



Model 820 Precision Data Logging Integrating Sound Level Meter

The handheld Model 820 from Larson•Davis Laboratories is a combination Type 1 precision integrating sound level meter and statistical data logger that substantially exceeds all worldwide accuracy requirements for the measurement of noise. Its internal software is designed to accommodate changing regulations and to overcome sound measurement problems.

Many sound level meters on the market create significant measurement errors because of their limited dynamic range, pulse range, and crest factor. The Model 820 does not have these limitations.

Sized and priced as a hand-held sound level meter, the 820 is a complete environmental noise monitoring instrument that contains features which will ensure quality measurements for many years.

Some of its most prominent applications and features are as follows:

Features and Functions

- Meets all requirements of ANSI S1.4, ANSI S1.25, IEC 651, and IEC 804 for Type 1 accuracy.
- 110 dB dynamic range for error free measurements.
- Impulse measuring range greater than 80 dB.
- Standard microphone allows measurements between 30 and 140 dB(A) in one range. Optional microphones allow measurements below 20 dB or as high as 190 dB(A).
- Selectable A and C weighting for RMS and A, C, Linear for Peak measurements.
- Dual detectors provide simultaneous RMS and PEAK measurements.
- Measures FAST, SLOW, PEAK (weighted), PEAK (unweighted), Impulse, Taktmaximal 3 and 5, L_{max} , L_{min} , SEL, Dose, Proj Dose, TWA, L_n (1-99%), L_{dn} , Time Histories, Histograms, Exceedance Events, Measurement Time-Date-Duration.
- Complete data logging capabilities with 256 kilobytes standard memory.
- User selectable exchange rate, criterion, and threshold for Dose measurements. Noise exposure calculated in % dose and Pa^2hr .
- Measures and stores more than 40,000 different DOSE combinations in a single measurement period. Allows comparisons of different DOSE standards using the same data
- Selectively creates special exceedance reports when signal level rises above a user-set threshold.
- Time history sampling periods are user selectable from 32 samples per second up to one sample every 255 minutes.
- Quartz clock/calendar system for data annotation and automatic time scheduled operation
- RS-232 computer and modem interface standard. All functions fully programmable. Software available for IBM-PC™ compatible computers
- Access to all data via keyboard, printer, or computer is allowed during ongoing data accumulation.
- Direct printer interface to print and graph all measurement results. Real-time print-out of data during actual measurements.

- Uses a standard 9V battery. Seventeen (17) hour typical battery life. Also operates from external battery or AC adapter
- Rugged ABS case with internal EMI and RFI protection shields.
- Small size: 15 x 7.5 x 2.5 cm (H x W x D)
Lightweight: 393 gm
- Optional certification for intrinsic safety (UL, BASEEFA)
- Interfaces with optional Model 2100 weather-proof outdoor microphone system for use in harsh environments and permanent installations.
- Environmental enclosures available for system security and harsh weather conditions
- Available on GSA contract
- 2-year warranty program

Applications and Uses

- Handheld precision sound level meter
- Employee noise exposure programs
- Noise survey instrument
- Community and environmental noise analysis
- Aircraft/Airport noise monitoring
- Traffic noise surveys
- Vehicle noise inspection
- Measurement of sonic boom, artillery, automatic weapon fire, and other highly impulsive noise events
- Production line testing

Flexible Features

Single, Preset Dynamic Range

- Standard 110 dB range

The dynamic range of a sound level meter is defined as a measure of the dB ratio between the largest and smallest measurable signal within a single range setting. Dynamic range is a key indication of the ability of an instrument to accurately respond to any changes in noise levels, regardless of how impulsive the noise is.

With the Model 820, measurements can be made from 25 to 135 dB(A). This large range is essential for industrial, community, and environmental noise monitoring programs. This large dynamic range also eliminates the need for range switches and autoranging circuits and prevents the loss or inaccurate measurement of data due to overload, under-range, or autorange errors.

Filter Weighting: A, C and Linear

A-weighting is used to measure environmental noise. It is the most common measurement because it correlates well with subjective loudness and noise induced hearing loss.

C-weighting is necessary to provide single-number data for purposes such as evaluating the noise reduction rating of hearing protectors, determining when low frequency noise is a problem, and measuring sonic boom and artillery fire.

Linear weighting (unweighted) is provided on the PEAK detector to measure the maximum impulse level of sound or vibration.

Six Detection Modes (Fast, Slow, Peak, Impulse, Integration, Takmaximal)

In spite of its small size, the Model 820 provides a full compliment of detector modes for the thorough analysis of all types of sounds.

- 200 μ s pulse rms level error <1.5 dB

Ambient noise levels in the work place environment can range from very small to very large SPLs over short intervals of time. Noise impulses (caused by pneumatic tools, punch presses, steam valves, explosions, etc.) can instantaneously raise ambient noise levels to very high SPLs.

With a pulse range of more than 80 dB (IEC 804), accurate measurement of all types of noise is assured regardless of the background noise level or reverberation time of the work area. For a single 200 ms pulse, the error is less than 1.5 dB, even when the background noise is 110 dB less than the amplitude of the measured pulse.

The performance of the Model 820 represents a significant technological breakthrough in the accurate measurement of impulsive sounds. This breakthrough ensures that normally difficult tests, such as measuring the energy of a rifle shot in a quiet open field, are performed properly.

- **40 dB Crest Factor**

The Model 820 has a 40 dB crest factor that virtually reaches the theoretical limit of any sound measurement equipment using A- or C-weighted filters.

Using a parallel detection system, the integrated level and peak data readings are taken simultaneously for each time interval. These samples can be stored simultaneously in a time history file, enabling direct measurement of the true crest factor of any noise.

Selectable Exchange Rates

Four selectable exchange rates of 3, 4, 5, and 6 dB are available for current or future needs

Adjustable Criterion and Threshold Levels

Dose and Leq criterion and threshold levels are adjustable in 1 dB steps anywhere in the 25 to 135 dB measurement range. While many industrial measurements will use the 80 dB threshold and 90 dB criterion, special applications are now feasible. For example, the

contribution of sound above a 115 dB threshold to a daily Dose could be measured by setting a 90 dB criterion level and a 115 dB threshold level.

- **40,000 combinations available**

More than 40,000 different combinations of Dose data are captured *accurately and simultaneously* during a single measurement period. Because the Model 820 captures all measured data, even below the selected threshold level, thousands of different Dose combinations can be displayed.

- **Logged Data Logic®**

The Model 820 provides the capability to perform "what if" analysis on data stored in memory. Using an exclusive new Logged Data Logic (LDL) storage technique, prior data based on particular threshold limit, criterion, and exchange rate parameters can be accurately retabulated using new parameters in any combination.

With more than one hundred selectable thresholds and criterions available and with four exchange rates, thousands of possible ways to analyze the same database are made available. This means that data stored in a computer can be reloaded into the 820 and re-evaluated under a new standard or law without retaking the data. This feature alone can save an industrial hygienist several man-years of effort if standards or legal requirements change.

The LDL function is a mathematically exact method and should not be confused with less accurate statistical approximation techniques.

- **Most Needed Measurements**

Besides Dose and Projected Dose, numerous acoustic parameters such as Leq, SEL, L_{max} , L_{min} , and L_{pk} are available.

With selectable exchange rates, LDOD (4 dB) and LOSHA (5 dB) are easily measured.

Using the LDL function, an exact comparison can be made between LOSHA, LDOD, and a 3 dB Dose for the same measurement period.

The ability to store multiple blocks of data on demand from the keyboard opens up new avenues for simple and effective data measuring. For example, a user could walk around a constant noise source and sample at specified locations. Each sample sequence, representing a different measurement position, would be stored in the Model 820 and retrieved at the end of the test sequence by reading the display through the keyboard control or by transferring the data to a computer or a printer.

Automatic Time/Date Scheduling

The Model 820 has a quartz clock/calendar for automatic time-scheduled operation. Two start and stop times can be set with one minute resolution from the keyboard or from a remote computer.

Three possible applications follow:

Example #1. A continuous noise survey (24 hours per day) spanning a 7-day time period is desired. The measurement interval is to extend from midnight Sunday to midnight of the following Sunday. After selecting the desired statistical reports for data gathering, the 820 is programmed to initiate testing at 2400 hours on July 28, 1991 and conclude testing at 2400 hours on August 4, 1991. Because total measurement time exceeds the normal 17 hour life of the internal 820 battery, an external power source will be used.

Example #2. An airport organization wishes to count aircraft departures and measure resulting noise between certain hours during the day, but only for aircraft emitting noise above a certain sound pressure level. The measurement is to be performed only during selected hours of the day, but over a several day interval and no system operator is to be present during actual measurements.

The 820 can be programmed to automatically turn on and initiate a test sequence anytime during the built-in 99 year calendar period. An operator can program a test schedule to measure hours of each day such as between selected 1200 and 1400 hours, Monday through Friday, but only for aircraft exceeding a 65 dBA sound pressure level. Because total

actual test time is only 10 hours (2 hours per day for five days) the test sequence is easily managed by the internal battery of the 820.

Example #3. A transportation department will perform a noise survey of rush hour traffic, morning and evening, during an entire month. The 820 is programmed to begin a test sequence on the first day of the desired month and to take data only from 700 hours to 900 hours and from 1600 hours to 1800 hours each day, and to end the test sequence on the last day of the month. An external battery will be used during the test.

Scheduled test sequences like those described above are easy to implement using the powerful features of the Model 820.

Two-way Computer Interface

For programming measurement modes, providing real-time data measurements, and storing data in a central file for later computer analysis, the Model 820 has an RS-232 port which allows two-way communication with most computers.

A multi-tasking digital processor in the Model 820 to perform several different tasks simultaneously while data is being gathered. Reports of existing data may be printed or viewed on the 820 digital display while preserving full system accuracy of the data being measured. All 820 functions, memory files, and reports can be viewed in real-time as data is being accumulated into memory.

Computer access to the 820 via the RS-232 is also allowed during data gathering. All data in memory, or any data subset can be downloaded to computer memory without interrupt of 820 operations.

In the design of the 820, Larson•Davis implemented an addressable RS-232 port to separately communicate with up to 127 different 820s on a daisy-chain cable.

The full duplex RS-232 interface in the 820 allows data transmission in ASCII mode or up to 10 times faster in the digital compression "binary mode" designed by Larson•Davis. For

example, the time required to download 100 Kbytes of data to a computer at 9600 Baud in the ASCII mode requires over about 38 minutes. The "binary mode" requires approximately 3 minutes for the same data transfer. Substantial amounts of data can be exchanged in a very short time period.

Direct Printer Interface

Built into the software of the Model 820 are print commands that allow direct down-loading of data to an Epson™ or Epson compatible printer.

Easy to Use

Even with its many features, the Model 820 is easy to use. A manual measurement requires only the press of one button to turn the device on and one press to start the measurement sequence. The reverse procedure stops the measurement period and turns the device off.

- Two line, 32 character, 7-segment LCD display

The 2 line, 32 character LCD display is the most clearly annotated in the industry, displaying all pertinent measurement parameters. The graphics capability displays a 120 dB range, thermometer-style bar graph, with 1 dB resolution. Elapsed time is always displayed with the Dose and Equivalent Level measurements to notify the operator that measurement is in process.

Rugged, Secure, Safe Design

- Shielded, plastic case

A shielded ABS plastic case with a sealed keyboard typifies the extra rugged construction of the Model 820. Temperature and humidity stability are excellent.

In addition, the microphone and cable connections are designed to take the heavy use of an industrial setting. Internal circuits are encased within copper shields to reduce noise and protect against radio frequency and electromagnetic interference.

- Nonvolatile memory

With nonvolatile memory, the Model 820 can be stored for months, or a battery change can be made without loss of mode selection or data. Therefore, in most situations the keyboard needs programming only once.

The internal 9 V battery has an expected life of more than 17 hours. Power is automatically turned off when the battery is low or after 12 minutes in the STOP mode.

For longer measurement needs, the 820 can operate continuously for months from an external battery supply.

- Data security

The keyboard and display can be disabled by entering a user defined code. This prevents accidental or unauthorized keyboard input.

- Shock proof

The plastic case provides additional protection against electrical shock, one of the key reasons plastic was selected over metal. The Model 820 can be modified to be UL listed as intrinsically safe for Class I (groups A, B, C, & D), Class II (groups E, F, & G), and Class III. This modification requires the use of a 9 V carbon-zinc battery, which will reduce the expected operation time to 8 hr. BASEEFA listing is also available.

- Two-year warranty

Although the Model 820 contains numerous sophisticated features, product performance is assured with a 2-year warranty program.

Reports Generated

The Model 820 can be programmed to automatically store a variety of statistical data reports into memory. The operator can choose to activate only those reports desired for a particular measurement application. Available reports are briefly described below.

1. **Interval:** This statistical report consists of

sequential time intervals, with each containing the L_{eq} , L_{max} , L_{pk} , L_{pk} (unweighted), SEL, duration, start time, etc. Six L_n values per interval can be collected. The interval time period can be set for as short as 1 min to as long as 99 hr.

2. **Time History:** This report consists of a sequence of short time periods which are user selectable from 1/32 seconds to 255 minutes. Each time period contains the average rms level (L_{eq}) for each period. The maximum peak level (weighted or unweighted) for each period can also be measured simultaneously.
3. **Exceedance:** This report is composed of the set of events in which a user-selectable threshold level is exceeded. For each event exceeded, the maximum level, peak level, L_{eq} , start time of event, duration of event, etc., will be stored.
4. **Histograms:** This report is a table of values showing the percent of total samples occurring at each sound pressure level over the 110 dB range of the instrument. Histograms are available for both RMS and PEAK data.
5. **Daily Report:** Provides the same measurement data as the interval report except for a 24-hour time period. Includes additional measures such as L_{dn} and TNI.

Memory Usage

Each Model 820 is provided with a standard memory size of 256 kilobytes. Clearly, the more reports that are activated by the user, the more quickly system memory is consumed. The number of bytes of memory used per special report is described below:

1. **Interval:** 52 bytes of memory are used per interval report. If the interval duration is set to one hour, then 24 one-hour interval reports would use 24 x 52 bytes, or 1248 total bytes of memory.

Time History: 2 bytes of memory are used per time history sample for 0.1 dB resolution data and 1 byte of memory is used for 1.0 dB resolution data. For

example, if one minute L_{eq} values were stored with 0.1 dB resolution, the 256 kilobytes memory would store more than 100,000 one-minute samples equivalent to more than 70 days of continuous data logging.

2. **Exceedance:** Each exceedance report uses 30 bytes of RAM, providing storage for up to 8000 exceedance events in 256 Kbytes of memory.
3. **Histograms:** Stored in a special memory segment in the Model 820.
4. **Daily Report:** Uses 65 bytes per day (24 hours).

Model 820 Specifications

Frequency Weighting

- RMS: A and C weight
- Peak: A, C, Linear

Detectors

- Characteristics: True RMS, weighted Peak, unweighted Peak
- Dynamic range: 110 dB
- Measurement Range: Typically <30 to 140 dB(A)
- Pulse Range: 100dB
- Crest Factor: 40dB

Time Weighting Characteristics and Functions

- Fast, Slow, Peak (weighted), Peak (unweighted), Impulse, Leq, Takmaximal 3 and 5, Lmax, Lmin, SEL, Dose (% Pa²hr), Proj Dose, TWA, Ln (1-99%), Ldn, Time histories, Histograms, Exceedance Events, Measurement Time-Date-Duration.

Typical Noise Floors

- 28 dB(A), 34 dB(C)
- 50 dB(A) weighted Peak
- 105 dB unweighted Peak
- <20 dBA (optional)

World Standards Met

- ANSI S1.4 (1983) Type 1
- ANSI S1.25 199X Type 1
- IEC 651 Type 1
- IEC 804 Type 1

Keyboard Characteristics

- 35 function sealed keypad
- Embossed finger pads
- Tactile long-life switches

Digital Display

- 2 line, 32 digit 7-segment LCD
- Full ASCII character set
- Fully annotated data displays parameter with units

Digital Display Resolution

- dB levels: 0.1 dB
- Dose: 0.1%
- Elapsed time: 1 second

Display Bargraph

- 120 dB range, 1 dB resolution for SPL

Real-time Clock/Calendar

- Military time clock: hh:mm:ss
- 1 sec resolution
- 99 yr. calender: mo/day/yr
- Automatic run/stop with two alarm dates and four alarm times

Run-time Clock

- 1 sec resolution
- 9999 hr 59 min 59 sec
- maximum (416 days)

Data Storage

- 256 Kbyte CMOS RAM
- 3 month memory retention
- Memory protect during battery change

Data Communications

- RS-232C interface
- Data transfer up to 9.6 K Baud in ASCII and up to 10 times faster in binary mode
- Computer compatible
- Modem compatible
- Cellular telephone link compatible
- Direct printer output with full graphics

Calibration

- Manual keystroke entry
- Computer programmable
- 0.1 dB resolution
- Date/time history calibration memory

Microphones

- Type: 1/2 inch LDL air condenser microphone
- Sensitivity: 13 mV/Pa
- Capacitance: 17 pF
- Polarization: 50 Vdc
- Model 2542: Free Field
- Model 2561: Random Inc.
- Optional microphones to extend SPL range

Power Supply

- Internal: 9 V battery, 17 hr operation
- External: 7 to 16 Vdc, 30 ma current drain
- Battery-life indication selected from keyboard or computer program

Effect of Temperature

- Complete instrument error < 0.5 decibel -10 to +50 °C
- Microphone: 0.003 dB/°C typically
- Storage without batteries -30 to 70°C

Effect of Humidity

- Complete instrument error < 0.5 dB to 90% RH (non-condensing)

Dimensions and weight

- Width: 7.5 cm (3 in)
- Length: 15.0 cm (6 in)
- Depth: 2.5 cm (1 in)
- Weight: 393 gm (14 oz.)