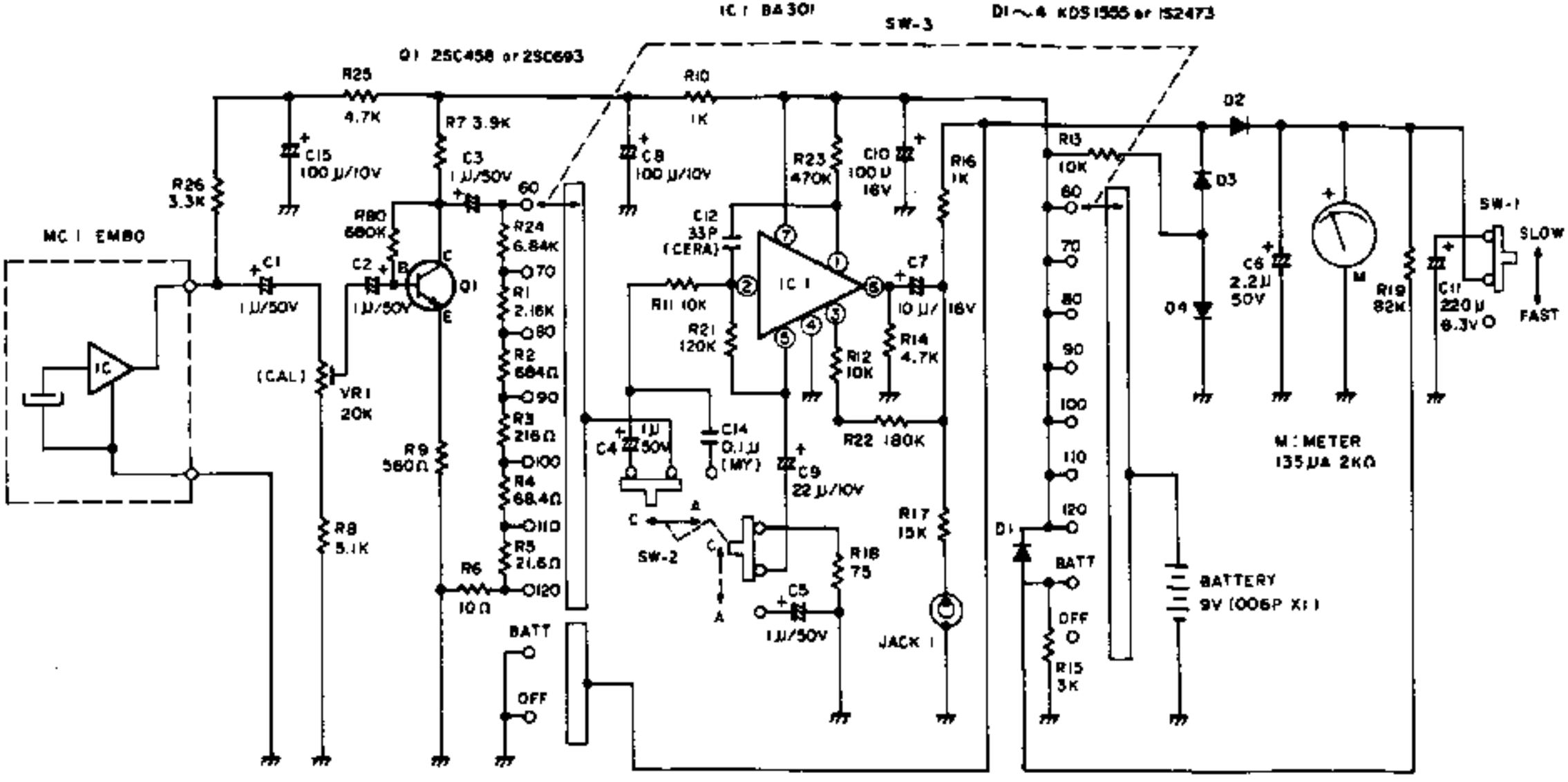
Depending on the speaker placement, standing waves might also develop in the room, giving your system a “peaky”, eccentric response.

To determine a room’s acoustics, analyze the acoustics with your meter and a suitable test recording. The test recording should produce pure tones, one at a time, at intervals spanning the audio spectrum. Make a graph or table showing the sound levels generated by the individual tones. This gives you a clear idea of the frequency response of your “total system”—home theater equipment and room included.

To smooth out the response, adjust the tone controls and vary the speaker placement. To approximate the ideal, “flat response”, you could add a frequency equalizer to your home theater system. Your local RadioShack store carries frequency equalizers that let you boost or cut response in different ranges, as indicated by your frequency response analysis. Properly equalized, your system can sound like one costing considerably more!

Note: When checking the frequency response, if **WEIGHTING** is set to **C**, the meter's frequency response is flat from 32 –10,000 Hz (± 3 dB). Above 10 kHz, the frequency response of the meter drops off rapidly. Be sure to consider this when you use a test recording that includes tones at the extreme high end of the audio spectrum.

SCHEMATIC DIAGRAM



NOTES:
1. ALL RESISTOR VALUES ARE GIVEN IN OHMS.
2. ALL CAPACITOR VALUES ARE GIVEN IN FARAD.

Schematic subject to change without notice. For most accurate schematic (and parts) contact Radio Shack, National Parts Dept., Fort Worth, TX 76101

In UK, contact Tandy Electronics, National Parts Dept., Bilston Road Wednesbury West Midlands WS10 7 JN.

In Australia, contact Tandy Australia Limited, National Parts Dept., 91 Kurrajong Avenue, Mount Druitt, N.S.W. 2770.

RadioShack®

33-2055
User's Guide

Digital Sound Level Meter

*Thank you for purchasing your Digital Sound Level Meter from **RadioShack**. Please read this user's guide before installing, setting up, and using your new meter.*

Setup

Package contents

- Digital Sound Level Meter
- User's Guide
- Carry Case
- Quick Start

Features

- For home/hobbyist use: fine tune your stereo, PA system, or home theater
- Attaches to a tripod with ¼ inch connector
- Selectable weighting for noise level or musical sound
- Displays average or maximum sound level
- Integrated averaging from 1 to 199 seconds

① Install battery

Your meter requires one 9V battery (not included) for power. When **BATT** displays or the meter stops operating properly, replace the battery.

1. Set **RANGE** to **OFF**.
2. Remove the battery compartment cover by pressing both side in and lifting the cover.
3. Install one 9V battery (not included) as indicated by the polarity symbols (**+** and **–**).

Battery Notes:

- *After using the meter, set* **RANGE** *to* **OFF** *to save power.*
- *Dispose of batteries promptly and properly. Do not burn or bury them.*
- *Use only fresh batteries of the required size and type.*


Microphone
RANGE Switch
OUTPUT Jack
DH / RESET / MIN / MAX
WEIGHTING / RESPONSE
Tripod Adapter
RANGE
OFF
120
110
100
90
80
70
60
DH
RESET
MIN
MAX
WEIGHTING
RESPONSE
RadioShack
SOUND LEVEL METER
RESPONSE
SLOW
WEIGHTING
dB
C
68
−10
0
+10

- *If you do not plan to use your meter for a long period, remove the battery. Batteries can leak chemicals that may damage electronic parts.*

② Mount and connect the meter (Optional)

1. Mount the meter on a (¼–inch) tripod to eliminate hand noise and minimize the effects of sound reflected from your body. This makes it easy to use the meter with auxiliary recording or test equipment.
2. Use an audio patch cord (not included) to connect the **OUTPUT Jack** to your stereo system or test equipment.

③ Set the sound range

Set **RANGE** to the desired sound range. If you cannot get a reading, try other ranges until you get a reading, refer to "**Continuous Average Measurements**" on Page 7.

④ Set the weighting

Press **WEIGHTING** to select **A** to determine the noise level of an area, or **C** to measure sound levels of musical material. Refer to "**Setting the Weighting**" on Page 5.

⑤ Set the response time

Press **RESPONSE** to set the response to **FAST** or **SLOW**. Refer to "**Setting the Response Time**" on Page 5.

⑥ Read the measurement

Point the microphone at the sound source. The meter displays the continuous average sound level. After the measurement, set **RANGE** to **OFF**.

Setting the Meter

Setting the Weighting

Press **WEIGHTING** to select **A** or **C**.

Weighting determines the meter's frequency response curve.

A-weighting has A-curve frequency characteristics and causes the meter to respond mainly to frequencies ranging from 500 to 10,000 Hz. This is the human ear's most sensitive range. Select **A** to determine the noise level of an area.

C-weighting has C-curve (flat) frequency characteristics and causes the meter to respond mainly to frequencies ranging from 32 to 10,000 Hz. Select **C** to measure sound levels of musical material.

Note: *You can change the weighting setting only during a continuous average or maximum measurement.*

Setting the Response Time

Press **RESPONSE** to select **FAST** or **SLOW**.

When set to **FAST**, the meter updates the bar graph every 0.2 seconds. When set to **SLOW**, the meter updates the bar graph every 0.5 seconds.

Note: *You can change the response setting only during a continuous average or maximum measurement.*

Understanding Indications

Level Indicator

The meter displays sound level using a number and a bar graph. The number shows the sound level in dB within ±10 dB of the selected range and is updated once a second.

The bar graph's center point represents the midpoint of the selected range, for example, for Range 70, the center point represents 70 dB. The bar graph updates every 0.2 seconds or 0.5 seconds.

Overrange Indicator

When the sound level is higher than the highest number in the selected range, the bar graph goes to + 10 dB and both the bar graph and the number that represents the next range flash.

For example, if the meter measures 91 dB in Range 80, then the number *90* and the bar graph flash. If the meter measures more than 126 dB in Range 120, the number *126* and the bar graph flash.

If you get the overrange indicator, try a higher range setting until you get a reading in the upper half of the range (0 to +10 dB).

Underrange Indicator

When the measured sound level is lower than the lowest sound level of the selected range, *LO* appears

and the bar graph disappears. If this happens, try the next lower range.

Notes:

- *The overrange or underrange indicator can also appear when you recall a reading using the measurement holding function and the measurement is under or over the selected range.*
- *The meter can measure sound levels only from 50 to 126 dB.*

Taking Measurements

Continuous Average Measurements

Follow these steps to measure the average sound level.

1. Set **RANGE** to the desired range setting. If the sound level is very high, start at the highest range setting (120) and reduce the setting until you get a reading.

   There are seven ranges. Each covers 20 dB. The number of a range represents the center of the range. When the measured value is lower or higher than the set range, an underrange or overrange indicator appears. See "**Underrange Indicator**" and "**Overrange Indicator**" on Page 6. Take measurements at several different points in the area to get a good average.

   Notes:

   - *If you set* **RANGE** *to 120, the meter measures sound levels from 110 to 126 dB.*
   - *If you change the range setting during a measurement, you clear all the current data and a continuous average measurement resumes.*

2. Set the weighting and response (see "**Setting the Weighting**" and "**Setting the Response Time**" on Page 5).
3. Point the meter's microphone at the sound source. The meter displays the continuous average sound level during a one-second sampling period and updates the number on the display once a second.
4. After the measurement, set **RANGE** to **OFF**.

Taking Maximum Measurements

1. Follow Steps 1-3 in "**Continuous Average Measurements**".
2. Press **MAX**; the word **MAX** appears.

   The meter displays only the loudest measured sound level during the one-second sampling period. The bar graph shows the maximum level every 0.2 or 0.5 seconds.

   The bar graph segment that corresponds to the peak reading stays on the display for 2 seconds or until the meter measures a higher maximum level.
3. Press **MAX** again to cancel the continuous maximum measurement. A continuous average measurement resumes.

Integrated Average Measurements

Follow these steps to monitor the sound level and average the measurement over a period of 1 to 199 seconds. The meter stores the average, maximum, and minimum sound levels during the set time.

1. Press and hold **DH** for about 2 seconds during a continuous average or maximum measurement. The digit **1** appears.

2. Press (or press and hold) **MAX** or **MIN** to set a period from 1 to 199 seconds; position the meter for the measurement.
3. Press **RESET** to start the monitoring.

The meter updates the current integrated average display once a second. **MIN** and **MAX** flash until the set time is up. When the set time is up, **DH** appears, and **MIN** and **MAX** go on flashing. The meter displays the total integrated average sound level.

4. Press **MAX** to display the maximum sound level for the set time, press again to return to the total integrated average sound level.

   Press **MIN** to display the minimum sound level for the set time, press again to return to the total integrated average sound level.
5. Press **RESET** after you check the average, maximum, and minimum sound levels. A continuous average or maximum measurement resumes.

Notes:

- *If you change the* **RANGE** *setting during an integrated average measurement, you clear any stored data and a continuous average or maximum measurement resumes.*
- *You must repeat the procedure for taking an integrated average measurement.*

Taking Maximum and Minimum Measurements during an Undetermined Time Period

1. Press **RESET** during a continuous average or maximum measurement. At the end of the desired time period, press **DH**. **DH** displays.
2. Press **MAX** and **MIN** respectively to check the average, maximum (**MAX** stops flashing), and minimum (**MIN** stops flashing) sound levels during the time period.
3. Press **RESET** to resume a continuous average or maximum measurement.

Checking Stereo System Acoustics

To check the sound of a stereo system, use an audio sample that produces pure tones, one at a time, at intervals that span the entire audio spectrum. Use C-weighting with either slow or fast response.

Make a graph or table to show the sound level each tone produces. This gives you a clear idea of the frequency response of the total audio system, including the room. To smooth out the response, adjust the tone control, change speaker placements, and use a frequency equalizer.

Holding Measurements

You can store the current measurements in memory and freeze measurements on the display. The meter stores the average, maximum, and minimum sound levels for the last one second.

1. Press **DH** during a continuous average or maximum measurement. **DH** displays and the last average or maximum measurement is frozen.
2. For an average measurement, what is frozen is the last average reading. Press **MAX** to check the last maximum measurement. **MAX** displays. Press **MAX** again to return to the average measurement.

   For a maximum measurement, what is frozen is the last maximum reading.
3. Press **MIN** to check the last minimum measurement. **MIN** displays. Press **MIN** again to return to the average or maximum measurement.
4. Press **RESET** to return to the continuous average or maximum measurement.

Note: *When you set* **RANGE** *to a different range during measurement holding, you disable the holding function and return to a continuous measurement.*

Care and Service

- Keep your meter dry and clean. If it gets wet or dirty, wipe it dry or clean immediately. Do not use harsh chemicals, cleaning solvents, or strong detergents to clean the meter.
- Use and store the meter in normal temperature environments only. Temperature extremes can shorten the life of electronic devices and distort or melt plastic parts.
- Handle the meter gently and carefully. Dropping it can damage the circuit boards and cause the meter to work improperly.
- Modifying or tampering the meter's internal components can cause malfunction and might invalidate its warranty. If your meter is not performing as it should, take it to your local ***RadioShack*** store for assistance.

Specifications

Battery ..... 9V Alkaline
Microphone ..... Electret Condenser
Range ..... 50 to 126 dB
Accuracy ..... ±2 dB at 114 dB SPL
Reference ..... 0dB = 0.0002 Micro Bar
Weighting ..... A and C
Display Response ..... Fast and Slow

Signal Output:

Voltage ..... 1 Volt Peak-Peak Min. (Open Circuit, Full Scale at 1 kHz)
Impedance ..... 10 Kohm Min. Load
Distortion ..... Less than 2% at 1 kHz, 0.5 V p-p Output (Input: Mic Out, Output: 10 Kohm)
Operating Temperature ..... 32 to 122 °F (0 to 50 °C)
Storage Temperature ..... -40 to 149 °F (-40 to 65 °C)
Dimensions (HWD) ..... 6¼ × 2½ × 1¾ inch (159 × 64 × 44 mm)
Weight (including battery) ..... 6.7 oz (190 g)

Specifications are subject to change and improvement without notice. Actual product may vary from the images found in this document.

Limited Warranty

RadioShack warrants this product against defects in materials and workmanship under normal use by the original purchaser for **ninety (90) days** after the date of purchase from a ***RadioShack***-owned store or an authorized ***RadioShack*** franchisee or dealer. ***RADIOSHACK*** MAKES NO OTHER EXPRESS WARRANTIES.

This warranty does not cover: (a) damage or failure caused by or attributable to abuse, misuse, failure to follow instructions, improper installation or maintenance, alteration, accident, Acts of God (such as floods or lightning), or excess voltage or current; (b) improper or incorrectly performed repairs by persons who are not a ***RadioShack*** Authorized Service Facility; (c) consumables such as fuses or batteries; (d) ordinary wear and tear or cosmetic damage; (e) transportation, shipping or insurance costs; (f) costs of product removal, installation, set-up service, adjustment or reinstallation; and (g) claims by persons other than the original purchaser.

Should a problem occur that is covered by this warranty, take the product and the ***RadioShack*** sales receipt as proof of purchase date to any ***RadioShack*** store in the U.S. ***RadioShack*** will, at its option, unless otherwise provided by law: (a) repair the product without charge for parts and labor; (b) replace the product with the same or a comparable product; or (c) refund the purchase price. All replaced parts and products, and products on which a refund is made, become the property of ***RadioShack***. New or reconditioned parts and products may be used in the performance of warranty service. Repaired or replaced parts and products are warranted for the remainder of the original warranty period. You will be charged for repair or replacement of the product made after the expiration of the warranty period.

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EXCEPT AS DESCRIBED ABOVE, ***RADIOSHACK*** SHALL HAVE NO LIABILITY OR RESPONSIBILITY TO THE PURCHASER OF THE

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Some states do not allow limitations on how long an implied warranty lasts or the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state. You may contact ***RadioShack*** at:

RadioShack Customer Relations
300 RadioShack Circle, Fort Worth, TX 76102 04/08

www.RadioShack.com

Protect the environment by recycling used electronics.
Go to E-CyclingCentral.com to find an electronic recycling center near you.

Printed in China 01A11
AO0330AAB1 33-2055

Care and Service

- Keep your meter dry and clean. If it gets wet or dirty, wipe it dry or clean immediately. Do not use harsh chemicals, cleaning solvents, or strong detergents to clean the meter.
- Use and store the meter in normal temperature environments only. Temperature extremes can shorten the life of electronic devices and distort or melt plastic parts.
- Handle the meter gently and carefully. Dropping it can damage the circuit boards and cause the meter to work improperly.
- Modifying or tampering the meter's internal components can cause malfunction and might invalidate its warranty. If your meter is not performing as it should, take it to your local ***RadioShack*** store for assistance.

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Battery .....9V Alkaline
Microphone..... Electret Condenser
Range.....50 to 126 dB
Accuracy .....±2 dB at 114 dB SPL
Standard .....0dB = 0.0002 Micro Bar
Weighting.....A or C
Display Response .....Fast or Slow
Signal Output..... 1.0Vp-p
.....Minimum into open circuit,
.....with full-scale meter, deflection at 1 kHz
Distortion.....Less than 2% at 1kHz,0.5Vp-p
Load Impedance.....10k Ohm minimum
Battery Check.....Test "good" from 7.0 to 10.5 V
Expected Battery Life ..... 110 working hours
..... (alkaline batteries)
Dimensions (LWD) ..... 5.1 × 2.8 × 1.4 Inches
.....(130 × 68 × 36 mm)
Weight (including battery) .....6.7 oz (190 g)

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RadioShack warrants this product against defects in materials and workmanship under normal use by the original purchaser for **ninety (90) days** after the date of purchase from a ***RadioShack***-owned store or an authorized ***RadioShack*** franchisee or dealer. ***RadioShack*** MAKES NO OTHER EXPRESS WARRANTIES.

This warranty does not cover: (a) damage or failure caused by or attributable to abuse, misuse, failure to follow instructions, improper installation or maintenance, alteration, accident, Acts of God (such as floods or lightning), or excess voltage or current; (b) improper or incorrectly performed repairs by persons who are not a ***RadioShack*** Authorized Service Facility; (c) consumables such as fuses or batteries; (d) ordinary wear and tear or cosmetic damage; (e) transportation, shipping or insurance costs; (f) costs of product removal, installation, set-up service, adjustment or reinstallation; and (g) claims by persons other than the original purchaser.

Should a problem occur that is covered by this warranty, take the product and the ***RadioShack*** sales receipt as proof of purchase date to any ***RadioShack*** store in the U.S. ***RadioShack*** will, at its option, unless otherwise provided by law: (a) repair the product without charge for parts and labor; (b) replace the product with the same or a comparable product; or (c) refund the purchase price. All replaced parts and products, and products on which a refund is made, become the property of ***RadioShack***. New or reconditioned parts and products may be used in the performance of warranty service. Repaired or replaced parts and products are warranted for the remainder of the original warranty period. You will be charged for repair or replacement of the product made after the expiration of the warranty period.

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EXCEPT AS DESCRIBED ABOVE, ***RadioShack*** SHALL HAVE NO LIABILITY OR RESPONSIBILITY TO THE PURCHASER OF THE PRODUCT OR ANY OTHER PERSON OR ENTITY WITH RESPECT TO ANY LIABILITY, LOSS OR DAMAGE CAUSED DIRECTLY OR INDIRECTLY BY USE OR PERFORMANCE OF THE PRODUCT OR ARISING OUT OF ANY BREACH OF THIS WARRANTY, INCLUDING, BUT NOT LIMITED TO, ANY DAMAGES RESULTING FROM INCONVENIENCE AND ANY LOSS OF TIME, DATA, PROPERTY, REVENUE, OR PROFIT AND ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, EVEN IF ***RadioShack*** HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Some States do not allow limitations on how long an implied warranty lasts or the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from State to State. You may contact ***RadioShack*** at:

RadioShack Customer Relations
300 RadioShack Circle, Fort Worth, TX 76102 04/08

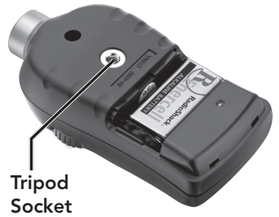
RadioShack®

Analog Sound Level Meter

User's Guide 33-4050

Thank you for purchasing your Analog Sound Level Meter from ***RadioShack***. Please read this user's guide before installing, setting up, and using your new meter.

① Install battery



1. Set range dial to **OFF**.
2. Slide open the battery compartment.
3. Install one 9V battery (not included), matching the polarity marks inside.
4. Replace the cover.

② Set weighting

Switch **WEIGHTING** to **A** to measure noise level.

Switch to **C** to measure musical sound level.

③ Set response

Switch **RESPONSE** to **FAST** if sound is in short bursts or to measure only high peak values.

Switch to **SLOW** to measure average sound levels.

④ Set range

Set the range dial to the desired sound range.

Start with the highest setting (120 dB) then adjust downward until there is significant deflection of the needle.

⑤ Read measurements

Point the microphone at the sound source and read the measurement on the level indicator.

Set range dial to **OFF** to turn off the Sound Level Meter.

What's Included

Sound Level Meter
Carry Case User's Guide

Features

- Measure the sound intensity in most acoustic environments
- Fine-tune the audio response on your sound system
- Selectable response speed for checking peak and average sound levels
- Built-in mounting socket to attach to your tripod

Note: *This meter should be used for home/hobbyist use only. This meter does not meet the requirements set forth by the American National Standards Institute (ANSI), Standard S1.4.*

Battery Notes:

- Replace the battery when the meter stops operating properly or when the meter shows reading beyond the red **BATT TEST** region.
  (See **"Battery Test"** on page 3 to test your battery.)
- Use only a fresh battery of the required size and type.
- Dispose of old batteries promptly and properly. Do not burn or bury them.
- After using the meter, set the range dial to **OFF**.
- If you do not plan to use your meter for a week or more, remove the battery. Batteries can leak chemicals that may damage electronic parts.

Protect the environment. Go to E-CyclingCentral.com to find a local electronic recycling center.

www.RadioShack.com

11A08 AO0172ADA1
33-4050 Printed in China

Setting the Meter

Set the Weighting

Slide **WEIGHTING** to **A** or **C** to weight the sound measurement for a particular frequency range.

- **WEIGHTING A** measures noise level. It primarily measures frequencies in the 500-10,000 Hz range, which is the area of greatest sensitivity to the human ear.
- **WEIGHTING C** measures sound level of musical material. It measures uniformly over the frequency range from 32-10,000 Hz, giving an indication of the overall sound level.

Set the Response

Slide **RESPONSE** to **FAST** or **SLOW**.

- **FAST** – Measures sound source that consists of short bursts or if you want to measure only peak values.
- **SLOW** – Measures average sound levels.

Set the Range

Rotate the range dial to select one of seven sound level ranges, each spanning 16 dB.

The dial's numbers refer to the midpoints of the ranges. The needle level indicator (meter scale) shows the actual sound level as a displacement from the center point.

For example:

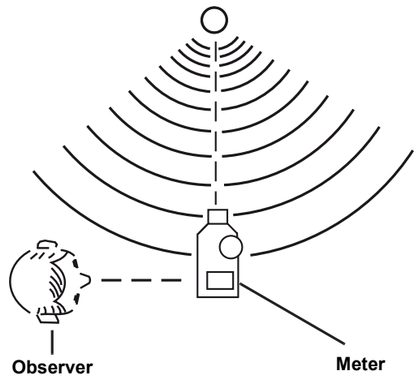
Range	Meter Scale	Actual Sound Level
80	-3	77
80	0	80

Set the range dial to the highest setting (120 dB) then adjust it downward until there is significant deflection of the needle. For greatest accuracy, always use the lower of any two possible settings.

For example, if the range dial is set to 80 dB and the meter reads -5, set the range dial to 70 dB so the meter reads +3, for an actual sound level of 73 dB.

Important:

- *Handle the meter carefully. The microphone and needle are fragile and might be damaged if the instrument is dropped. Do not operate the meter at a range setting that causes pegging of the needle. This could damage the movement.*
- *Do not hold the meter directly between you and the sound source, as this might produce an error of several decibels in the frequency range above 100 Hz. Position the meter as illustrated, so you are perpendicular to the sound source.*



- *While taking measurements, minimize the effect of your body's presence. When the sound is coming mainly from one direction, the level reading might be significantly affected by reflections from your body. You can mount the meter on a camera tripod (¼-20 thread) to eliminate hand noise and minimize the effects of sound reflected from your body.*
- *For meaningful readings, any particular sound to be measured must be at least 10 dB louder than the background noise level.*
- *For the most accurate readings and the best response, point the meter's microphone toward the sound source.*

Measuring Sound from Other Equipment

1. Connect recording or other measurement equipment (such as high-impedance headphones, an oscilloscope, a frequency analyzer, or other test equipment) to the **OUTPUT** jack of your meter. For example, use an audio patch cord (not supplied) to connect the meter to the AUX or high-level input of a recorder.

Note: *The meter response will not be flat, due to the A- and C-weighting networks.*

2. Set range dial so the maximum needle reading is never greater than +4, to prevent the built-in amplifier from clipping.
3. Slide **WEIGHTING** to **A** for voice recordings or slide **WEIGHTING** to **C** for full-range musical material.

Measuring Noise Level

Noise is inevitable in almost any environment. Depending on the level and duration, noise can be a minor irritant, a definite disturbance, or even a threat to your hearing.

To use your meter to check noise levels, set **WEIGHTING** to **A** and **RESPONSE** to **SLOW**. Take measurements at several points in the test area, with the meter positioned properly.

This chart shows permissible noise exposures listed in the U.S. Department of Labor Noise Regulations.

Sound Level (dB) (A-weighting, SLOW response)	Duration Maximum per Day (hours)
90	8
92	6
95	4
97	3
100	3
102	1½
105	1
110	½
115	½ or less

Checking Room Acoustics

The size, shape, and furnishings of a room can have a positive or negative effect on a home theater system's performance. A "hard" room with bare surfaces tends to exaggerate treble response, sometimes giving the music a harsh, discordant quality. A "soft" room with curtains, overstuffed furniture, carpet, and so on, might reduce high-frequency response. This may result a dominant bass sound.

Depending on speaker placement, standing waves might also develop in the room, giving your system a "peaky," eccentric response.

To determine a room's acoustics, analyze with your meter and a suitable test recording. The test recording should produce pure tones, one at a time, at intervals spanning the audio spectrum. Make a graph or table showing the sound levels generated by the individual tones. This gives you a clear idea of the frequency response of your room's acoustics—home theater equipment, room dimensions and furnishings included.

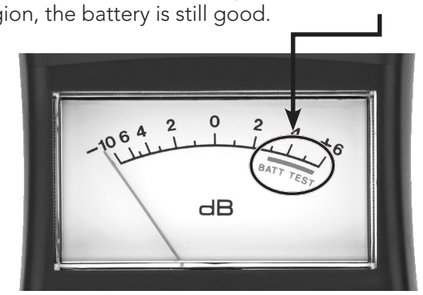
To smooth out the response, adjust the tone controls and vary the speaker placement. To approximate the ideal, "flat response," you could add a graphic equalizer to your home theater system. Your local ***RadioShack*** store carries graphic equalizers that let you boost or cut response in different ranges, as indicated by your frequency response analysis. Properly equalized, your system can produce much higher-quality sounds.

Note: *When checking the frequency response, if WEIGHTING is set to C, the meter's frequency response is flat from 32-10,000 Hz (± 3 dB). Above 10 kHz, the frequency response of the meter drops off rapidly. Be sure to consider this when you use a test recording that includes tones at the extreme high end of the audio spectrum.*

Battery Test

Set the range dial to **BATT**.

If the meter shows a reading in the red **BATT TEST** region, the battery is still good.



Replace the battery when the reading drops below the indicator or the meter stops working.

Do more with your Sound Level Meter

Visit your local ***RadioShack*** store or www.RadioShack.com to purchase these and other useful products.

Graphic Equalizer

Audio patch cord

- Connect to recording or other equipment

Tripod

- Eliminate hand noise
- Minimize the effects of sound reflected from your body

Limited Ninety-Day Warranty

This product is warranted by RadioShack against manufacturing defects in material and workmanship under normal use for ninety (90) days from the date of purchase from RadioShack company-owned stores and authorized RadioShack franchisees and dealers. EXCEPT AS PROVIDED HEREIN, RadioShack MAKES NO EXPRESS WARRANTIES AND ANY IMPLIED WARRANTIES, INCLUDING THOSE OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO THE DURATION OF THE WRITTEN LIMITED WARRANTIES CONTAINED HEREIN. EXCEPT AS PROVIDED HEREIN, RadioShack SHALL HAVE NO LIABILITY OR RESPONSIBILITY TO CUSTOMER OR ANY OTHER PERSON OR ENTITY WITH RESPECT TO ANY LIABILITY, LOSS OR DAMAGE CAUSED DIRECTLY OR INDIRECTLY BY USE OR PERFORMANCE OF THE PRODUCT OR ARISING OUT OF ANY BREACH OF THIS WARRANTY, INCLUDING, BUT NOT LIMITED TO, ANY DAMAGES RESULTING FROM INCONVENIENCE, LOSS OF TIME, DATA, PROPERTY, REVENUE, OR PROFIT OR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, EVEN IF RadioShack HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Some states do not allow limitations on how long an implied warranty lasts or the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you.

In the event of a product defect during the warranty period, take the product and the RadioShack sales receipt as proof of purchase date to any RadioShack store. RadioShack will, at its option, unless otherwise provided by law: (a) correct the defect by product repair without charge for parts and labor; (b) replace the product with one of the same or similar design; or (c) refund the purchase price. All replaced parts and products, and products on which a refund is made, become the property of RadioShack. New or reconditioned parts and products may be used in the performance of warranty service. Repaired or replaced parts and products are warranted for the remainder of the original warranty period. You will be charged for repair or replacement of the product made after the expiration of the warranty period.

This warranty does not cover: (a) damage or failure caused by or attributable to acts of God, abuse, accident, misuse, improper or abnormal usage, failure to follow instructions, improper installation or maintenance, alteration, lightning or other incidence of excess voltage or current; (b) any repairs other than those provided by a RadioShack Authorized Service Facility; (c) consumables such as fuses or batteries; (d) cosmetic damage; (e) transportation, shipping or insurance costs; or (f) costs of product removal, installation, set-up service adjustment or reinstallation.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

RadioShack Customer Relations, 200 Taylor Street, 6th Floor, Fort Worth, TX 76102

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REALISTIC®

SOUND LEVEL METER

OWNER'S MANUAL

Catalog Number: 42-3019

CUSTOM MANUFACTURED FOR RADIO SHACK A DIVISION OF TANDY CORPORATION

Your REALISTIC® **Sound Level Meter** is an extremely versatile device for measuring sound intensity in just about any acoustic environment — loud or soft; high-pitched, low-pitched or broad-band; intermittent or continuous. It has scores of practical applications for professional and home use: measuring noise levels in factories, schools, offices, airports, etc.; checking acoustics of studios, auditoriums and home hi-fi installations.

The precisely calibrated meter features a large, easy-to-read indicator for taking quick measurements anywhere. Power is supplied by a 9-volt rectangular battery, so the unit is completely portable.

Other exceptional features of the Sound Level Meter:

- Six sound-level ranges, allowing measurements from 60 dB to 126 dB (referenced to 0.0002μbar)
- A and C weightings for checking compliance with safety regulations as well as making acoustic analyses
- SLOW and FAST response settings for checking peak and average noise levels
- Built-in battery condition indicator
- Phono-type output jack for connection to hi-fi or test equipment
- Threaded insert for attachment of meter to camera tripod for increased accuracy

SPECIFICATIONS

Ranges: Switch setting	Range of measurement
70 dB	60 to 76 dB
80 dB	70 to 86 dB
90 dB	80 to 96 dB
100 dB	90 to 106 dB
110 dB	100 to 116 dB
120 dB	110 to 126 dB

Accuracy	: ± 2 dB at 114 dB sound level
Standard	: 0 dB = 0.0002 μbar
Weighting	: A and C (see graph, Figure 2)
Response	: FAST and SLOW
Signal Output	: 1.0 volt (peak) minimum into open circuit, with full-scale meter deflection at 1 kHz.
Impedance	: 10K ohms minimum load
Distortion	: Less than 2% at 1 kHz, 0.5-volt
Microphone	: Electret condenser; omnidirectional becoming slightly directional with increase in frequency (see graph, Figure 3)
Battery	: One 9-volt rectangular type
Battery Check	: Tests "good" from 7.0 to 10.5 volts
Expected Battery Life	: 110 working hours, alkaline battery
Size	: 6-1/4" (H) X 2-7/16" (W) X 1-3/4" (D) (160 X 62 X 44 mm)
Weight	: 7.76 ounces (220 grams) approx.

CONTROLS AND THEIR FUNCTIONS

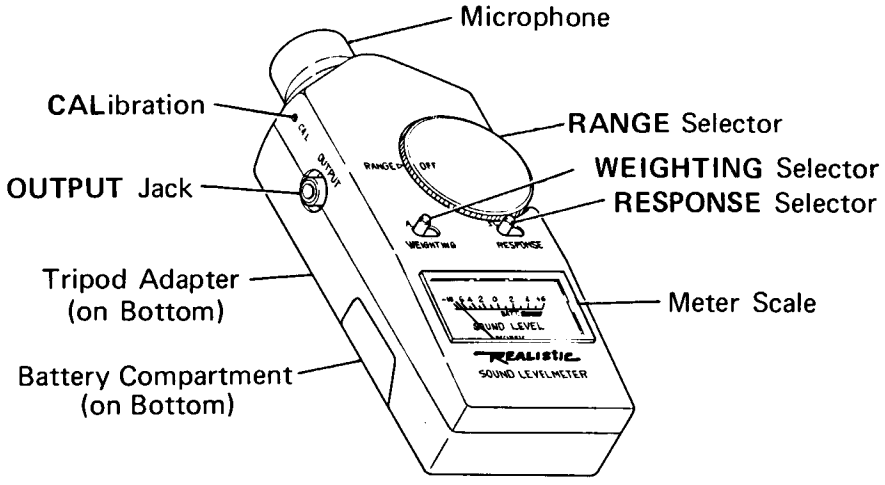


Figure 1.

Battery Compartment.

Flip open battery compartment cover and install a 9-volt battery in the Battery Compartment. Be sure to observe proper polarity. Check battery condition by setting **RANGE** switch to BATT position; meter scale should read in the BATT. OK region. When battery needs replacing, we recommend Radio Shack's Catalog Number 23-583, or 23-553 for extra-long life. Be sure to leave **RANGE** switch in OFF position when Meter is not in use, and remove battery if Meter is to be stored for a long period.

RANGE Selector

The rotary switch lets you select one of six sound level ranges, each spanning 16 dB. Numbers on the **RANGE** switch refer to the center-points of the six ranges. The needle indicator shows the actual sound level as a displacement from the center-point. Examples: Suppose RANGE is set to 80, and meter scale reads −3. Actual sound level is 80 − 3 = 77 dB. If meter scale reads 0 (same RANGE setting), actual sound level is 80 + 0 = 80 dB.

RESPONSE Selector

In FAST position, Meter will react quickly to changes in sound level, giving you an indication of peak sound levels present in the environment. In SLOW position, Meter is damped and indicates an average-value sound level. The effect of brief sound peaks is minimized in this position.

WEIGHTING Selector

The frequency response of the Sound Level Meter for each weighting characteristic is shown in Figure 2. The C-weighting curve is nearly uniform over the frequency range from 32 to 8,000 Hz, thus giving an indication of overall sound level. The A-weighting characteristic responds primarily to frequencies in the 500-to-10,000 Hz range, which is the area of greatest sensitivity of the human ear.

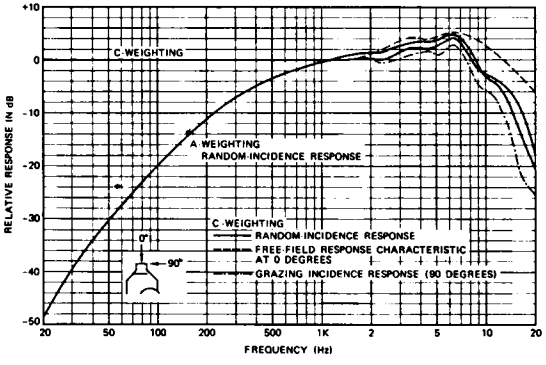


Figure 2

Typical A-and C-weighted response curves of Sound Level Meter (A-weighted with random-incidence).

OUTPUT Jack

The phono-type output jack lets you connect the unit to recording or other measurement equipment. For example, you might connect it via an audio patch cord to the AUX input of a recorder. Note that the meter response will not be flat, due to the A and C weighting networks. Set the **RANGE** selector so that maximum needle deflection is *never greater than +4*, to prevent the built-in amplifier from clipping. Use A-weighting for voice recordings, or C-weighting for full-range musical material. The **OUTPUT** jack may also be connected to high-impedance headphones, oscilloscope, frequency analyzer or other test equipment.

Tripod Adapter

You can mount the Sound Level Meter on a camera tripod (1/4" [6.5 mm] thread) to eliminate hand noise and minimize the effects of sound reflected from your body. A tripod mount is also convenient for using the Meter with auxiliary recording or testing equipment.

CALibration

The Sound Level Meter has been accurately calibrated at our factory, and normally will not require further adjustment. Special equipment, including a sound generator, is required for calibration. Adjustments can be made through the hole provided.

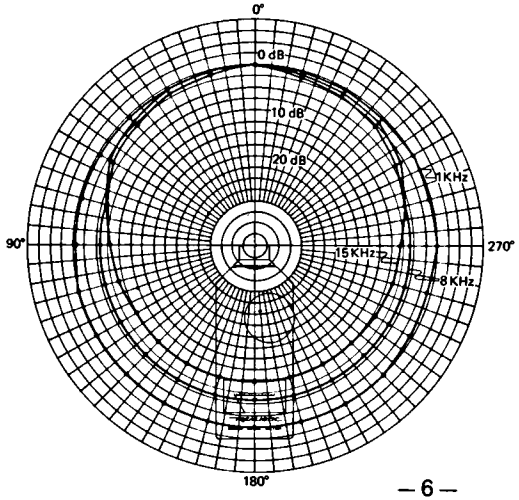


Figure 3.
Polar response of the built-in Mic. Note that best response is obtained when you point the Mic at the source.

TAKING ACCURATE MEASUREMENTS

Select the desired Response and Weighting.

If the sound source consists of short bursts, or if you're interested in peak values only, set **RESPONSE** to FAST. To measure average sound levels, use the SLOW setting. Select A-weighting for noise-level determinations, and C-weighting for measuring sound levels of musical material.

Determine the appropriate Range setting.

Start with the highest setting (120 dB) and work downward until there is significant deflection of the needle. For greatest accuracy, always use the lower of any two possible settings. Example: If **RANGE** is set to 80 dB and meter reads around – 5, reset **RANGE** to 70 dB and meter will read +5, for an actual sound level of 75 dB.

Note: For meaningful readings, any particular sound to be measured should be at least 10 dB louder than the background noise level.

Minimize the effect of your body's presence.

When the sound is coming mainly from one direction, the level reading may be significantly affected by reflections from your body. Do not hold the Meter directly between you and the sound source, as this may produce an error of several decibels in the frequency range above 100 Hz. Position the Meter so that an imaginary line between you and the Meter is perpendicular to a line between the Meter and the sound source. For the most accurate readings, point the MIC towards the sound source when possible.

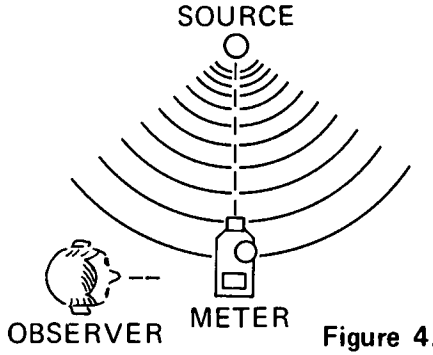


Figure 4.

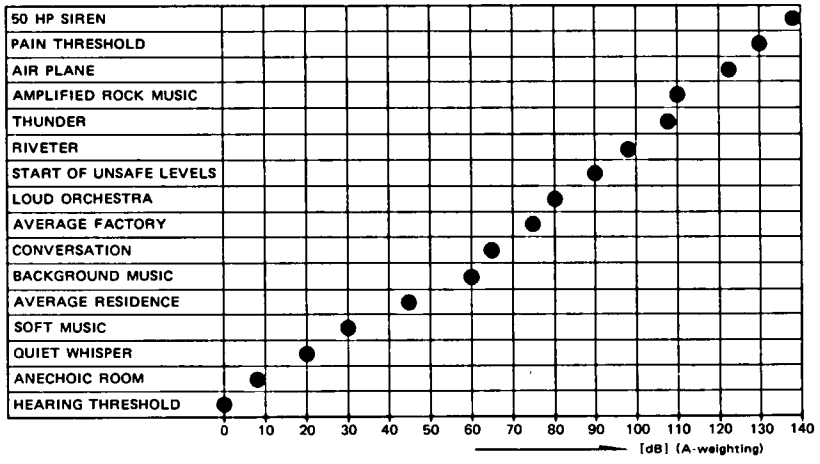
Handle the Meter carefully.

The microphone and meter movement are fragile and may be damaged if the instrument is dropped. Don't operate the Meter at a range setting that causes "pegging" of the needle. This could damage the movement.

CHECKING NOISE LEVELS

Noise is an important aspect of any environment — home, office, factory, school or recreation area. As Figure 5 illustrates, every one of us is exposed to a tremendous range of noise levels, no matter where we go or what we do.

Figure 5. Typical sound levels.



Depending on the level and duration, noise may be a minor irritant, a definite disturbance, or even a threat to your hearing. Federal, state and local agencies have established standards for just how much noise is acceptable. Figure 6 gives one such standard.

Duration per day, hours	Sound level (dB), A-weighting, 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

Figure 6. Permissible noise exposures. Extracted from U.S. Department of Labor noise regulations.

To check noise levels with the Sound Level Meter, use A-weighting with SLOW response. Take measurements at several points in the test area, with the Meter positioned as indicated in Figure 4.

CHECKING HI-FI ACOUSTICS

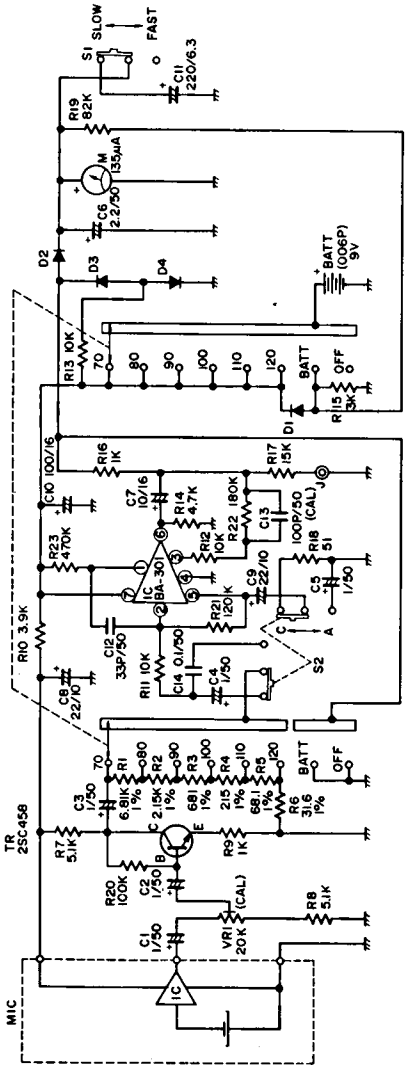
The size, shape and furnishings of a room can have a tremendous effect on a hi-fi system's performance. A "hard" room with bare surfaces tends to exaggerate treble response, sometimes giving the music a strident quality. A "soft" room with curtains, overstuffed furniture, carpet, etc., may reduce high-frequency response so the bass sounds dominant. Depending on speaker placement, standing waves may also develop in the room, giving your system a peaky, eccentric response.

The first step in solving this problem is to analyze the room's acoustics with your Sound Level Meter and a suitable test record. The test record will produce pure tones, one at a time, at intervals spanning the audio spectrum. Make a graph or table showing the sound levels generated by the individual tones. This gives you a clear idea of the frequency response of your "total system" — hi-fi equipment and room included.

The next step is to smooth out the response. Adjusting tone controls and varying speaker placement may improve things significantly. But to approximate the ideal "flat response", you should add a frequency equalizer to your hi-fi system. We recommend Radio Shack's Catalog Number 31-1987. This component lets you boost or cut response in five different ranges, as called for by your frequency response analysis. Properly equalized, your system can sound like one costing considerably more!

Note: With C-weighting, the Sound Level Meter's frequency response is flat from 35 to 7000 Hz (±3 dB). At 10 kHz, response is down about 4 dB and at 20 kHz it is down about 7 dB. Above 10 kHz, the frequency response of the Sound Level Meter drops off rather rapidly: be sure to take this into account when using a test record which includes tones at the extreme high end of the audio spectrum.

SCHEMATIC DIAGRAM



NOTES:
1. ALL RESISTOR VALUES ARE GIVEN IN OHMS.
2. ALL RESISTORS ARE 1/8WATT ±5% UNLESS OTHERWISE NOTED.
3. CAPACITOR VALUES ARE GIVEN IN MICROFARADS/VOLTS.
4. D1 THRU D4 ARE SILICON.

RADIO SHACK LIMITED WARRANTY

This equipment is warranteed against defects for 90 days from date of purchase. Within this period, we will repair it without charge for parts and labor. Simply **bring your sales slip** as proof of purchase date to any Radio Shack store. Warranty does not cover transportation costs. Nor does it cover equipment subjected to misuse or accidental damage.

This Warranty gives you specific legal rights and you may also have other rights which vary from state to state.

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RS SPL METER (33-2050) MODIFICATIONS

Abstract

The analog RS SPL meter is an inexpensive instrument that can be employed to measure the frequency response of DIY speaker systems. Two modifications are described that improve its accuracy at the upper and lower extremes of the audio spectrum, and make it more convenient to use.

Introduction

The analog RS SPL meter (cat.no.33-2050) is an effective, useful, and cheap tool that should be in every DIY speaker builder's arsenal. When coupled with a test CD or other signal source, accurate anechoic-like bass measurements can be performed using this meter in a "close-miked" setup; and in-room response can also be measured easily.

In many ways the analog RS meter is better than the digital meter RS offers: The resolution of the readout is higher (fractions of a dB, while the digital meter only reads to the nearest dB), the analog meter movement provides more information when analyzing dynamic signals, and finally it is less expensive than the digital meter. If the digital meter dispensed with the range selector switch and read fractional dBs, I would consider purchasing one, but with it, I consider the analog meter more useful and the better value.

The electronics of the stock analog RS SPL meter rolls off the bass (many poles) somewhere around 35Hz, and rolls off the treble (one pole) at 10kHz.

This is roughly comparable to the "C" weighting curve (from a post to the bass list by Thomas Danley):

> 20HZ =6.2DB 25HZ =4.4DB 31.5HZ =3DB 40HZ =2DB 50 =1.3DB
> 63HZ =.8DB 80 HZ =.5DB 100HZ =.3DB 125HZ =.2DB 160 =.1DB
> 200HZ to 1250HZ Flat
> 1600HZ = .1DB 2000HZ =.2DB 2500HZ =.3DB 3150HZ =.5DB
> 4KHZ =.8DB 5KHZ =1.3DB 6.3KHZ =2DB 8KHZ =3DB 10KHZ =4.4DB
> 12.5KHZ =6.2DB 16KHZ =8.5DB 20KHZ =11.2DB

The frequency response mod described makes the *electronics* flat over the entire audible range for the "C" setting of the A/C switch. After perfoming the mod, direct meter readings should be accurate for bass SPL measurements down to 20Hz or so using the internal mic *without* using any correction factors like those listed above -- in other words, pure WYSIWYG for bass readings!

The treble response of the stock meter is another matter. The poor "roller coaster" response of the meter in the treble region (as seen in the instruction manual for the meter) is caused (this is in fact *informed* speculation, but speculation nonetheless) partly by the physical mounting of the internal mic and partly by the mic module itself. The external mic mod (coupled with the frequency response mod) *should* correct for this if you use a Panasonic mic module mounted in the end of some tubing ala the MMII. I have no way of checking the frequency response of the mic element, but I have used the added external mic *input* to check the frequency response of the modified electronics. Basically, if the external mic cartridge you use has a flat frequency response, then the modified meter electronics will be able to keep up with it and not introduce any additional response irregularities.

Recommended external mic cartridge (excerpt from an email I got from Mike Feldman, thanks Mike):

> Panasonic electret mic capsules from Digi-Key; 1-800-344-4539. They carry several, but I think you want WM-60AY, Digi-Key part P9959-ND, $2.24 in quantity 1-9; $19.88/10.

This is the same cartridge used in the Mity Mike II, and typically has a +1dB hump around 10kHz, but is very flat otherwise.

Both mods are simple and may be free if you have some caps in your junk box and some plumbing supplies in your closet / garage. Mod your meter today and you'll be able to train a monkey to do your sub testing tomorrow!

FREQUENCY RESPONSE MOD

Click here for the schematic.

Instructions are as follows:

- To extend the LF response: -

CHANGE (either replace or solder in parallel to the old value, your choice, use electrolytic caps):

- C1, C2 from 1uF to 10uF
- C3, C4 from 1uF to 47uF
- C7 from 10uF to 220uF
- C8 from 100uF to 470uF
- C15 from 100uf to 220uF
- C9 from 22uF to 220uF

- To extend the HF response: -

CHANGE (replace, use ceramic or NPO cap):

- C12 from 33pF to 12pF (controls HF response)

NOTE:

> In order to change the value of C12, it is necessary to replace it, and not simply solder a 12pF in parallel with it. It is not necessary to alter this cap if you are only interested in good bass measurements and don't care about the treble response of the meter, as this cap rolls off the HF and also compensates the amplifier IC. In other words, if you think you will not perform the external mic mod, this capacitor can be left alone.

The easiest way to change these caps (except for C12, which must be replaced of course) is to leave the originals on the PC board, and solder the new caps (the values given above) to the back of the board, where there is plenty of room. Shouldn't take more than a half hour total if you have the parts. If you are a stickler for neatness and can't sleep at night knowing that the caps in your SPL meter in the next room are on the wrong side of the board, then by all means take the extra hour or so and actually replace them (I did, and I'm resting soundly :-).

Case Disassembly:

1. Remove the two phillips head screws on the back, one is behind the battery door.

2. Pull the back away about 1cm from the mic section. Watch out not to crack the plastic hooks on the bottom!
3. Holding the unit so that the microphone is pointing up, pull down on the back so that the plastic hooks on the bottom let go. Remove the back.
4. Unscrew the two brass posts holding the pc board in position.
5. Unscrew the philips head screw on the rotary switch, remove the phenolic wafer.
6. Remove the pc board along with the mic (with housing) and meter. A gooey substance may fight you when you remove the mic housing from the case.

This mod should not affect the calibration of the meter, since only the poles in the circuits have changed, not the ac gain in the passband. On the most sensitive settings the meter will seem to be a bit jumpier. This is due to the amplification of low frequency data such as wind and case thumps. In fact, this is an indication that the mod is working correctly. The breeze from a finger moving near the mic causes the needle to move quite a bit, as does air conditioning.

After this mod, I (or the meter, rather) exhibited some instability (hf oscillations). Making C12 12pF cured this (it was 10pF in the inital mod). If you experience similar instability (needle jumps around, stays pegged on the lower ranges, is influenced by the position of your hand over the needle area) increasing C12 is the way to fix this. Be aware that the larger this cap is, the lower the hf rolloff will be, though of course the meter is useless if it is not stable.

Regardless of whether you do the external mic mod or not, after the basic electronics mod is done, you will notice that the meter needle pegs a couple of times at turn-on before settling down. This is normal since the circuit now has many very long time constants. As I stated before, on the most sensitive settings, the meter will seem somewhat jumpier. This is due to the amplification of low frequency data such as wind and case thumps. In fact, this is an indication that the mod is working correctly. My meter, on the 60dB setting, registers my moving hand from several feet away. And this isn't the breeze from my hand "blowing" on the mic, this is my hand moving in a rythmic closer-farther-closer motion relative to the mic at a couple of Hz rate, Xmax ~3" p-p (sorry, ~1.5" peak :-). It is the sensitivity of the mic cartridge to very low bass in this test that lead me to believe the cartridge is probably pretty flat to a few Hz.

I just want everyone who is contemplating performing this mod on their meter (the frequency response correction mod, with or without the external mic mod) to be well aware of the behavior afterward. I am quite happy with the results, but if this sort of behavior (i.e. the double pegging and settling at turn-on) drives you crazy, perhaps you should decide against surgery and go with the old therapy, i.e. equalization charts.

The SPL meter electronics (including the meter needle itself) now respond in the following way (regardless of the range switch, external mic input, C12=12pF):

"Fast" response switch position:
+/-3dB: 6Hz to 50kHz
+/-1dB: 28Hz to 23kHz
-1.2dB @ 20Hz
-0.8dB @ 20kHz
Flat otherwise.

"Slow" response switch position:
+/-3dB: 4Hz to 50kHz
+/-1dB: 8Hz to 23kHz
-0.2dB @ 20Hz
-0.8dB @ 20kHz
Flat otherwise.

The "Slow" response setting looks like the way to go for accurate low bass measurements. Based on the -0.2dB @ 20Hz figure, we can now pretty much ignore the frequency response of the electronics for most bass measurements.

EXTERNAL MIC MOD

I have performed this mod and recommend it highly, as it makes the meter more versatile. Basically, the internal mic element is removed and placed on the end of 3 meters of coaxial cable. This places the element itself in a less compromising position acoustically, and has the added benefit of placing the meter needle far away from the measurement location and closer to the eye where it is much easier to read. If you decide to plug in a better mic cartridge, the HF response should be flat up to 20kHz or so. Instructions are as follows:

1. Disassemble the case (instructions above).
2. Desolder the mic leads from the main PC board.
3. Looking at the back of the silver plastic mic holder you should see (concentrically working from the center out) the mic element, the inner black plastic bushing, the outer black plastic bushing, and finally the holder itself. Using a small screwdriver, break the glue seal between the outer (largest) plastic bushing and the silver holder. Next, using a needlenose pliers, try to break the outer bushing free from the holder and remove it. You can push on the windscreen mesh also to facilitate this.
4. Remove the inner bushing and mic as a unit from the outer bushing. Be careful not to push on the front of the mic element when doing this.
5. Remove the mic element from the inner bushing. I had to saw lengthwise through the inner bushing with a hacksaw (just most of the way through and then crack it apart with a screwdriver in the saw kerf). Discard the inner bushing.
6. Using the windscreen mesh as a template, cut a circle out a piece of sheet aluminum or plastic. Drill a hole in the center and mount a panel-mount phono jack (RS no. 274-346 or the gold plated version) in the hole (don't forget the ground lug). Solder some wires on the jack at this point. Put the circle and jack assembly in place of the windscreen and glue in the outer bushing in order to hold it in place.
7. Solder the jack wires to the PC board. Observe correct polarity (outer shield to the left '-' mic trace). Close the meter case and set aside.

Here is a picture of the final result:

That finishes up the mods to the case. Next for the mounting of the mic element:

1. Buy one of those 3/8" OD gray plastic plumbing tubes that hooks up toilets and sinks to the supply. Cut it to the length you desire (I recommend 200 mm). Discard the end with the "knob" on it.
2. Buy a 1/2" long, 3/8" ID nylon spacer and enlarge the diameter of one end enough to take the mic

element (10 mm). I did this with my drill and an exacto knife, took about 10 minutes. Leave the other end at 3/8". Crazy glue the 3/8" diameter end on to the 3/8" pipe so that half of the spacer hangs off the end of the pipe (the enlarged end that will hod the mic element).

3. Buy a 1" long, 1/4" OD nylon spacer. Drill out the other end of the pipe to accept it, and then crazy glue this spacer in place, again, with half of it extending out of the pipe. This forms a strain relief for the cable. Make sure your cable will fit through the ID of the spacer.
4. Cut a 3 m length of audio coax (the slimmer the better) and mount a phono plug on one end. Thread the coax through the the holder, and solder it the mic element. Slip the mic element into the enlarged end of the 3/8" spacer. You might want to use tape to build up the element diameter so that the fit is *slightly* snug. All done!

FAQ SECTION

```
> A Quick Question
>
> You indicated you left the caps on & attached caps to back of board meaning
> you, in case of first cap change, added 9uF to back inparallel or cust lead
> on one on front & added a 10uF
>
> also, I assume I would match the type of caps ie. electrolytic, tantulum,
> mica etc....
>
> I have a 'basic' understanding of electronics at best

The idea is only to lower the poles so that they do not
significantly alter the meter response at the frequencies of
interest (>10Hz or so).  So it is really just a matter of
increasing the capacitance of C1, C2, C3, C4, C7, C8, C9, and
C15 until this condition is true.

There is no need to remove the original caps, and no need to
find special values to make the resulting parallel capacitance
values exact.  For example, soldering a 10uF in parallel with a
1uF only makes the resulting value off by 10%, and this is
usually within the tolerance of the 10uF in the first place!

The resulting pole may be 10% lower, but all the better.  If
you use values that are significantly larger than those that I
specifiy for the signal path, the meter will take a lot longer
to settle down at turn-on, which might drive your crazy if you
are sensitive to such things.  Mine takes about 3-5 seconds to
calm down after turn-on, and is stable during and after
changing the range switch.  It is very sensitive to wind and
case shock after the mod, which makes sense if you think about
it.

C12 is the only capacitor that needs to be replaced, since its
value has to be reduced.

If you find that your meter is unstable after the high
frequency mod (needle moves erratically, pegs or stays
somewhere in the midrange even with no sound input), try adding
small values of capacitance (2pF or so) across C12 until the
meter stabilizes.  This will make your meter less accurate in
the high-end (the high-end response will start rolling off
sooner).  Better to err on the side of stability, since the
meter is useless if it is not stable.

Use electrolytics in parallel with the electrolytics (which is
every modified cap except C12).  I used some that I scrounged
from an old VCR.  These caps were very small for their size,
```

making them an easy fit. Any voltage level at or above 10V is fine. Observe polarity when installing them (s/b same as the originals).

A ceramic or NPO will do for C12. R/S sells an assortment of small value caps (1-30pF) that will do nicely for C12, and will allow you to find the critical value that will yield both stability and maximum flat hf response. As I stated above, starting with 12pF would probably be wise.

> You had previously written :
>
> > The easiest way to change these caps (except for c12, which
> > must be replaced) is to leave the originals on the PC board,
> > and solder the new caps to the back of the board, where there
> > is plenty of room.
>
> I assume from the above that you meant to add the new parts
> to the old ones (in parallel). So C1 goes from 1 uF to 11 uF
> not to 10 uF. This looks safe enough since you're just lowering
> the pole frequency even more than if the old cap were removed.

Right. The tolerance on electrolytics is usually rather wide, and all we are trying to do is lower the poles below some (rather arbitrary) frequency (I picked ~1Hz).

> FYI, I made the meter mods last night - just the 9 caps.
> So far as i can tell, it's acting as you described. The needle
> jumps a lot on power-up and when changing ranges, especially in
> "fast" mode. Hand motion is detectable. Next step is to
> run some tests on it and compare it to previous results.
>
> Also, I think I'll keep it as an internal mic device only if
> the existing mic module seems to be pretty sensitive. It's probably
> not flat all the way to DC, but there's a decent chance it's
> flat to at least 20 (the Panasonic module I bought from DigiKey is
> supposed to be rated 20-20k; I wonder how far off it is below
> that ?) and that's good enough for me. Then I'll use the other mic
> for something else I guess.

Mine pegs twice on power-up, but then settles down. Switching ranges doesn't affect it very much when in the "slow" mode, which is where mine stays now.

Note that the "slow" setting will give much better low frequency readings, -0.2dB @ 20Hz vs. the "fast" setting response of -1.2dB @ 20Hz. This also keeps the needle from jumping around during range switching.

I guess you changed high frequency cap C12 also. Did you make it 10pF or 12pF? I had to go to 12pF for stability reasons, outlined in my second post. If *holding* your hand near the meter area causes readings, you have oscillation and should increase C12 until they go away.

Adding the external mic option is a snap. Have you considered this? I think that one of the reasons the HF response sucks so bad (in the RS manual, the roller coaster action in the highs) is due to the funky mounting of the internal mic. That huge plastic flange (I thought it was aluminum until I took the thing apart; some things I would rather not know :-) and that funky "PC board" screen *have* to be altering the response curve in a major way. An external mic (like the wand-type MMII cartridge at the end of a tube type thing - without all the

fancy electronics) would make this unit accurate all the way up to 20kHz, where the response of the electronics is down only -0.8dB (with C12=12pF). Getting my body out of the measurement area and the meter nearer to my eye would be added bonuses (boni?).

HF response aside, I bet dollars to donuts that the mic cartridge itself is, as you say, flat to at least 20Hz based on the "waving ~3Hz hand" experiment. Be nice to have some way to check this. All we need is a calibrated sub good to 3Hz (next project...just kidding) or a specral noise source that doesn't employ speakers (maybe released compressed air?). Till then, I'll trust that the bass readings I get are fairly accurate.

> Just to clarify, am I correct in assuming that this mod will
> correct the deficiencies of the internal mike, but that the
> impact of C/A weighting will still have to be cranked in the
> the readings?

Just the opposite! After the mod, the electronics will be flat (including the meter needle itself) but the internal mic will continue to contribute its poor hf response.

The internal mic seems to be fine for bass readings, and continues to work well for those situations when you need calibrated "A" weighting readings (rock concerts and jet planes and such). The external mic mod should easily get around the high-end response problem, and also will get your body out of the measurement field and place the meter nearer to your eyes where you can more closely scrutinize the trembling little needle.

> I've just found your instructions for modifying the meter's response and
> was wondering if this also affects the signal sent to the output jack?

This mod should correct for the output jack response also, since the meter amplifier ic actually feeds the output jack. So you should do both the hf and lf mods if you want the frequency response of the signals at the output jack to be flat.

> Have you done any tests on the output? I was wondering if it was constant
> if a part of the signal drops off the current range (eg range = 90dB, but
> at say, 500Hz the signal is only 80dB)?

I have checked the fr of the output jack, and the response of the electronics after the mod follows the actual meter needle response over the entire 20Hz - 20kHz range. Everything *after* the built-in mic in the signal chain is flat over this range, including the meter response and the output jack response.

> Will the output jack give a sensible (linear) reading if I'm measuring a
> signal where 1kHz reads 90dB, 10kHz reads 80dB and 100Hz reads 100dB with
> the range set to 90dB?
>
> I know the meter scales the reading (ie switching the 80dB range in this
> example would make the output higher) but would signals that are out of the
> meter's current range be output at the correct relative value?

Since the single transistor pre-amp circuit is class A (and I assume the op-amp used for meter drive / output jack drive is class A as well) then signals at the output jack should be linear for input signals outside of the meter range. The caveat here would be for signals that are so large that they cause clipping, and thus overload the op-amp. Smaller signals should be no problem as long as they are not so attenuated that they are buried in noise.

Last updated: 03/19/2005 12:33:27

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RS *DIGITAL* SPL METER (33-2055) MODIFICATIONS

Thanks

Noah Katz was kind (and trusting) enough to offer up his digital meter up for possible sacrifice. It came in the mail yesterday so opened it up and promptly began exploratory surgery (don't worry Noah, I used anesthetic!).

Looking Under the Hood

Click here for the schematic.

I traced each component and drew up a a schematic. Several pain-filled hours later, wherein much cursing of RS management could be overheard emenating from my work area, the bulk of the signal path was traced out. A pole frequency analysis determined which capacitors would need to be changed in order to move all poles significantly outside of the passband. I picked 1Hz and 100kHz as targets for these calculations.

Before I changed anything, I measured the frequency response of the *electronics* of the stock meter by removing the microphone element and driving the pads where it was connected with a function generator, coupled through a 10k resistor and a 100uF capacitor. The electronics of the stock digital RS SPL meter rolls off the bass (many poles) somewhere around 28Hz (-3dB), and rolls off the treble (two poles) at 12kHz (-3dB). The "A" weighting setting introducesa pole at 500Hz when engaged, which rolls off the bass beginning at this higher frequency.

The frequency response mod as described below improves the frequency response of the *electronics* for the "C" setting of the A/C switch. After perfoming the mod, direct meter readings should be accurate for bass SPL measurements down to 10Hz or so using the internal mic *without* using any correction factors.

The treble response of the stock meter is another matter. For some reason, the designer of this meter decided to use the same cruddy mic element as used in the analog RS SPL meter, and this is responsible for a major treble roll off somewhere between 10 and 15 kHz. While the designer dispensed with the skanky stone-age BA 301 op-amp found in the analog meter, (s)he inexplicably settled on using the (in some ways even skankier, particularly for this application) LM324 quad op-amp for most of the electronics, and this is the main cause for the high frequency response *of the electronics* to be down 3 dB @ 17 kHz even after the mod is performed.

Equally inexplicably, the single transistor input stage is almost exactly the same as the analog meter. Jeez, I could have done a better design with one brain lobe tied behind my back. You had a whole *quad* there buddy! Anyway, for these reasons I am disinclined to recommend installing a jack for an external mic mod, and would suggest you purchase the analog meter if you are interested in using the meter itself as a mic preamp.

If you have already purchased the digital meter and desire a better high end response than this mod will produce, you could try replacing the op amp with a higher quality quad unit with the same pinout. The specs to look for would benear rail-to-rail input and output, along with reduced supply voltage operation and high slew rate. I tried replacing the LM324 with a TL074, but the rectifier formed by two of the

op-amp sections stopped working, so I put the original op-amp back (I installed a 14 pin socket, and so was able to check more than one TL074, but none worked in-circuit). The design biases the rectification section asymetrically and rather low (+1.5V from the '-' terminal) and the TL074 probably just won't work this close to the supply rail. Anyway, the moral of this story is to use a socket so you can easily put the old chip back if the new one doesn't work (and of course that a TL074 won't work without possible further modification to the circuit).

Regardless of the high end though, this mod will at least make bass measurements easier (since no correction factors are necessary between 10Hz and 10kHz or so) and should extend any high frequency readings somewhat also.

Note also this mod should not affect the calibration of the meter, since only the poles in the circuits have changed, not the ac gain in the passband.

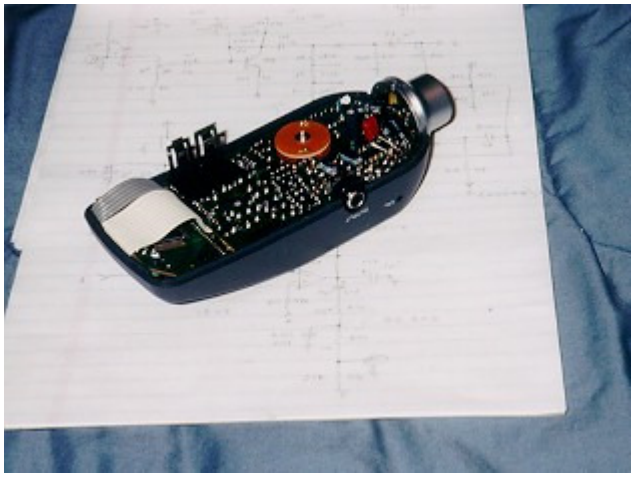
The Mod

Full speed ahead into the mod! But first you have to get the thing open to work on it:

Case Disassembly:

1. Remove the two phillips head screws on the back, one is behind the battery door.
2. Pull the back away slightly from the mic section, pushing on the battery terminals as necessary to free them up.
3. Holding the unit so that the microphone is pointing up, pull down on the back so that the plastic hooks on the bottom let go. Remove the back.
4. Unscrew the philips head screw on the rotary switch, remove the phenolic wafer.
5. Remove the pc board along with the mic (with housing). The pc board will remain connected to the top of the housing through a ribbon cable. There is no need alter this situation (leave that little board in there and leave it connected to the main pc board).
6. Remove the mic housing.

Now that the case is open, look as the component side of the board for the printed component numbers listed below. These designations are printed immedately next to the component they refer to.



Here is a picture of the inside of the meter with the back off. Note the brown disk, which is the wafer switch.

To extend the LF response:

SOLDER IN PARALLEL WITH THE OLD VALUE, on the back (non-component side of the pc board).

Use electrolytic caps (except where noted), observing polarity:

- C1, C3 (100uF original) add 47uF or 100uF (no difference, your choice).
- C2 (1uF original) add 10uF.
- C5 (1uF original) add 4.7uF.
- C6 (1uF original) add 22uF.
- C7, C17 (1uF original) add 1uF.
- C11 (1uF non-polar original) add 22uF polar, the (-) terminal should go nearest to the output jack.
- C18 (0.022uF original) add 0.1uF (polyester or mylar).

To extend the HF response:

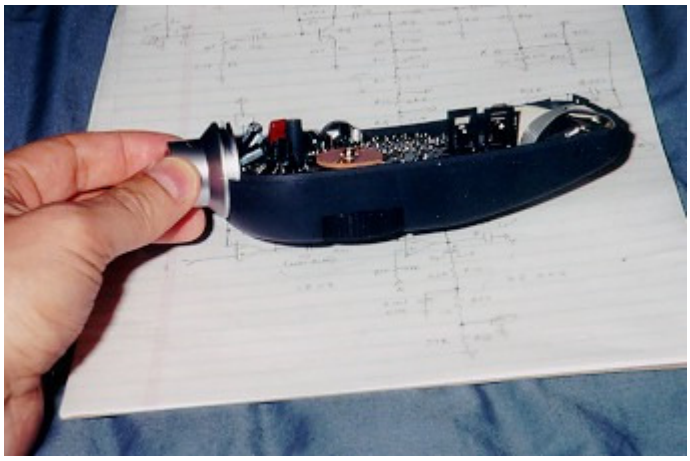
CHANGE (replace, use ceramic or NPO cap):

- C9, C12 (27pF original) change to 10pF.

REMOVE (and don't jumper the holes or anything, just take it out of circuit):

- C4 (100pF original) *REMOVE!*

So, except for C9 and C12 (which must be replaced) and C4 (which must be removed) leave the original capacitors on the PC board and solder the new caps (the values given above) to the back of the board where there is plenty of room. Shouldn't take more than an hour total if you have the parts handy.



Here is a picture of the meter after the mod. Note the electrolytics soldered onto the back of the PC board near the microphone silver holder.

The SPL meter *electronics* (including the digital meter itself and the signal at the output jack, but *not* including the built-in mic capsule) now respond in the following way (regardless of the range switch):

"MAX" response switch position, "C" weighting:
+/-1dB: 8Hz to 11kHz
+/-2dB: 5Hz to 14kHz
+/-3dB: 3Hz to 17kHz
Flat otherwise.

Parting Thoughts

The digial version of the RS meter has one thing over the analog meter: it reads +/- 10 dB within a single range setting. If it dispensed with the range selector switch and read fractional dBs, I would consider

purchasing one, but with the selector switch, I consider the analog meter more useful and the better value. The analog meter also goes higher in terms of frequency response before rolling off, and so makes a better preamp for external microphone capsules.

FAQ SECTION

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This section reserved for future questions regarding this mod...
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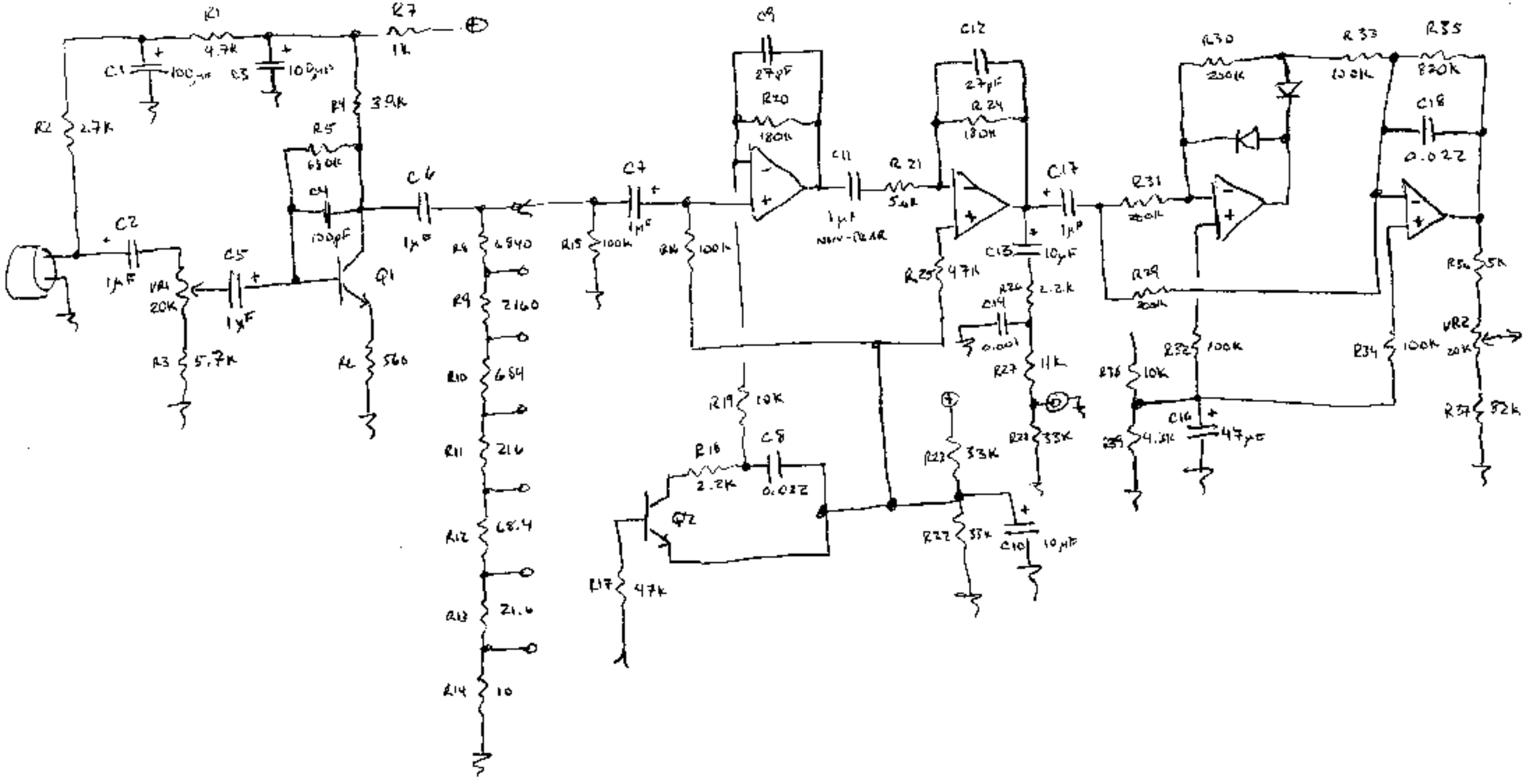
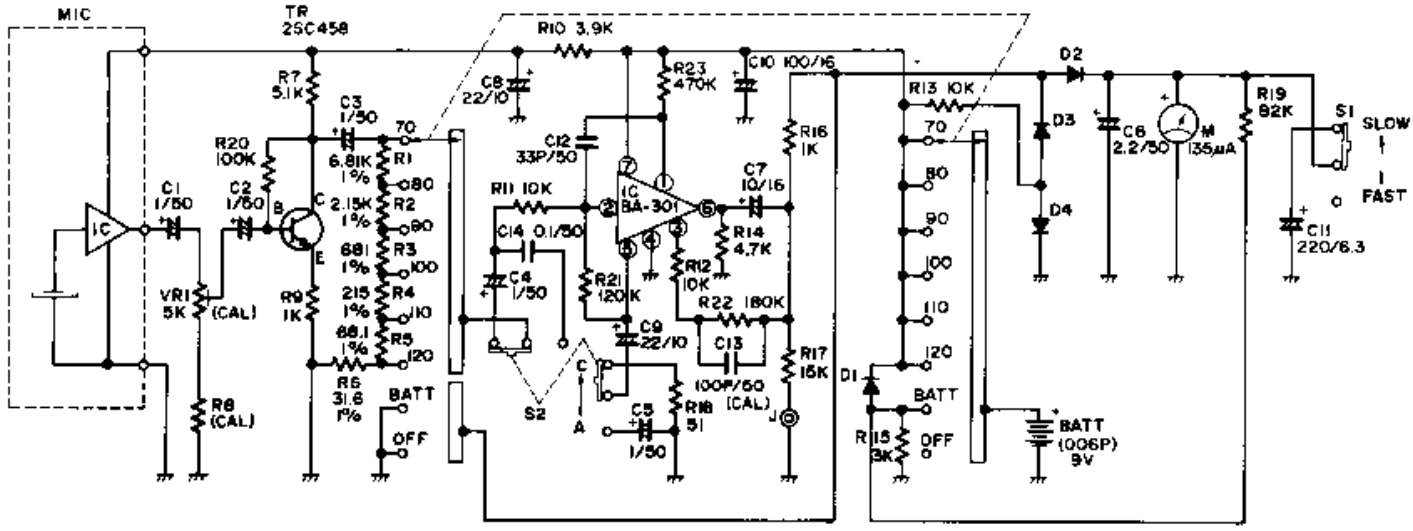

R1
4.7K
R7
1K
C1
100μF
C3
100μF
R2
2.7K
R4
3.9K
R5
680K
C4
100pF
C6
1μF
C2
1μF
VR1
20K
C5
1μF
R3
5.7K
Q1
RL
560
R6
6840
R9
2160
R10
684
R11
216
R12
68.4
R13
21.6
R14
10
C7
1MF
R15
100K
R8
100K
C9
27pF
R20
180K
C11
1μF
NON-POLAR
R21
5.6K
C12
27pF
R24
180K
C13
10μF
R25
47K
R26
2.2K
C14
0.001
R27
11K
R19
10K
R18
2.2K
C8
0.022
Q2
R17
47K
R23
33K
R22
33K
C10
10μF
C17
1μF
R30
250K
R33
10K
R35
820K
C18
0.022
R31
250K
R29
250K
R32
100K
R36
10K
R34
100K
R54
5K
VR2
20K
R37
82K
C16
47μF

RS SPL METER (42-3019) MODIFICATIONS

Yet another meter mod!

At my request, Sean Collins sent me the schematic to this Radio Shack meter so that I might suggest some modifications to extend its frequency response (thanks Sean!). The schematic is almost exactly the same as the current anaolg meter that RS carries, the 33-2050, with the main difference being it employs a three terminal microphone element, rather than the two terminal type found in the 33-2050 and 33-2055. This makes any external mic mod difficult unless you use a stereo jack or something for the interface. I'll leave any such mods to the ingenuity of the reader.



The frequency response mod described here should makes the *electronics* flat over the entire audible range for the "C" setting of the A/C switch. After perfoming the mod, direct meter readings should be accurate for bass SPL measurements down to 20Hz or so using the internal mic *without* using any correction factors. The treble response of the meter will be limited only by the frequency response of the internal microphone (probably -3dB @ 15kHz at best for the stock cartridge).

FREQUENCY RESPONSE MOD

Instructions are as follows:

- To extend the LF response: -

CHANGE (either replace or solder in parallel to the old value, your choice, use electrolytic caps):

- C1, C2 from 1uF to 10uF
- C3, C4 from 1uF to 47uF
- C7 from 10uF to 220uF
- C8 from 22uF to 220uF
- C9 from 22uF to 220uF

- To extend the HF response: -

CHANGE (replace, use ceramic or NPO cap):

- C12 from 33pF to 12pF (controls HF response)

REMOVE (see possible calibration note below!):

- C13 100pF

The easiest way to change these caps (except for C12, which must be replaced of course) is to leave the originals on the PC board, and solder the new caps (the values given above) to the back of the board, where there is plenty of room.

Case Disassembly:

1. Remove the two phillips head screws on the back, one is behind the battery door.
2. Pull the back away about 1cm from the mic section. Watch out not to crack the plastic hooks on the bottom!
3. Holding the unit so that the microphone is pointing up, pull down on the back so that the plastic hooks on the bottom let go. Remove the back.
4. Unscrew the two brass posts holding the pc board in position.
5. Unscrew the philips head screw on the rotary switch, remove the phenolic wafer.
6. Remove the pc board along with the mic (with housing) and meter. A gooey substance may fight you when you remove the mic housing from the case.

Possible Calibration Note: This mod should not affect the calibration of the meter, since only the poles in the circuits have changed, not the ac gain in the passband. The possible exception here is the removal of C13, which has a (CAL) marking next to it on the schematic. These old opamps, like the Lord, work in mysterious ways, and I'm not completely certain what this cap is doing. All I *can* say is that this cap is not in the 33-2050 meter, though all of the surrounding circuitry is the same. If I were modifying this meter, I would hold the meter about an inch away from the dust cap of a small woofer producing a 1kHz tone, and switch this cap in and out of circuit. If no steady-state level change results then it is safe to just remove the cap. If a steady-state change occurs, you should re-calibrate the meter with the capacitor removed based on the level experienced with the cap in-circuit. Use the same setup as just described to accomplish this: note level on meter with cap in-circuit, remove cap, adjust "cal" pot until you get the same level as before.

If your modified meter displays instability (needle jumps around, stays pegged on the lower ranges, is influenced by the position of your hand over the needle area) increasing C12 is the way to fix this. Be aware that the larger this cap is, the lower the hf rolloff will be, though of course the meter is useless if it is not stable. If you are not interested in extending the high frequency response, or if you use the "A" weighting setting a lot, leave C12 and C13 alone and you should experience no instability problems.

FAQ SECTION

(This section reserved for any FAQ-type stuff in the future.)

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