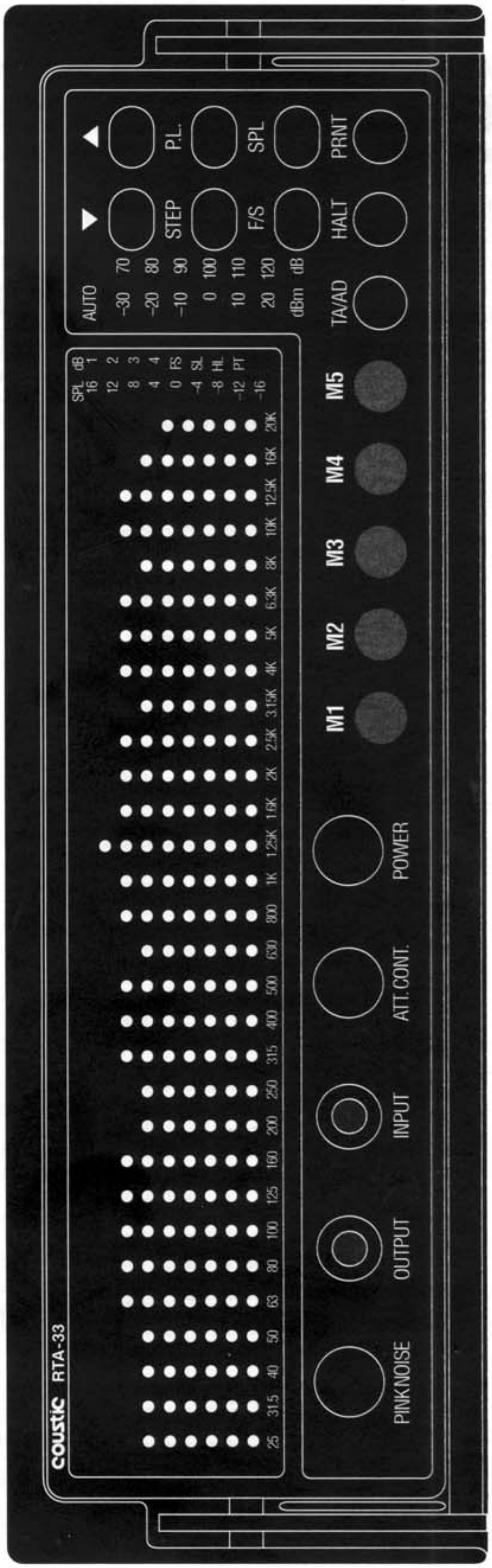

coustic®

RTA-33

30-BAND
ONE-THIRD OCTAVE
REAL TIME ANALYZER

4260 Charter Street
Vernon, CA, 90058-2596, U.S.A.

TEL: 800-227-8879 or 213-582-2832
FAX: 213-582-4328
TLX: 910-240-6376

A DIVISION OF CONCEPT ENTERPRISES, INC.

CONGRATULATIONS...

... on purchasing the Coustic RTA-33 30-Band One-Third Octave Real Time Analyzer. Your choice shows a serious appreciation for critical music reproduction. The Coustic RTA-33 is the first real time analyzer to utilize digital signal processing technology, and in doing so it surpasses previous technology in terms of accuracy and efficiency. Whether you are using the RTA-33 to measure the acoustics of recording studios, homes or cars, you are certain to notice immediate performance benefits.

Your RTA-33 utilizes advanced Digital Signal Processing (DSP) technology to measure the frequency response and sound pressure level (SPL) of any acoustic system with amazing precision. Your RTA-33 features a built-in "pink noise" generator, programmable system memories with Lithium back-up battery, parallel printer port, internal Ni-Cd rechargeable battery pack, calibrated microphone and much, much more. A masterpiece of mobile/audio engineering, the RTA-33 combines extraordinary features into a compact, self-contained, precision instrument.

Coustic does not just manufacture precision test equipment. We also build a full range of sophisticated audio products for automotive application. Our product line includes full-feature high performance AM/FM CD/Cassette units, state-of-the-art power amplifiers, award winning electronic crossovers, graphic equalizers, dynamic full-range component speakers, as well as a family of 8-, 10-, 12-, and 15-inch subwoofers — in other words, everything you need to create the ultimate car audio system.

Coustic ...a sound investment.

Please take a moment to complete and mail the Warranty Registration Card, and record the serial number in the space provided below. This will ensure that you receive future information regarding software updates for the RTA-33. Your Coustic RTA-33 serial number is located on the back of the unit.

Serial Number: ______________________ Date of Purchase: ______________________

TABLE OF CONTENTS

HIGHLIGHTS

Your RTA-33 represents the state-of-the-art in precision instrumentation, and a major breakthrough in sophisticated audio electronics. Its advanced design features include:

- Applied Digital Signal Processing (DSP) Technology
- 30 One-third Octave Bands from 25 Hz to 20 KHz
- Digital Fourth-Order Band-pass Filters
- Programmable System Memories with Lithium Back-up Battery
- Time Averaging of Frequency Response
- Auto Difference of Frequency Response
- 9 x 30 Matrix LED Array Bar Graph or Digital SPL Spectrum Display
- Input Sensitivity Selector with AutoRange Function
- Input Attenuation Control
- Selectable 1, 2, 3, or 4 dB per step Display Resolution
- Peak Latch Switching
- Fast/Slow Display Speed
- Built-in Pink Noise Generator
- Selectable A-Weighted Filter
- Microphone and Unbalanced RCA Signal Inputs
- Calibrated Condenser Microphone
- Built-in Centronics Compatible Parallel Printer Port
- DIN-size/Removable Chassis for Custom/ Portable Application
- Flexible Operations — 12-Volt DC, internal Ni-Cd Rechargeable Battery Pack, or 110-Volt AC/DC Adaptor
- Custom EPROM Package with Print-out Referencing Official Competition Frequency Response Scoring Parameters

Accessories included:

- Reference Test CD
- Soft Carrying Case with Shoulder Strap

FEATURES

APPLIED DIGITAL SIGNAL PROCESSOR (DSP) TECHNOLOGY

Your RTA-33 utilizes a state-of-the-art Digital Signal Processor (DSP) which manipulates signals in the digital domain (instead of analog) at blinding speed - a technology widely used in NASA's space program, as well as other sophisticated military, medical, and satellite programs. Analog circuitry varies with temperature, component accuracy and age. It typically has low noise immunity, is difficult to modify, and requires adjustment. DSP technology requires no adjustment, uses fewer discrete components, and offers a high degree of noise immunity and amazing precision.

30 ONE-THIRD OCTAVE BANDS

Your RTA-33 divides the audio spectrum, between 25 Hz and 20 KHz, into 30 one-third octave bands with design centers conforming to ANSI/ISO preferred frequencies (ANSI S1.6-1984/ISO Recommendation R266-1975).

DIGITAL FOURTH-ORDER BAND-PASS FILTERS

Built-in fourth-order band-pass filters are implemented mathematically with the DSP, yielding far superior accuracy and consistency. Your RTA-33 filter set is designed to exceed ANSI S1.11-1966 Class III Type E standards.

PROGRAMMABLE SYSTEM MEMORIES WITH LITHIUM BACK-UP BATTERY

Your RTA-33 has five programmable system memories which can be used to store/recall frequency response samples. When power to the unit is disconnected, an internal Lithium back-up battery maintains the preset memories.

TIME AVERAGING OF FREQUENCY RESPONSE

When activated, your RTA-33 will automatically compute and display an average of 256 frequency response samplings, recorded evenly within a 10-second period. This response curve can then be stored in any of the five system memories for later use. This feature permits consistent "Pink Noise" measurement.

AUTO DIFFERENCE OF FREQUENCY RESPONSE

When activated, your RTA-33 will automatically compute and display the difference between a stored frequency response and a new "Time-Averaged" response for accurate calibration. This feature provides more accurate calibration and eliminates the "guess work" when analyzing acoustical systems.

BAR GRAPH / DIGITAL SPL SPECTRUM DISPLAY

A setting on your RTA-33 can be selected to display frequency response either digitally in decibels (dB) or by bar graph. The maximum SPL measurable is 136 dB — above and beyond the sonic reproduction capabilities of most audio systems.

INPUT SENSITIVITY SELECTOR WITH AUTORANGE FUNCTION

You can manually select the input sensitivity of your RTA-33 by pressing the ▲ (INCREASE) or ▼ (DECREASE) button on the front panel. With AutoRange activated, your RTA-33 will automatically adjust the input sensitivity.

INPUT ATTENUATION CONTROL

This control allows fine adjustments of the input sensitivity. It is useful in measuring the frequency response of audio equipment.

SELECTABLE DISPLAY RESOLUTION

The spectrum display resolution of your RTA-33 is selectable at 1, 2, 3, or 4 dB per step. At the 4 dB per step setting, each dot on the LED display represents a value of 4 dB, with the overall range being 32 dB. This setting is most useful in monitoring an audio system.

PEAK LATCH SWITCHING

The Peak Latch Switch feature allows you to display only the highest reading in each of the 30 bands for peak frequency response reference. In dot display mode, your RTA-33 will update a particular band only when the input signal exceeds the previously recorded level. In bar graph mode, your RTA-33 will dynamically update the peak SPL of each band, holding the recorded peak for two seconds, then the peak SPL for each band is refreshed.

FAST/SLOW DISPLAY SPEED

This feature allows you to choose between a fast or slow decay (transient response) time for the LED display. FAST setting is best for monitoring transients, such as program material. SLOW setting is ideal for measurements such as pink noise testing.

BUILT-IN PINK NOISE GENERATOR

Your RTA-33 features a built-in pink noise generator which can be used to calibrate the acoustic system. Pink noise is filtered white noise and, because it contains equal energy per octave, it is a relatively flat reference test signal and very useful for equipment calibration purposes. The pink noise output level is adjustable from the RTA-33's front panel.

FEATURES

SELECTABLE A-WEIGHTED FILTER

Your RTA-33 includes a user selectable A-weighted filter. This represents a standard weighting curve applied to SPL measurements to approximate the ear's frequency response at low sound intensity levels. The A-weighted curve has a low frequency rolloff starting at around 1 KHz and falling to –40 dB at 30 Hz.

MICROPHONE AND UNBALANCED RCA SIGNAL INPUTS

Your RTA-33 has a built-in mini-headphone jack on the front panel for connecting the supplied calibrated microphone. An additional connector is located on the back panel for connection to an unbalanced signal source using RCA cable.

CALIBRATED CONDENSER MICROPHONE

Your RTA-33 is supplied with a carefully selected and specially calibrated condenser microphone. In general, condenser microphones are better than most dynamic microphones. Because condenser microphones have a smaller diaphragm with less mass, they can respond more quickly and accurately to transients, which are critical considerations in analyzing any acoustic system.

BUILT-IN CENTRONICS COMPATIBLE PARALLEL PRINTER PORT

Your RTA-33 can provide a print-out of the recorded frequency response and SPL using any dot-matrix printer with Centronics compatible interface.

DIN-SIZE/REMOVABLE CHASSIS FOR CUSTOM/ PORTABLE APPLICATION

Your RTA-33 is the smallest and most powerful 30-band One-third Octave Real Time Analyzer. It is specially designed to fit inside a standard DIN-size, in-dash car radio chassis for custom installation in a vehicle. It also features a removable chassis for portability and security.

FLEXIBLE OPERATIONS

Your RTA-33 can operate on three different kinds of power sources: 12-volt DC; its internal Ni-Cd rechargeable battery pack which provides up to 3 hours of continuous use when fully charged; or a 110-volt AC/DC adaptor (included).

CUSTOMIZED COMPETITION SCORING MODE

Your RTA-33 is fitted with a customized EPROM package to produce a print-out which references audio system performance levels to Official Competition scoring parameters.

CONTROLS, INDICATORS, AND CONNECTIONS

This section will help you become familiar with each of the controls, display indicators and connections found on your COUSTIC RTA-33 30-BAND ONE-THIRD OCTAVE REAL TIME ANALYZER.

Take a few moments to read the information presented in this section to facilitate your understanding of the powerful control options available at your fingertips. As you read about each control, we suggest you try experimenting with the control setting at the same time, to briefly learn the effect of its range of adjustment. This will allow you to quickly familiarize yourself with your RTA-33 and increase your testing and calibrating knowledge and ability. The OPERATION section provides more detailed operating instructions.

Front Panel Controls and Connections

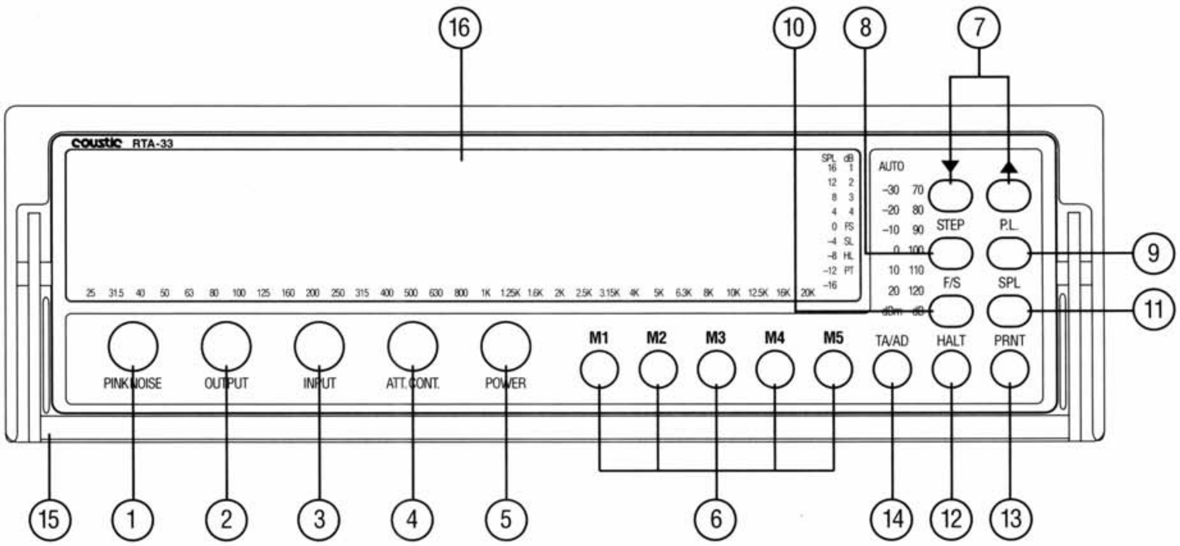

Figure 1. RTA-33 Front Panel.

1. **PINK NOISE OUTPUT LEVEL CONTROL**
   Increase the built-in Pink Noise output level by first pushing the knob then rotating it clockwise. Decrease output level by first pushing the knob then rotating it counter-clockwise. Push the knob in again to retain the correct setting.

2. **PINK NOISE OUTPUT**
   This socket sends a Pink Noise signal via shielded cable with mini-plugs to the input of the audio system being measured.

3. **MICROPHONE INPUT**
   This socket receives signals via shielded cable with mini-plug from the calibrated condenser microphone (included).

4. **INPUT ATTENUATION CONTROL**
   Increase the input signal attenuation by first pushing the knob then rotating it clockwise. Decrease the input signal attenuation by first pushing the knob then rotating it counter-clockwise. The adjustment range is ±10 dB. Push the knob in again to retain the correct setting.

   Caution: Leave this control at center detent position when performing measurements that require input level (or SPL) readings.

5. **POWER ON/OFF CONTROL**
   First push the knob in to turn on the unit. Observe the greeting message scrolling on the spectrum display from right to left. Push the knob again to turn off the unit.

6. **MEMORY BUTTONS**
   Any of the five light-grey colored buttons (labelled M1 through M5) will store and recall frequency response curves.

7. **INPUT SENSITIVITY SELECTOR BUTTONS**
   Press the ▲ button to increase (or press the ▼ button to decrease) the input sensitivity of your RTA-33. These controls actually lower (or raise) the reference level of the response curve shown respectively. For example, when the selected reference level is at –20 dBm/80 dB, with the Input Attenuation Control at center detent, the "zero reference line" is set at 80 dB.

   AutoRange Selector Button
   To activate the AutoRange function, first press the ▲ button until the reference level indicator is at –30 dBm/70 dB, then again press the ▲ button to change the mode to AutoRange. Observe the AUTO indicator located above the –30 dBm setting lighting up. Press the ▲ button again to deactivate the AutoRange function.

8. DISPLAY RESOLUTION SELECTOR BUTTON (STEP)
This control allows you to set the spectrum display resolution at 1, 2, 3, or 4 dB per step. To set display resolution, press the STEP button and observe the display resolution indicator lighting up. Continue pressing the STEP button until you reach the desired setting.

9. PEAK LATCH BUTTON (P.L.)
The Peak Latch Switch feature allows you to display only the highest reading in each of the 30 bands for peak frequency response reference. In dot display mode, your RTA-33 will update a particular band only when the input signal exceeds the previously recorded level. In bar graph mode, your RTA-33 will dynamically update the peak SPL of each band, holding the recorded peak for two seconds, then the peak SPL for each band is refreshed. Press the P.L. (Peak Latch) button and observe the Peak Latch indicator lighting up. Press the P.L. button again to deactivate this function.

10. DISPLAY SPEED SELECTOR BUTTON (F/S)
In dot display mode this control allows you to select a fast or slow decay (transient response) time for the LED display. Press the F/S (FAST/SLOW) button and observe the FS or SL indicator lighting up.

11. SOUND PRESSURE LEVEL BUTTON (SPL)
This control allows you to display the measured sound pressure level (SPL) digitally. Press the SPL button and observe the spectrum display change to indicate a number (in decibels) representing the recorded SPL. Press the button again to return to bar graph display.

12. DISPLAY HALT BUTTON (HALT)
This control allows you to freeze the spectrum display instantly in order to analyze the measured frequency response. Once halted, you can store the response curve into system memory or print a hard copy for reference. Press the HALT button; observe the HL indicator lighting up and the spectrum display freezing. Press the button again to return to dynamic mode.

NOTE: You must press this button first to store or print the displayed frequency response.

13. PRINT BUTTON (PRNT)
This control allows you to print a hard copy of the recorded frequency response and SPL using any dot-matrix printer with Centronics compatible interface. To produce a hard copy print-out, first press the HALT or any memory button labelled M1 through M5, then press the PRNT button. Observe the PT indicator lighting up and the word "PRINT" flashing on the display. Press the HALT button again to return to spectrum display.

14. TIME AVERAGING/AUTO DIFFERENCE FUNCTION BUTTON (TA/AD)

Time Averaging (TA)
This control allows you to automatically compute and display the average of 256 frequency response samplings recorded evenly within a 10-second period. To start this function, press the TA/AD (Time Averaging/Auto Difference) button and observe the message "AVG" flashing on the spectrum display. When the flashing stops, the resulting averaged frequency response curve will be displayed. Press the HALT button to exit this function and return to dynamic mode.

Auto Difference (AD)
This control also allows you to automatically compute and display the difference between a stored frequency response and a new "Time-Averaged" response for accurate calibration. To activate this function, first recall a stored response curve from memory, then press the TA/AD (Time Averaging/Auto Difference) button and observe the letters "DIF" flashing on the spectrum display. When the flashing stops, the resulting difference is displayed. Press the HALT button to exit this function and return to dynamic mode.

15. HANDLE
Your RTA-33 also features a retractable handle for carry-around convenience. For optional in-dash installation, lift and pull this handle and gently slide the unit out to remove from the mounting chassis.

16. LED SPECTRUM DISPLAY
Displays frequency response of the 30 one-third octave bands, SPL and other function indicators.

CONTROLS, INDICATORS, AND CONNECTIONS

Spectrum Display and Indicators

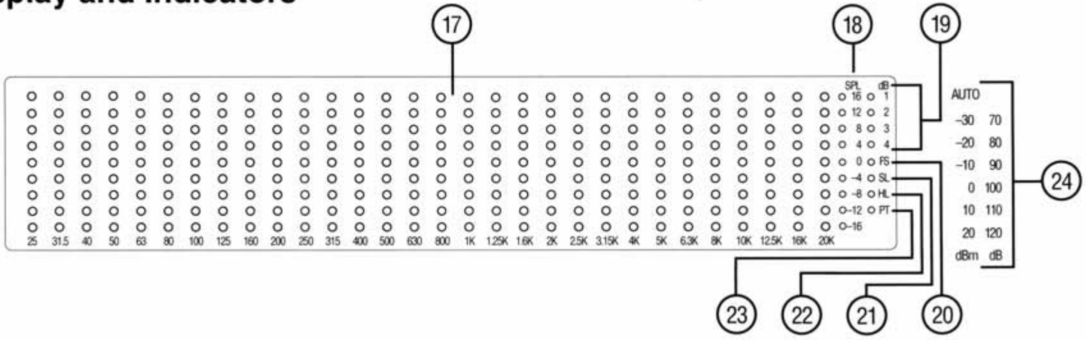

Figure 2. RTA-33 LED Spectrum Display and Indicators.

17. 30-BAND ONE-THIRD OCTAVE LED DISPLAY
A 9 X 30 LED matrix displays the frequency response of the 30 one-third octave bands between 25 Hz and 20 KHz.

18. SPL SCALE
In addition to accessing the SPL digitally, you can also refer to an SPL scale on the right hand side of the LED display.

19. DISPLAY RESOLUTION INDICATOR
The 1, 2, 3, or 4 dB per step display resolution indicator lights up when one of these settings is selected.

20. FAST DISPLAY SPEED INDICATOR
The FS (FAST) indicator lights up when the display speed is set at the fast mode.

21. SLOW DISPLAY SPEED INDICATOR
The SL (SLOW) indicator lights up when the display speed is set at the slow mode.

22. DISPLAY HALT INDICATOR
The HL (HALT) indicator lights up whenever the display is halted (frozen) to facilitate analysis of the frequency response curve.

23. PRINT INDICATOR
The PT (PRINT) indicator lights up whenever the print button (PRNT) button is pressed.

24. DISPLAY REFERENCE LEVEL INDICATOR
One of the display reference level indicators will light up when a reference level is selected. When in AutoRange mode, the "AUTO" indicator, and a reference level indicator (automatically selected by the RTA-33) will light up.

Rear Panel Layout

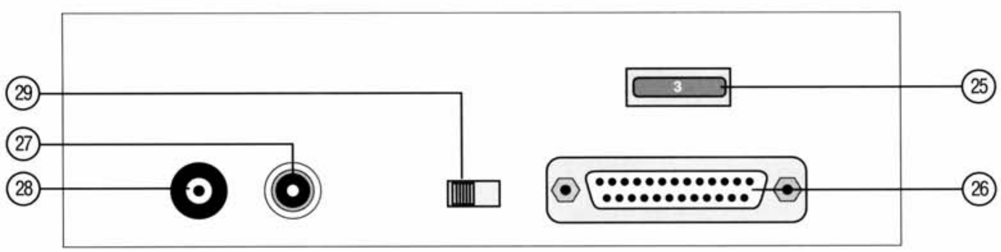

Figure 3. RTA-33 Rear Panel.

25. FUSE RECEPTACLE
This receptacle houses a standard ATC (blade) type fuse with a rating of 3 Amps.

26. PARALLEL PRINTER PORT (CENTRONICS COMPATIBLE INTERFACE)
This is a 25-pin connector (DB-25F) which sends data via a parallel printer cable (not supplied) to the input of any dot-matrix printer with a Centronics compatible interface.

27. RCA LINE LEVEL INPUT
This connector receives line level signals from the output of any audio source (e.g. equalizer, crossover, tape deck, or CD player) via RCA cable.

28. DC POWER INPUT
This socket receives external power for the RTA-33 when connected to the AC/DC adaptor (supplied), a car cigarette lighter adaptor, or a B+/Ground wire harness.

29. FILTER SWITCH
This switch controls the operation of the A-weighted filter. Slide to the right for filter ON, slide to the left for filter OFF.

OPERATION OF THE REAL TIME ANALYZER

This section outlines powering details, including proper care and maintenance for the internal Ni-Cd battery pack. It also tells you how to set up your RTA-33 as well as operate display settings and basic functions in order to begin system analysis and measurement.

Powering the RTA

Your RTA-33 will operate on four different power sources:

1. **110-VOLT AC POWER SOURCE**
   – Indoor use (home, recording studio, theatres, etc.)
   First plug the AC/DC adaptor (supplied) into any 110-volt AC outlet, then connect the DC plug to the DC power socket located on the rear panel of the RTA-33.
2. **B+/GROUND POWER HARNESS**
   – In-dash installation (Optional)
   Refer to "IN-DASH INSTALLATION" section.
3. **12-VOLT CIGARETTE LIGHTER PLUG**
   – In-vehicle use
   Connect the cigarette lighter plug to the socket in the vehicle and connect the DC plug to the DC power socket located on the rear panel of the RTA-33 .
4. **INTERNAL RE-CHARGEABLE BATTERY**
   – Portable application
   When fully charged, your RTA-33 will operate on its internal Ni-Cd rechargeable battery for up to 3 hours of continuous use.

Making the Necessary Connections

INPUT/OUTPUT	PRIME CONNECTION	DESCRIPTION
MIC INPUT (FRONT PANEL)	MICROPHONE TO RTA-33	Connect supplied microphone with mini-plug to Microphone input on front panel.
PINK NOISE OUTPUT (FRONT PANEL)	RTA-33 TO AUDIO SYSTEM	Connect from RTA-33's pink noise output to input of audio system (cable not supplied).
RCA INPUT (REAR PANEL)	LINE LEVEL OUTPUT(S) OF AUDIO SYSTEM TO RTA-33	Connect from line output (RCA) of audio system to RCA connector on rear panel of RTA-33 (cable not supplied).
PRINTER OUTPUT PORT (REAR PANEL)	RTA-33 TO PRINTER	Connect from printer output port of RTA-33 to any dot matrix printer with Centronics compatible interface via a 25-pin printer cable (not supplied).

Electrical Wiring

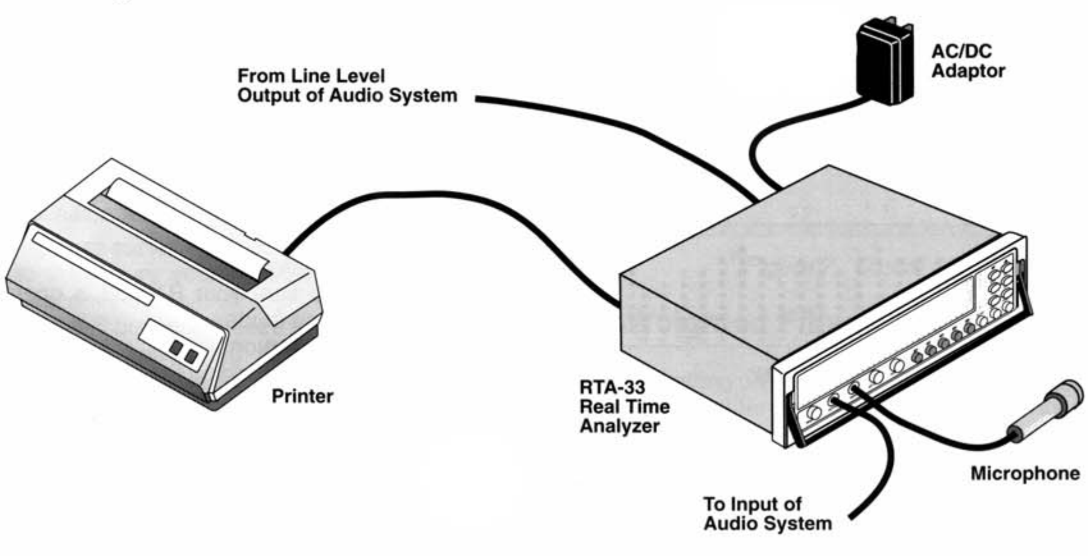

Figure 4. Electrical Wiring Diagram

OPERATION OF THE REAL TIME ANALYZER

Recharging the Internal Ni-Cd Battery Pack

To recharge the internal Ni-Cd battery pack:

1. Turn your RTA-33 off.
2. Check to make sure the proper power source is connected to the DC power socket located in the rear panel of your RTA-33 (refer to "Powering the RTA" section).
3. The battery will be fully charged in 14 hours.

WARNING ABOUT POSSIBLE SHORTENING OF BATTERY LIFE:

1. **NEVER** recharge a battery that is storing unused power. **ALWAYS** wait until battery is completely discharged (approx. 3 hours of continuous use) before recharging.
2. Do not leave an idle unit connected to a power source unless you are recharging it. Your battery will charge if left connected to a power source when the unit is turned off.
3. If the battery is left charging longer than it should be (approx. 14 hours), its chemicals will overheat and begin to break down, possibly ruining the battery.
4. Allowing your battery to fully discharge, then recharging it again, a process called "deep-cycling," is advisable every six to eight weeks.

Turning on the RTA-33

To turn on the RTA-33:

1. Push the power switch.
2. Observe the greeting message "COUSTIC RTA" scrolling across the spectrum display.
3. As the message ends, the unit is ready for operation.

Bar or Dot Spectrum Display

Your RTA-33 can monitor frequency response in bar graph display or dot spectrum display mode.

To switch display mode:

1. Turn the unit off.
2. Press and hold the ▼ button.
3. Push the power switch again to turn the unit on.
4. Release the ▼ button as soon as the power is on.
5. Repeat Steps 1 through 4 to switch mode again.

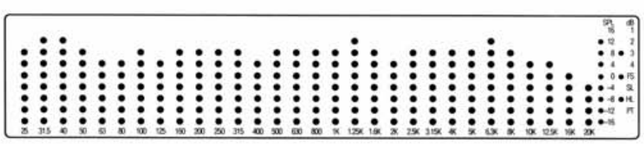

Figure 5a. Bar Graph Display.

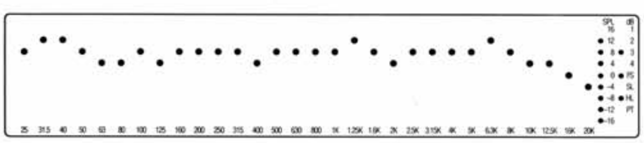

Figure 5b. Dot Display.

Adjusting Input Sensitivity

Your RTA-33 receives input signals from either the calibrated microphone or a line level source connected to the RCA input located on the rear panel. This signal is processed and displayed as a frequency response curve on the LED spectrum display, which is updated approximately 20 times per second.

To adjust input sensitivity:

1. Check to make sure your RTA-33 is operating in frequency response mode.
2. Press the ▲ or ▼ button to place the curve roughly in the center position (also known as "zero reference line"). The "zero reference line" refers to the center row (5th row - from top or bottom) of LEDs on your RTA-33 spectrum display.
3. Observe the corresponding display reference level indicator (e.g. –20 dBm/80 dB) changing and lighting up indicating the selected zero reference level.

Selecting AutoRange Mode

With AutoRange activated, your RTA-33 will automatically adjust the input sensitivity.

To select AutoRange:

1. Check to make sure your RTA-33 is operating in frequency response mode.
2. Press the ▲ button until both the AutoRange (AUTO) indicator and the display reference level indicator light up. The AutoRange (AUTO) indicator is located directly above the –30 dBm/70 dB indicator.
3. To return to manual reference level, press the ▲ button again. The "AUTO" indicator will turn off.

Selecting Display Resolution (dB per Step)

The spectrum display resolution of your RTA-33 is selectable at 1, 2, 3, or 4 dB per step. At the 4 dB per step setting, each LED on the display represents a value of 4 dB, with the overall range being 32 dB (± 16 dB). This setting is most useful when monitoring an audio system. At the 1 dB per step setting, each LED on the display represents a value of 1 dB, with the overall range being 8 dB (± 4 dB). This setting is most useful when performing accurate pink noise testing.

To select display resolution:

1. Check to make sure your RTA-33 is operating in frequency response mode.
2. Press the STEP button.
3. Observe the corresponding Display Resolution indicator lighting up.
4. Continue pressing the STEP button until you reach the desired setting.

OPERATION OF THE REAL TIME ANALYZER

Selecting Display Speed

Display speed refers to the quickness of the transient response time of the display LEDs.

To change the display speed:
1. Check to make sure your RTA-33 is operating in frequency response mode.
2. Press the F/S button.
3. Observe the Display Speed indicator ("FS" or "SL") lighting up.

NOTE: We recommend using the SLOW mode for pink noise measurement. Use the FAST mode for all other operations.

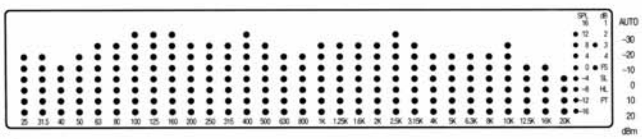

Figure 6. Display Reference Level, Display Resolution, Display Speed Indicators and Response Curve

Halting the Display

Halting the spectrum display permits you to analyze, store, or print the measured frequency response curve.

To halt ("freeze") the display:
1. Check to make sure your RTA-33 is operating in frequency response mode.
2. Press the HALT button.
3. Observe the HL indicator lighting up and the spectrum display freezing.
4. Press the HALT button again to return to dynamic mode.

Storing and Recalling Preset Memories

Your RTA-33 has five programmable system memories which can be used to store/recall frequency response samples. When power to the unit is disconnected, an internal Lithium back-up battery maintains the preset memories.

To store a response curve:
1. Check to make sure your RTA-33 is operating in frequency response mode.
2. Press the HALT button to freeze the display.
3. Press a Memory button (e.g. M1) to store the "frozen" response curve into memory.
4. Observe the Memory indicator located directly above the Memory button lighting up.
5. Press the HALT button again to return to dynamic mode.

To recall a response curve from memory:
1. Press any Memory button, labelled M1 through M5, once. Your RTA-33 will immediately retrieve and display the frequency response stored in the selected memory location (in dot display mode).
2. Observe the Memory indicator located directly above the Memory button lighting up.
3. Press the HALT button to return to dynamic mode.

Digital Sound Pressure Level (SPL) Readout

A setting on your RTA-33 can be selected to display the averaged sound pressure level (SPL) digitally in decibels (dB). The display is updated approximately 20 times per second.

To display sound pressure level:
1. Check to make sure your RTA-33 is operating in frequency response mode.
2. Press the SPL button.
3. Observe the spectrum display changing to a numeric readout indicating the measured sound pressure level in decibels (dB).
4. Press the SPL button again to return to bar graph display.

NOTE: A. "OVR" is displayed if the measured SPL exceeds the selected reference level. For example, if the reference level is at 90 dB (at 3 dB per step resolution) and the measured SPL exceeds 102 dB, the message "OVR" will replace the digital reading. Reset the appropriate reference level to display the SPL again.

B. "LOW" is displayed if the measured SPL is lower than the selected reference level. For example, if the reference level is at 90 dB (at 3 dB per step resolution) and the measured SPL is below 78 dB, the message "LOW" will replace the digital reading. Reset the appropriate reference level to display the SPL again.

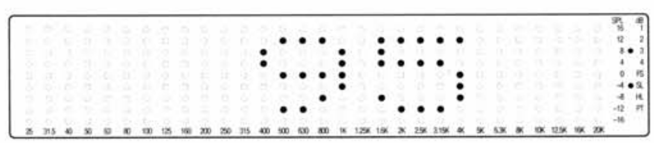

Figure 7. Digital SPL Readout.

A-Weighted Filter

A setting on your RTA-33 can be selected to engage the A-weighted filter during SPL measurements (see Page 8).

Caution: Please be sure that the filter is disengaged before performing frequency response measurements. Failure to do so will result in erroneous frequency response data.

OPERATION OF THE REAL TIME ANALYZER

Using Peak Latch Function

The peak latch setting on your RTA-33 can be switched to display only the highest reading in each of the 30 bands for peak frequency response reference. In dot mode it will update a particular band only when the input signal exceeds the previously recorded level. In bar graph mode, it will dynamically update a band, holding the recorded peak for two seconds, then the peak SPL is refreshed.

To use the Peak Latch function:
1. Check to make sure your RTA-33 is operating in frequency response mode.
2. For "permanent" peak recording, switch spectrum display to dot mode. For "dynamic" peak recording, switch spectrum display to bar graph mode. Refer to steps 1-5 as described under section Bar or Dot Spectrum Display.
3. Press the P.L. button.
4. Observe the occasional update of the highest LED dot of each of the 30 bands.
5. Press the P.L. button again to exit this function.

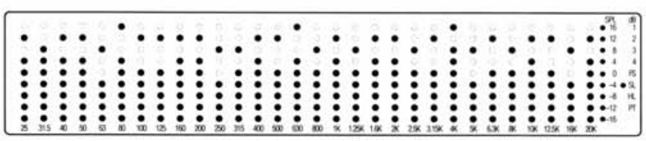

Figure 8a. Display with Peak Latch in Dynamic Mode.

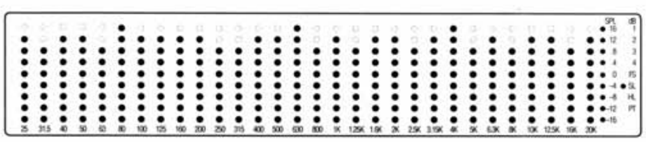

Figure 8b. Display Halted with Peak Latch in Bar Graph Mode.

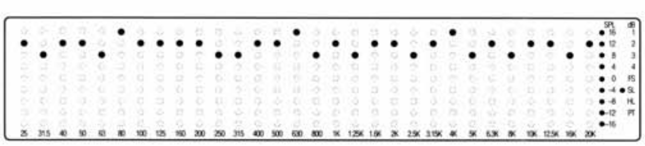

Figure 8c. Display Halted with Peak Latch in Dot Display Mode.

Time-Averaging Testing

This function allows you to activate a mathematical "Time-Averaging" function which will automatically compute and display the average of 256 frequency response samplings, recorded evenly within a 10-second period.

To start Time-Averaging testing:
1. Check to make sure your RTA-33 is operating in frequency response mode.
2. Press the TA/AD (Time Averaging/Auto Difference) button and observe the letters "AVG" flashing on the spectrum display.
3. When the flashing stops, the resulting averaged frequency response curve is displayed.
4. If desired, press one of the memory buttons to store this response curve or press the PRNT button to print a hard copy of this response curve for reference.
5. Press the HALT button to return to dynamic mode.

Auto-Difference Testing

When activated, your RTA-33 will automatically compute and display the difference between a frequency response previously stored in memory and a new "Time Averaged" response. This feature provides more accurate calibration and eliminates the "guess work" when analyzing acoustical systems.

To start Auto-Difference testing:
1. Check to make sure your RTA-33 is operating in frequency response mode.
2. Press the appropriate memory button to recall the stored response curve from memory that you want to compare with a new response curve.
3. Press the TA/AD (Time Averaging/Auto Difference) button and observe the letters "DIF" flashing on the spectrum display.
4. When the flashing stops, a curve showing the difference between the current Time-Averaged curve and the stored curve will be displayed.
5. If desired, press any memory button to store this response curve or press the PRNT button to print a hard copy of this response curve for reference.
6. Press the HALT button to return to dynamic mode.

Printing the Frequency Response Curve

Your RTA-33 can print a hard copy of the frequency response curve under any one of the following circumstances:

A. By freezing the display - Refer to section "Halting the Display."
B. From recalled memory - Refer to section "Storing and Recalling Preset Memories."
C. From "Time-Averaging" result - Refer to section "Time-Averaging Testing."
D. From "Auto-Difference" result - Refer to section "Auto-Difference Testing."

To print a hard copy of the frequency response curve:
1. Check to make sure your RTA-33 is operating in frequency response mode.
2. Select a frequency response curve for printing (refer to A thru D above).
3. Select the desired resolution (dB/step) for print-out. (Refer to section "Selecting Display Resolution")
4. Press the PRNT button and observe the message "PRINT" flashing on the spectrum display.
5. Press the HALT button to return to dynamic mode.

```
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** ACOUSTIC MEASUREMENT **   1 dB PER STEP DISPLAY

=========================================================================

REF                   SYSTEM FREQUENCY RESPONSE PLOT                   SPL
     +---------------------------------------------------------------+
+12  |                                                               | 102
+11  |  X                                                            | 101
+10  |    X X                                                        | 100
+ 9  |                                                               | 99
+ 8  |        X X                                                    | 98
+ 7  |                                                               | 97
+ 6  |            X                                                  | 96
+ 5  |                                                               | 95
+ 4  |              X X                                              | 94
+ 3  |                  X                                 X          | 93
+ 2  |                                                  X            | 92
+ 1  |                    X                                          | 91
  0  |----------------------X----------------------------------------| 90
- 1  |                        X                                      | 89
- 2  |                          X                     X              | 88
- 3  |                            X                         X        | 87
- 4  |                              X X X X       X X                | 86
- 5  |                                      X X X             X      | 85
- 6  |                                                          X    | 84
- 7  |                                                               | 83
- 8  |                                                            X  | 82
- 9  |                                                               | 81
-10  |                                                               | 80
-11  |                                                               | 79
-12  |                                                               | 78
     +----+-----+-----+-----+-----+-----+-----+-----+-----+-----+----+
 dB     31.5   63   125   250   500   1K    2K    4K    8K    16K       dB
      <------- LOW ---------><------- MID --------><----- HIGH ----->

        PEAK SOUND PRESSURE LEVEL (SPL) MEASURED : 101 dB @ 25Hz
=========================================================================
PERFORMED BY: ____________________________________________________________

ADDRESS     : ____________________________________________________________

TELEPHONE   : __________________________________  FAX    : ________________

DATE        : __________________________________  JOB #  : ________________

CLIENT      : ____________________________________________________________

ADDRESS     : __________________________________  CITY   : ________________

STATE       : _______________  ZIP: ____________  PHONE  : ________________

SYSTEM      : ____________________________________________________________

__________________________________________________________________________

COMMENTS    : ____________________________________________________________

__________________________________________________________________________
```
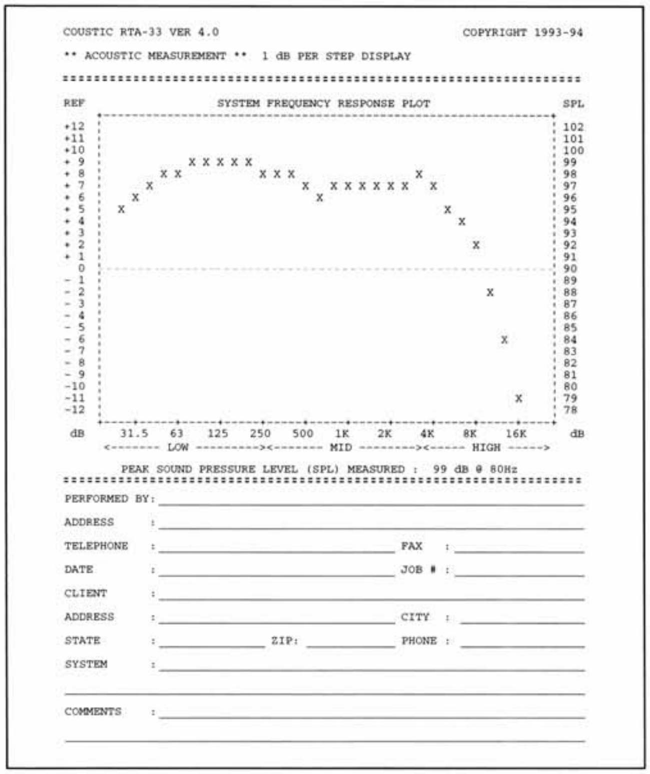

Figure 9a. Frequency Response Curve Print-out (1 dB/Step).

OPERATION OF THE REAL TIME ANALYZER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** ACOUSTIC MEASUREMENT ** 1 dB PER STEP DISPLAY

REF SYSTEM FREQUENCY RESPONSE PLOT SPL

+12 +11 +10 +9 +8 +7 +6 +5 +4 +3 +2 +1 0 -1 -2 -3 -4 -5 -6 -7 -8 -9 -10 -11 -12

102 101 100 99 98 97 96 95 94 93 92 91 90 89 88 87 86 85 84 83 82 81 80 79 78

dB 31.5 63 125 250 500 1K 2K 4K 8K 16K dB

<------- LOW ---------><------- MID --------><----- HIGH ----->

PEAK SOUND PRESSURE LEVEL (SPL) MEASURED : 99 dB @ 80Hz

PERFORMED BY:

ADDRESS :

TELEPHONE : FAX :

DATE : JOB # :

CLIENT :

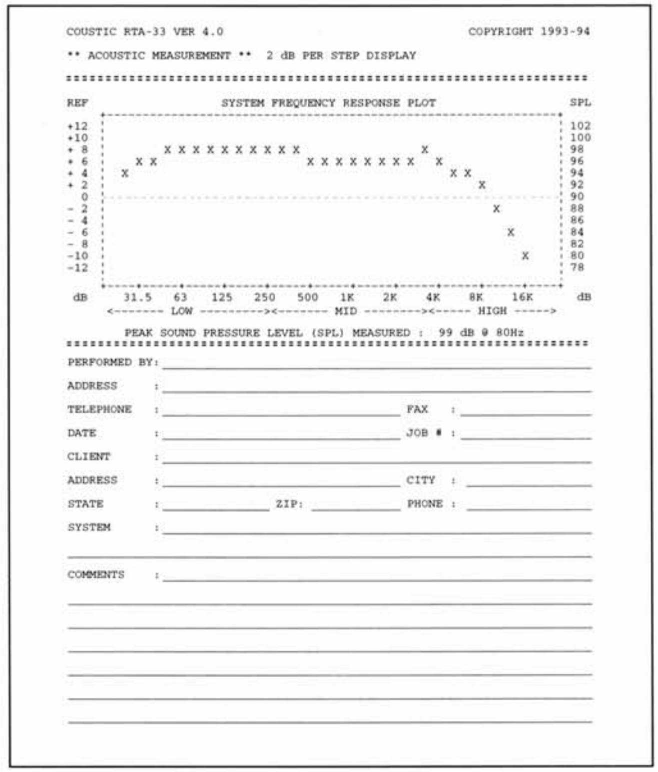
ADDRESS : CITY :

STATE : ZIP: PHONE :

SYSTEM :

COMMENTS :

Figure 9b. Frequency Response Curve Print-out (1 dB/Step).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** ACOUSTIC MEASUREMENT ** 2 dB PER STEP DISPLAY

REF SYSTEM FREQUENCY RESPONSE PLOT SPL

+12 +10 +8 +6 +4 +2 0 -2 -4 -6 -8 -10 -12

102 100 98 96 94 92 90 88 86 84 82 80 78

dB 31.5 63 125 250 500 1K 2K 4K 8K 16K dB

<------- LOW ---------><------- MID --------><----- HIGH ----->

PEAK SOUND PRESSURE LEVEL (SPL) MEASURED : 99 dB @ 80Hz

PERFORMED BY:

ADDRESS :

TELEPHONE : FAX :

DATE : JOB # :

CLIENT :

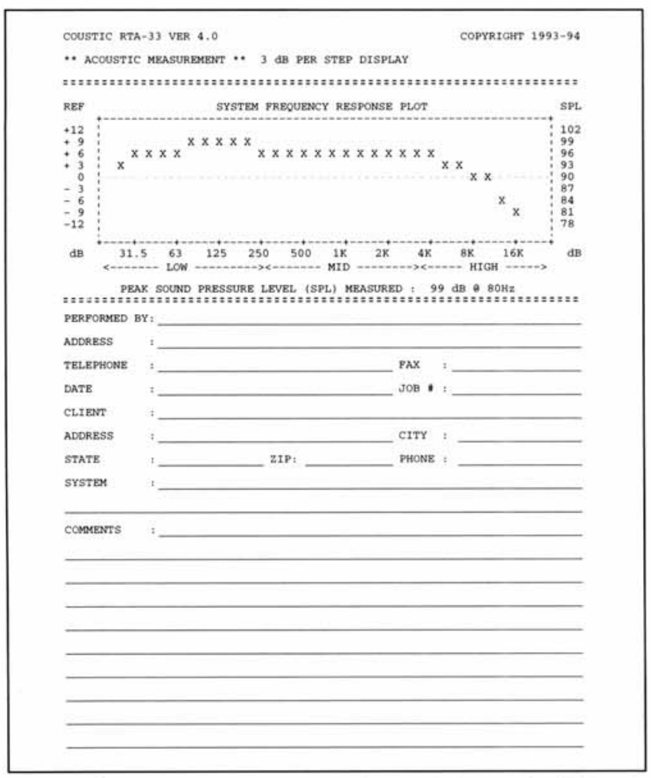
ADDRESS : CITY :

STATE : ZIP: PHONE :

SYSTEM :

COMMENTS :

Figure 9c. Frequency Response Curve Print-out (2 dB/Step).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** ACOUSTIC MEASUREMENT ** 3 dB PER STEP DISPLAY

REF SYSTEM FREQUENCY RESPONSE PLOT SPL

+12 +9 +6 +3 0 -3 -6 -9 -12

102 99 96 93 90 87 84 81 78

dB 31.5 63 125 250 500 1K 2K 4K 8K 16K dB

<------- LOW ---------><------- MID --------><----- HIGH ----->

PEAK SOUND PRESSURE LEVEL (SPL) MEASURED : 99 dB @ 80Hz

PERFORMED BY:

ADDRESS :

TELEPHONE : FAX :

DATE : JOB # :

CLIENT :

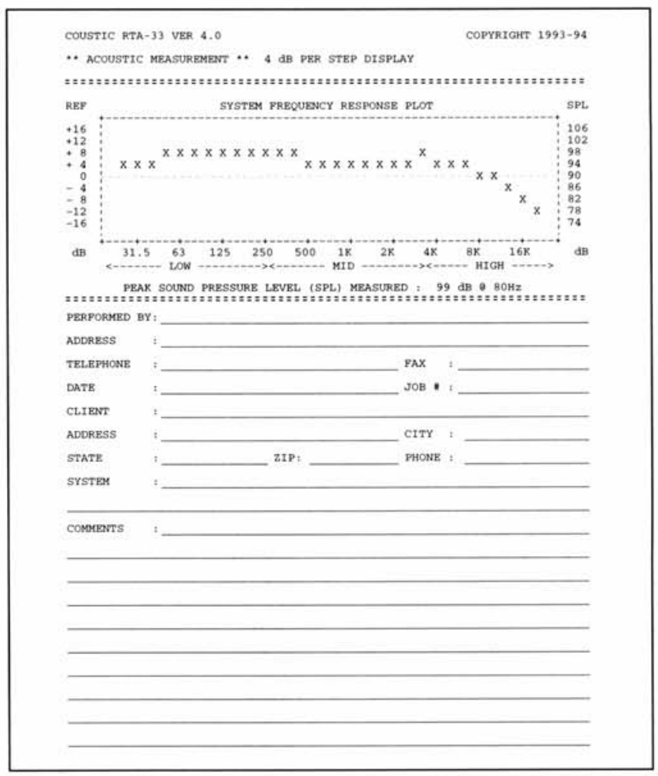
ADDRESS : CITY :

STATE : ZIP: PHONE :

SYSTEM :

COMMENTS :

Figure 9d. Frequency Response Curve Print-out (3 dB/Step).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** ACOUSTIC MEASUREMENT ** 4 dB PER STEP DISPLAY

REF SYSTEM FREQUENCY RESPONSE PLOT SPL

+16 +12 +8 +4 0 -4 -8 -12 -16

106 102 98 94 90 86 82 78 74

dB 31.5 63 125 250 500 1K 2K 4K 8K 16K dB

<------- LOW ---------><------- MID --------><----- HIGH ----->

PEAK SOUND PRESSURE LEVEL (SPL) MEASURED : 99 dB @ 80Hz

PERFORMED BY:

ADDRESS :

TELEPHONE : FAX :

DATE : JOB # :

CLIENT :

ADDRESS : CITY :

STATE : ZIP: PHONE :

SYSTEM :

COMMENTS :

Figure 9e. Frequency Response Curve Print-out (4 dB/Step).

```
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** IASCA SCORE SHEET **                            DATE : ________________

NAME : ___________________________________         ENTRY NO. _____________

========================================================================

REF                 SYSTEM FREQUENCY RESPONSE PLOT & SCORING              SPL
     +---------------------------------------------------------------+
+12  |                                                               | 102
+ 9  |  X X X                                                        |  99
+ 6  |        X X X                                                  |  96
+ 3  |              X X X                                 #          |  93
  0  |--------------------X-X-X-X---------------------X-X------------|  90
- 3  |                            X X X X X X X X X X       # X      |  87
- 6  |                                                          X X  |  84
- 9  |                                                               |  81
-12  |                                                               |  78
     +----+-----+-----+-----+-----+-----+-----+-----+-----+-----+----+
 dB     31.5  63   125   250   500    1K    2K    4K    8K   16K       dB
     <------- LOW ---------><------- MID --------><----- HIGH ----->
```

FREQ. (Hz)	LEVEL (dB)	ADJACENT DIFF	FREQ BAND DEVIATION	POINTS	COMMENT
25	99	N/A			PEAK_SPL____
31.5	99	0			__________
40	99	0			__________
50	96	-3			__________
63	96	0			__________
80	96	0			__________
100	93	-3			__________
125	93	0			__________
160	93	0			__________
200	90	-3			__________
250	90	0			__________
315	90	0			__________
400	90	0			__________
500	87	-3			__________
630	87	0			__________
800	87	0			__________
1K	87	0			__________
1.25K	87	0			__________
1.6K	87	0			__________
2K	87	0			__________
2.5K	87	0			__________
3.15K	87	0			__________
4K	87	0			__________
5K	90	+3			__________
6.3K	90	0			__________
8K	93	+3			__________
10K	87	-6	MAJOR	-6	__________
12.5K	87	0			__________
16K	84	-3			__________
20K	84	0			__________

OVERALL SPL = 114 dB   FREQUENCY RESPONSE SCORE : 40 - 6 = 34

** MAJOR DEVIATION : 01 ** MINOR DEVIATION : 00 ** OFF SCALE : 00 **

Figure 10. Example of Customized Competition Scoring Print-out

OPERATION OF THE REAL TIME ANALYZER

Initializing the Printer

Your RTA-33 uses an advanced micro-processor to monitor and control the printing function. Sometimes the printer may not be initialized properly, causing an improper sequence of events to occur, such as condensed mode printing, erratic line or form feed, etc.

To clear this problem and restore normal operations:
1. Turn both printer and RTA-33 off.
2. Check to make sure the printer cable is properly connected.
3. Turn the printer on.
4. Push the power switch again to turn the RTA-33 on.
5. Your printer can now be utilized and normal operation should resume.

Resetting the RTA-33

Your RTA-33 uses an advanced micro-processor to monitor and control a number of electronic functions. Sometimes static electricity or noise spikes on the electrical system can jumble the instruction set, causing an improper sequence of events to occur.

To clear this problem and restore normal operations:
1. Turn the unit off.
2. Press and hold the Memory 1 button (M1).
3. Push the power switch again to turn the unit on.
4. Release the M1 button.
5. Your RTA-33 should resume normal operation.

NOTE: All stored memories will be cleared after performing this procedure.

Fuse Replacement

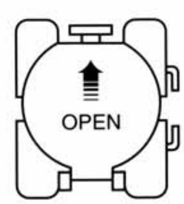
If your RTA-33 does not operate when turned on or the LED display does not light up, you may need to check or replace the fuse.

To check or replace the fuse:
1. Turn the unit off.
2. If connected, remove the power source to the unit.
3. Remove fuse from fuse receptacle on the rear panel
4. Check the fuse and replace if necessary. Use only the standard ATC (blade) type fuse with a rating of 3.0 Amps.

Replacing the Lithium Battery

If your RTA-33 does not retain memory whenever the power source to it is removed, or if the lithium battery is over two years old, you may need to replace the lithium battery.

To replace the lithium battery:
1. Turn the unit off.
2. If connected, remove the power source to the unit.
3. Lift up the securing tab of the battery holder located on the left hand side of the unit. The battery holder cover will be released. See Figure 11.
4. Remove the lithium battery. Be sure to notice the proper battery polarity marked on the inside cover.
5. Replace with a new battery of type CR2032 only.
6. Push the battery holder cover back into place.
7. Turn the unit on again and check to make sure the memory storage function is working properly.



Lift to open the battery cover

Figure 11. Replacing the Lithium Battery

RTA-33 AND YOUR AUTOMOBILE AUDIO SYSTEM

Your RTA-33 is an extremely accurate measuring instrument, which utilizes the latest in Digital Signal Processing (DSP) technology and sophisticated micro-processor design. It divides the audio spectrum into 30 equal bandwidth intervals by mathematically derived digital band-pass filters. It then displays their output on a 9 X 30 matrix LED display in 1, 2, 3, or 4 dB per step display resolution for precise system equalization. Your RTA-33 can also measure sound pressure levels (SPL) and display the results digitally in decibels. The following section will discuss the acoustical problems relating to the inside of an automobile and how to use your real-time analyzer as a tool to overcome them.

Simple Resonance

A number of factors cause frequency response variations inside the vehicle. Some of these variations are caused by highly reflective material, such as glass, as well as highly absorbent material, such as carpet and upholstery. Other variations are caused by resonances produced within the vehicle due to its relatively small interior. Resonances are an important consideration inside the vehicle because its interior dimensions are only a few wavelengths long at the lower (bass) frequencies. Following are two mathematical equations describing the relationship between wavelength and dimension, as well as frequency and wavelength:

$$w = 2 \times L \qquad f = \frac{v}{w}$$

where w is wavelength, L is length, f is frequency, and v is the speed of sound in air (approx. 1128 feet per second).

Combining the two equations, we get:

$$f = \frac{v}{2L} \qquad f = \frac{1128}{2L}$$

where frequency is the speed of sound divided by two times the length (2L). This frequency is called the "fundamental resonant frequency" and is considered a natural frequency of the space between two reflecting surfaces. To help understand how this information pertains to the inside of a vehicle, we have compiled a table showing the relationship between certain lengths and frequencies.

Length (feet)	Frequency (hertz)
0.50	1,128
1.00	564
2.00	282
3.00	188
4.00	141
5.00	113
6.00	94
7.00	80
8.00	70
9.00	62
10.00	56

Table 1. Relationship between lengths and fundamental resonant frequency.

If the interior dimensions of a vehicle are 7 feet in length, 4.5 feet in width and 3.8 feet in height, we can see that resonances are produced at about 80 Hertz, 130 Hertz, and 150 Hertz. Resonances create peaks (or rises) in frequency response. This explains why you often hear "boomy" sound systems in vehicles.

Complex Resonance

Not only is there a set of resonant frequencies associated with each of the vehicle's dimensions (sound waves reflecting back and forth between two surfaces to produce standing waves), but there is also another, new set of complex standing waves occurring when the wave reflects obliquely between two or more surfaces. There can be a large number of resonances in each of the three directions (up-down, left-right, and front-rear). The following equation relates the various resonant frequencies of the vehicle's interior to its physical dimensions:

$$f = \left(\frac{v}{2}\right)^2 \sqrt{\left(\frac{x}{L}\right)^2 + \left(\frac{y}{W}\right)^2 + \left(\frac{z}{H}\right)^2}$$

where v is the speed of sound in air, L is the length, W is the width, H is the height, x, y, z are any integers (0, 1, 2, 3 .. etc).

For the same average vehicle described above (7 feet long, 4.5 feet wide and 3.8 feet high), we have tabulated some of the resonant frequencies according to the last equation (Table 2).

x	y	z	f (Hertz)	
1	0	0	80.57	
0	1	0	125.33	Single dimension
0	0	1	148.42	
1	1	0	149.00	
1	0	1	168.88	Mutiple dimensions
0	1	1	194.26	
1	1	1	210.31	
2	0	0	161.14	
0	2	0	250.67	Second harmonics
0	0	2	296.84	

Table 2. Resonances for an average vehicle having interior dimensions of 7 feet in length, 4.5 feet in width and 3.8 feet in height.

It is important to note that most resonances occur below 300 Hz. The reason for this is that as frequency increases, the wavelength greatly decreases (see Table 1). Therefore, at frequencies of 300 Hz or above, frequency response tends to become smoother. Knowing where and why these frequencies resonate helps you to counteract their effect on your system's sound.

Multi-Amp Systems

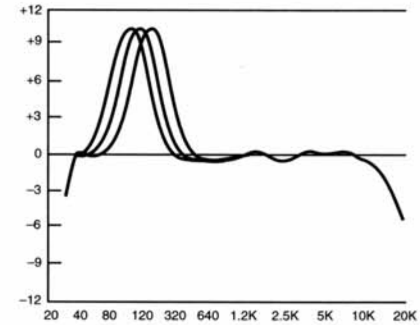
Coustic's research has shown that internal obstructions and the external noises present in a moving vehicle require 10 dB to 20 dB (or 10 to 100 times) of additional power on signals below 100 Hz in order to achieve a smooth overall frequency response. Using an electronic crossover (in bi-amp, tri-amp or multi-amp mode) allows this extra power to be applied to the low (bass) frequencies. This reduces the possibility of over-driving the amplifiers and distorting the mid and high frequency signals.

An electronic crossover with "bi-amp" capability divides the audio frequency spectrum (20 Hz to 20,000 Hz) into two distinct sections —high and low frequency. For example, if a crossover point of 160 Hz was selected, frequencies below 160 Hz are directed to the sub-woofer/amplifier output, and all frequencies above 160 Hz are directed to the mid-high/ amplifier output. An amplifier connected to the low-pass (sub-woofer) outputs is then responding to only low frequencies (below 160 Hz), while an amplifier connected to the high-pass (mid-high) outputs will only respond to high frequencies (above 160 Hz). Hence, the term "BI-AMPLIFICATION" or the use of two amplifiers, each operating in different frequency ranges.

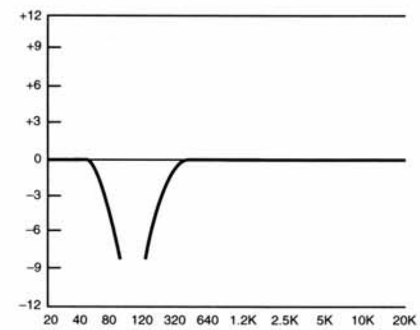
A "bi-amp" system typically has lower distortion, higher SPL, and consequently, higher dynamic range capabilities (due to improved system damping factor) than a single amplifier system of equal or higher output power rating. An electronic crossover with "tri-amp" capability divides the audio frequency spectrum into three distinct sections — high, mid and low frequency — and feeds these three groups of signals to three amplifiers, each operating in different frequency ranges.

Asymmetrical Electronic Crossover

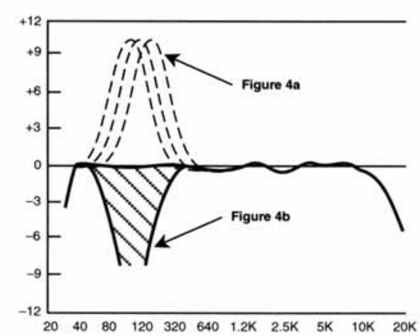
An electronic crossover, of which the high-pass, band-pass(es) and low-pass crossover sections are continuously adjustable and completely independent of each other, is called an "asymmetrical" electronic crossover. It permits you to have a different crossover point for the low-pass and high-pass outputs. As mentioned earlier, resonant frequencies, present in all vehicles (see Table 2), cause peaks (or rises) in frequency response (see Figure 12a). To achieve an acoustically flat system response, you actually need to adjust the crossover points at slightly above, as well as slightly below, the resonant frequencies (see Figure 12b). With Coustic's built-in asymmetrical electronic crossovers (XM-7, XM-5a and XM-3a), you can easily and effectively flatten this undesirable low frequency boost, thereby eliminating the distracting boom effect (see Figure 12c).



(a) Peaks of 10 dB at 80, 130, 150 Hz, caused by fundamental resonances



(b) Setting Asymmetrical Electronic Crossover points above and below resonant frequencies (high pass: 320 Hz, low pass: 40 Hz)



(c) Acoustically flat frequency response as a result of crossover counteracting fundamental resonances

Figure 12. Effects of Asymmetrical Electronic Crossover on undesirable boost of Low Frequencies Caused by Resonances.

RTA-33 AND YOUR AUTOMOBILE AUDIO SYSTEM

Parametric Equalization

The term "parametric" equalizer refers to a class of equalizers where individual parameters (i.e. gain, frequency, and Q) can be varied without interaction among the remaining controls. It is an indispensable tool in professional recording studios throughout the world. Coustic's XM-7 electronic cross-over has two parametric equalizers, one for the front and the other for the rear channel, to provide more flexibility in shaping frequency response. Other types of equalizers (e.g. Tone Controls, Graphic EQ, etc.) have fixed frequency band contours that can be adjusted only for gain and frequency. A boost or cut on this type of equalizer affects a pre-set band of frequencies that may or may not produce desired sound en-hancement. A parametric equalizer has an additional control, known as Q, to adjust the selected frequency's bandwidth.

The term Q is a convenient measurement that relates an equalizer's center frequency to the bandwidth of its filter, according to the following mathematical formula:

$$Q = \frac{f_c}{BW}$$

where fc is the equalizer's center frequency and BW is the filter's bandwidth.

As shown in Figure 13, a high Q setting (e.g. 1.5) represents an equalizer having a narrow filter, while a low Q setting (e.g. 0.3) produces a filter having a much wider range. This control allows you to focus on as much or as little of the frequency band you want to enhance.

Although parametric equalization can be quite useful in contouring the overall sound, it should be used sparingly after the entire system is installed and has been balanced for sound. Listen to a wide variety of musical sounds. If you still feel a certain frequency band is too pronounced or is lacking in distinction, then you can use the parametric equalizer to compensate for this deficiency. Figure 14 shows how to use parametric equalization to eliminate acoustic resonance in a typical automobile.

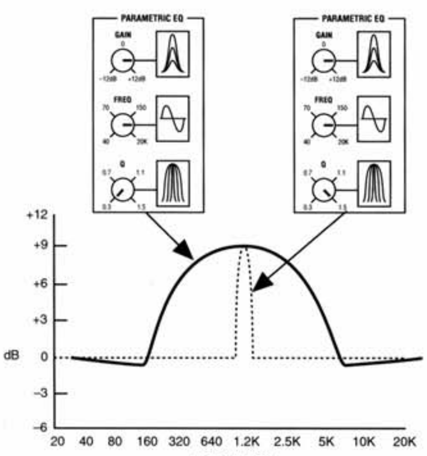
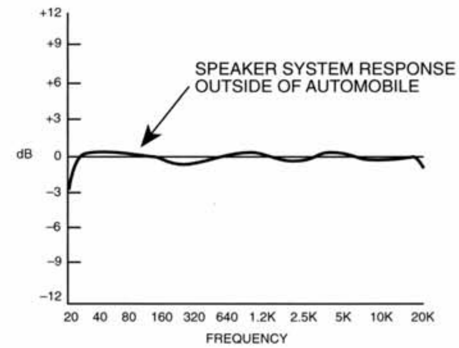
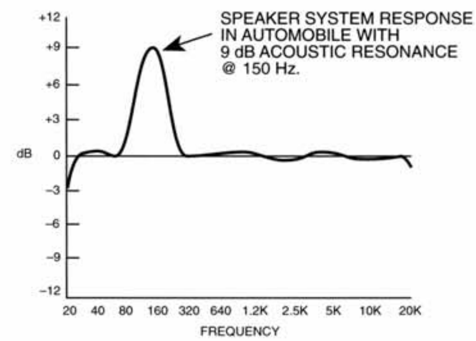


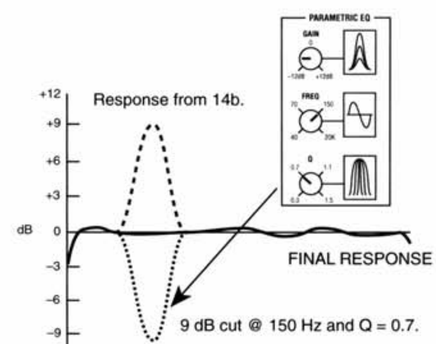
Fig. 13. This figure shows how frequency response is affected by minimum and maximum Q settings (0.3 and 1.5). For both graphs, the FREQ Control is set to 1.2 KHz and the GAIN Control is positioned for +9dB of signal boost.



(a) This figure shows the frequency response of a typical sound system measured outside of an automobile.



(b) This figure shows the frequency response of the same sound system installed in an automobile. An acoustic resonance at 150 Hz adds 9 dB of boost which produces an disturbing "boom" sound when low frequencies are reproduced.



(c) With Parametric Equalization, a 9 dB cut at 150 Hz can be introduced to eliminate the acoustic resonance. In this example, a Q of 0.7 provides the correct amount of frequency bandwidth adjustment. The result is tight, powerful bass response.

Fig. 14. The Effects of Parametric Equalization on Acoustic Resonance in a typical Automobile.

AUDIO SYSTEM ANALYSIS WITH THE RTA-33

The Real Time Analyzer is a measuring instrument only, and by itself will not improve the performance of your audio system. It will only show you how the audio system is performing in terms of frequency response and measure how much sound energy the system is producing in terms of sound pressure level in decibels (dB). Once you know the performance characteristics of your audio system, you can improve upon it by proper equalization and crossover adjustment. When used properly, equalizers (graphic or parametric) and crossover networks (passive or active) are very important considerations in high quality car audio systems.

Fine tuning a sound system is an intensive procedure. First, you must listen to the sound system, then measure its performance parameters with an RTA (real-time analyzer), then you adjust and/or equalize your system's various components. You may have to repeat the fine-tuning process several times in order to create a system that sounds close to the way you want it. Although the system may not "look" particularly smooth in response, the essence of sound equalization is customizing a system to a particular automobile in order to suit personal preferences in musical reproduction.

Pink Noise Source

Your RTA-33 has a built-in pink noise source which can be used to calibrate an acoustic system or audio equipment. Pink noise is filtered white noise and contains equal energy per octave. It is a relatively flat reference test signal and very useful for equipment calibration purposes. Using the calibrated microphone, the RTA-33 picks up the pink noise signal reproduced by the audio system and displays the frequency response curve for analysis and equalization. The built-in pink noise source can be used for most testing purposes. However, because of its superior accuracy, we recommend using a test CD pre-recorded with a pink noise track whenever possible.

Basic Testing Procedures in an Automobile

1. Be sure the audio system is off.
2. Use a test CD or a test tape containing a pre-recorded pink noise track as the reference test signal. Using a test CD is recommended because of its superior accuracy and dynamic range.
3. Position the microphone at normal listening position (as near to your ear as it would be if you were sitting inside the vehicle).
4. Turn the audio system on and slowly increase the volume control until the pink noise level is well above the ambient noise level.
5. Set the display speed to SLOW mode by pressing the F/S button.
6. Select the desired display resolution (1, 2, 3, or 4 dB per step) by pressing the STEP button.
7. Adjust the reference level of the spectrum display by pressing the ▲ or ▼ buttons so that the frequency response curve (from the microphone's location) is roughly in the middle of the LED display.
8. Press the SPL button to check the overall sound pressure level. Press the button again to return to frequency response mode.
9. If the frequency response curve indicates sharp dips and/or peaks, reposition the microphone slightly, away from reflective and absorbent materials, until the response is smoother.
10. Perform the Time-Averaging function by pressing TA/AD button once. This function provides an averaged reading, eliminating output fluctuation.
11. Observe the letters "AVG" flashing on the LED display. The averaged frequency response reading will be displayed after a 10-second interval.
12. Store the averaged frequency response curve into one of the memories by pressing any Memory button once (e.g. "M1").
13. Figure 15 shows a typical pink noise curve of an average vehicle. You will notice that this vehicle exhibits a "peak" of +6 dB at 50 Hz, then a "dip" of –6 dB at 160 Hz, and subsequent "dips and peaks" in other frequencies and the response rolls off at 12.5 KHz. This indicates that the system has a boomy bass and little or no high frequencies.

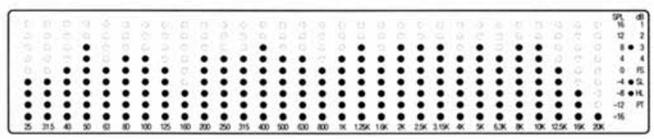


Figure 15. Pink Noise Curve of an Average Vehicle.

14. The desired response is ideally a smooth response at your ear (meaning microphone). A smooth response may not be flat. To obtain a smooth response, you have to "equalize" the system by eliminating, as much as possible, the "dips and peaks" so that the response curve looks smooth (and sounds smooth) by using a parametric or graphic equalizer. A crossover can also help smooth out the response by properly choosing crossover frequencies to match the speakers' output characteristics.
15. Flatten out the highest peak shown on the RTA with the equalizer first. Repeat the process with the next highest peak and so on.
16. Next try to equalize the dips. Smooth out the dips gently. Remember, do not try to flatten out every dip as doing so requires twice the power just to increase a point on the curve by 3 dB. A reasonably smooth curve is more energy efficient than one that is perfectly flat.
17. Listen to the equalized system with music programs. You may need to add some smooth-contoured bass boost to compensate for the low-frequency loss due to ambient noise.
18. Listen to the system at different road speeds (to overcome road noise) and continue fine-tuning if necessary to obtain a smooth-sounding system.

AUDIO SYSTEM ANALYSIS WITH THE RTA-33

19. Listen to the system for a longer period of time to judge if any listening fatigue results. Readjust equalization again if necessary.
20. We advise that you print a hard copy of the fine-tuned system response for future reference.

OTHER SYSTEM ANALYSIS AND MEASUREMENT

Your RTA-33 can be used to measure the frequency response of a source unit, or any equipment between the source unit and speakers (e.g. crossovers, equalizers, amplifiers, etc.). A few typical examples are described in the next section:

Frequency Response Measurement of a Source Unit (CD/Cassette Radio)

The frequency response of a CD player should be rather flat across the audio spectrum. On the other hand, due to technical limitations of cassette tape mechanisms which could only provide a fairly flat response from 40 Hz to 15 KHz, the curve should indicate a fast roll-off of frequency response below 40 Hz and above 15 KHz. Only the very best cassette mechanisms with carefully aligned tape azimuth and complicated compensation circuitry can improve the response slightly (a relatively flat response can be achieved between 30 and 18 KHz).

1. Be sure the audio system is off.
2. Use a test CD or a test tape containing a pre-recorded pink noise track as the reference test signal. Using a test CD is recommended because of its superior accuracy and dynamic range.
3. Connect the RCA output (L or R) of the source unit to the line level input (mono) on the rear panel of the RTA-33. If a stereo input is required, connect both the left and right output to the RTA via a Y-adaptor (available at most electronics stores) to the input.
4. Set the display speed to SLOW mode by pressing the F/S button.
5. Set the reference level of the spectrum display at 0 dBm (100 dB) by pressing the ▲ or ▼ buttons.
6. Select the desired display resolution (1, 2, 3, or 4 dB per step) by pressing the STEP button. A 3 dB per step resolution is recommended in most cases.
7. Turn the system on and keep all tonal controls at their center positions. Slowly increase the volume control of the source unit until the measured frequency response curve is roughly in the center of the LED display (at the zero reference line).
8. If necessary, use the "ATT.CONT" (attenuation control) to fine tune the curve to this reference line.
9. Perform the Time-Averaging function by pressing the TA/AD button once. This function provides an averaged reading, eliminating output fluctuation.
10. Observe the message "AVG" flashing on the LED display. The averaged frequency response reading will be displayed after a 10-second interval.
11. Store the averaged frequency response curve into one of the memories by pressing any memory button once (e.g. "M1").
12. If desired, obtain a hard copy printout of the analyzed curve using the PRINT function.
13. Figure 17 shows typical frequency response curves.

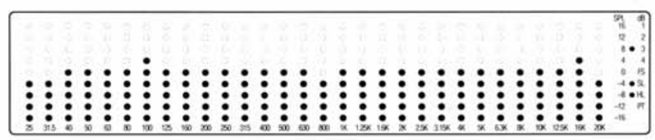


Figure 17a. Frequency Response Curve of a typical CD Player.

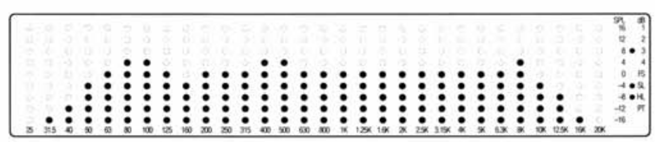


Figure 17b. Frequency Response Curve of a typical Cassette Player.

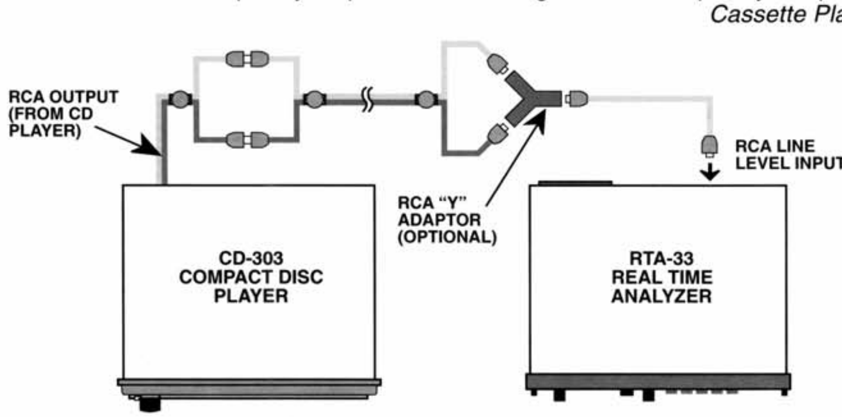


Figure 16. Frequency Response Measurement of a Source Unit (CD/cassette radio).

AUDIO SYSTEM ANALYSIS WITH THE RTA-33

Frequency Response Measurement of an Amplifier

Your RTA-33 is capable of receiving input signals from most power amplifiers producing outputs of up to 7 volts (that is, 6 Watts at 8 ohms or 12 Watts at 4 ohms).

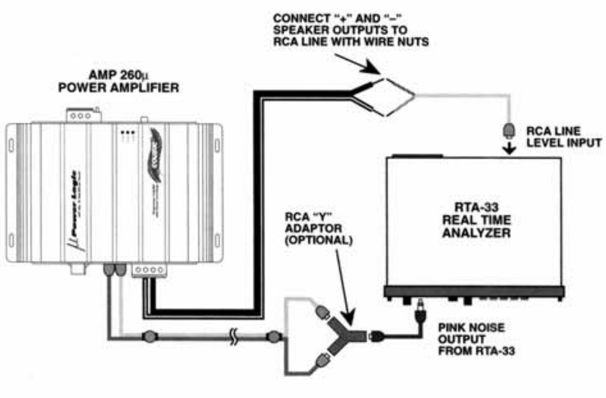


Figure 18. Frequency Reponse Measurement of an Amplifier.

1. Be sure the audio system is off.
2. Connect the Pink Noise Output of the RTA-33 to the amplifier input(s) using a Y-adaptor, if necessary.
3. Connect the left or right speaker output of the amplifier to the line input jack on the RTA-33's rear panel.
4. Repeat Steps 4 through 12 as described under section "Frequency Response Measurement of a Source Unit."
5. Increase or decrease the Pink noise level with the Pink Noise Output Level Control.
6. Figure 19 shows the frequency response curve of a typical amplifier.

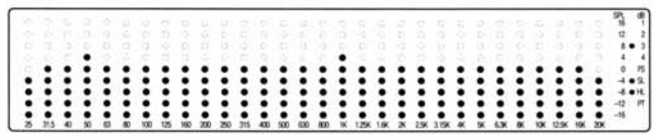


Figure 19. Frequency Response Curve of a typical Amplifier.

Frequency Response Measurement of an Electronic Crossover

The display range of your RTA-33 is selectable from 8 dB, 16 dB, 24 dB, or 32 dB. An appropriate display resolution can be chosen for measuring the frequency response of most crossovers (high-pass, low-pass, or band-pass).

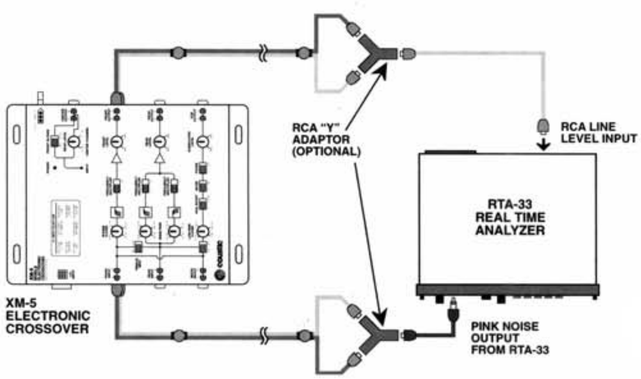


Figure 20. Frequency Response Measurement of an Electronic Crossover.

1. Be sure the audio system is off.
2. Repeat the following steps 3-15 for each of the crossover points — high-pass, band-pass(es), and low-pass.
3. Connect the Pink Noise Output of the RTA-33 to the electronic crossover input(s) using a Y-adaptor, if necessary.
4. Connect the RCA output (L or R) of the source unit to the line level input (mono) on the rear panel of the RTA-33. If a stereo input is required, connect both the left and right output to the RTA via a Y-adaptor (available at most electronics stores) to the input.
5. Set the display speed to SLOW mode by pressing the F/S button.
6. Set the reference level of the spectrum display at –30dBm/70dB.
7. Select the display resolution at 4 dB per step by pressing the STEP button.
8. Turn the system on and keep all tonal controls at their center positions. Slowly increase the pink noise output level and/or the output level of the crossover unit until the measured frequency response curve moves to the upper half of the LED display. This will provide enough display space for showing the crossover's roll-off.
9. Press the P.L. (Peak Latch) function and adjust the Pink Noise Output Level Control, the output level of the cross-over unit, or the ATT.CONT to fine tune the frequency response curve peaking steady at the sixth LED from the bottom with occasional peaks at the seventh LED.

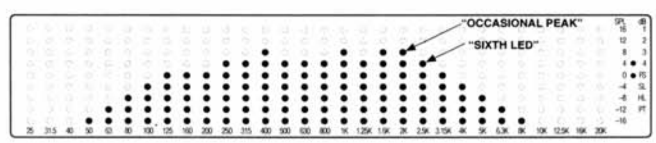


Figure 21. Frequency response peaking steady at the sixth LED.

10. Press the P.L. button again to return to dynamic mode.
11. Perform the Time-Averaging function by pressing the TA/AD button once. This function provides an averaged reading, eliminating output fluctuation.
12. Observe the letters "AVG" flashing on the LED display. The averaged frequency response reading will be dis-played after a 10-second interval.

13. Store the averaged frequency response curve into one of the memories by pressing any memory button once (e.g. "M1").
14. For more detailed analysis of the measured frequency response, change the display resolution to 1, 2, or 3 dB per step by pressing the STEP button.
15. If desired, obtain a hard copy print-out of the analyzed curve using the PRINT function.
16. Figure 22 shows typical frequency response curves of electronic high-pass, band-pass and low-pass crossovers.

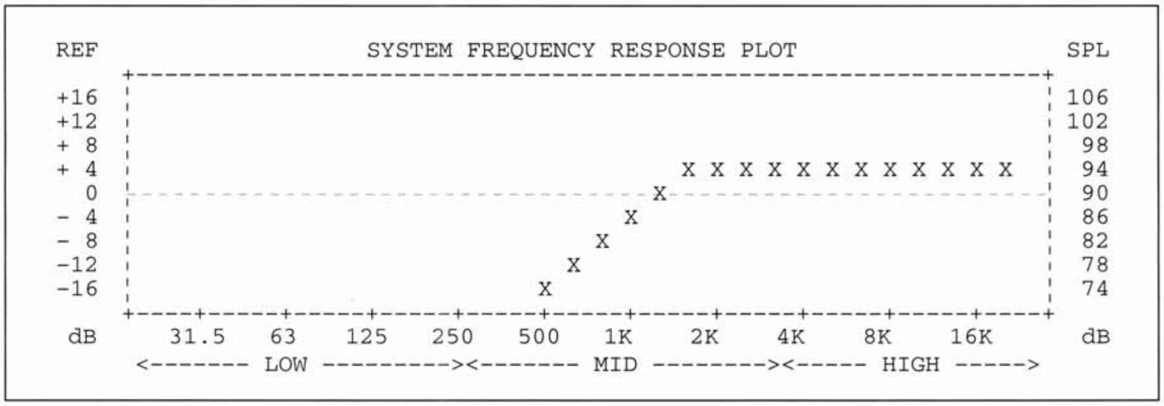


Figure 22a. Frequency Response Curve of a typical Electronic High-Pass Crossover.

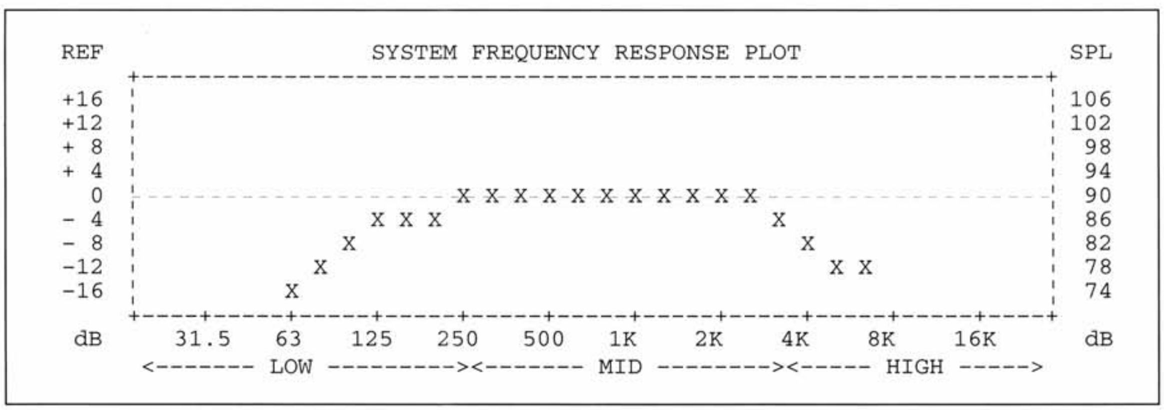


Figure 22b. Frequency Response Curve of a typical Electronic Band-Pass Crossover.

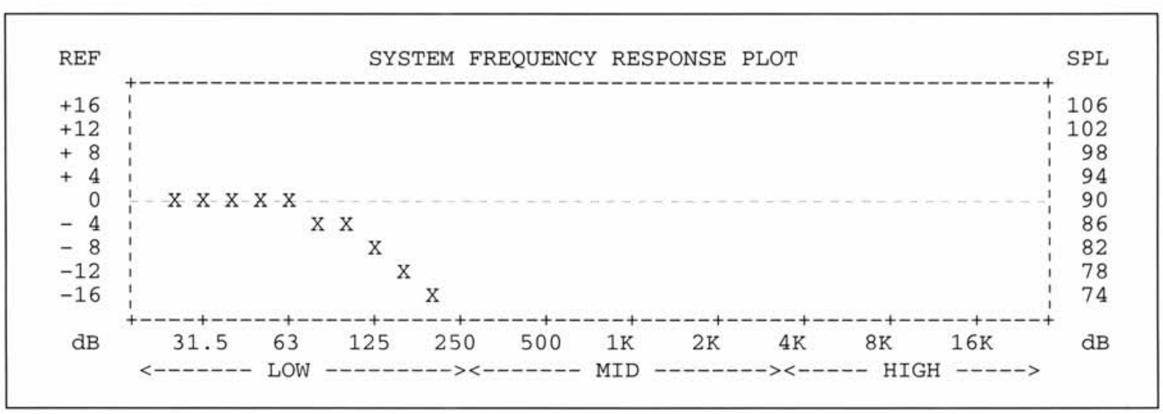


Figure 22c. Frequency Response Curve of a typical Electronic Low-Pass Crossover.

AUDIO SYSTEM ANALYSIS WITH THE RTA-33

Approximating the Crossover Point of an Asymmetrical Electronic Crossover

Your RTA-33 can also measure the crossover point of an asymmetrical electronic crossover (high-pass, low-pass, or band-pass). The display resolution of your RTA-33 is selectable from 1, 2, 3, or 4 dB per step. An appropriate display resolution and display range can be chosen for measuring the crossover point of most crossovers.

1. Refer to Figure 20 and repeat steps 1-13 as described under section "Frequency Response Measurement of an Electronic Crossover."
2. With the response curve displayed, change the display resolution to 1 dB per step by pressing the STEP button. Notice the curve is expanded to show more detail of the crossover slope.
3. For the next step, it will be easier to read the frequency response from a hard copy. We advise that you do so at this point.
4. Refer to Figure 23 for typical crossover points of an electronic crossover. From the flat response portion of the curve, count 3 rows (3 dB) down and locate the LED dot on this row. This is the "Crossover Point" of the electronic crossover (also known as the "3 dB down point").

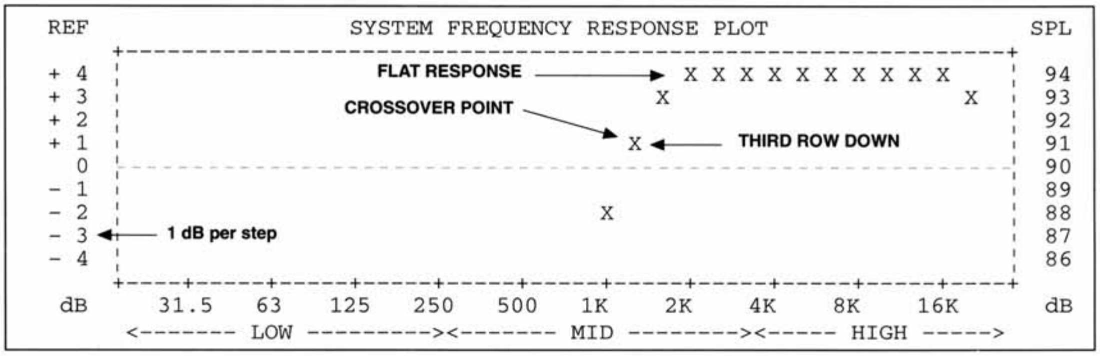


Figure 23a. Crossover Point of a typical High-Pass Crossover.

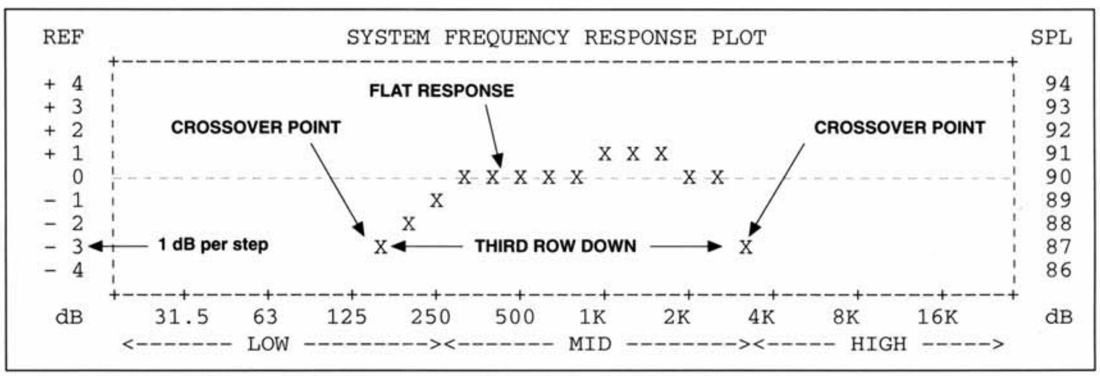


Figure 23b. Crossover Point of a typical Band-Pass Crossover.

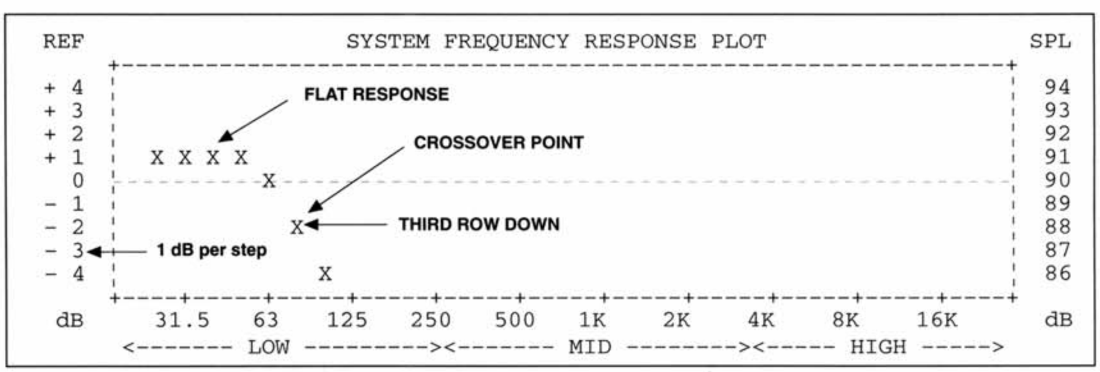


Figure 23c. Crossover Point of a typical Low-Pass Crossover.

AUDIO SYSTEM ANALYSIS WITH THE RTA-33

Slope Rate Measurement of an Electronic Crossover

Your RTA-33 can measure the slope rate of an electronic crossover (high-pass, low-pass, or band-pass). An appropriate display resolution can be chosen for measuring the slope rate of most crossovers.

1. First locate the "Crossover Point" of the electronic crossover by following steps 1-4 as described under section "Approximating the Crossover Point of an Asymmetrical Electronic Crossover."
2. Change the display resolution to 3 dB per step by pressing the STEP button again. We recommend using a 3 dB per step resolution when measuring a crossover slope rate of 6 or 12 dB per octave, and a 4 dB per step resolution for higher slope rate, such as 18 or 24 dB per octave.
3. Refer to Figure 24 for typical slopes of an electronic crossover. From the "Crossover Point," count 3 columns (one octave) to the left (for high-pass) or to the right (for low-pass), and locate the LED dot on this column.
4. Calculate the SPL difference between this LED dot and the "Crossover Point." For example, with the Display Resolution set at 3 dB per step, and when the LED dot is three rows below the "Crossover Point," the SPL difference is 9 dB (3 rows x 3 dB per step). Therefore, the crossover slope rate is 9 + 3 (the 3 dB down point) = 12 dB per octave.

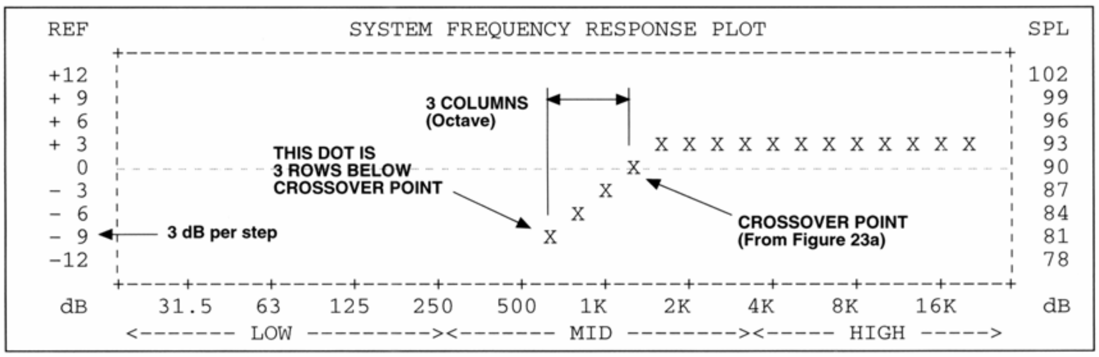


Figure 24a. Slope Rate of a typical High-Pass Crossover.

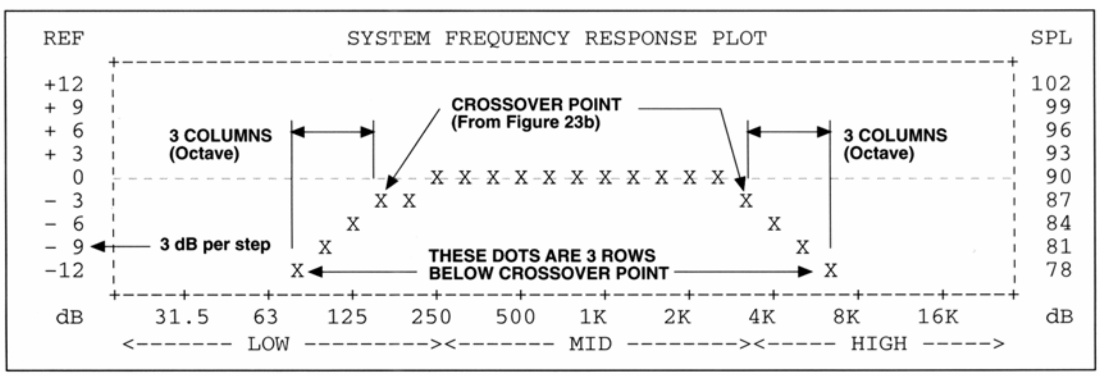


Figure 24b. Slope Rate of a typical Band-Pass Crossover.

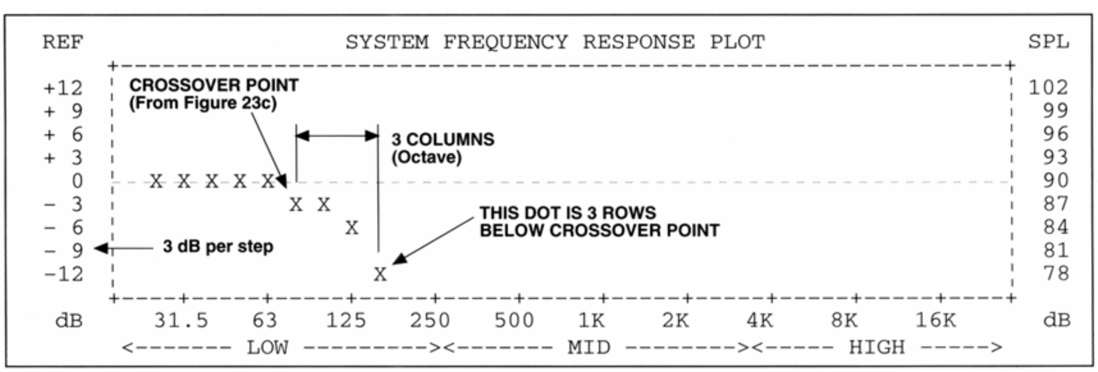


Figure 24c. Slope Rate of a typical Low-Pass Crossover.

OPTIONAL IN-DASH INSTALLATION

This section provides you with the Mechanical and Electrical Installation Procedures to successfully install and operate your RTA-33 in any vehicle. If you are not installing this unit in the dash of your vehicle, skip this entire section.

Mechanical Installation Procedures

Mechanical Installation Procedures include General Precautions, Required Tools, Mounting Location, and Installation.

General Precautions:

1. **ALWAYS DISCONNECT THE SYSTEM FROM THE BATTERY BEFORE ATTEMPTING TO MAKE OR ALTER ANY CONNECTIONS.**
2. Be sure to follow the step-by-step directions, check all important points and have every item necessary for installation on hand.
3. Check to make sure the vehicle's battery is in good condition for proper operation of the RTA-33.
4. This product is designed for use in any 12-volt NEGATIVE GROUND electrical system ONLY.
   CAUTION: Installing this product in any positive ground electrical system could seriously damage the product, as well as void the product warranty.
5. A set of tools and hardware is required. Be sure to check the "Required Tools" list for any special tools that may also be needed.
6. Do not install or use the RTA-33 in any manner other than that outlined in this manual. Doing so could reduce the product's performance capabilities, as well as void the product warranty.

Required Tools:

1. Electric drill and drill bits.
2. Saber saw/fine tooth metal cutting blades.
3. Razor knife.
4. Philips and flathead screwdrivers.
5. Pliers (standard and needle nose).
6. Wire cutters/strippers.
7. Wire crimping tool.
8. Electrical tape or heat shrink tube for professional finish.
9. Soldering iron and solder.
10. Nylon tie wraps.
11. Volt/Ohm meter (VOM or DVM).

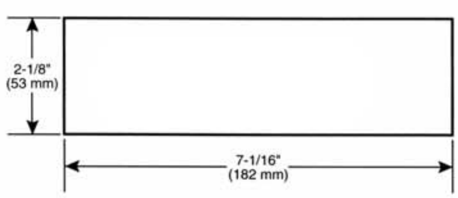


Figure 25. Opening Required.

Mounting Location

1. Select a mounting location that is convenient and easily accessible.
2. Do not mount unit near the engine or any heat-generating ducts, as the unit may be damaged.
3. The RTA-33 is a standard DIN-E chassis, requiring an opening of 2-1/8 inches (53 mm) x 7-1/16 inches (182 mm), as shown in Figure 25.
4. Make sure there is a clearance of at least seven inches (178 mm) behind the dash (see Figure 26).

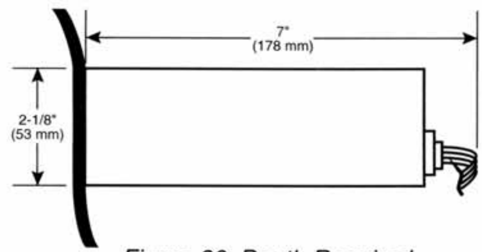


Figure 26. Depth Required.

Installation:

1. If your car is a domestic model (Ford, GM, etc.), make sure there is enough room (i.e. width, height, and depth) before attempting installation. You may need an additional installation kit. If so, contact American International, Metra, Scosche, or your local Coustic dealer.
2. Use the RTA-33 mounting sleeve to check the dash opening and depth. Make sure the mounting sleeve can slide easily into the dash opening, but without any excessive play (no more than 1/16" or 1.5 mm. on all sides).

   CAUTION: When installing the mounting sleeve, make sure that it is correctly oriented, with the large square opening for the printer port on the left-hand side.

3. In some vehicles, the firewall provides a bushing support for the rear of the sleeve. Check the firewall for this bushing support before installing the sleeve. If the support is available, insert the rubber grommet (included) to the stud at the back of the sleeve and slide the sleeve into place as shown in Figure 27.

OPTIONAL IN-DASH INSTALLATION

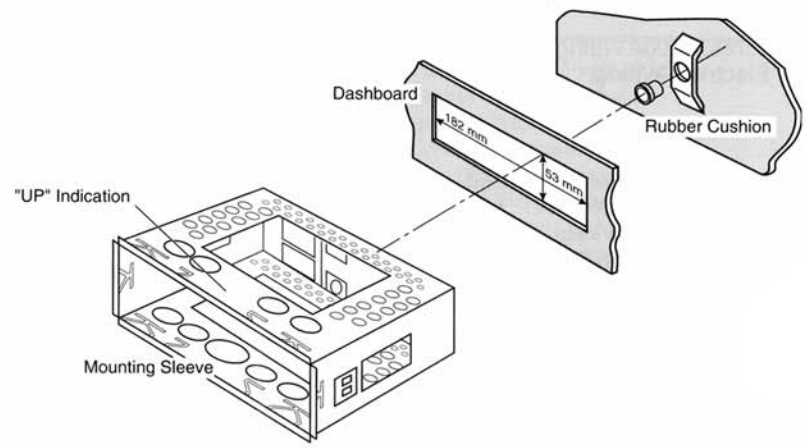


Figure 27. Bushing Support for the Mounting Sleeve.

4. Secure the mounting sleeve to the dashboard by bending the flanges 90 degrees. If necessary, use a screwdriver and/or pair of needle nose pliers (see Figure 28). Be careful not to scratch the dashboard when bending the flanges.

   CAUTION: THE INSTALLATION AS SHOWN IN FIGURES 27 & 28 IS USED FOR MOST DOMESTIC AND FOREIGN CARS. TAKE EXTRA TIME TO SECURE THE FLANGES ON THE RTA-33 MOUNTING SLEEVE TO THE DASH.

5. If you were able to secure the mounting sleeve properly in Steps 3 and 4 above, skip this step and go to Step 6. Otherwise, secure the rear of the mounting sleeve to the vehicle by fastening the metal strap (included).
6. After the sleeve has been firmly secured, insert the RTA-33 slowly into the sleeve. It will be locked securely by a spring-loaded catch on the right-hand side of the unit.
7. You can remove the chassis by pushing on either side, raising the handle to release the catch, and then pulling the unit out, as shown in Figure 29.

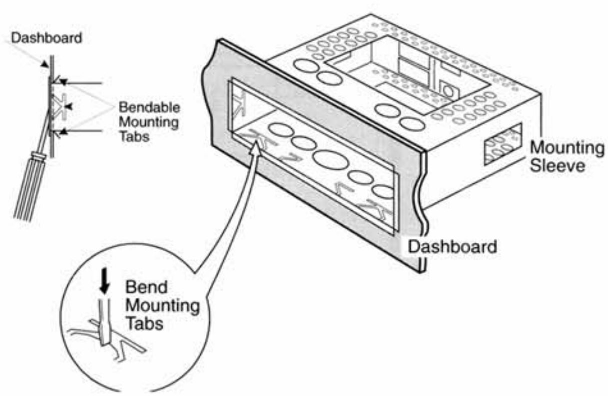


Figure 28. Securing the Mounting Sleeve.

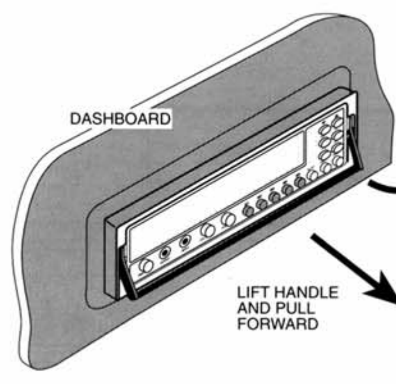


Figure 29. Removing the RTA-33 Chassis from the Mounting Sleeve.

OPTIONAL IN-DASH INSTALLATION

Electrical Installation Procedures

Electrical Installation Procedures include Wiring Precautions, Wiring Descriptions, and Electrical Wiring.

Wiring Precautions

1. For safety purposes, first disconnect the battery ground cable before you begin any electrical installation.
2. Route all wires with existing electrical wiring in your vehicle to conceal them from view. **DO NOT ROUTE AUDIO CABLES AND POWER CABLES TOGETHER! THIS CAN RESULT IN ENGINE NOISE TO YOUR AUDIO SYSTEM.**
3. To both protect and conceal wires, we recommend using automotive flexible plastic tubing and plastic tie-wraps to bundle wires for ease of handling (see Figure 30).

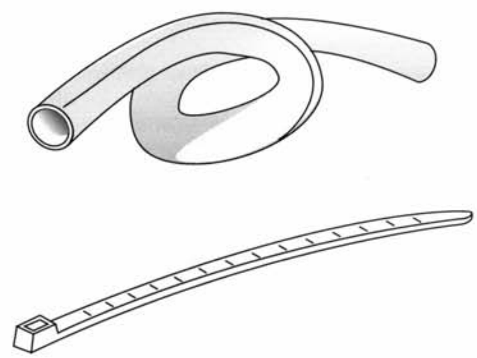


Figure 30. Flexible Plastic Tubing and Tie-wraps.

Wiring Descriptions

The Coustic RTA-33 is equipped with its own electrical wiring harness.

ELECTRICAL	PRIME CONNECTION	DESCRIPTION
BLACK/WHITE	BATTERY (+)	Connect to the positive battery terminal, constant +12 V source
BLACK	GROUND (-)	Connect to the vehicle's chassis ground (bare metal).

Electrical Wiring

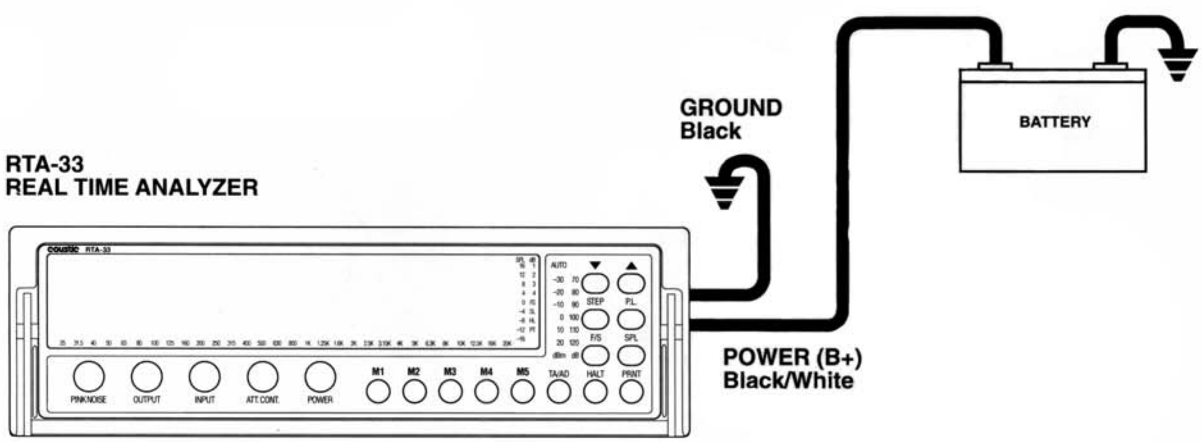


Figure 31. RTA-33 Electrical Wiring.

TROUBLE SHOOTING GUIDE

BASIC OPERATION PROBLEMS	SOLUTIONS	REFER TO SECTION
1. No display or light after turning on the unit.	• Check to see that AC/DC adaptor or 12-volt plug is connected to DC power socket on rear panel. • Check to see that rechargeable battery is charged. • For in-dash installation, make sure positive and negative leads are properly connected to vehicle's B+ and B- battery terminals and the plug is properly connected to DC power socket on rear panel. • Check fuse in rear panel. Replace fuse if it is blown. If fuse continues to blow, see your Coustic dealer.	"Powering the RTA" "Fuse Replacement"
2. Power on with light but without display when sound system is on.	• Check to see that MIC or line level input is properly connected. • Check to see that input sensitivity is set at an appropriate level.	"Adjusting Input Sensitivity"
3. Internal Ni-Cd battery does not re-charge.	• Check to see that proper power source is connected. • Check to see that the power switch is in the "OFF" position when charging the Ni-Cd battery.	"Recharging the Internal Ni-Cd Battery Pack"
4. Cannot print by pressing "PRNT" button.	• Check to see that printer is dot matrix printer with Centronics compatible parallel interface. • Check to see that parallel printer cable is properly connected. • Check to see that display is halted. If display is still active, printing can not take place.	"Printing the Frequency Response Curve"
5. Printer prints in condensed mode; erratic line or form feed; or printer hangs up.	• Check to make sure the printer is properly initialized.	"Initializing the Printer"
6. Unit does not retain memory.	• Check to see that lithium battery is installed (on left side of RTA-33's chassis). • Replace lithium battery if it is over 2 years old.	"Replacing the Lithium Battery"

SPECIFICATIONS

DIGITAL SIGNAL PROCESSOR

Type & Speed	:	Motorola DSP 56001 - 20 MHz

FILTERS

Mode	:	Digital
Bands	:	Thirty (30) 1/3 Octave Bands with design centers conforming to ANSI/ISO preferred frequencies (ANSI S1.6-1984/ ISO Recommendations R266-1975).
Type	:	Fourth Order Bandpass
Class Standards	:	Exceed ANSI S1.11-1966 Class III Type E Standards
Frequency Range	:	From 25 To 20 KHz
Center Frequencies	:	25, 31.5, 40, 50, 63, 80, 100, 125, 160, 200, 250, 315, 400, 500, 630, 800, 1K, 1.25K, 1.6K, 2K, 2.5K, 3.15K, 4K, 5K, 6.3K,8K, 10K, 12K, 16K, 20KHz
Accuracy	:	Better than ± 1 % at Band Center

INPUTS

Front Panel Input	:	Condenser Microphone, 3.5 mm Phone Jack, 600 Ohm Impedance, 54 to 136 dB SPL Audio Signal Level
Rear Panel Input	:	RCA Connector, 100 KOhm Impedance, -46 to +36 dBm Line Level
Calibration	:	0 dBm = 100 dB SPL
Attenuation	:	± 10 dB

DISPLAY

Audio Spectrum	:	9 X 30 LED Matrix
SPL Readout	:	9 LED Bar-Graph or Digital Readout
Resolution	:	Selectable - 1, 2, 3, or 4 dB per Step
Speed	:	Selectable - Fast and Slow
Curve Shown	:	Unweighted

MEMORY

Type & Number	:	5 CMOS memories with Lithium Backup Battery

PRINTER

Parallel Output Port	:	Centronics Compatible Interface

POWER

Source	:	13.8 V DC Negative Ground, internal Ni-Cd rechargeable battery or 110-Volt AC/DC Adaptor
Current Consumption	:	650 mA

DIMENSIONS	:	7" W X 2" H X 6" D (178 X 50 X 150 mm)
WEIGHT	:	3.3 lbs. (1.45 Kg)

DUE TO ONGOING RESEARCH AND PRODUCT IMPROVEMENTS, WE RESERVE THE RIGHT TO UPDATE THE LISTED FEATURES AND SPECIFICATIONS WITHOUT ANY PRIOR NOTICE.

SAMPLE PRINT-OUT

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COUSTIC RTA-33 VER 4.0            SAMPLE                COPYRIGHT 1993-94

** ACOUSTIC MEASUREMENT **  4 dB PER STEP DISPLAY

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REF                   SYSTEM FREQUENCY RESPONSE PLOT                   SPL
     +---------------------------------------------------------------+
+16  |----+-----+-----+-----+-----+-----+-----+-----+-----+-----+----|  106
+12  |----+-----+-----+-----+-----+-----+-----+-----+-----+-----+----|  102
+ 8  |----+-----+-----+-----+-----+-----+-----+-----+-----+-----+----|   98
+ 4  |----+-----+-----+-----+-----+-----+-----+-----+-----+-----+----|   94
  0  |----+-----+-----+-----+-----+-----+-----+-----+-----+-----+----|   90
- 4  |----+-----+-----+-----+-----+-----+-----+-----+-----+-----+----|   86
- 8  |----+-----+-----+-----+-----+-----+-----+-----+-----+-----+----|   82
-12  |----+-----+-----+-----+-----+-----+-----+-----+-----+-----+----|   78
-16  |----+-----+-----+-----+-----+-----+-----+-----+-----+-----+----|   74
     +----+-----+-----+-----+-----+-----+-----+-----+-----+-----+----+
 dB      31.5   63   125   250   500   1K    2K    4K    8K   16K      dB
      <------- LOW --------><------- MID --------><----- HIGH ----->

        PEAK SOUND PRESSURE LEVEL (SPL) MEASURED :     dB @    Hz
========================================================================
PERFORMED BY: __________________________________________________________

ADDRESS     : __________________________________________________________

TELEPHONE   : _________________________________  FAX   : _______________

DATE        : _________________________________  JOB # : _______________

CLIENT      : __________________________________________________________

ADDRESS     : _________________________________  CITY  : _______________

STATE       : ______________  ZIP: ____________  PHONE : _______________

SYSTEM      : __________________________________________________________

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COMMENTS    : __________________________________________________________

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SAMPLE LED SPECTRUM DISPLAY