System **824**

Training Manual

Larson Davis Inc.
1681 West 820 North
Provo, UT 84601 USA
Phone: 801-375-0177
FAX: 801-375-0182
www.LarsonDavis.com
I824.02 Rev C

Copyright

Disclaimer

The following paragraph does not apply in any state or country where such statements are not agreeable with local law:

Even though Larson Davis, Inc. has tested the software and reviewed its documentation, Larson Davis Incorporated makes no warranty or representation, either expressed or implied, with respect to this software and documentation, its quality, performance, merchantability, or fitness for a particular purpose. This documentation is subject to change without notice, and should not be construed as a commitment or representation by Larson•Davis Inc.

This publication may contain inaccuracies or typographical errors. Larson Davis Inc. will periodically update the material for inclusion in new editions. Changes and improvements to the information described in this manual may be made at any time.

Warranty

For warranty information, refer to our Terms and Conditions of Sale on our website, www.larsondavis.com/TermsConditions.aspx.

Recycling

PCB Piezotronics, Inc. is an environmentally friendly organization and encourages our customers to be environmentally conscious. When this product reaches its end of life, please recycle the product through a local recycling center or return the product to:
PCB Piezotronics, Inc.
Attn: Recycling Coordinator
1681 West 820 North
Provo, Utah, USA 84601-1341
where it will be accepted for disposalis manual may be made at any time.

Table of Contents

Chapter 1 "Quick Start"

Chapter 2 Environmental Measurements

Chapter 3 RT60 Measurements

CHAPTER

1 824 “Quick Start”

The 824 sound level meter and real-time analyzer is the culmination of four years of research and development. It advances the state-of-the-art in acoustic instrumentation. This Training Manual has been developed to jump-start your initiation into the use of your new instrument. Consider it a “getting started” guide as you get to know your 824.

What you will Learn

This manual is best used accompanied with the instrument and 824 Reference Manual. You will be guided through a step by step tour of the System 824.

After reading this chapter you should be able to do the following:

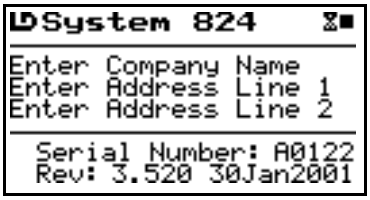
- Power on the 824
- Navigate through the different menus
- Setup the 824 for a simple measurement
- Take a simple measurement
- Store data
- View data from the 824 screen
- Download data using 824 Utility software
- Look at reports generated by the 824 Utility software

Power ⏻ Key Functions

Powering on the 824

Turn the 824 on by pressing the On/Off ⏻ key .

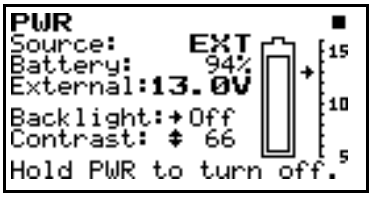
The instrument will go through a brief start up cycle, where it flashes the 824 ID screen.

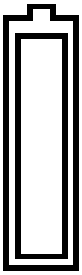


It will then switch to the display that was established before it was powered off in its previous session. The On/Off ⏻ key can also be used to check the battery power, as well as verify the on/off status of the display's backlight. Press the On/Off ⏻ key again to view the PWR screen:

Battery Life

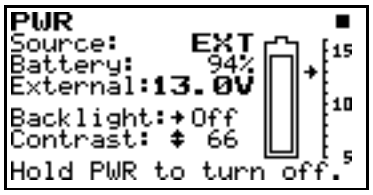
Battery life is expressed in a percentage (100% being fully charged). If you are powering the 824 with an external source (such as the AC/DC adaptor), the voltage level will be shown.





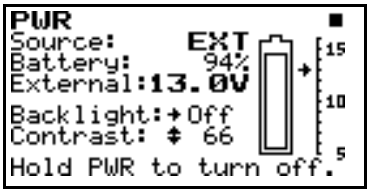
LCD Screen Backlight

You can toggle the screen's backlight on and off by pressing the right arrow key ▶ .



LCD Screen Contrast

The screen contrast can be adjusted by continuous presses of ▲ or ▼. Contrast is expressed as a number between 0 and 100. You will find a value between 64 and 70 to be optimal.



Press ◀ to exit the PWR screen

An Acoustic Chameleon

**Even if you didn't purchase some of the options, demo versions are provided of all of the optional virtual instruments.*

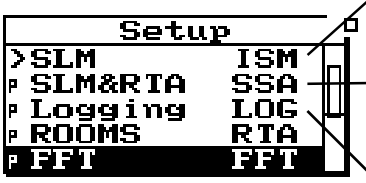
The 824 is a quick-change artist and can be configured many different ways. Depending on the options* that you purchased the 824 could have the following instruments:

- ISM - Integrating sound level meter
- SSA - Sound spectrum analyzer
- LOG - Logging sound level meter
- RTA - Real-time analyzer
- FFT - Fast Fourier transform analyzer
- AUD - Audiometer calibration system
- TAL - Tonality analyzer

Each of these instruments are available from the Setup ⊘ menu.

Viewing Instrument IDs

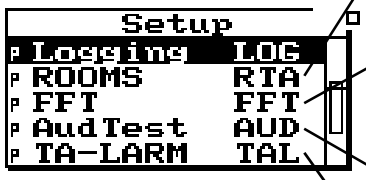
Push the Setup ⊘ key to view the instruments (virtual instruments) in your 824.



Integrating sound level meter - Measures Leq, SEL, Min, Max, Peak, with all weights (A, C, Flat) and with all detectors (Slow, Fast, Impulse) simultaneously. Includes a high and low measuring range.

Sound spectrum analyzer - This SLM and RTA measures Leq, SEL, Min, Max, Peak, with all weights (A, C, Flat) and with all detectors (Slow, Fast, Impulse) simultaneously, plus 1/1 and 1/3 octave data stored in a time history at storage rates as fast as 8 times per second. Included are Ln data showing six Ln values, a graph of L1 through L99 (broadband) and six spectral Lns.

Logging - Measures Leq, SEL TWA, Min, Max, Peak, with all weights (A, C, Flat) and with all detectors (Slow, Fast, Impulse) simultaneously. Includes time history, interval history, exceedance history, daily history, Ln percentiles, statistical data, exposure, and dual SLM (current and overall).



Real-time analyzer - High speed spectral data gathering of up to 400 spectra per second using Autostore function. Spatial averaging of any number of spectra. Flexible triggering for data acquisition. Performs RT60, RC, NCB, HTL. Exponential and linear detectors.

Fast Fourier Transform - 400 line FFT with Hanning or Rectangular window, snapshot data storage, display zoom with a factor of 2, 4, or 8. Count averaging (1 to 16384), measures THD, and linear units can be user defined.

Audiometer - Audiometer testing for level, frequency, linearity, THD, pulse, crosstalk, frequency modulation, narrow band, broadband, and speech noise.

Tonality analyzer - Performs complex tonality calculations required by DIN 45681. Measures the frequency of a dominant tone (F_T), the level of the tone (L_T), the bandwidth of the tonal group (ΔF), the level of the group (L_G), and difference of the two levels (L_T - L_G). SLM measures L_A, L_C, L_{Aeq}, L_{Ceq}, L_{Amax}, L_{Cmax}, L_{AFTM5}, L_{95}, and L_{Ceq}-L_{Aeq}. A snapshot history is provided to store and display data from the various modes.

Navigating the Menus

The main menu keys are shown below. To access the different instrument functions, simply press the appropriate key.

Figure 1- 1 ***View, Data, Setup, Tools, and Print Keys.***

- The **VIEW** key is used to select which measured data to display. The views available depend upon the measurement setup you have selected.

- The **DATA** key is used to store a measurement and recall it at a later time.

- The **SETUP** key allows selection of the instrument setup menus. From here you can select a pre-configured measurement setup, create a new one, or edit an existing setup.

- The **TOOLS** key is used to access:

Calibration

Clock/Timer

Memory

Power Monitor

Communications

- The **PRINT** key is used to establish the settings required to communicate with an external serial printer and to select the type of report to print.

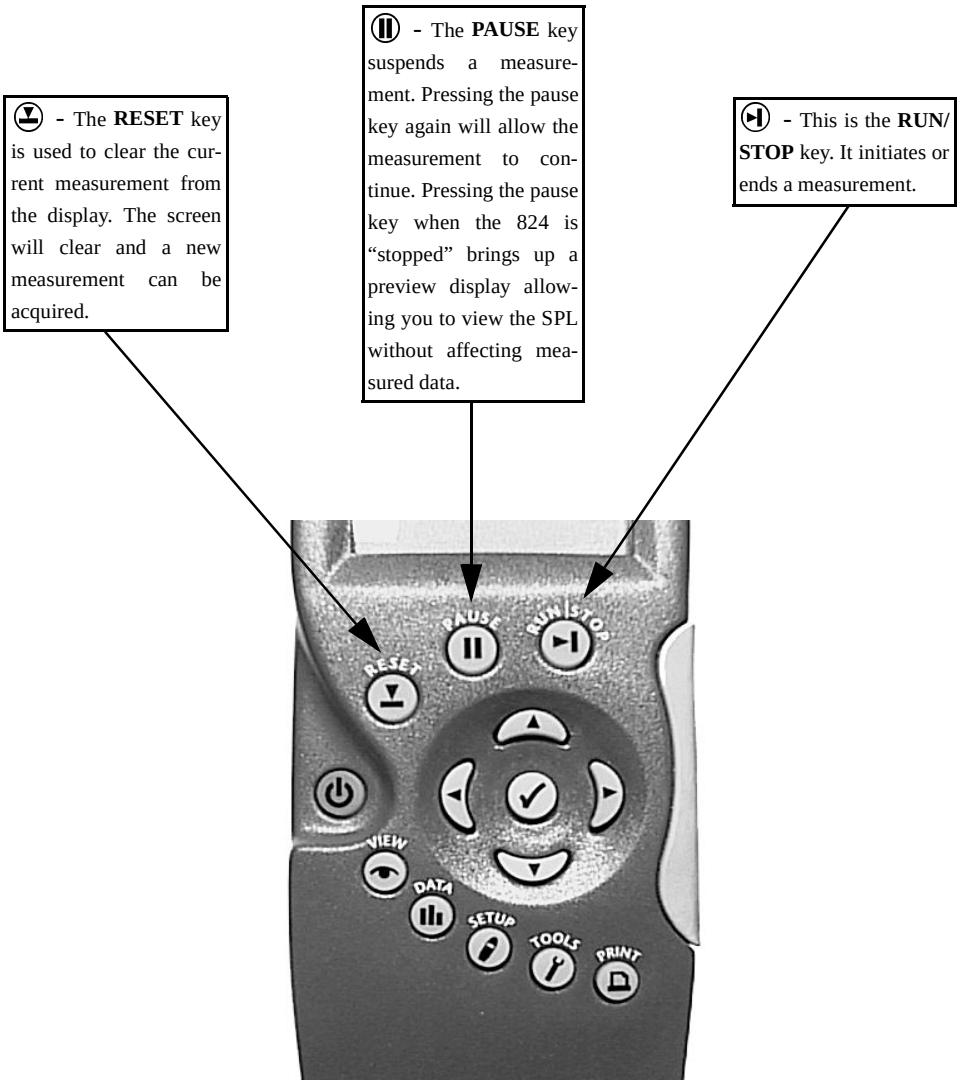


Figure 1-2 ***Reset, Pause, and Run/Stop keys.***

Arrow Keys

The four arrow keys are used to navigate through each selected menu and display.

When **displaying data** the up ⏶ and down ⏷ arrow keys move through display screens. The left ◀ and right ▶ arrow keys move the user from one related screen to the next.

In **menus**, they control cursor movement. The up ⏶ and down ⏷ arrow keys move the cursor between items in a menu. The right ▶ arrow key enters submenus and settings.

The left ◀ arrow key will back you out of menus. Better know as the exit or escape key.

When **modifying** a setting the left ◀ and right ▶ arrow keys select a character or digit to modify. The up ⏶ and down ⏷ arrow keys will modity the parameter.

Check key

The check key ✓ is used to select an option or choice from a menu. Pressing the check key ✓ in many displays (views) allows the user to make changes appropriate to that display.

The check key ✓ also serves as the Enter key when changing a setting's value.

Let's Push Some Buttons

To get a feel for how easy the 824 is to use, push the following keys sequentially:

*These are called **"push-on"**, **"push-off"**, menus.*

Now push each of these keys twice (in any order). You will notice that the second push of the key takes you out of that menu and shows the display previously selected.

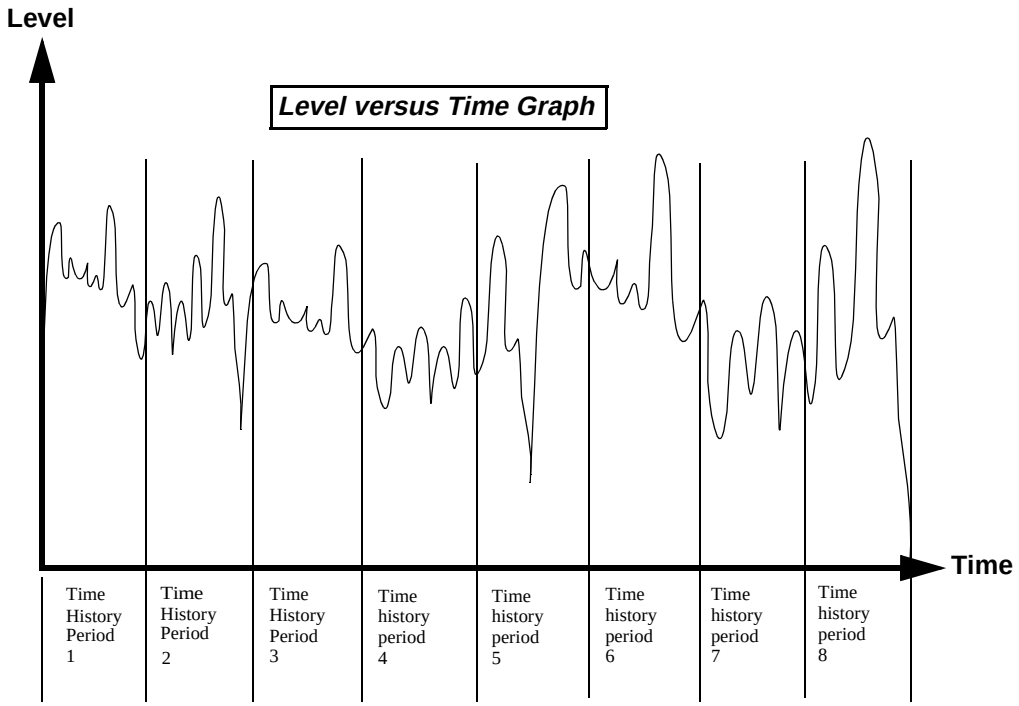
SSA Measurements

The most frequently used instrument of the 824 is the Sound Spectrum Analyzer or SSA. The SSA instrument includes frequency analysis with sound level meter functions. Lets take a look at what the SSA instrument can measure.

Time History

The Time History records time segments down to 1/8th of a second. The Time History is intended for a more detailed look at the data versus time. The time history is valuable at detecting what might be the offending noise source(s).

Below is a level versus time graph showing several Time History periods:



The graph is divided into eight equal time history periods. The duration of each period can be adjusted from one-eighth of a second to 255 minutes.

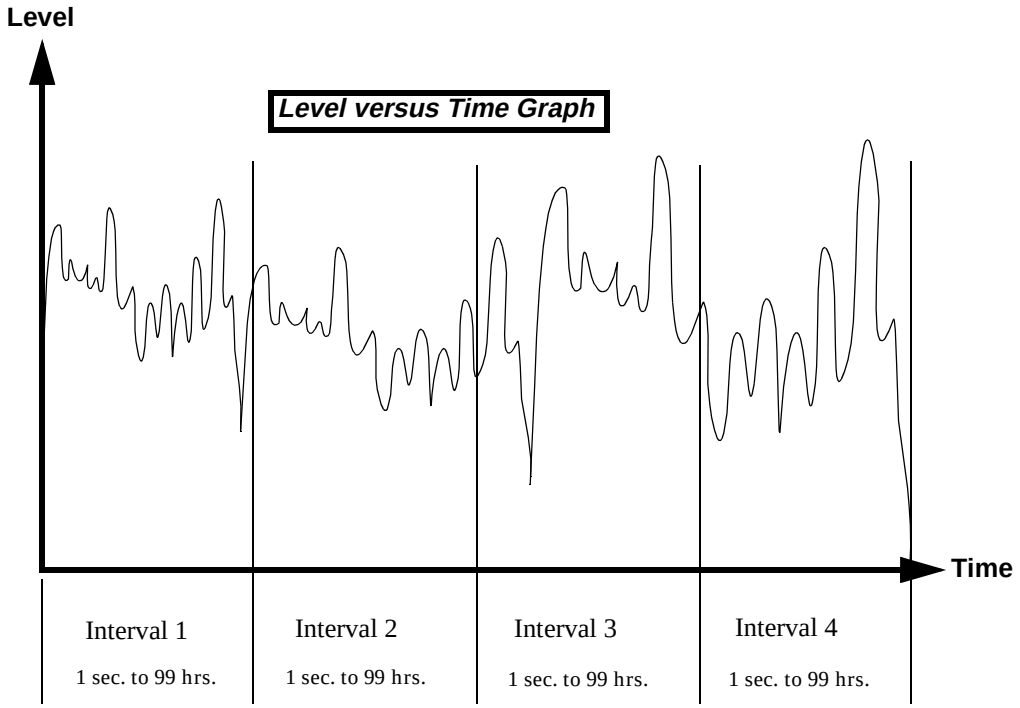
For each Time history period you can select any of the following to be recorded:

Metric	Explanation of Metric
SPL Fast (dBF)	The instantaneous SPL of the given frequency and time weighting found at the end of the period.
SPL Fast (dBC)	
SPL Fast (dBA)	
SPL Slow (dBF)	
SPL Slow (dBC)	
SPL Slow (dBA)	
SPL Impl (dBF)	
SPL Impl (dBC)	
SPL Impl (dBA)	
RTA Leq	An energy average of all the samples for each frequency band.
RTA Live	The instantaneous SPL for each frequency band found at the end of the period.
Lmax Fast (dBF)	The maximum instantaneous SPL during the period.
Lmax Fast (dBC)	
Lmax Fast (dBA)	
Lmax Slow(dBF)	
Lmax Slow(dBC)	
Lmax Slow(dBA)	
Lmax Impl (dBF)	
Lmax Impl (dBC)	
Lmax Impl (dBA)	
Lmin Fast (dBF)	The lowest instantaneous SPL during the period.
Lmin Fast (dBC)	
Lmin Fast (dBA)	
Lmin Slow (dBF)	
Lmin Slow (dBC)	
Lmin Slow (dBA)	
Lmin Impl (dBF)	
Lmin Impl (dBC)	
Lmin Impl (dBA)	
Peak (dBF)	The largest peak level achieved during the period for the given frequency weighting.
Peak (dBC)	
Peak (dBA)	
Leq (dBF)	The energy average or equivalent level of all samples during the period. (This is a “true Leq” rather than an integration of SPL)
Leq (dBC)	
Leq (dBA)	
Temperature	The internal case temperature found at the end of the period.
External Voltage	The voltage of the external power source found at the end of the period.
Battery Voltage	The battery voltage found at the end of the period.

Interval History

Another history available to the SSA is the Interval History. This statistical history provides a number of parameters calculated over a period of time that can be set from 1 second to over 99 hours.

Below is a level versus time graph showing four interval periods:



For each Interval period the following are recorded automatically:

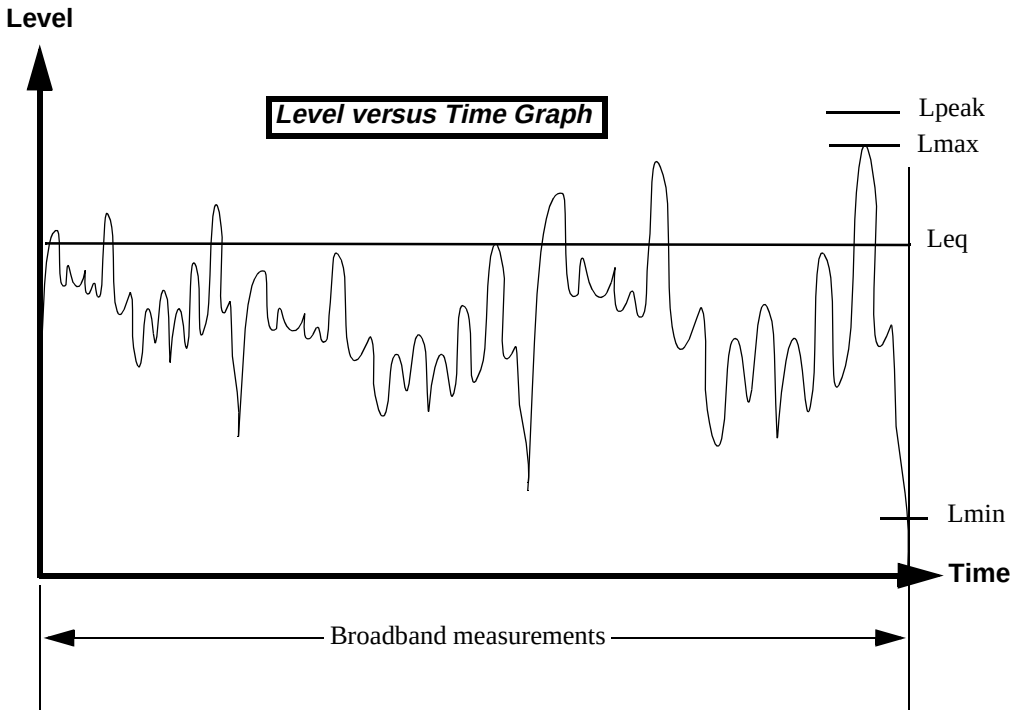
Metric	Explanation of Metric
Leq (dB) w/selected weighting	Short Leq average of all energy during interval
SEL (dB) w/selected weighting	SEL of all energy during interval
Lmin (dB) w/selected weighting	Minimum instantaneous SPL during the interval
Lmax (dB) w/selected weighting	Maximum instantaneous SPL during the interval
Lpeak-I (dBF)	Greatest peak level during the interval
Lpeak-II (dB) w/selected weighting	Greatest peak level during the interval
Leq spectrum	Energy average of all samples for each frequency band

For each Interval period the following can be optionally selected:

Metric	Explanation of Metric
Six Ln values (broadband)	The level that the instantaneous SPL was over for n% of the time
Six spectral Lns	Six spectral Lns whose frequency band levels were over for n% of the time
Min spectrum(bin by bin minimum)	Lowest instantaneous level reached for each frequency band during the interval.
@Max spectrum	Instantaneous SPL of each frequency band at the occurance of the broadband Lmax during the interval

Broadband Measurements

The SSA instrument records several broadband measurements over the total run time. This means from the time the 824 is set to run until it is stopped.



For the total run time of the instrument the following metrics are recorded:

Metric	Explanation of Metric
SPL Fast (dBF)	The instantaneous SPL of the given frequency and time weighting found at the end of the measurement.
SPL Fast (dBC)	
SPL Fast (dBA)	
SPL Slow (dBF)	
SPL Slow (dBC)	
SPL Slow (dBA)	
SPL Impl (dBF)	
SPL Impl (dBC)	
SPL Impl (dBA)	
Lmax Fast (dBF)	The maximum instantaneous SPL during the measurement.
Lmax Fast (dBC)	
Lmax Fast (dBA)	
Lmax Slow(dBF)	
Lmax Slow(dBC)	
Lmax Slow(dBA)	
Lmax Impl (dBF)	
Lmax Impl (dBC)	
Lmax Impl (dBA)	
Lmin (dBF)	The lowest instantaneous SPL during the measurement.
Lmin (dBC)	
Lmin (dBA)	
SEL (dBF)	Sound exposure level during the measurement. [Leq + 10 Log (T)], where T is in seconds
SEL (dBC)	
SEL (dBA)	
Peak (dBF)	The largest peak level achieved during the measurement.
Peak (dBC)	
Peak (dBA)	
Leq (dBF)	The energy average or equivalent level of all samples during the measurement. (This is a “true Leq” rather than an integration of SPL)
Leq (dBC)	
Leq (dBA)	
RTA Live	Instantaneous SPL for each frequency band.
RTA Leq	Energy average of all samples for each frequency band.
RTA Max	A record of the RTA Live spectrum at the occurance of the broadband Lmax selected by weight and detector settings.
RTA Min	The lowest instantaneous RTA Live reading per frequency band.

Lets Go For a Test Drive

Now that we know what the SSA instrument will measure, let's setup the 824 to take a simple measurement.

Step 1 Push the SETUP ⊘ key to get into the SETUP menu. Your screen should look like the one below:

Step 2

If your screen doesn't look like this despite anything that you do, the instrument is probably deep into the menu. Press the left arrow key until you have backed out to the main menu or press the POWER v key to exit all menus and try again.

Step 3 If the SSA instrument does not appear at the top of the list, use the up and down arrow keys to highlight SLM&RTA.SSA and press the Check ✓ key to select it. With "Edit Settings" highlighted, press the right ▶ arrow to enter into the SSA settings menu.

For an explanation of any of these settings, please see chapter 7 of the 824 Reference Manual.

You will notice that you have alot of choice concerning the setup of the SSA instrument.

Step 4 Referring to the diagrams on the following pages, configure the 824 with the following parameters:

SLM

- Detector [Slow]
- Gain [+0]
- Transducer [Condenser]
- Random Correction [No]

RTA

- RTA Detector [Fast]
- RTA Weighting [FLT]

- Bandwidth [1/3]

Intervals

- Intv Enable [No]

Time History

- Hist Enable [No]

Ln

- Enable Ln [No]

For now we will not change any settings for **Triggering**, **Define Report**, and **Controls**. We will rely on the default settings.

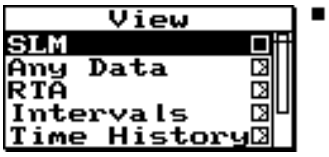
We did not turn on the **Interval Histor**y, **Time History**, or enable the **Lns** (statistical data).

For this measurement we will only record SLM & RTA broadband data over the run time of the instrument.

Step 5 Once you have completed configuring the 824, back out of the the submenus by pressing the left arrow key (repeatedly if needed).

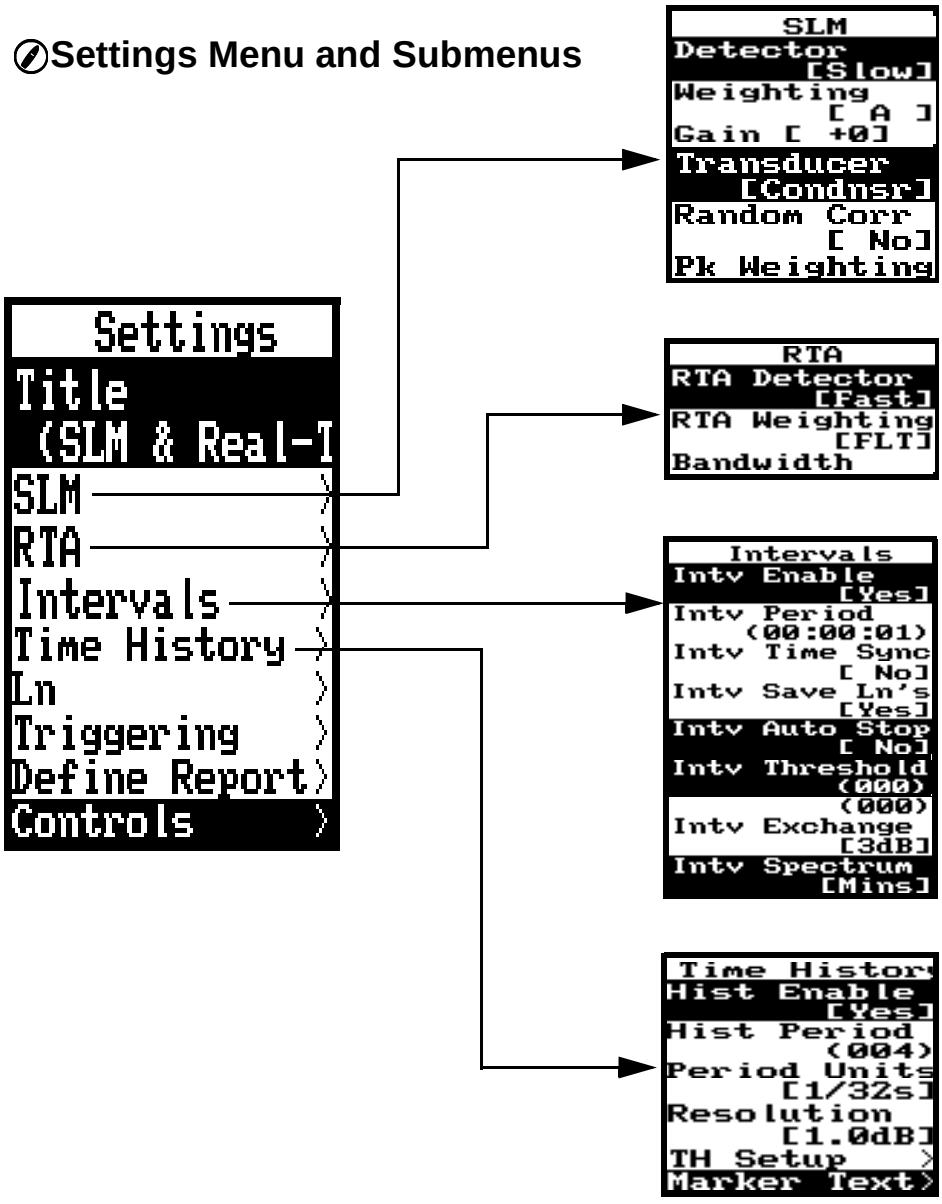
All data will be collected regardless of which display you are viewing on the 824.

Step 6 In order to see the data collection process, press the VIEW ⦿ key.

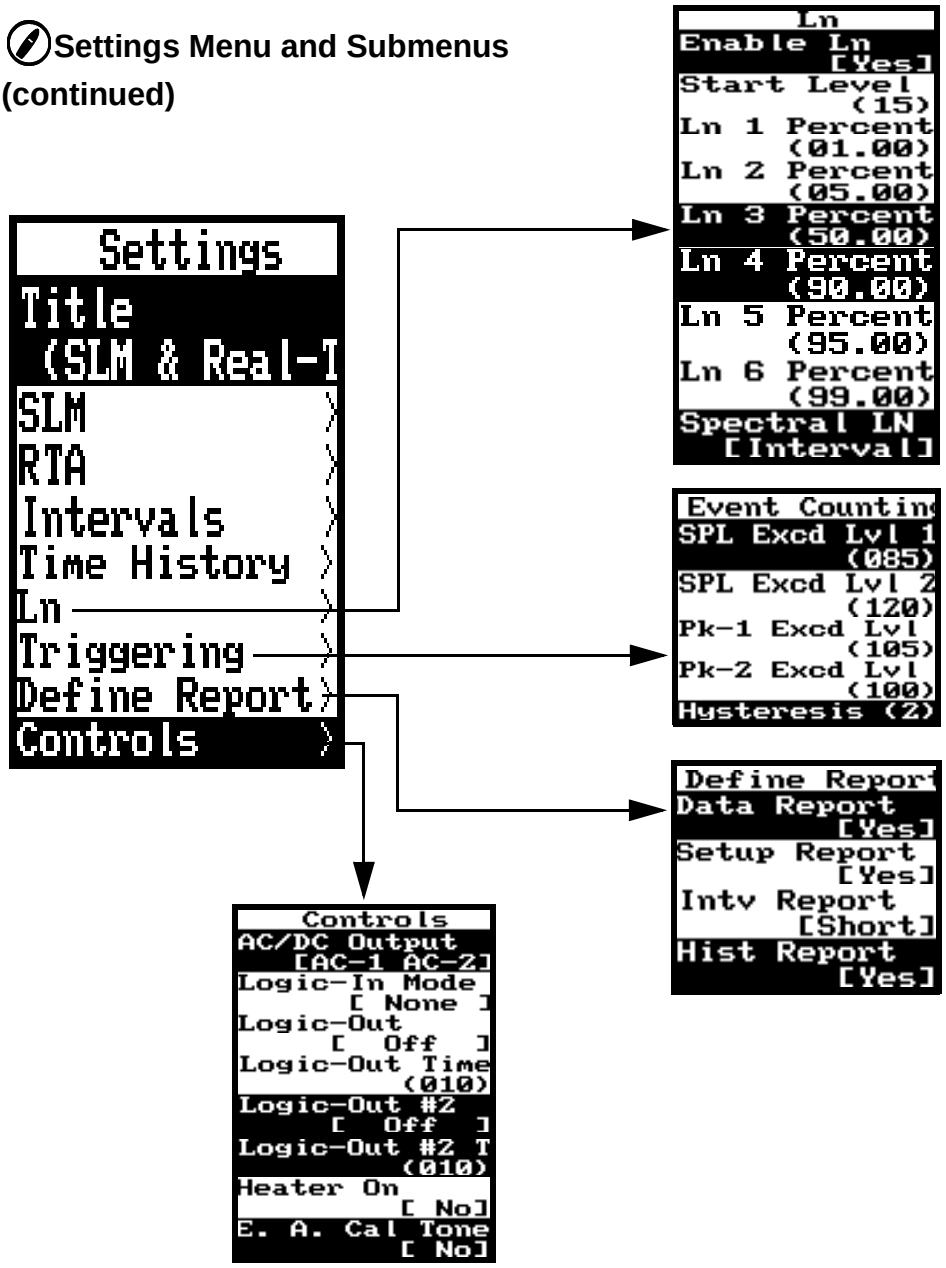


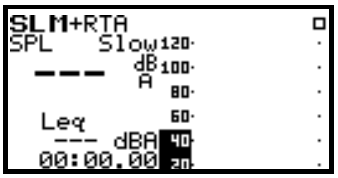
Step 7 Select the SLM view by highlighting “SLM” and pressing the Check ✓ key.

Settings Menu and Submenus



Settings Menu and Submenus (continued)





Resetting Data

Step 8 At this point it is a good idea to reset the 824 for a new measurement. Press the RESET ⏯ key, select "OverAll" then press the Check √ key.

Calibration

Step 9 Calibrate the 824 according to the procedure found in chapter 2 of the 824 Reference Manual.

Taking a Measurement

Step 10 Press the RUN/STOP ⏯ key to start taking a measurement. Let the instrument run for about a minute then press the RUN/STOP ⏯ key again to stop the measurement. The measurement time is shown on the bottom of the **SLM**+RTA display.

Viewing Data from the 824 Screen

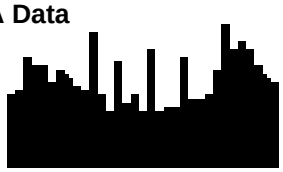
SLM Data

After the measurement is taken we can look at the data we just collected by pressing the VIEW 👁 key. Highlight the "Any Data" menu item and press the Check √ key.

Refer to page 1-12 or the 824 Reference Manual for an explanation of these metics and displays.

With “Any Level” highlighted, press the Check ✓ key again. To scroll through the different displays use the right ▶ and left ◀ arrow keys You will see that metrics for A,C, and Flat and Slow, Fast, and impulse are all measured simultaneously.

RTA Data



To view the RTA data press the VIEW 👁 key and back out to the main VIEW menu by pressing the left ◀ arrow key. Highlight “RTA” from the VIEW menu and press the right ▶ arrow.

Highlight “RTA Live, RTA Leq, RTA Max, or RTA Min” and press the Check ✓ key to display the spectral data collected.

Storing Data

To store the data that was just collected, press the DATA 📊 key.

With “Store File” highlighted, press the Check ✓ key. Thedata has now been stored to a file.

Recalling Data

To recall the data you just stored, press the DATA 📊 key and highlight “Recall Files”.

Press the Check ✓ key to bring up the Data Files display.

As you can see this display shows the total number of records and the current record you are viewing along with the date and time the record was taken.

Use the up and down arrow keys to select the record you would like to recall and press the Check ✓ key. Further options such as "Recall file, Beginning, Ending, Find, Purge All" will be displayed.

Highlight "Recall File" and press the Check ✓ key. The recalled record will be displayed from the VIEW menu. From the VIEW menu you can view the data that is important to you.

Download Data Using 824 Utility Software

Using the 824 Utility software allows you to download the data files stored in the 824. These files are then transferred to your computer for storage and viewing. You can also import the files into a spreadsheet such as Excel for further manipulation for reporting purposes. The reports can be

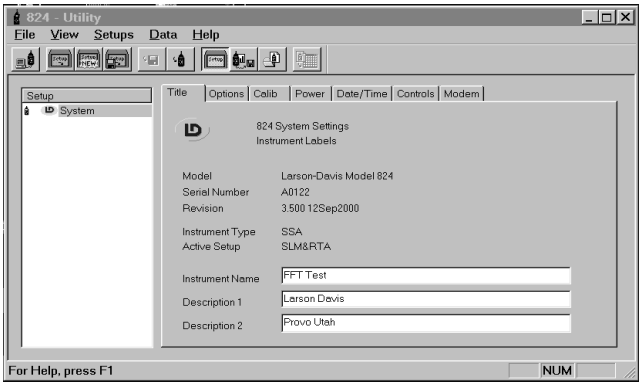
printed directly from the 824 Utility software or from your Excel file.

Downloading the Data

For this exercise you will need to have already installed the 824 Utility software on your computer and connected the CLB006 computer interface cable between the 824 and the serial port on your computer. Refer to chapter 9 of the 824 Reference manual if you need help getting to this point.

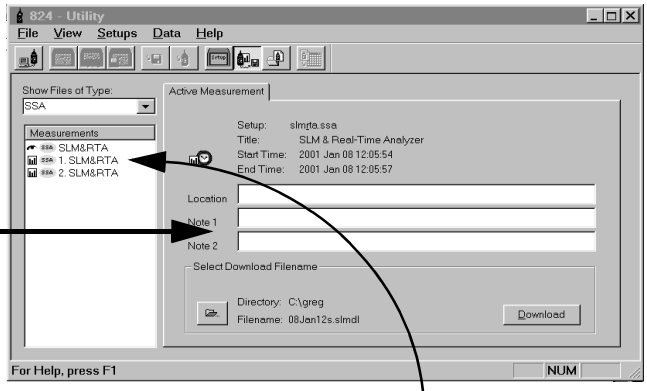
Step 1 Run the 824 Utility software by clicking on the icon on your desktop.

Step 2 Connect the 824 to your computer by double clicking this button from the tool bar. The communcation screen will appear. Select the COM PORT you are connected to on your computer and press “Connect”. The startup window will appear:



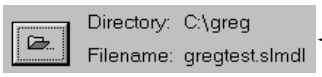
Step 3 On the tool bar select the download window by double clicking on this button. The download window will appear:

Use the note facility to identify your measurement before hitting the download button.

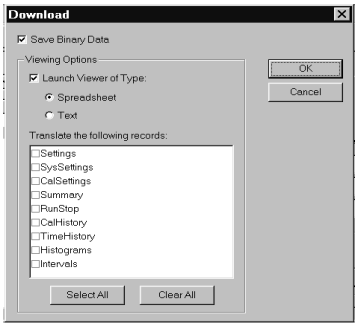


Use the "Ctrl" key of your computer in conjunction with your mouse to select more than one measurement.

Step 4 You will notice on the left hand side of the window shows the measurements that are stored in the 824. Select the measurements you would like to download by highlighting them with your mouse. You can highlight one or all of the same type of measurement. **Let's select the first measurement for download LM&RTA)**. The file will automatically be named using the date the measurement was taken on. You have the option of changing the file name by clicking on the file folder.



Step 5 Start the download by pressing the download button in the lower right-hand corner. A window will appear giving you some more options concerning the download.



Step 6 Select these options from this window:

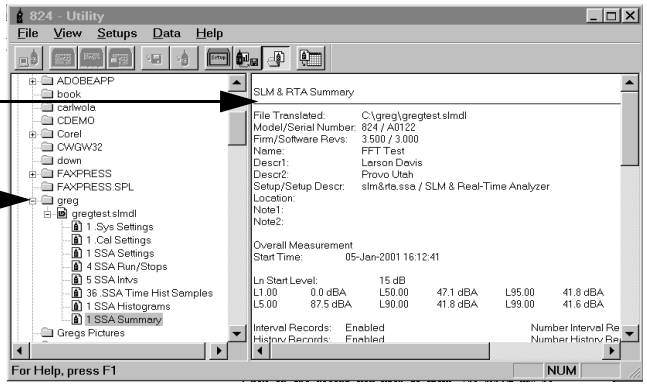
- “Save binary data”
- De-select “Launch viewer of type”
- From “Translate the following records” click on the “Select All” button.

Step 7 Click on the “OK” button to start the download. A window will appear showing the status of the download. You have now successfully downloaded a measurement. **Now let’s look at some reports**.

Translating the Data and Looking at the Reports

To get the data into a form that we can look at we need to translate it. To translate the data, click on the translate window button on the tool bar.

The translate window is shown below.



To look at the file you just downloaded, find the directory where it was downloaded to on the left hand side of the window.

Double click on the file name of the directory where the file is stored. You will see several records such as SSA Summary, SSA Settings, SSA Time Hist Samples, and so on. **Click on the record you wish to view**. The report will be displayed on the right-hand side of the window.

Once the report is displayed on the right side of the window it can be printed or exported to a spreadsheet for viewing.

Printing a Report

To print the report you are viewing, select “File” and then “Print”.

Exporting Data

To export the report to a file or view in a spreadsheet, select “File” and then “Export Data” or “View Data in a Spreadsheet”.

The report will be printed in the format you see on the screen. For some reports such as the “Time History” report, you may need to export the data to view all of the information in the report.

Content of Reports

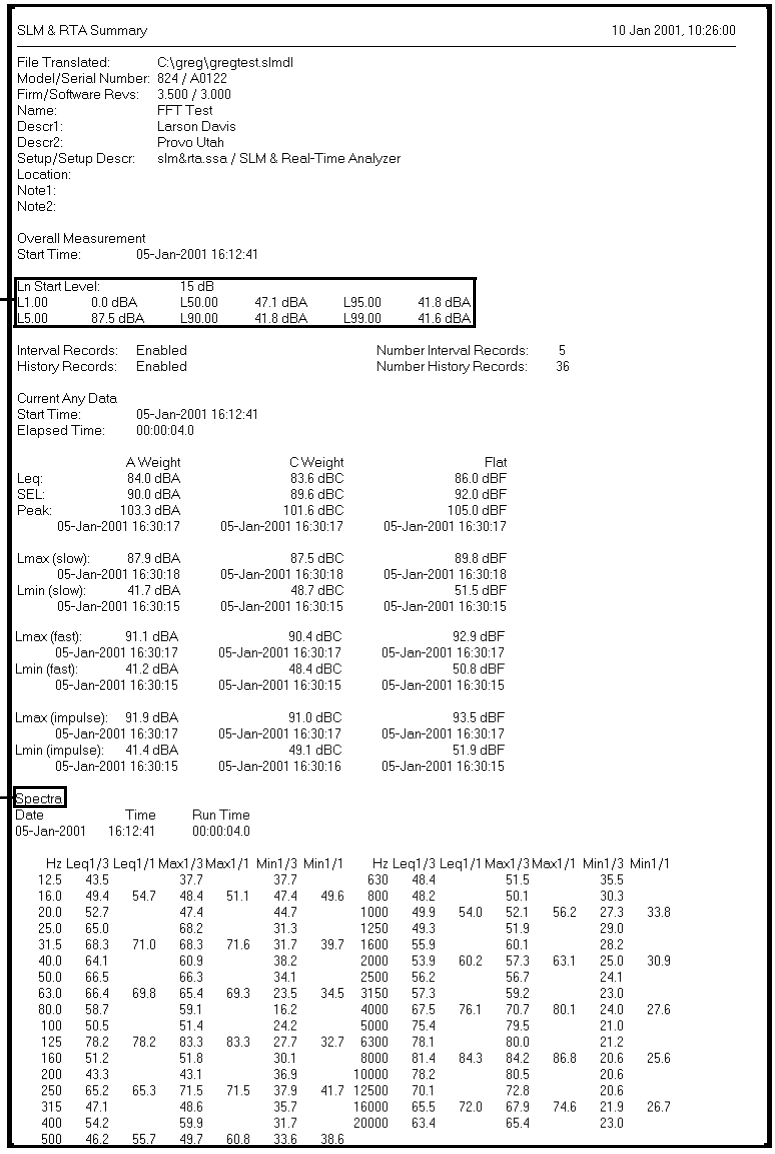
Below are some examples of reports that can be printed, along with explanations of some of the data contained in them.

Summary Report

The Summary report gives you the overall broadband and spectral values for the run time of the instrument.

6 Ln statistical values over the run time of the 824 showing the distribution of the SPL exceeded n% of the time.

Shows values for each filter for Leq spectra, @Max spectra, and Min spectra.



SLM & RTA Summary 10 Jan 2001, 10:26:00

File Translated: C:\greg\gregtest.slmdl
Model/Serial Number: 824 / A0122
Firm/Software Revs: 3.500 / 3.000
Name: FFT Test
Descr1: Larson Davis
Descr2: Provo Utah
Setup/Setup Descr: slm&rta.ssa / SLM & Real-Time Analyzer
Location:
Note1:
Note2:

Overall Measurement
Start Time: 05-Jan-2001 16:12:41

Ln Start Level:		15 dB			
L1.00	0.0 dBA	L50.00	47.1 dBA	L95.00	41.8 dBA
L5.00	87.5 dBA	L90.00	41.8 dBA	L99.00	41.6 dBA

Interval Records: Enabled — Number Interval Records: 5
History Records: Enabled — Number History Records: 36

Current Any Data
Start Time: 05-Jan-2001 16:12:41
Elapsed Time: 00:00:04.0

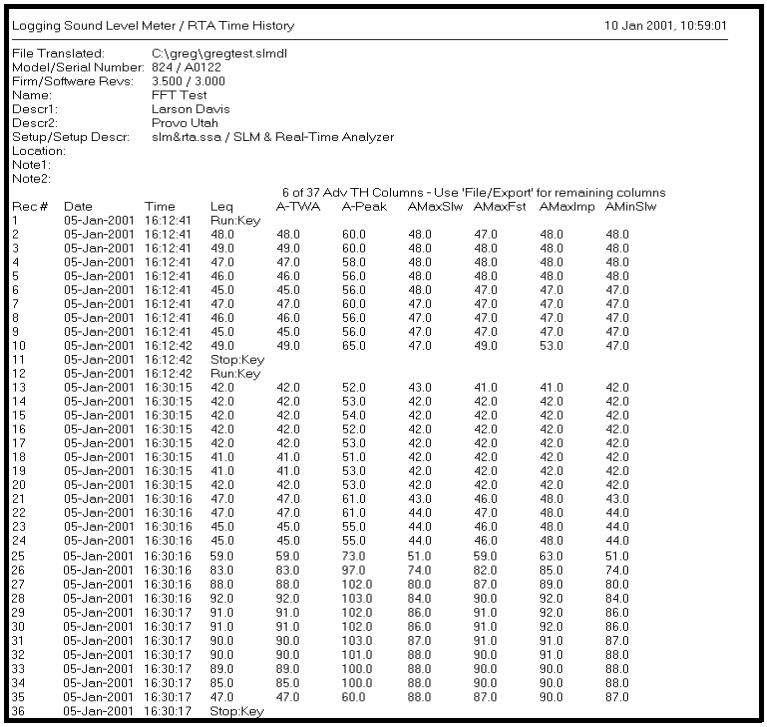
	A Weight	C Weight	Flat
Leq:	84.0 dBA	83.6 dBC	86.0 dBF
SEL:	90.0 dBA	89.6 dBC	92.0 dBF
Peak:	103.3 dBA	101.6 dBC	105.0 dBF
	05-Jan-2001 16:30:17	05-Jan-2001 16:30:17	05-Jan-2001 16:30:17
Lmax (slow):	87.9 dBA	87.5 dBC	89.8 dBF
	05-Jan-2001 16:30:18	05-Jan-2001 16:30:18	05-Jan-2001 16:30:18
Lmin (slow):	41.7 dBA	48.7 dBC	51.5 dBF
	05-Jan-2001 16:30:15	05-Jan-2001 16:30:15	05-Jan-2001 16:30:15
Lmax (fast):	91.1 dBA	90.4 dBC	92.9 dBF
	05-Jan-2001 16:30:17	05-Jan-2001 16:30:17	05-Jan-2001 16:30:17
Lmin (fast):	41.2 dBA	48.4 dBC	50.8 dBF
	05-Jan-2001 16:30:15	05-Jan-2001 16:30:15	05-Jan-2001 16:30:15
Lmax (impulse):	91.9 dBA	91.0 dBC	93.5 dBF
	05-Jan-2001 16:30:17	05-Jan-2001 16:30:17	05-Jan-2001 16:30:17
Lmin (impulse):	41.4 dBA	49.1 dBC	51.9 dBF
	05-Jan-2001 16:30:15	05-Jan-2001 16:30:16	05-Jan-2001 16:30:15

Spectra
Date 05-Jan-2001 Time 16:12:41 Run Time 00:00:04.0

Hz	Leq1/3	Leq1/1	Max1/3	Max1/1	Min1/3	Min1/1	Hz	Leq1/3	Leq1/1	Max1/3	Max1/1	Min1/3	Min1/1
12.5	43.5		37.7		37.7		630	48.4		51.5		35.5	
16.0	49.4	54.7	48.4	51.1	47.4	49.6	800	48.2		50.1		30.3	
20.0	52.7		47.4		44.7		1000	49.9	54.0	52.1	56.2	27.3	33.8
25.0	65.0		68.2		31.3		1250	49.3		51.9		29.0	
31.5	68.3	71.0	68.3	71.6	31.7	39.7	1600	55.9		60.1		28.2	
40.0	64.1		60.9		38.2		2000	53.9	60.2	57.3	63.1	25.0	30.9
50.0	66.5		66.3		34.1		2500	56.2		56.7		24.1	
63.0	66.4	69.8	65.4	69.3	23.5	34.5	3150	57.3		59.2		23.0	
80.0	58.7		59.1		16.2		4000	67.5	76.1	70.7	80.1	24.0	27.6
100	50.5		51.4		24.2		5000	75.4		79.5		21.0	
125	78.2	78.2	83.3	83.3	27.7	32.7	6300	78.1		80.0		21.2	
160	51.2		51.8		30.1		8000	81.4	84.3	84.2	86.8	20.6	25.6
200	43.3		43.1		36.9		10000	78.2		80.5		20.6	
250	65.2	65.3	71.5	71.5	37.9	41.7	12500	70.1		72.8		20.6	
315	47.1		48.6		35.7		16000	65.5	72.0	67.9	74.6	21.9	26.7
400	54.2		59.9		31.7		20000	63.4		65.4		23.0	
500	46.2	55.7	49.7	60.8	33.6	38.6							

Time History Report

The Time History report shows each time history sample selected for the time history period. For each time history period you can record up to 37 data parameters as explained on page 1-9.



Logging Sound Level Meter / RTA Time History — 10 Jan 2001, 10:59:01

File Translated: C:\greg\gregtest.slmdl
Model/Serial Number: 824 / A0122
Firm/Software Revs: 3.500 / 3.000
Name: FFT Test
Descr1: Larson Davis
Descr2: Provo Utah
Setup/Setup Descr: slm&rta.sse / SLM & Real-Time Analyzer
Location:
Note1:
Note2:

6 of 37 Adv TH Columns - Use 'File/Export' for remaining columns

Rec #	Date	Time	Leq	A-TWA	A-Peak	AMaxSlw	AMaxFst	AMaxImp	AMinSlw
1	05-Jan-2001	16:12:41	Run:Key						
2	05-Jan-2001	16:12:41	48.0	48.0	60.0	48.0	47.0	48.0	48.0
3	05-Jan-2001	16:12:41	49.0	49.0	60.0	48.0	48.0	48.0	48.0
4	05-Jan-2001	16:12:41	47.0	47.0	58.0	48.0	48.0	48.0	48.0
5	05-Jan-2001	16:12:41	46.0	46.0	56.0	48.0	48.0	48.0	48.0
6	05-Jan-2001	16:12:41	45.0	45.0	56.0	48.0	47.0	47.0	47.0
7	05-Jan-2001	16:12:41	47.0	47.0	60.0	47.0	47.0	47.0	47.0
8	05-Jan-2001	16:12:41	46.0	46.0	56.0	47.0	47.0	47.0	47.0
9	05-Jan-2001	16:12:41	45.0	45.0	56.0	47.0	47.0	47.0	47.0
10	05-Jan-2001	16:12:42	49.0	49.0	65.0	47.0	49.0	53.0	47.0
11	05-Jan-2001	16:12:42	Stop:Key						
12	05-Jan-2001	16:12:42	Run:Key						
13	05-Jan-2001	16:30:15	42.0	42.0	52.0	43.0	41.0	41.0	42.0
14	05-Jan-2001	16:30:15	42.0	42.0	53.0	42.0	42.0	42.0	42.0
15	05-Jan-2001	16:30:15	42.0	42.0	54.0	42.0	42.0	42.0	42.0
16	05-Jan-2001	16:30:15	42.0	42.0	52.0	42.0	42.0	42.0	42.0
17	05-Jan-2001	16:30:15	42.0	42.0	53.0	42.0	42.0	42.0	42.0
18	05-Jan-2001	16:30:15	41.0	41.0	51.0	42.0	42.0	42.0	42.0
19	05-Jan-2001	16:30:15	41.0	41.0	53.0	42.0	42.0	42.0	42.0
20	05-Jan-2001	16:30:15	42.0	42.0	53.0	42.0	42.0	42.0	42.0
21	05-Jan-2001	16:30:16	47.0	47.0	61.0	43.0	46.0	48.0	43.0
22	05-Jan-2001	16:30:16	47.0	47.0	61.0	44.0	47.0	48.0	44.0
23	05-Jan-2001	16:30:16	45.0	45.0	55.0	44.0	46.0	48.0	44.0
24	05-Jan-2001	16:30:16	45.0	45.0	55.0	44.0	46.0	48.0	44.0
25	05-Jan-2001	16:30:16	59.0	59.0	73.0	51.0	59.0	63.0	51.0
26	05-Jan-2001	16:30:16	83.0	83.0	97.0	74.0	82.0	85.0	74.0
27	05-Jan-2001	16:30:16	88.0	88.0	102.0	80.0	87.0	89.0	80.0
28	05-Jan-2001	16:30:16	92.0	92.0	103.0	84.0	90.0	92.0	84.0
29	05-Jan-2001	16:30:17	91.0	91.0	102.0	86.0	91.0	92.0	86.0
30	05-Jan-2001	16:30:17	91.0	91.0	102.0	86.0	91.0	92.0	86.0
31	05-Jan-2001	16:30:17	90.0	90.0	103.0	87.0	91.0	91.0	87.0
32	05-Jan-2001	16:30:17	90.0	90.0	101.0	88.0	90.0	91.0	88.0
33	05-Jan-2001	16:30:17	89.0	89.0	100.0	88.0	90.0	90.0	88.0
34	05-Jan-2001	16:30:17	85.0	85.0	100.0	88.0	90.0	90.0	88.0
35	05-Jan-2001	16:30:17	47.0	47.0	60.0	88.0	87.0	90.0	87.0
36	05-Jan-2001	16:30:17	Stop:Key						

Interval Report

The Interval report shows the data for each interval period. See page 1-10 for explanation of data parameters for interval history.

Sound Level Meter / RTA Intervals 12 Jan 2001, 11:12:26

File Translated:	C:\greg\gregtest.slmdl
Model/Serial Number:	824 / A0122
Firm/Software Revs:	3.500 / 3.030
Name:	FFT Test
Descr1:	Larson Davis
Descr2:	Provo Utah
Setup/Setup Descr:	greg_rta.ssa / SLM & Real-Time Analyzer
Location:	Greg's Office
Note1:	Computer Noise
Note2:	

Interval Records: 38

Exch. Rate	Threshold	Intv Period	Sync Hours/Minutes	Save Ln	Auto Stop
3 dB	0	00:01:00	No	Yes	No

Note: Use 'File/Export' to see interval Leq and Min spectra

Rec #	Time	Duration	Leq	SEL	Min	Max
1	10:35:58	00:01:00.0	46.3 dBA	64.0 dBA	44.4 dBA	55.5 dBA
UwPeak	Peak	Excd RMS	Excd UwPk	Excd Peak	Overloads	
80.4 dBF	75.2 dBA	0	0	0	0	
L1.00	L5.00	L50.00	L90.00	L95.00	L99.00	
53.8 dBA	49.0 dBA	45.4 dBA	44.4 dBA	44.4 dBA	44.4 dBA	

Rec #	Time	Duration	Leq	SEL	Min	Max
2	10:36:58	00:01:00.0	45.3 dBA	63.1 dBA	44.4 dBA	50.8 dBA
UwPeak	Peak	Excd RMS	Excd UwPk	Excd Peak	Overloads	
79.0 dBF	69.4 dBA	0	0	0	0	
L1.00	L5.00	L50.00	L90.00	L95.00	L99.00	
49.5 dBA	46.6 dBA	45.2 dBA	44.4 dBA	44.4 dBA	44.4 dBA	

Rec #	Time	Duration	Leq	SEL	Min	Max
3	10:37:58	00:01:00.0	48.6 dBA	66.4 dBA	44.4 dBA	57.4 dBA
UwPeak	Peak	Excd RMS	Excd UwPk	Excd Peak	Overloads	
86.5 dBF	86.1 dBA	0	0	0	0	
L1.00	L5.00	L50.00	L90.00	L95.00	L99.00	
56.7 dBA	54.0 dBA	45.7 dBA	44.4 dBA	44.4 dBA	44.4 dBA	

Rec #	Time	Duration	Leq	SEL	Min	Max
4	10:38:58	00:01:00.0	52.0 dBA	69.8 dBA	44.1 dBA	61.6 dBA
UwPeak	Peak	Excd RMS	Excd UwPk	Excd Peak	Overloads	
90.1 dBF	90.1 dBA	0	0	0	0	
L1.00	L5.00	L50.00	L90.00	L95.00	L99.00	
60.3 dBA	58.3 dBA	47.6 dBA	45.1 dBA	44.7 dBA	44.1 dBA	

Rec #	Time	Duration	Leq	SEL	Min	Max
5	10:39:58	00:01:00.0	45.5 dBA	63.3 dBA	44.4 dBA	51.8 dBA
UwPeak	Peak	Excd RMS	Excd UwPk	Excd Peak	Overloads	
86.3 dBF	71.2 dBA	0	0	0	0	
L1.00	L5.00	L50.00	L90.00	L95.00	L99.00	
50.5 dBA	47.7 dBA	44.9 dBA	44.4 dBA	44.4 dBA	44.4 dBA	

Rec #	Time	Duration	Leq	SEL	Min	Max
6	10:40:58	00:01:00.0	45.4 dBA	63.2 dBA	44.3 dBA	53.7 dBA
UwPeak	Peak	Excd RMS	Excd UwPk	Excd Peak	Overloads	
79.2 dBF	72.6 dBA	0	0	0	0	
L1.00	L5.00	L50.00	L90.00	L95.00	L99.00	
52.3 dBA	46.9 dBA	44.6 dBA	44.3 dBA	44.3 dBA	44.3 dBA	

Rec #	Time	Duration	Leq	SEL	Min	Max
7	10:41:58	00:01:00.0	45.4 dBA	63.1 dBA	44.3 dBA	53.1 dBA
UwPeak	Peak	Excd RMS	Excd UwPk	Excd Peak	Overloads	
72.7 dBF	71.9 dBA	0	0	0	0	
L1.00	L5.00	L50.00	L90.00	L95.00	L99.00	
51.5 dBA	46.8 dBA	44.7 dBA	44.3 dBA	44.3 dBA	44.3 dBA	

That's the basics. Now you can move on to some more powerful measuring and analyzing capabilities of the 824 and software.

CHAPTER

2 Environmental Measurements

Because of its features, ruggedness and tolerance to environmental extremes the System 824 is uniquely qualified for environmental noise monitoring.

Environmental Noise

Environmental noise impacts our quality of life. It can cause annoyance, hearing loss, stress, and loss of sleep. The number of noise sources are increasing on a daily basis. For those involved in measuring, analyzing, and processing of environmental noise data the challenges are many.

Types of Environmental Noise

Here are some common types of noise sources:

- **Road traffic**
  - DOT planning studies
  - Enforcement of vehicle noise limits
  - Noise barriers
  - Complaints of existing roadways
- **Aircraft noise**
  - Airport noise studies by consultants

- Small airport systems

- New developments around airports and land use planning

- FAR 36 testing of airplanes (FAA operations)

- Encroachment on wilderness areas and National Parks

- Military overflights and sonic booms

- **Railroad noise**

  - Locomotive noise, whistles, switching operations

  - Rail car retarders can produce up to 120dB peak at 100 feet away

- **Construction noise**

  - Can significantly change the acoustic environment

  - Major projects usually require an environmental impact study (roadways, new plants, mines, etc.)

  - May require permanent noise monitoring system

- **Industrial noise**

  - Industrial noise may come from machinery such as fans, compressors, conveyor belts, compressors, heavy equipment, gas flares, etc.

- **Building noise**

  - Building noise includes HVAC, plumbing, appliances, human activity, amplified music, TV, etc.

  - Modern construction methods & materials can worsen sound transmission and isolation problems

  - Can involve many types of measurements including room acoustics measurements (RT60, transmission loss), environmental noise measurements and vibration indoors and outdoors.

- **Product noise**

  - Noise from power tools, appliances, office products, lawn mowers, etc.

  - Acoustic measurements normally done by manufacturer

- **Recreational noise**

  - Recreational vehicle noise (snow mobiles, power boats, jet skis, off road vehicles, etc.)

  - Events and venues such as outdoor concerts, race tracks, theme parks, amusement parks, etc.

  - Firearms: small arms ranges

Why Measure Community Noise?

Community noise is measured for a lot of reasons, but mostly because someone is being annoyed by some noise source.

Here are some other reasons to measure community noise:

- To determine if a source is in compliance with a property line or a point in space (noise ordinance)
- To predict levels based on measured data
- To detect events
- To identify a noise source
- Politics
- Baseline measurement
- To check sound isolation
- To determine sound power output
- To determine the quality of sound
- To characterize the source

824 LOG Instrument

The 824 LOG instrument was designed and configured to measure all types of environmental noise, thus the name "LOG". It is designed for long-term recording and contains several histories to help you, the environmental noise analyst, to get the most from your measurement time in the field.

What Does the LOG Instrument Measure?

The LOG instrument has the following histories:

- Time History
- Interval History
- Excd History
- Daily History

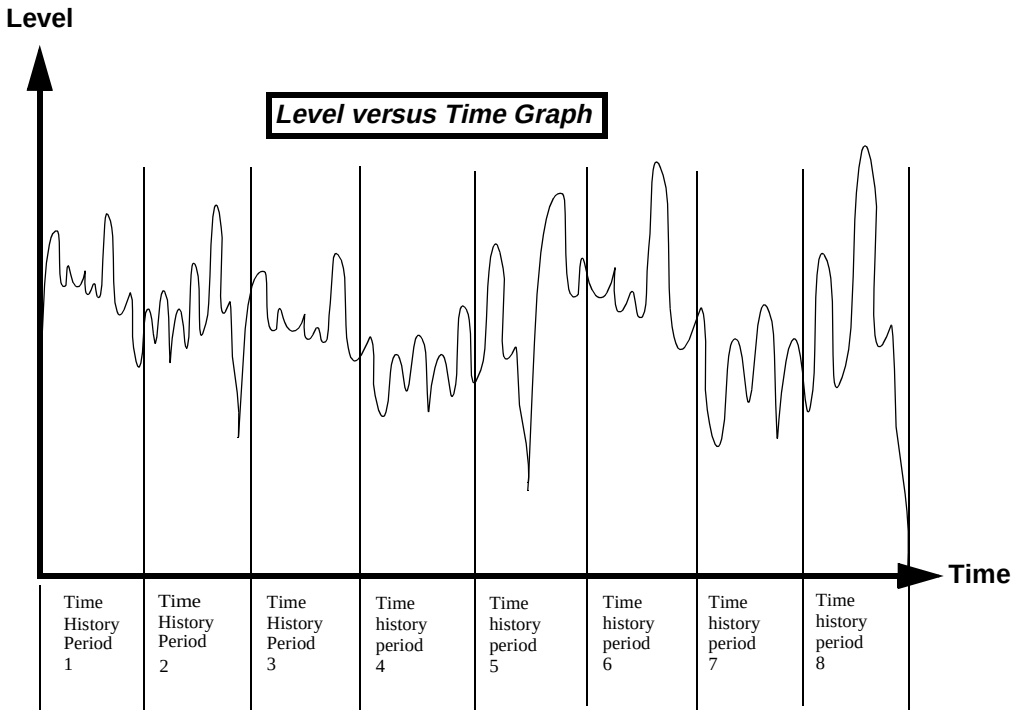
In addition to the Histories, the LOG instrument measures the following:

- Current/Overall levels
- Six Ln percentiles plus a graph of 1-99 percentiles
- Exposure
- LDN and CNEL metrics
- PassBy

Time History

The Time History of the LOG instrument is almost identical to the Time History of the SSA instrument except for some minor details. The LOG time history does not record RTA spectral data. The time history period can be as short as 1/32 of a second compared to 1/8 of a second for SSA.

Below is a level versus time graph showing several time history periods:



The graph is divided into eight time history periods. The duration of each period can be adjusted from 1/32 of a second to 255 minutes.

For each time history period any of the following can be recorded:

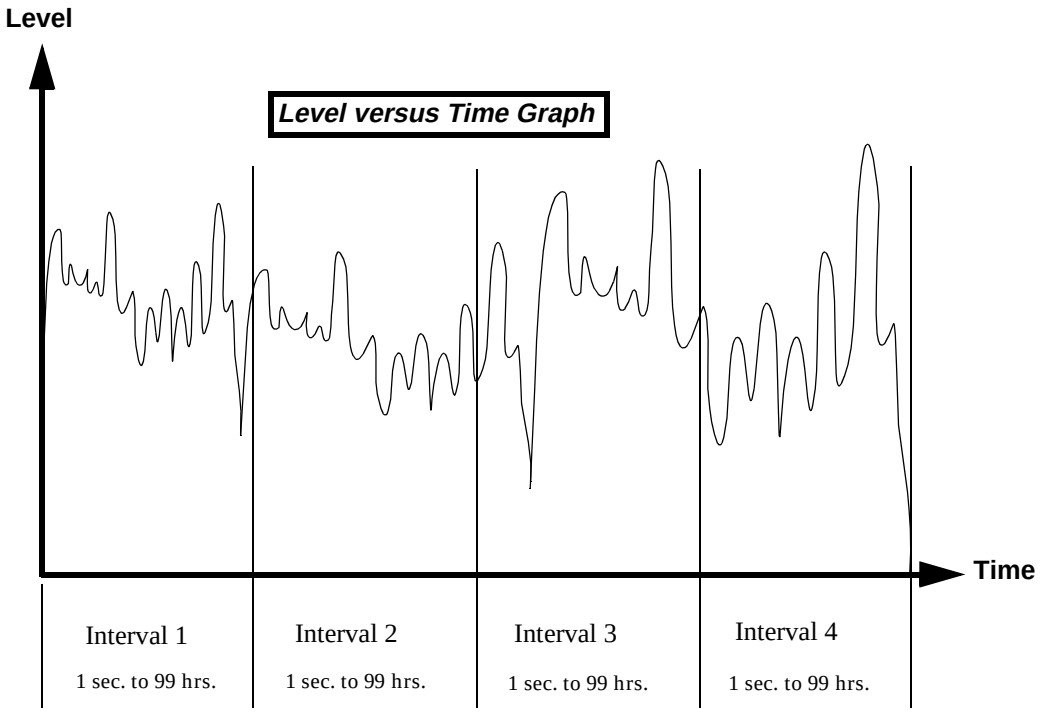
SPL Fast (dBF)	SPL Impl (dBC)	Lmax Slow(dBA)	Lmin Slow (dBF)	Peak (dBC)
SPL Fast (dBC)	SPL Impl (dBA)	Lmax Impl (dBF)	Lmin Slow (dBC)	Peak (dBA)
SPL Fast (dBA)	Lmax Fast (dBF)	Lmax Impl (dBC)	Lmin Slow (dBA)	Leq (dBF)
SPL Slow (dBF)	Lmax Fast (dBC)	Lmax Impl (dBA)	Lmin Impl (dBF)	Leq (dBC)
SPL Slow (dBC)	Lmax Fast (dBA)	Lmin Fast (dBF)	Lmin Impl (dBC)	Leq (dBA)
SPL Slow (dBA)	Lmax Slow(dBF)	Lmin Fast (dBC)	Lmin Impl (dBA)	Temperature
SPL Impl (dBF)	Lmax Slow(dBC)	Lmin Fast (dBA)	Peak (dBF)	External Voltage
				Battery Voltage

See page 1-9 for a description of each of these metrics.

Interval History

Another history available to the LOG instrument is the Interval History. This statistical history provides a number of parameters calculated over a period of time that can be set from 1 second to over 99 hours.

Below is a level versus time graph showing four interval periods:



For each Interval period the following are recorded automatically:

Metric	Explanation of Metric
Leq (dB) w/selected weighting	Short Leq average of all energy during interval
SEL (dB) w/selected weighting	SEL of all energy during interval
Lmin (dB) w/selected weighting	Minimum instantaneous SPL during the interval
Lmax (dB) w/selected weighting	Maximum instantaneous SPL during the interval
Lpeak-I (dBF)	Greatest peak level during the interval
Lpeak-II (dB) w/selected weighting	Greatest peak level during the interval

For each Interval period the following can be optionally selected:

Metric	Explanation of Metric
Six Ln values (broadband)***	The level that the instantaneous SPL was over for n% of the time

*****Special advanced feature**

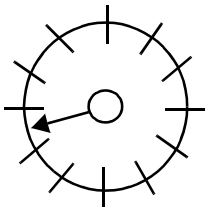
Since Ln's cannot be combined over time, the 824 and DNA software (also 824 Utility software) store and process the binary Ln table for every interval in a way that records can be combined and any percentiles may be calculated (post processed) at any time.

Time synchronization

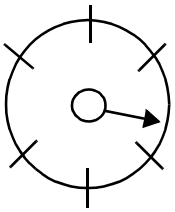
One feature of the Interval History is its ability to be synchronized with the time of day clock. This allows each interval record, for example, to begin at the start of each new hour of the day. Syncing can be done to the following increments of time:

- 1 minute
- 5 minutes
- 10 minutes
- 15 minutes
- 20 minutes
- 30 minutes
- 60 minutes

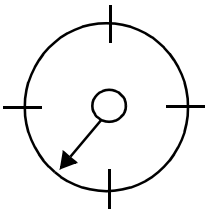
Below is an illustration showing when each new interval will begin based on the Interval setting:



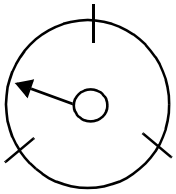
5 minute



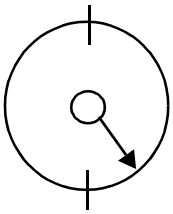
10 minute



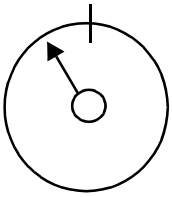
15 minute



20 minute



30 minute

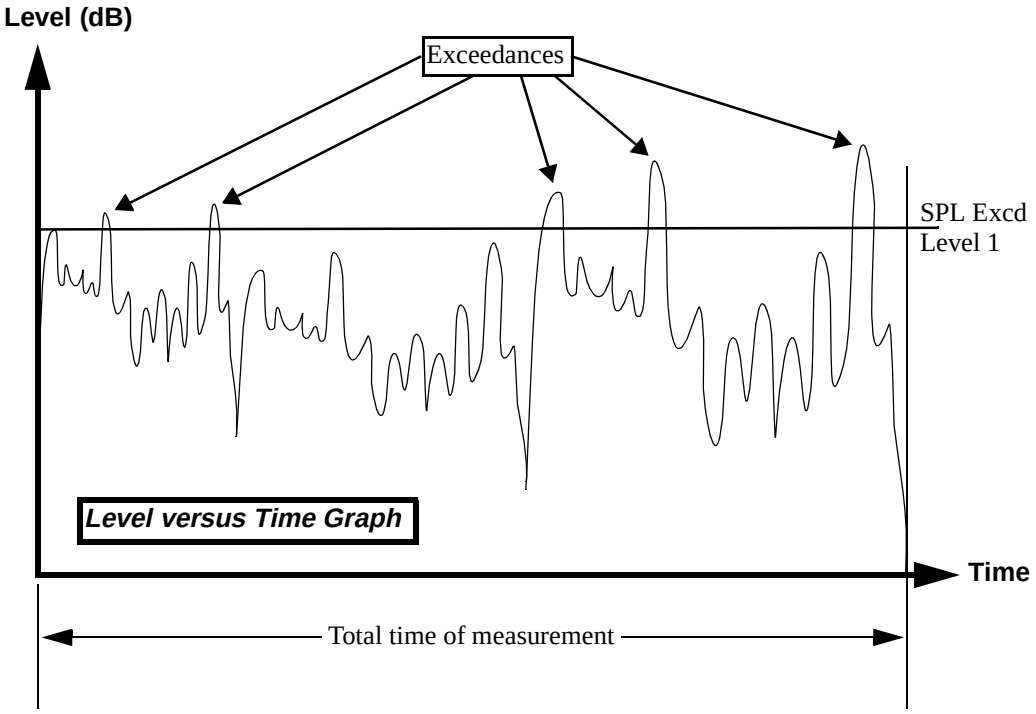


60 minute

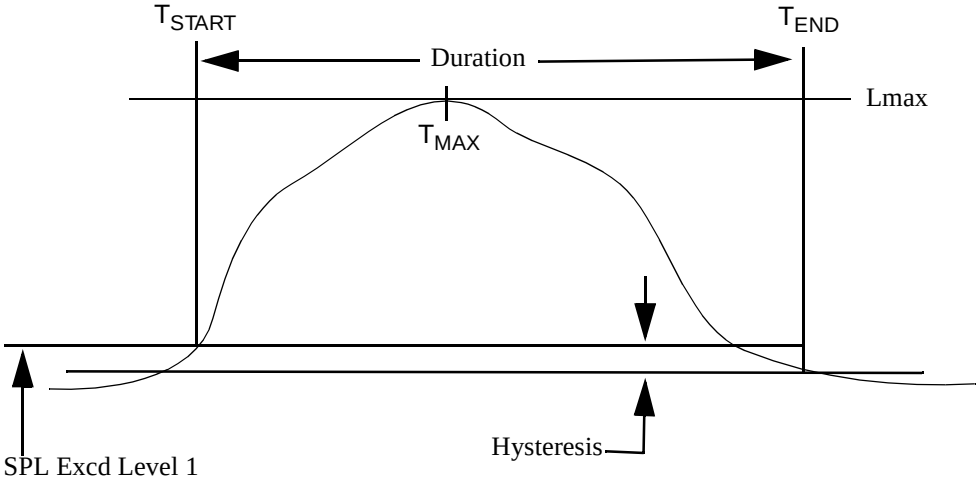
Exceedance History

The Exceedance History is a special history of events which go over a set threshold. For each exceedance history the following are recorded:

- Duration
- Leq
- Lmax
- SEL
- Peak-I
- Peak-II
- Time and date of occurrence (time at start of event or time of maximum level)
- Exceedance time history (optional)



Let's take a closer look at what constitutes an exceedance. Below is a detail of one of the peaks shown in the previous graph.



An exceedance begins when the instantaneous SPL is found to be greater than the trigger level (SPL Excd Level 1) or when the instantaneous Peak I or Peak II levels are found to be over their respective trigger levels (Pk-1 Excd Lvl and Pk-2 Excd Lvl). An exceedance ends when the SPL and both peak levels are below their respective trigger levels less the hysteresis level. Hysteresis is used to prevent multiple exceedance records being created by one actual event. Without hysteresis a Jack hammer could trigger an exceedance on every cycle of the cylinder rather than every time the hammer was actuated by the operator.

The duration is the time from when the exceedance began, to when it ended. The Leq and SEL are calculated over this period. The Lmax is the largest instantaneous SPL achieved during this period.

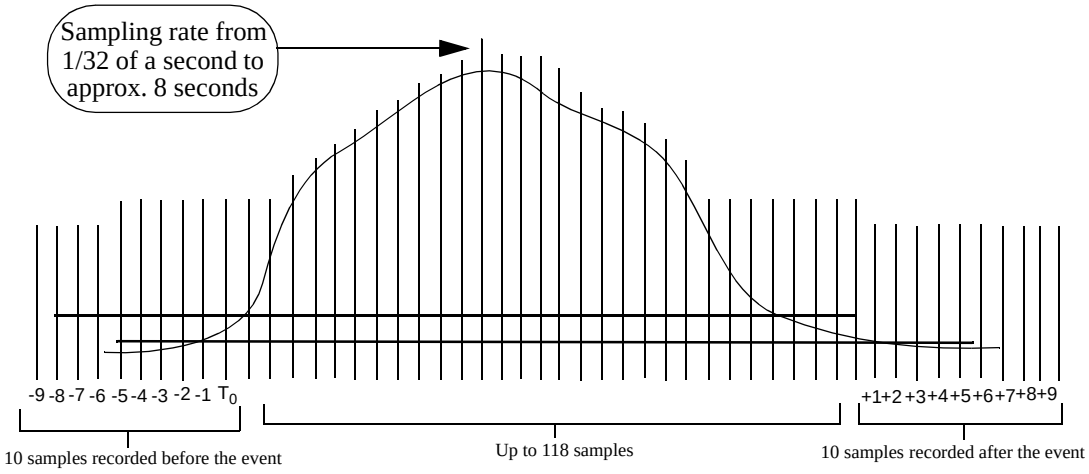
Exceedance Time History

A time history of the exceedance can be recorded and the sampling time is user selectable from 1/32 of a second to approximately 8 seconds. For a more detailed picture of a potential noise source the exceedance history can be very valuable.

In the case of a higher sampling rate, the 824 will give the end of the event priority.

A buffer is used to capture the Exceedance time history. This allows the 824 to store data prior to the triggering of the exceedance. The buffer holds 128 samples. That means that if you are sampling at 1/32 of a second, you can capture an event as long as four seconds. If your sampling rate is set at a maximum of 8 seconds, you can capture an event as long as 17 minutes. A typical sample periods is one second (enter 32 for “Excd T.H. Period”).

Below is a graph of a time history for an exceedance:



Hint: *Up to ten samples are stored prior to the trigger and up to ten samples are stored after the exceedance to give a graphical indication of the noise profile.*

Setting the parameters for an Exceedance History

Before setting the parameters for the Exceedance history or Exceedance time history it is recommended that you get familiar with the type of events you would like to capture.

Remember that the data recorded in the Exceedance history are: Duration, Leq, Lmax, SEL, Peak-I, Peak-II, time and date of occurrence (time at start of event or time of maximum level)

Referring to the diagrams on the following pages, configure the 824 with the following parameters:

Triggering

- SPL Excd Lvl 1 (70)
- SPL Excd Lvl 2 (90)
- Pk-1 (105)
- Pk-2 Excd Lvl (100)
- Hysteresis (2)

Excd Enable (Yes)

Min Duration (000)

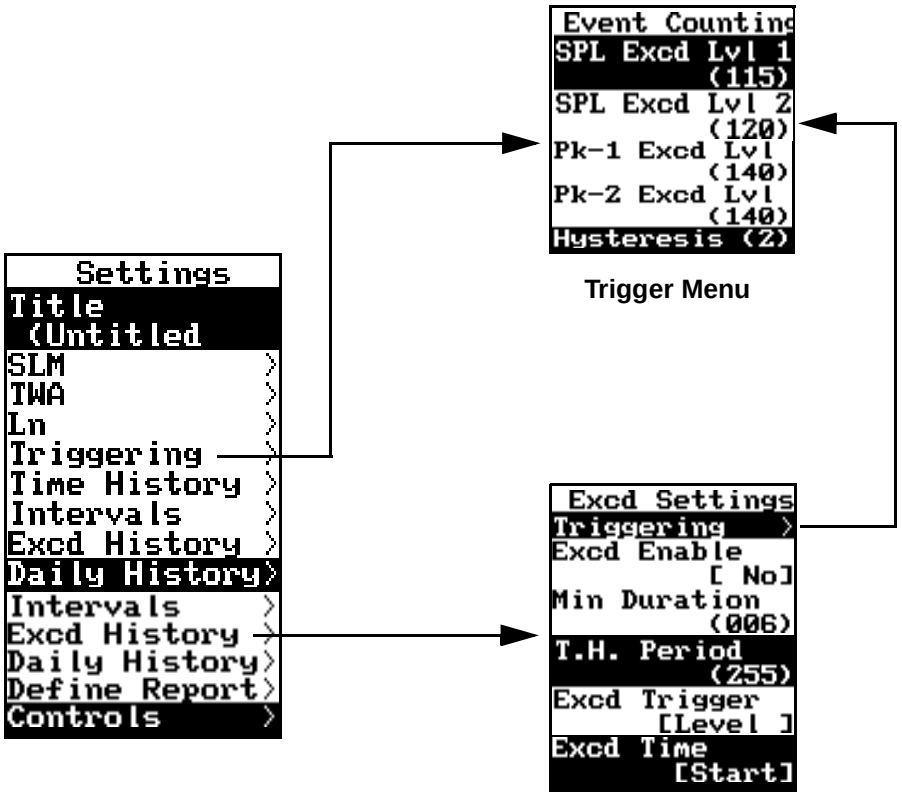
Excd Time-Hist(Yes)

T.H. Period (032)

Excd Trigger (Level)

Excd Time (Start)

Exceedance History & Triggering Menus



Trigger Menu

Exceedance History Menu

After configuring the 824, press the RUN/STOP key to begin a measurement. Since the “SPL Excd Level 1” is set to 70 dB, you will need a noise source which is louder than 70 dB to trigger an exceedance.

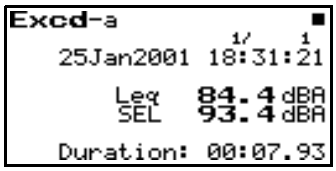
Whistle near the microphone for a few seconds while monitoring the sound level (make sure the level goes over 70 dB) to trigger an exceedance. Allow the meter to run for several seconds after triggering the exceedance in order for the level to drop below the hysteresis level. Press the RUN/STOP key to stop the measurement.

Viewing Exceedance History Data on the 824

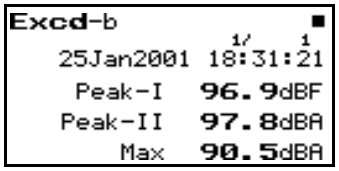
Press the VIEW key to access the view menu. Scroll down to “Excd History” and press the right arrow key. Select “Exceedance” by pressing the Check key. The exceedance data is shown on two displays “Excd-a” and “Excd-b”.

Use the arrow keys to step between the two exceedance displays.

Excd-a

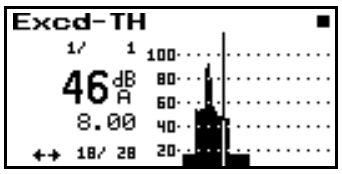


Excd-b



Time History

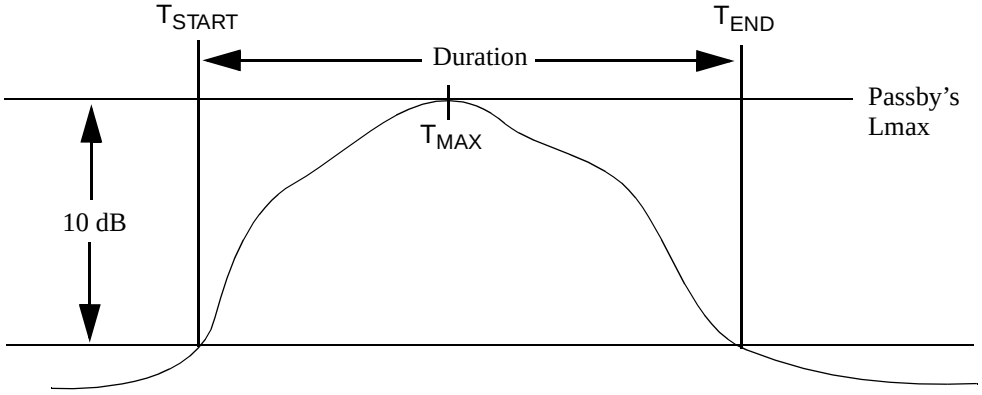
From either the “Excd-a” and “Excd-b” displays, press the Check ✓ key to access the “Time History” display.



The Exceedance time history is triggered off of the selected detector and uses a short Leq function to show actual energy.

PassBy Exceedance

When the parameter, “Excd Trigger”, is set to “Passby” a special event detector is selected that measures the Lmax, Leq, and SEL of the highest event to raise and lower 10 dB in SPL. It is used to capture single events such as a vehicle or aircraft passby, or other event noises such as blasts or gas jetting noise as required by certain ordinances or standards. In addition to the levels measured, the date and time of the Lmax and the duration of the event are recorded.



Only events that are longer than the minimum duration and having Lmax greater than the SPL Excd Level 1 will be recorded.

A time history of the PassBy exceedance can be recorded by turning on the “Excd Time-Hist”.

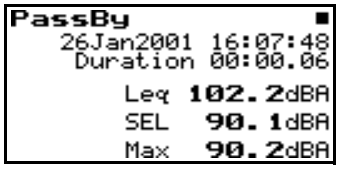
The largest passby event will be shown in the PassBy view.

PassBy Measurement

Whether or not you turn on the Exceedance history, the **PassBy function** will automatically record the highest passby to occur during the run time of the instrument.

You don't have to enable the Exceedance History to get a passby measurement. If you would like to record each passby measurement, then it is necessary to enable the Exceedance History and select "PassBy" under the "Excd Trigger" setting. The data for the PassBy function can be stored manually.

To access this display, press the VIEW V key, scroll down to "PassBy" and press the Check c key.



For the passby measurement, Lmax has to be higher than the "SPL Excd Level 1". It differs from the PassBy Exceedance in that it does not require the minimum duration set in the Exceedance History settings. It will record a passby event of any duration.

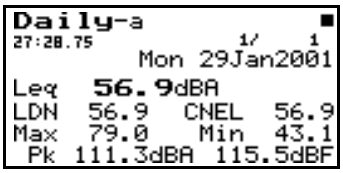
Daily History

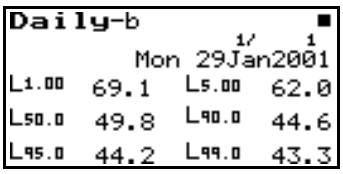
The Daily History is accessed from the VIEW ⊙ menu and is a special 24 hour history which logs daily sound statistics including the following:

- Leq 24 (equivalent energy level over 24 hour period)
- L_{dn}
- CNEL
- Ln's
- Max
- Min
- Peak I
- Peak II

The measurement period is from 12:00 midnight to 12:00 midnight each day.

Use the ◀ ▶ arrow keys to step between the two Daily displays.





Explanation of L_{dn} and CNEL

L_{dn} and CNEL are similar to a 24 hour Leq except the nighttime hours are weighted.

The L_{dn} adds 10 dB to the Leq's measured during the hours of 10:00 PM to 7:00 AM.

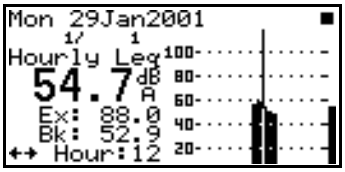
CNEL is similar to L_{dn} except that 5 dB is added to the measurement levels between 7:00 PM and 10:00 PM and 10 dB are added between 10:00 PM to 7:00 AM.

These measurements are used because people tend to be more sensitive to noise during the nighttime and early morning hours.

Hourly Statistics

For each hour the Daily History logs the following:

- Hourly Leq
- Background Leq
- Hourly Excd Leq



Hourly Leq

The Hourly Leq is the equivalent sound level calculated over an hour period for each hour during the day.

Background Leq

Background Leq can be considered the Leq expected if the exceedances had not occurred.

The Background Leq is the total hourly energy (hourly Leq) minus the total energy (event Leq) of any valid event during that hour.

Hourly Excd Leq

The Hourly Excd Leq is the total energy for all exceedances that occurred during that one hour period.

Hint: *What happens if there is an exceedance at the change of the hour? Since most events are rather short in duration, the hour is extended until the exceedance ends (up to 30 seconds). If after 30 seconds the exceedance has not ended, the exceedance is split and the new hour begins. This slight deviation in timing creates no noticeable errors in data and facilitates the proper calculation of Hourly Background Leq.*

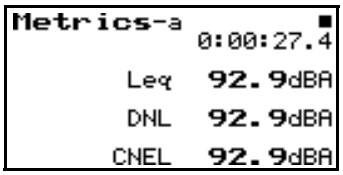
Metrics

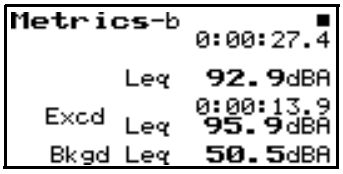
The Metrics display provides comparative information for DNL, CNEL, Excd Leq, Bkgd Leq and Leq for the elapsed time or run time of the instrument.

The data in the Metrics display is always recorded and saved with the broadband data.

The Metrics display differs from the Daily History in that the values are integrated over the run time of the instrument instead of a 24-hour period.

Use the ◀ ▶ arrow keys to step between the two Metrics displays.





DNL (L_{dn})

The DNL (Day-Night Average Sound Level) is the equivalent sound level for the entire measurement period with a +10 dB weighting applied to all sounds occurring between the time of 10:00 PM to 7:00 AM.

CNEL

CNEL is similar to L_{dn} except that 5 dB is added to the measurement levels between 7:00 PM and 10:00 PM and 10 dB are added between 10:00 PM to 7:00 AM.

These measurements are used because people tend to be more sensitive to noise during the nighttime and early morning hours.

Background Leq

Background Leq can be considered the Leq expected if the exceedances had not occurred.

The Background Leq is the total energy minus the total energy (event Leq) of any valid event during the entire measurement period.

Excd Leq

The Excd Leq is the total energy for all exceedances that occurred the entire measurement period or run time of the 824.

CHAPTER

3 RT60 Measurements

The versatility of the 824 includes the measurement of RT60 or reverberation time. This capability combined with advanced triggering features allows the use of a noise generator without an interconnecting cable to the 824.

Those of you involved in determining decay times of rooms, theatres, or any acoustic space designed for a specific acoustic application or in analyzing the absorptive qualities of walls, doors, barriers or partitions will find the 824 to be a valuable tool in your arsenal.

What is an RT60 and how is it measured?

RT60 Defined

Sound decay measurements are used to determine the sound absorption characteristics of a room. This is also known as the reverberation time or the decay time.

The reverberation time in a room at a given frequency is the time required for the sound pressure level to decay from a steady state value by 60 dB after the sound suddenly ceases.

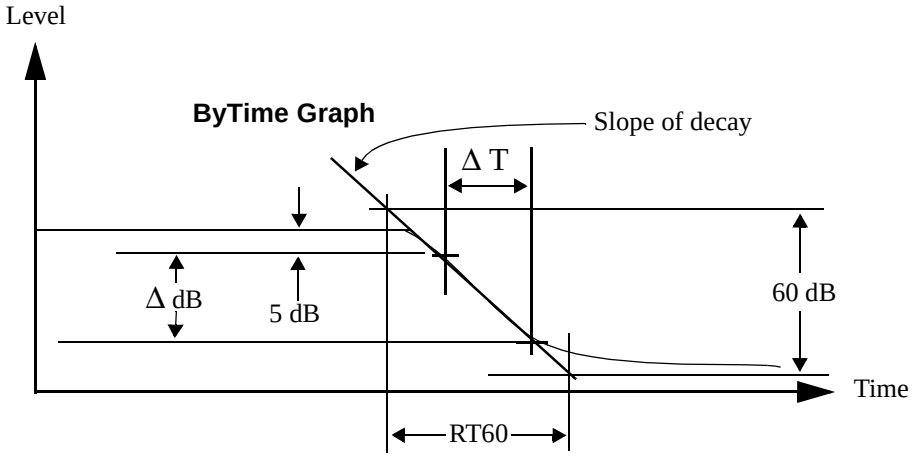
For example: A room is excited with a gun blast or a balloon pop and the maximum sound pressure level reached is 115 dB. RT60 is the amount of time it would take for the room to absorb the acoustic energy such that the sound pressure level reaches 55 dB. Typical values of reverberation times are between .01 to 3.5 seconds.

Though RT60 specifies that the time be measured for a level drop of 60 dB it is unlikely that 60 dB drop be obtained. Therefore, RT60 is actually a slope function with the drop of

the level by some dB for some time and extrapolated to obtain a time for a 60 dB drop

How does my 824 measure an RT60?

RT60 measurements are usually made with real-time analyzers with 1/3 octave filters. The 824 uses the high speed RTA option to gather spectra at a rate of up to 400/second. These spectra are stored in what is known as an autostore ByTime record. The ByTime autostore records show each time slice (2.5mS) as the sound is decaying in the room. The "ByTime" display of the 824 shows each of the 1/3 octave frequencies over time. The following diagram shows the level versus time of a single frequency.



The curve above could be any 1/3 octave frequency from 12.5 Hz to 20 kHz. For each of these frequencies a ByTime curve is generated. The slope of the decay part of the curve determines the time it takes the sound to decay.

$$RT60 = \frac{\Delta T}{\Delta dB}$$

The slope is determined by using the least squares method for a dB down setting chosen by the user.

Taking an RT60 Measurement

This next section will take you through a step by step process for acquiring an RT60 measurement.

Exciting the Room

To find out the absorption qualities of a particular room using an RT60 measurement, you will have to energize the room with some sound source. There are two basic methods for energizing a room with sound:

- A continuous noise source such as a pink noise generator and a speaker (preferably an omni-directional speaker).
- An impulsive noise source such as a starter pistol, canon, balloon, etc.

Setting up the 824 for an RT60 measurement

For an RT60 measurement use the RTA instrument of the 824.

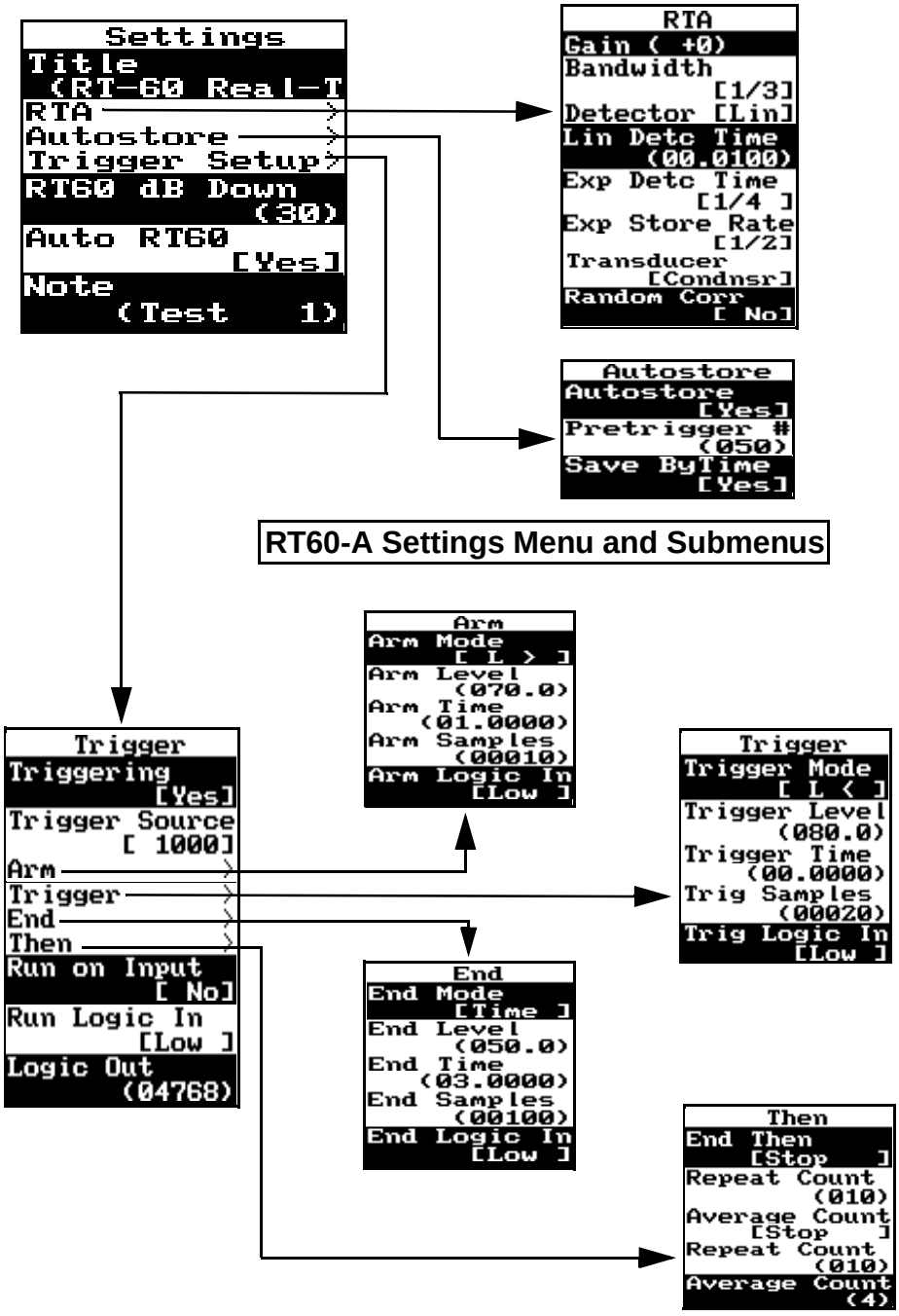
Step 1 To select the RTA instrument, press the SETUP ⊘ key. Use the up and down arrow keys and highlight either “RT60-A” or “RT60-B” and press the Check ⓥ key.

RT60-A and RT60-B Setups

There two setups named “RT60-A” and “RT60-B”. The “RT60-A” setup is configured to gather data to measure an RT60 by exciting a room with steady sate noise (typically using a pink noise generator and speaker system). The “RT60-B” setup is configured to measure an RT60 by exciting a room with impulsive noise such as a gunshot or popping a balloon or paper bag.

Step 2 Press the SETUP ⊘ key again. With “Edit Settings” highlighted, press the Check ⓥ key. The following page shows the settings for RT60-A.

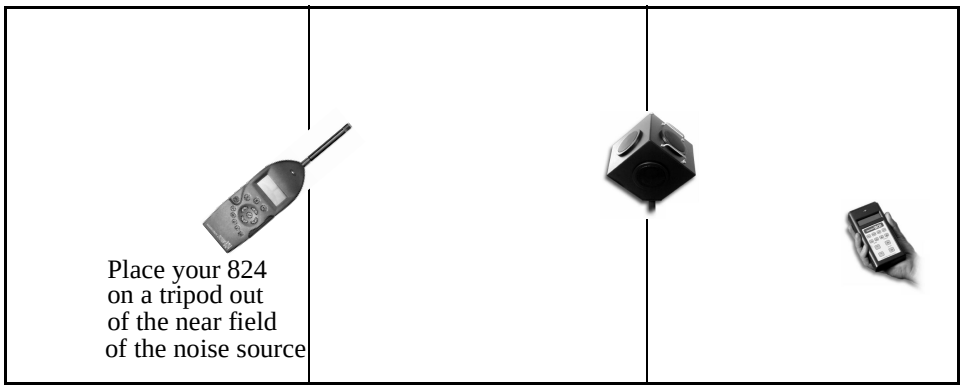
NOTE: The menus are the same for all RTA instruments.



RT60-A Settings Menu and Submenus

See the 824 Reference Manual, chapter 10, for details concerning each of the setup parameters.

Since the RT60-A setup is already configured to take a measurement using steady state noise, let's setup our generator and speaker to energize a room with noise.



Step 3 Just to get a feel for an RT60 measurement, configure your speaker, and 824 as shown above.

Hint: *Before making an RT60 measurement keep the following in mind:*

- The background noise in the room should be kept to a minimum. If possible turn off any noise makers such as HVAC systems. Shut all windows and doors and do it during an appropriate time of day when your test will be free of interference.

Caution: Wear hearing protection when generating noise levels of 90 dB or more. Remember that levels will be greater near the noise source.

- Make sure you can energize the room with enough noise to get a valid measurement. 100 dB would be an ideal level but is not always achievable. Shoot for a level between 60 to 80 dB.

- It is preferable to use an omni-directional speaker to get uniform coverage in the room. If you have to use a single speaker, direct its energy into a corner to obtain better results.

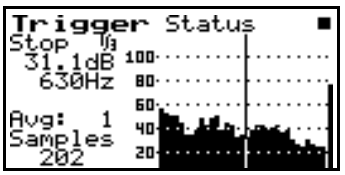
WARNING! Be careful when driving your loudspeaker as pink noise has equal energy per octave. Over driving them may cause failure. This is especially true for high frequency transducers (tweeters) which may have reduced power handling capabilities.

You can trigger your pink noise ON & OFF manually though you may find pulses of noise more convenient.

Step 4 You will need to configure your generator (Larson Davis SRC20) to output pink noise in pulse mode with an ON time of 2 seconds and an OFF time of 5 seconds. Unmute the generator to drive the amplifier for a test run to check your levels in the room. Adjust levels on the amplifier if necessary.

Step 5 If the levels are within 80 to 100 dB you are now ready to take a measurement. Press the VIEW key, highlight "Trigger" and press the right arrow key. Select "Status" and press the Check key.

Trigger Status



The "Trigger Status" display will show these four states sequentially as the measurement is taken:

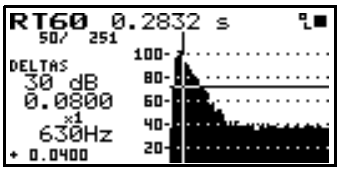
- Stop
- Ready
- Armed
- Triggered

NOTE: Triggering is performed on one frequency band (or Flat) as selected by the "Trigger Source" setting. If desired you may change this to a band that has the energy profile that will be best to trigger from.

Step 6 Press the RUN/STOP key on the 824 to put the 824 in the "Ready" mode. Start the generator to energize the room with noise. As the noise pulses ON and reaches a level > 80 dB the 824 will change to the "Armed Mode". When the generator pulses OFF and drops below 80 dB the 824 will change to the trigger mode and start recording an autostore. After 3 seconds the autostore will end and the 824 will stop.

You now have an autostore record in memory from which the RT60 can be calculated.

Step 7 Press the VIEW key, highlight "Autostore" and press the right arrow key. Select RT60 and press the Check key.



To easily access the RT60 menu to change the "RT60 dB Down" parameter, press the Check key from the RT60 display.

With the "Auto-Select" feature selected, a vertical line or cursor will be positioned on the time sample that is 5 dB below the maximum level. A horizontal line will be drawn at the level that is the number of dB down from the cursor level. The RT60 will be calculated using the least squares method on the data between these two points.

To view each frequency, use the up and down arrow keys.

Hint: *Due to the differing geometries and acoustic characteristics of some rooms, a perfectly linear decay curve may not always be obtained. Using the left and right arrow keys a custom start point can be chosen and the "RT60 dB Down" setting can be adjusted, as desired, to bound the area of slope calculation.*

Advanced RT60 Measurements

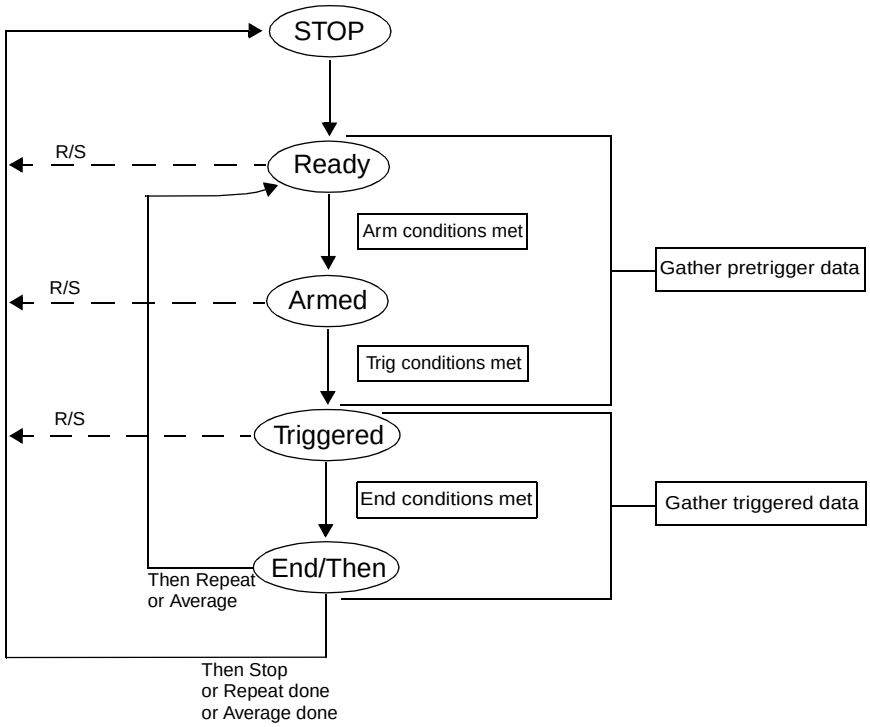
Since every room or situation may be different, it may be necessary to make some adjustments to the standard settings provided in "RT60-A" and "RT60-B".

A more accurate appraisal of the reverberation time of the room can be made by averaging together several measurements possibly at varying locations.

Triggering

A good understanding of the triggering menu and its capabilities will help you better make setting choices for your particular application. The diagram on the following page discusses these five states:

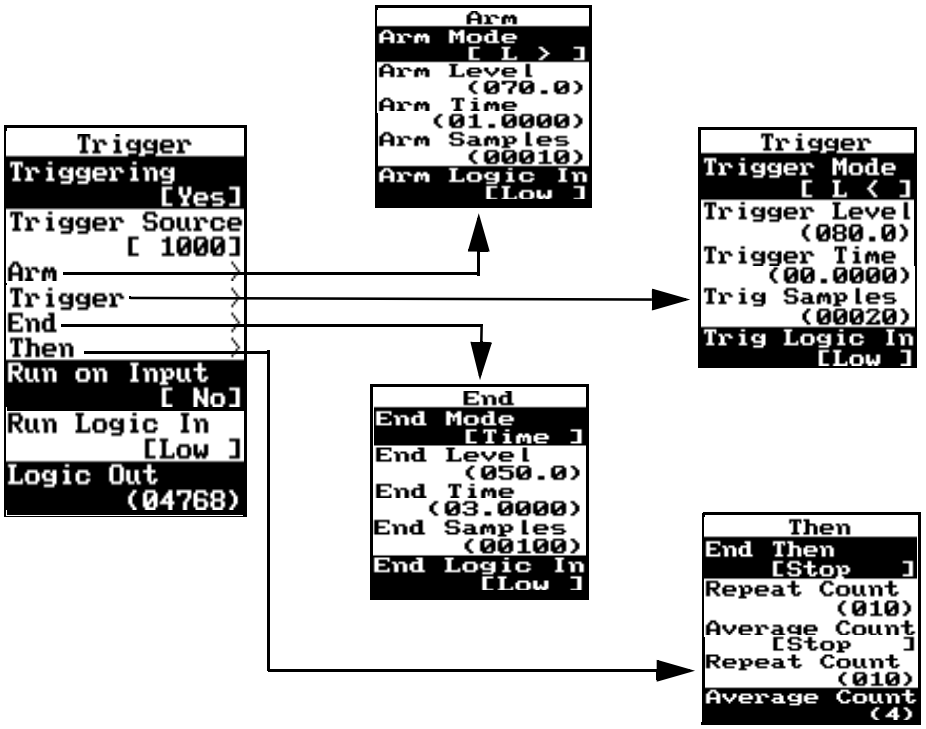
Stop, Ready, Armed, Triggered, End/Then



Arms when the selected condition is met	**Triggers** when the selected condition is met	**Ends** when the selected condition is met
Immediately when arm condition is set to “Now”	Immediately when trigger condition is set to “Now”	The RUN/STOP (R/S) key is pressed
Level is equal to or greater then or less then a preset level for a certain amount of time	Level is equal to or greater then or less then a preset level for a certain amount of time	Level is equal to or greater then or less then a preset level for a certain amount of time
Logic In line changes	Logic In line changes	Logic In line changes
A preset amount of time has passed (“Time” setting)	A preset amount of time has passed (“Time” setting)	A preset amount of time has passed (“Time” setting)
A preset number of samples have been taken	A preset number of samples have been taken	A preset number of samples have been taken

Customizing the Trigger Menu

Following the diagram below, access the trigger settings by pressing the SETUP ⊘ key. With “Edit Settings RT60-A” highlighted press the Check ⓨ key. Scroll down to “Trigger Setup” and press the right arrow key. From here you can customize the trigger settings for a particular application.



Averaging

The average data does not take any additional memory. Each additional measurement will be averaged insitu with the first. The END condition must be TIME or SAMPLES so that the records are all identical lengths.

To average several measurements together go to the “Then” menu and change “End then” to “Average”. You also need to change the “Average Count” to the number of additional measurements you would like to average to the first. For example, select 4 counts. For each location five triggered measurements will be averaged together (the first one plus 4 averaged repeats).

A pulsing noise generator may be very helpful. Each pulse can trigger a new measurement without any user intervention.

Press the RUN/STOP key on the 824 to put the 824 in the "Ready" mode. Start the generator to energize the room with noise. As the noise pulses ON and reaches a level > 80 dB the 824 will change to the "Armed Mode". When the generator pulses OFF and drops below 80 dB the 824 will change to the trigger mode and start recording an autostore. After 3 seconds the autostore will end and the 824 will be ready for the next average. Repeat this four times until the 824 is in the STOP mode. You now have five averaged records for one location. Move to another location in the room and press the RUN/STOP key again to average five more pulses as a new autostore record.

End Time

It is very likely the room you are measuring may have a shorter or longer reverberation time than the 3 seconds selected in the "End" menu. If the reverberation time is much shorter it is not necessary to store additional unneeded samples which would take more memory. If the reverberation time is longer you will need to increase the "End" time.

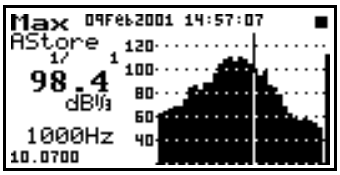
Trigger and Arm Levels

As you get a feel for the sound in the room and the triggering capabilities of the 824 you will be able to fine tune the 824 to optimize room measurements. The trigger and arm levels can be easily adjusted to work with your noise source. Remember that the level adjustment is also tied to trigger time and arm time. The sound must meet both the level that is set for a certain amount of time before it changes to the next state.

Autostore Display

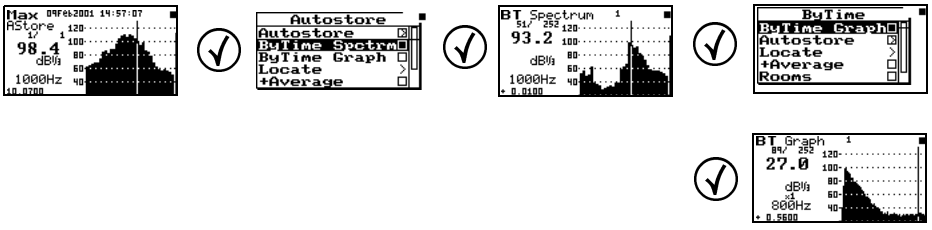
Use the "Autostore" display to see the energy distribution in the Leq and Max spectra.

Press the VIEW key and select "Autostore". Press the right arrow key to open up the "Autostore" menu. Select "Autostore" again and press the right arrow key. Highlight "Leq" or "Max" and press the Check key.



The following diagram shows the key presses necessary to view the Leq and Max displays:

From the Leq, Max, or Min display, pressing the up ⏶ and down ⏷ arrow keys will take you from one autostore record to the next. Pressing the Check ✓ key will put you in the "Autostore" check menu. From the "Autostore" check menu you can view the ByTime spectra and ByTime graph (each frequency over time).



NOTE: If an averaged measurement record gets corrupted, perhaps by some extraneous noise, that one record can be deleted using the Delete Last function. See chapter 3 in the 824 Reference manual for an explanation of this function.

Index

Numerics

A

B

C

D

E

F

H

I

K

L

M

O

P

R

S

T

V

W