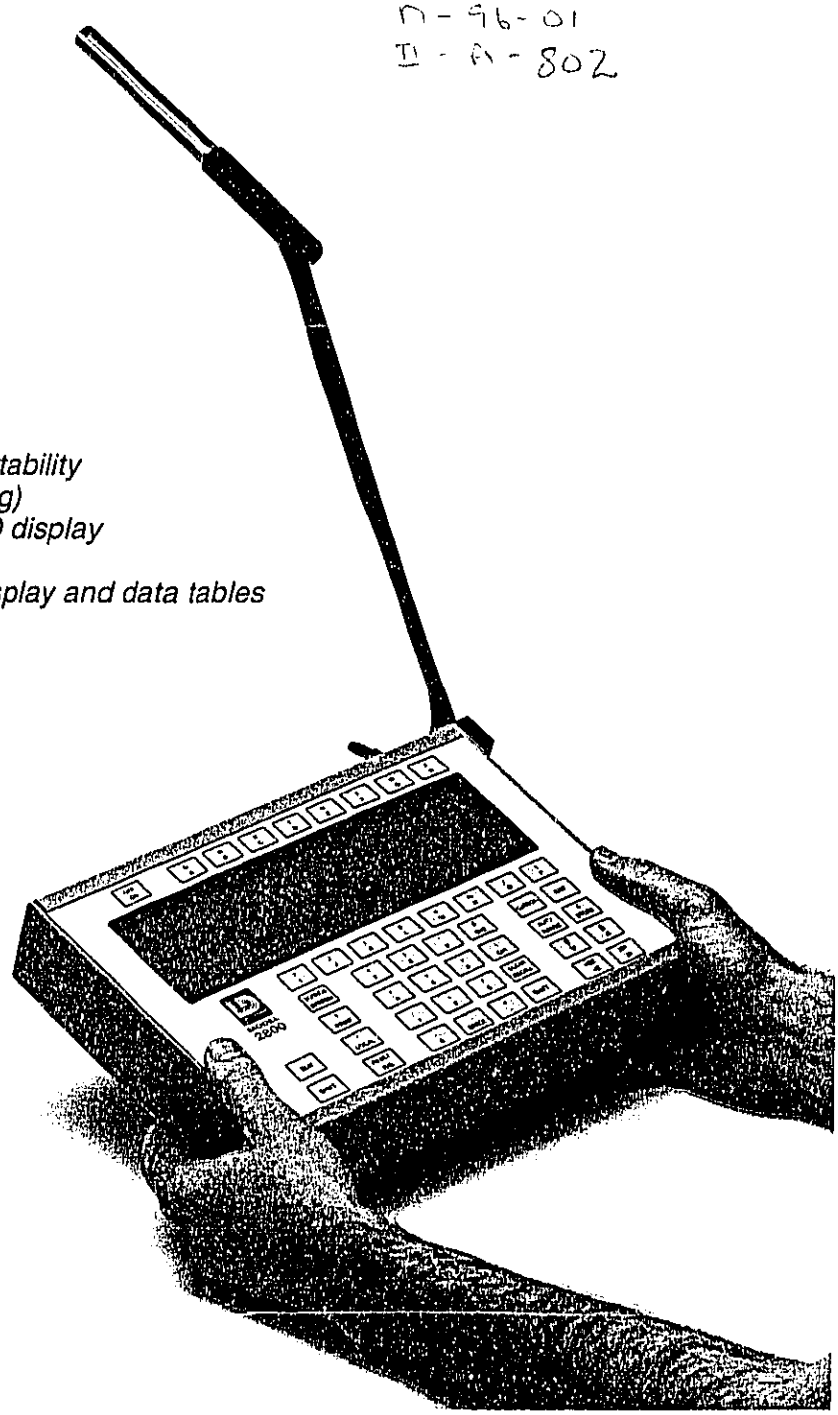
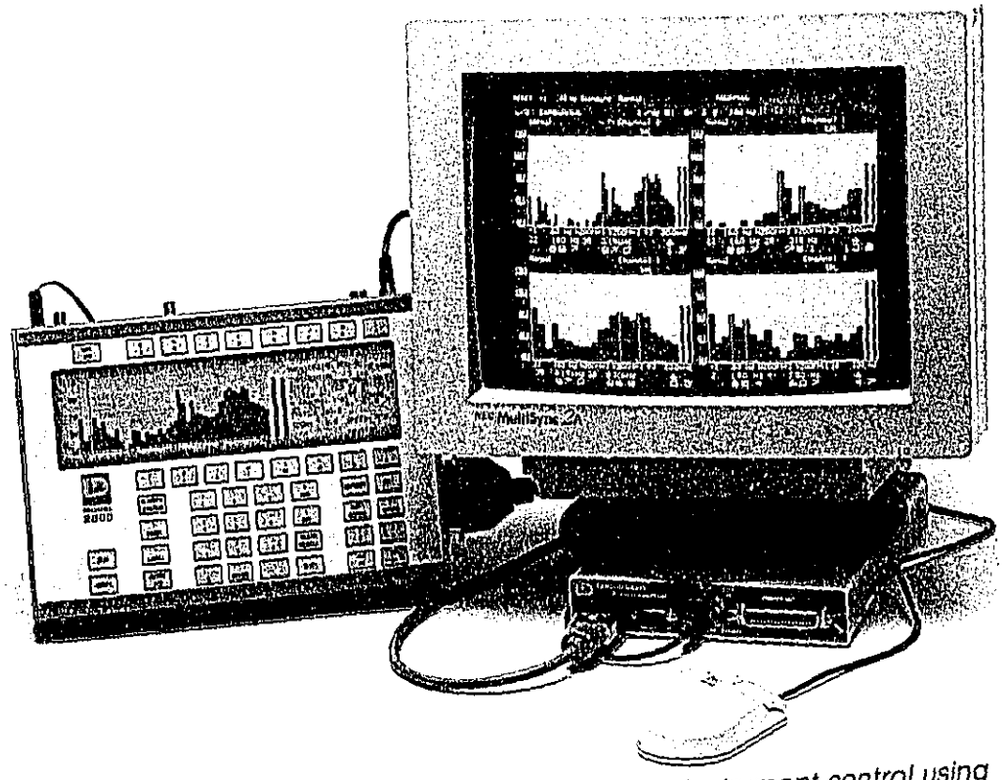
In The Field...

II-A-802

- *True battery powered portability*
- *Lightweight; 7.5 lb. (3.4 kg)*
- *High-contrast backlit LCD display*
- *AC/DC outputs*
- *Direct printout; screen display and data tables*



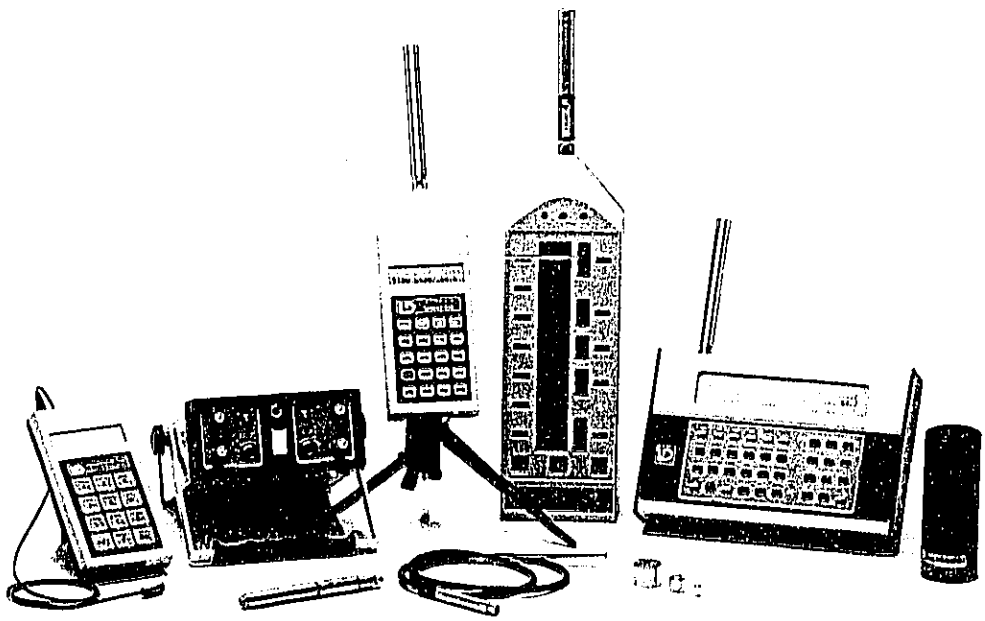
...In The Lab



Multi-Window Color Display using Model 2500 Color Video Adapter and EGA, VGA or SuperVGA Monitor

Complete instrument control using mouse with pop-up and pull-down menus.

A Family Of Quality



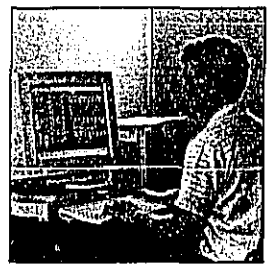
LARSON • DAVIS
LABORATORIES

1681 West 820 North • Provo, UT 84601 U.S.A. • 801-375-0177 Telex 705560 FAX 801-375-0182

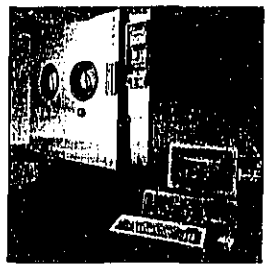
Company Profile:

Larson Davis Laboratories has been designing and manufacturing precision instruments for the measurement and analysis of sound and vibration since 1981. Their diverse product line includes condenser microphones and accessories, handheld sound level meters, portable real-time frequency analyzers, noise dosimeters and environmental noise monitoring systems. They are a major supplier of integrated systems used around airports for the measurement, analysis and real-time mapping of noise related to aircraft operations.

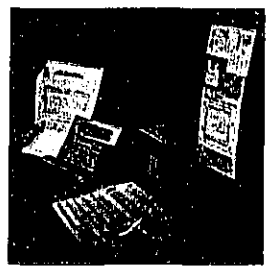
Larson Davis Laboratories makes extensive use of the most modern hardware and software technologies in their design, manufacturing, quality control, and instrument service/calibration activities.



CAD-CAM (Computer Aided Design and Manufacturing) has played an important role since the very beginnings of the company.



Environmental chambers with programmed cycling of temperature and humidity are used on a regular basis for the development of new products and the qualification of products intended for outdoor applications.



Automated testing systems are used extensively for quality control verification of product performance prior to shipping.

Analog Outputs

AC output: 5 volt full scale

DC Output: 0-5 Volts

Display Characteristics:

Internal LCD:

Type: Flat panel, supertwist with anti-reflective treatment
Backlighting: Electroluminescent
Contrast: Adjustable: dark to full sunlight
Size: Height 2.6 inch (6.60 cm)
Width 9.3 inch (23.62 cm)
Resolution: 128 X 489, with full graphics and alphanumerics

External Color Display (Color Video Adapter required):

1, 2 or 4 display windows using EGA, VGA or SuperVGA Monitor

Environmental:

Operating Temperature: 13 to 122 °F (-10 to 50 °C)

Storage Temperature: -13 to 158 °F (-25 to 70 °C)

Relative Humidity (non-condensing): 90% max at 104 °F (40 °C)

Physical

Size: 11" wide x 7.75" high x 2.4" thick
(28 cm x 19.7 cm x 6.1 cm)

Weight: 7.5 lb. (3.4 kg)

Power

Battery Power:

Typical operating time in Run mode is 4 hours using removable NiCd pack supplied with the instrument, reduced by operation of the noise generator and the floppy disk drive. When On, but not Running, power consumption is reduced by approximately 40%. When using the AC/DC converter supplied with the instrument, the NiCd battery pack is charged while within the instrument. Typical charge time after total discharge is 15 hours.

DC Power:

5-18 VDC. Typical current requirements:
1.5 Amp @ 5 Volt; 0.5 Amp @ 16 Volt
AC/DC converter is supplied with the 2800/2900

FFT Bandwidths:

Linear single, linear repeat, exponential,
Exponential by N (number of spectra),
Count single (number of spectra),
Count repeat (number of spectra),
Count manual (number of spectra, manual accept)

Digital Display Weighting:

For Standard (2800/2900) and Intensity Analysis (2900 only) Modes;
Octave and FFT Bandwidths:

No weight, A-weight, C-weight, user weight,
-(A-weight), -(C-weight), -(user weight)

Units:

dB re 1 µV, dB SPL, dB re 1 pW/m² (intensity),
dB re 1 pW (sound power), user definable (and named) units, log or linear scale, including:

single or double integration
single or double differentiation
scaling factor

User selectable bandwidth compensation
(eg, power spectral density)

Memory:

CMOS Non-volatile:

256 KB standard (typical capacity of 992 1/3 octave or 142 800-line FFT spectra)
Additional 1 MB available

Floppy Disk:

External 3 1/2" MS-DOS™ compatible floppy disk drive, powered from the 2800/2900, is available as an option. Supports high density (1.44 MB) and low density (720 KB) format disks.

Noise Generator:

The optional noise generator provides pink and white broadband random noise, with the On/Off synchronized with byTime autostore for automatic measurement of sound decay in rooms. It can also provide a sequence of digitally repeatable one millisecond duration noise bursts with the repetitions rate user adjustable.

Digital Output and Control:

Printer Output: Centronics™ Parallel Port for use with Epson™ compatible printers with graphics capability. Also used for communication with Model 2500 Color Video Adapter

Computer Interface: RS-232

FFT:

100, 200, 400, 800 line FFT analysis
Upper frequency limit: 20 kHz in 4 ranges (1 or 2 channels)
Maximum real-time frequency: 20 kHz (1-channel)
10 kHz (2-channel)

Zoom Capability:

Real-time zoom: X256
Buffered* (non-real-time) Zoom:
X64 (1 channel)
X32 (2 channels)
* applies when operating in a non-real-time frequency range

Time Domain Windows (FFT analysis):

Rectangular, Hanning, Flat-Top, ZeroPad* (w or w/o Bowtie correction), Impact*, Exponential*

*2900 Only

Triggering:

Continuous (free-run)
Digital remote (via interface)
Frequency domain: level in selected frequency band
Time Domain: Level in channel 1 (- 99% to +99% full scale)
adjustable ch 1 delay (±)
adjustable ch 2 delay w/r to ch 1 (+ only)

Measured And Displayed Parameters:

Sound Level Meter Mode (2800/2900):

Simultaneous measurement of sound pressure level (A, C or Linear weighted) corresponding to the following detectors: RMS Slow, RMS Fast, Min and Max (RMS Slow and RMS Fast), Impulse, Leq, Peak, Taktmaximal 3 and Takmaximal 5.
A time history trace of RMS Slow, RMS Fast, Leq, or Impulse is displayed in real-time, simultaneously with a frequency spectrum display.

Standard Analysis Mode (2800/2900): Octave and FFT

Normal, Leq, Max, Min and SEL Spectra; plus MaxSpec

Intensity Analysis Mode (2900 only): Octave and FFT

Intensity, SPL, Particle Velocity, Quality (Int/SPL)

Cross Channel Analysis Mode (2900 only): FFT

Autospectra, Cross Spectra, Transfer Functions (H1,H2), Inverse Transfer Functions, Coherence, Coherent Output Power, Waveforms, Weighted Waveforms, Auto-correlation, Cross-correlation, Impulse Response, Cepstra, Liftered Spectra

Cross Channel Analysis Mode (2900 only): Octave Bandwidths

Autospectra, Cross Spectra, Transfer Functions (H1,H2), Inverse Transfer Functions, Coherence, Coherent Output Power

Digital Averaging:

Octave Bandwidths:

Linear Single: 0.0025 sec's to 278 hours
Linear Repeat: 0.0025 sec's to 278 hours
Exponential: 1/64 sec to 512 sec's, binary sequence
BT/Exponential: 1 to 32,768 BT products,
binary sequency, Exponential averaging
BT/Lin: 1 to 32,768 BT products,
binary sequency, Linear averaging

Specifications

Input

Measuring Range: - 10 to 200 dB SPL with appropriate transducer
Impedance: 10 GΩ ‖ 2.0 pF with preamplifier
Polarization Voltage: 0, 28, 200 VDC
Gain: - 30 to 90 dB in 10 dB steps
Connector: Multi-pin for use with Larson•Davis Models 900B (1/2") and 910B (1/4") microphone preamplifiers and ECXXX microphone extension cables.
Adapters: Available for use with ICP accelerometers and direct voltage inputs.

Analog Input Filters:

Highpass/Lowpass Filters:
3-pole Chebyshev
Highpass: 1 Hz, 20 Hz
Lowpass: 10 kHz, 20 kHz
A-weight and C-weight Filters:
in accordance with the following:
ANSI S1.4-1983 Type 0
IEC 651 Type 0 and IEC 804 Type 0

Digital Characteristics:

Digitization:
16-bit A:D per channel
Anti-aliasing:
Oversampling delta-sigma converter providing anti-aliasing stop band rejection >96 dB
Detector:
Digital true RMS with 0.1 dB resolution
Dynamic Range:
> 80 dB
Amplitude Stability:
± 0.1 dB
Amplitude Linearity:
The greater of ± 0.05 dB or ± 0.005% of the maximum input signal. Linearity is measured using a sine wave test signal in the upper 40 dB of the dynamic range. For signals more than 40 dB below maximum input the linearity is measured using a two-tone test procedure.

Filters:

Octave and Fractional Octave:
1/1 and 1/3 octave real-time digital filters
Satisfying or exceeding requirements for ANSI S1.11-1986
Type 0-AA and Type 1-D (user selectable) and IEC 225.
Lower Frequency Limit: 1 Hz
Upper Frequency Limit: 20 kHz (1-channel)
10 kHz (2-channels)

Digital Communication:

The 2800/2900 includes an RS-232 interface with a transfer rate up to 19,200 Baud for communication with external digital devices such as computers and modems. The instrument can be completely controlled by an external computer via this interface.

Software is available from Larson Davis Laboratories for use with IBM PC™ and compatible computers to provide bi-directional transfer of data records and instrument setups, 2-D and 3-D graphics and data file conversion to ASCII format for use with other software programs.

LCD Display for the Field:

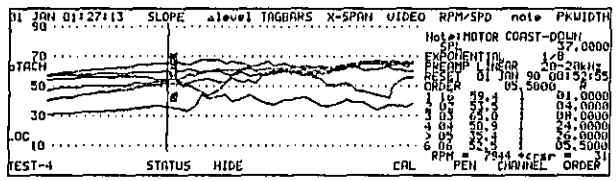
Under battery power, an adjustable backlit non-reflective supertwist LCD display provides excellent viewing, in darkness and under the brightest sunlight.

Multi-Window Color Display and Mouse Control for the Lab:

A hardware module is available which permits the 2800/2900 to communicate with an EGA, VGA or Super VGA color monitor through the Centronics" interface. This rapid interface permits near real-time display of data records from the instrument using 1,2 or 4 data windows.

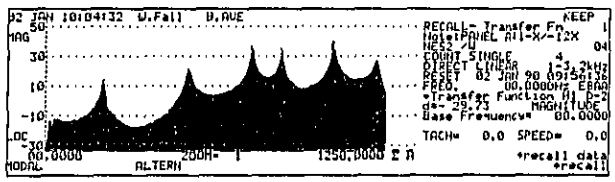
Using pop-up windows on the monitor screen, mouse control of the instrument and external monitor through the hardware module provide a user interface which is far superior to reaching out and pressing front panel keys. Optimize your use of desk or table space by placing the color monitor on top of the Color Video Adapter, the instrument in a remote location (maybe underneath), and just point and click!

Using a procedure called post-process order tracking, the spectral data can be rescaled based on the RPM value stored with each spectrum to produce a similar graphic plot in which each curve represents a specific order number and channel number, the order referenced to the RPM value.

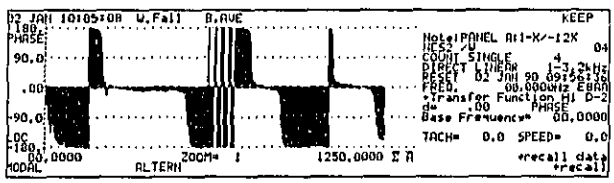


Order Levels versus RPM

Structural Testing and Modal Analysis (Model 2900 only): The Model 2900 can measure transfer functions (H1 and H2) and coherence with up to 800-lines of resolution for the analysis of structures and to serve as input for modal analysis. An adjustable time domain trigger and impact and exponential time weighting windows are provided for use with impact excitation using an instrumented hammer. A number of popular modal analysis software packages already provide interfaces to the Model 2900.



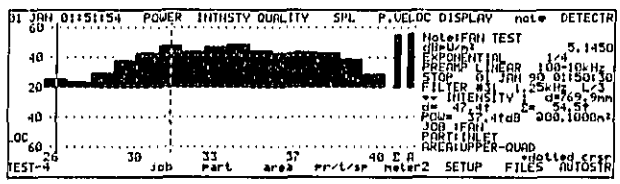
Transfer Function; Magnitude



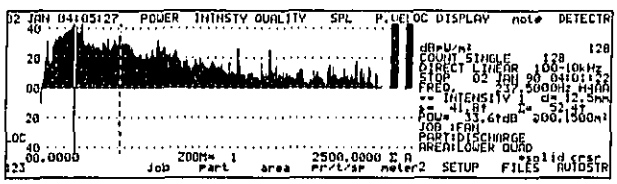
Transfer Function; Phase

Graphic and Tabular Printouts:

A Centronics™ parallel interface is provided for use with Epson™ compatible printers to produce both a graphic hardcopy of the screen and a tabular data printout of levels as a function of frequency or time. All parameters which can be displayed on the 2800/2900 screen can be printed in this manner.



1/3 octave intensity

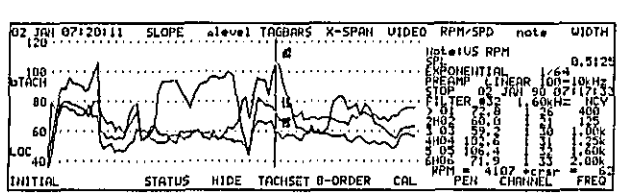


FFT Intensity

Within the Model 2900, individual intensity measurements can be identified within a three-level hierarchy designated as JOB:PART:AREA, where the JOB is divided into a number of PARTs and each PART is further divided into a number of AREAs. At the conclusion of a testing sequence which could involve large numbers of individual intensity spectra, the user can use internal routines to sum these to determine the contributions of complete PART or JOB structures. For example, from a single set of intensity spectra one could determine the total sound power output, as a function of frequency, of an ENGINE (a JOB), that associated with just the FAN or FUELPUMP (PARTs of the JOB) or that radiated from AREA_10 (an AREA) of the BLOCK (a PART of the JOB).

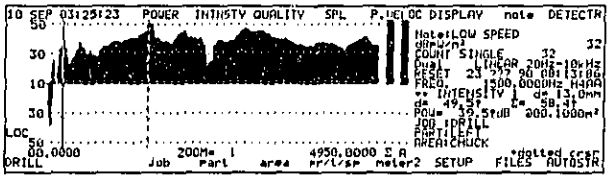
Automotive Testing and Machinery Analysis/Diagnostics (Model 2900 only): The Model 2900 includes a connector for the input of a signal from an external transducer producing a pulse train whose frequency is proportional to a desired parameter. Typical transducers include optical or eddy-current non-contact probes producing an integral number of pulses per revolution of a rotating shaft. The Model 2900 will display this frequency on the screen, scaled by the user for proper units. The Larson Davis Model T 100 Tachometer, a small battery-powered instrument which works with inductive, piezoelectric and optical probes, is ideal for these applications.

The Model 2900 has a byTach autostore capability whereby the storage of spectra is determined by the scaled value of this pulse train. In the case of a vehicle acceleration, the user could configure the 2900 to acquire spectra every 50 RPM between 1,000 and 6,000 RPM. He can further define the test to be an acceleration (runup) only, a deceleration (coastdown) only, or an acceleration followed by a deceleration such that the test sequence is terminated automatically. At the conclusion of the test, a unique graphics capability of the Model 2900 permits the display of up to six curves in the form of level versus RPM. Each curve will represent a specific frequency band and channel number. A sum band curve, linear or A-weighted, representing the total energy of the spectrum for a specific channel can also be generated.

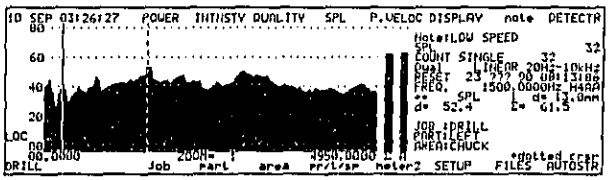


Frequency Band Levels versus RPM

Sound Intensity Measurements (Model 2900 only): Used with a Larson•Davis Sound Intensity Probe, the Model 2900 provides real-time measurement and display of Sound Intensity, Sound Pressure Level, Particle Velocity and Quality.

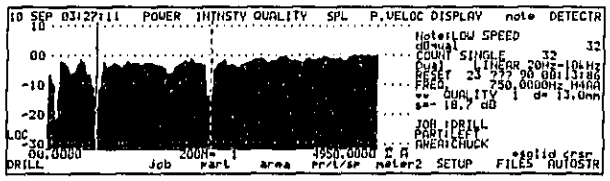


Sound Intensity Display



SPL Display

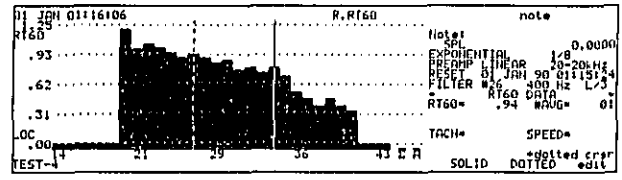
Sound Intensity can be a difficult measurement when the acoustic field is highly reactive. A large dynamic range is necessary and it is important that the Quality (intensity/SPL) of a measurement be examined in the field to determine to what degree the measurement being made is really an accurate representation of the sound intensity.



Quality Display

Sound intensity measurements for the purpose of quantifying the noise radiation of a device are most practically performed in 1/3 octave bandwidths. The octave frequency format is important for evaluating noise in terms of human response, and the 1/3 octave bandwidth represents a good compromise between the frequency resolution needed to differentiate between different source mechanisms and the size of the data blocks themselves. However, for optimal source mechanism identification, particularly with vibrating structures and machinery, the finer resolution of the FFT is desirable. The Model 2900 provides intensity in both formats.

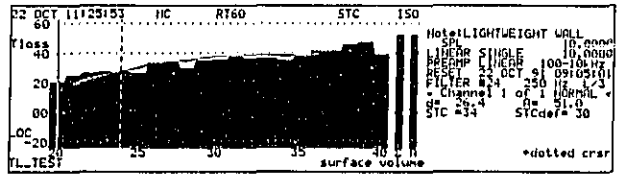
Or, a complete set of RT60 decay time values can be automatically generated for a range of frequency values based on user-defined upper and lower level thresholds.



RT60 versus frequency display

In a typical test of this type, the user would obtain several sound decay autostore records each at a number of different microphone positions. RT60 values extracted from different records using either of the above methods could be averaged together to increase the statistical accuracy of the RT60 measurement, or the autostored decay blocks themselves could be averaged together to obtain an averaged decay record from which to extract the RT60 values. The 2800/2900 offers numerous possibilities for averaging and editing of RT60 data.

For on-site sound insulation testing of walls and partitions, measure the source and receiving room spectra and use them with the RT60 data for the receiving room to obtain the transmission loss and the STC (ASTM) and Ia (ISO) ratings.

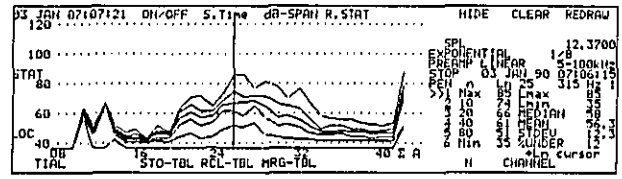


Transmission Loss with STC calculation and overlay

Loudness Level Measurements: When configured for 1/3 octave frequency analysis, the 2800/2900 measures loudness level in phons as specified by ANSI S3.4-1980 (R1986) and ISO Recommendation R 523.

Environmental Noise Analysis: To measure the statistical properties of environmental noise as a function of frequency, the real-time 1/3 octave analysis capability of the 2800/2900 is essential to ensure that the data for each filter band is based on the same measurements. With autoranging active, the 2800/2900 evaluates Ln values (n= 1-99) over a measurement range of 120 dB. Also calculated for each frequency band are Maximum Level, Minimum Level, Median Level, Mean level and Standard Deviation.

The user can view simultaneously up to six curves of Ln (user-selected) as a function of frequency.

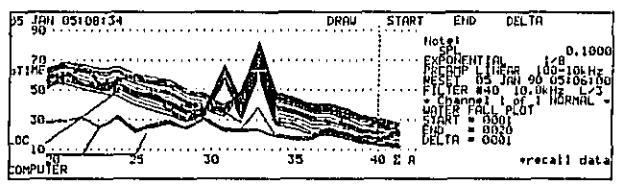


1/3 octave Ln display

Application Specific Hardware and Firmware:

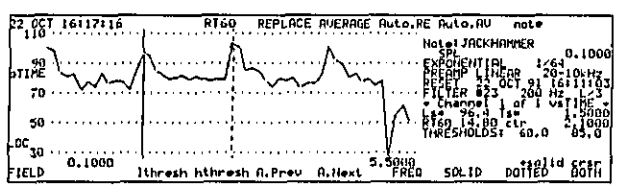
Transient Event Measurements: The 2800/2900 can autostore 1/1 and 1/3 octave spectra to memory as fast as 400 spectra/second, and FFT spectra as fast as they are produced from the processor. We refer to this as byTime autostore. Upon recall, the user may choose to simply page through them one-by-one, bringing each to the screen under manual control.

Or, he may select to examine them using the unique live waterfall display (2D) which sequentially draws the stored spectra, in slow motion, each overlaying the preceding ones, for dynamic visualization of the spectral changes in time.



Waterfall Display, 1/3 octave

Or, he may wish to examine the level versus time curve for any particular frequency band, with easy scrolling forwards and backwards through the frequency bands.

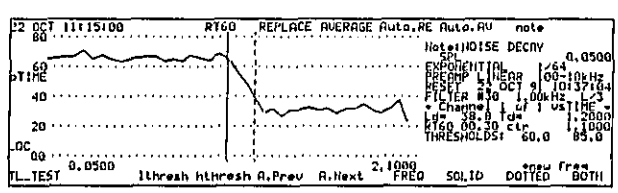


Time History Display; 200 Hz, 1/3 octave

Architectural Acoustics: The pink and white noise output from the optional noise generator can be synchronized with the byTime autostore to provide automatic measurement of sound decay data for all bandwidths simultaneously.

If using an external impulsive sound source, such as a pistol or breaking balloon, the frequency trigger function can be used to trigger the byTime autostore on either the rising or decaying level in a selected bandwidth.

Using the level versus time display format of the autostored spectral data, the RT60 decay time for any frequency band is determined based on a user-defined portion of the decay curve.



Sound Decay Display; 1 kHz, 1/3 octave

BUT IT TAKES MUCH MORE:

Signal Conditioning:

Proper signal conditioning is an integral part of making an accurate sound or vibration measurement.

Dual Microphone Inputs: The Models 2800 and 2900 have two independent microphone inputs. With the single channel Model 2800, the sound level meter and frequency analyzer signal processing operate in parallel. This means that both sound level measurements and frequency analysis can be performed simultaneously using either one or the other of these inputs. Two transducers can be connected at one time, with switching between the inputs performed manually or remotely via the RS-232 interface. With the dual channel Model 2900, when the sound level meter function is active, it functions as a Model 2800. When it is configured for a dual channel measurement, the one input is channel 1 and the other is channel 2.

The microphone power supplies associated with these inputs are optimized for use with Larson•Davis ultra low-noise microphone preamplifiers and precision condenser microphone cartridges. Polarization voltages of 0, 28 and 200 VDC are available. The unique high current output capability of the Larson•Davis microphone power supply permits the use of extremely long microphone cables without loss of sensitivity and minimal reduction of the flat region of the frequency response.

Accelerometer and Direct Inputs: Adapters are available to permit the microphone inputs to handle direct voltages and to drive integrated circuit piezoelectric (ICP) accelerometers.

Analog Filters: Analog highpass and lowpass filters at the inputs are useful for optimizing the dynamic range of the 2800/2900 for a particular measurement, such as when the input signal contains high level components outside the frequency range of interest. Broadband analog A and C-weighting filters at the inputs are important for acoustic measurements. The analog filters (broadband or highpass/lowpass) are selected independently for the sound level meter and frequency analysis functions.

The Model 2800/2900 also provides digital integration (single and double) and differentiation (single and double).

Data Storage:

Non-volatile CMOS Memory: 256 KB are provided; sufficient to store 992 1/3 octave or 142 800-line FFT spectra. An additional 1 MB of memory can be added.

3 1/2" Floppy Disk Drive: An external 3 1/2" MS-DOS™ compatible floppy disk drive, powered directly from the 2800/2900, is available from Larson•Davis. This disk drive supports both high density (1.44 MB) and low density (720 KB). A high density disk can store 5,748 1/3 octave or 817 800-line FFT spectra. Data and instrument setups can be transferred from the non-volatile memory to the floppy disk for archiving and to free-up the on-board memory. Data stored on the disk can be transferred directly to a PC and also back to the analyzer for utilization of the powerful post processing and graphics capabilities Model 2800/2900.

MODERN DSP TECHNOLOGY IS ESSENTIAL:

By utilizing the latest in digital signal processing (DSP) technology, this small, lightweight instrument functions as both a precision sound level meter and a single channel (Model 2800) or dual channel (Model 2900) real-time frequency analyzer.

As a Precision Sound Level Meter...

it meets or exceeds the following specifications over a 65 dB primary indicator range:

ANSI S1.4 1983 TYPE 1
IEC 651 TYPE 1
IEC 804 TYPE 1

providing simultaneous measurements of RMS Slow, RMS Fast, Min and Max (RMS Slow and Fast), Impulse, Leq, Peak, Taktmaximal 3 and Taktmaximal 5 using A, C or Linear weighting.

A time history trace of RMS Slow, RMS Fast, Leq or Impulse (user-selectable) is generated in real-time alongside a frequency spectrum display.

As a Frequency Analyzer

it provides 1/1 and 1/3 octave digital filtering and FFT analysis as follows:

1/1, 1/3 octave digital filters

Satisfying or exceeding filter requirements for ANSI S1.11-1986
Type 0-AA and Type 1-D (user selectable) and IEC 225

Lower Frequency Limit: 1 Hz

Upper Frequency Limit: 20 kHz (1-channel)
10 kHz (2-channel)

100, 200, 400, 800-line FFT analysis

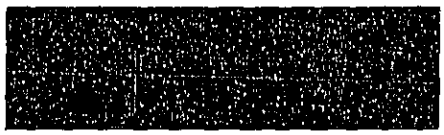
Upper Frequency Limit: 20 kHz

Real-time Rate: 20 kHz (1-channel)
10 kHz (2-channel)

Measure It Right

With Precision:

For accurate measurements of sound pressure level, the 2800/2900 meets or exceeds international sound level meter specifications for Type 1 accuracy.



Spectrum and Broadband Time History

and in Real-time:

For those "without compromise" sound and vibration measurements, the 2800/2900 provides the only fractional octave real-time digital filters meeting the highest ANSI filter classification of 0-AA in addition to 100, 200, 400 and 800-line FFT analysis with real-time rates exceeding many of the benchtop analyzers presently on the market.

1/3 Octave Spectrum

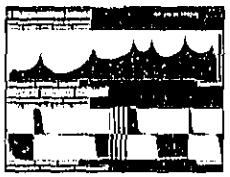
800-line FFT Spectrum

Display It Bright

In the Field:

The adjustable backlit non-reflective supertwist LCD provides excellent viewing, in darkness or under the brightest sunlight.

and in the Lab:

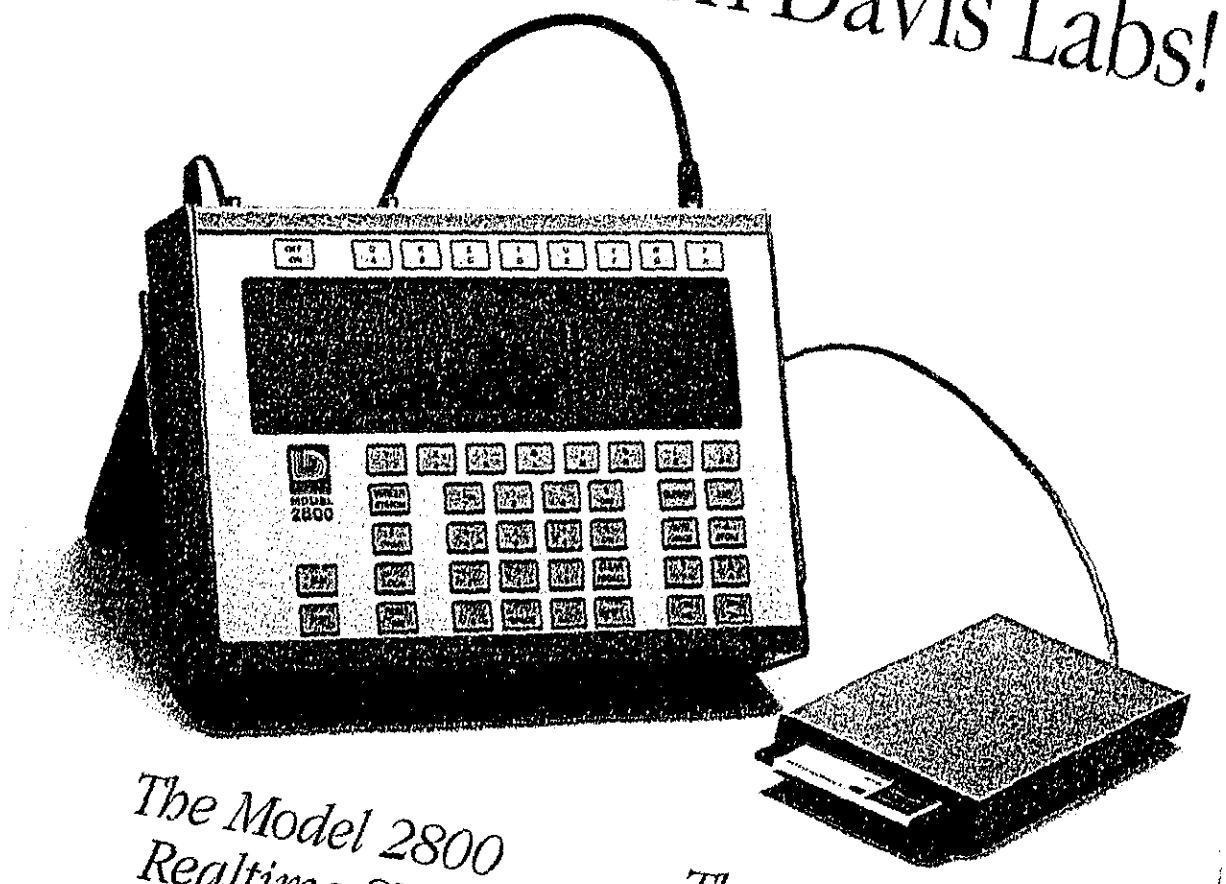


Use an external EGA, VGA or Super VGA monitor to obtain a multi-window color display. Mouse control of the analyzer and monitor provides a truly spectacular user interface.

And Keep It Light

Weighing in at 7.5 pounds with internal batteries, the 2800/2900 provides both precision sound level meter accuracy and benchtop analyzer performance in a notebook size package.

A State-of-the-Art Advance from Larson Davis Labs!



The Model 2800 Realtime SLM:

A Precision Sound Level Meter and a 1/1, 1/3 Octave/FFT Realtime Analyzer with statistical analysis capability and on-board room acoustics software in a lightweight, notebook-size package including:

- Battery Operation
- 256 KB CMOS memory
- External 3 1/2" floppy disk drive, MS-DOS® compatible
- RS 232 Interface

LARSON•DAVIS LABORATORIES

The Model 2900 Handheld Dual Channel Analyzer:

All of the features of the Model 2800 plus a tachometer input and cross-channel measurement capability for:

- Acoustic Intensity
- Frequency Response
- Coherance
- Impulse Response