

instructions for

Models 1900 and 2900

Integrating and Logging Sound Level Meter

Note: Due to the new ATEX Directive in Europe, all references in this document to "Ex" or "EEx" for intrinsic safety approvals should be disregarded effective 7/1/03 within the member countries of the European Union (EU). At this time, this product is not approved in accordance with the new ATEX Directive and is not sold for use in hazardous atmospheres or explosive zones by customers within the EU. Outside of the EU, all references to intrinsic safety continue without change.

56-352
Rev. F
1/98

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1. INTRODUCTION TO THE MODELS 1900/2900

The Quest Models 1900 and 2900 are advanced sound level meters which perform a wide variety of acoustical measurements. Both exponential averaged and time integrated measurements may be made, with the capability of either internal or external data logging. The output of an independently weighted peak detector may also be displayed or logged. Applications include laboratory, industrial, community and audiometric measurement and analysis.

The models 1900 and 2900 provide a numerical readout of measurements as well as a moving bar graph indication. The results of individual sound studies may be stored in internal memory for future reference. Meter operation is controlled from either the membrane keypad or through the communications port. AC and DC output jacks are provided for connecting to external devices such as audio recorders, chart recorders, oscilloscopes, etc. Data may be sent to a parallel printer by using a special interface cable. The meters are housed in a tough injection molded plastic case with internal shielding to protect against external electrical interference, such as that from motors or portable radios.

The Model 1900 delivers Type 1 accuracy for critical measurements, while the model 2900 is a Type 2 instrument for general field survey work. The model 2900 uses a 0.52 inch electret microphone, while the 1900 accommodates a variety of microphones to meet even the most unconventional applications. As both meters are operationally identical, this manual will refer only to the model 1900 except where appropriate.

Options include expanded logging memory and a second RMS detector to allow simultaneous measurement of C-A frequency weighted LEQ or LAVG.

Plug in the Model OB-300 combination 1/3 - 1/1 Octave Filter Set and create a 1/3 or 1/1 octave band analyzer covering 33 bands from 12.5 Hz to 20 kHz. The addition of the Model OB-100 Octave Filter Set will create an octave band analyzer covering 10 bands from 31.5 Hz to 16 kHz.

If sound measurements need to be made from a distance, simply remove the microphone/pre-amplifier and insert either an ICM-10 (10 foot) or an ICM-50 (50 foot) extension cable. Distances of up to 100 feet can be accommodated by adding two ICM-50 extension cables in series.

With the microphone and preamplifier removed, the meter can accept other input devices such as the Quest Model VI-90 Vibration Integrator. The VA-508C Vibration Assembly, combined with the Models 1900 or 2900, provides a quick and precise method of measuring and analyzing many types of industrial vibration.

1.1 Assembling the Meter

The microphone and preamplifier must be assembled prior to making any measurements.

Microphone Handling and Storage

The microphones used with the model 1900 will provide years of reliable use, but certain precautions should be followed with regard to handling and storage.

1. Never remove the microphone grid. This will expose the diaphragm, making it susceptible to physical damage. When removing a microphone from the preamplifier be careful not to unscrew only the grid.
2. Never touch the diaphragm.
3. Electret (prepolarized) microphones should never be stored at high temperatures, as long term degradation of the polarization charge may occur. This results in a decrease in microphone sensitivity.
4. An electret microphone should be stored in its protective box when not in use for long periods of time.

To attach the microphone to the preamplifier, screw the microphone onto the threaded end of the preamplifier. Attach the preamplifier to the meter by placing the connector ends together and rotating the preamplifier until it drops onto the meter. Finger tighten the black locking ring by screwing it onto the meter.

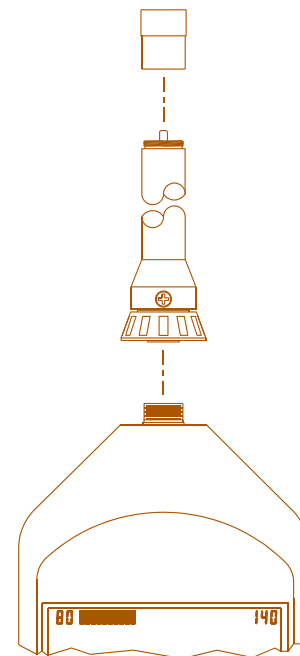


Figure 1 Preamp Assembly

MODEL 1900 ONLY: Microphone Polarization Voltage - 200VDC

Check that the microphone polarization voltage switch is set properly. This switch is located inside the battery compartment on the rear of the meter. To locate this switch, remove the battery door with a phillips head screwdriver and pull the 9 volt batteries out of the compartment. Electret, or prepolarized microphones such as the QE4146 or QE224 should be operated with the 200 Volt microphone polarization voltage turned OFF. Condenser microphones must be operated with the 200 Volts turned ON.

CAUTION: Be careful not to turn on the 200 volt polarization switch if a prepolarized (electret) microphone is attached. The microphone may be damaged.

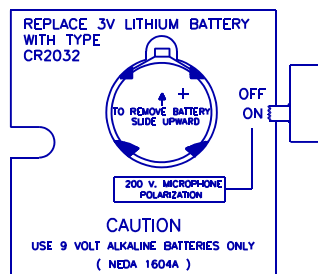


Figure 2 200V Polarization Switch

1.2 Initial Turn On and Check

Before taking measurements with the Model 1900, there is a series of quick checks that should be performed. Turn the unit on by pressing the ON/OFF key. The display will indicate that a brief warmup is taking place. Check for the BAT indicator in the display. If it indicates a low battery condition, replace the batteries.

A measurement display such as SPL or LEQ will appear in the display. Pressing the FUNCTION key will select a different display. Press FUNCTION to review the possible measurements. When you have done this, set the display to read SPL. The meter is now displaying current Sound Pressure Level. Press the A/C/LIN key to change the frequency weighting. Press the FAST/SLOW/PEAK/IMPULSE key to change the response time of the reading.

To perform an Acoustic Study, press RUN/PAUSE. Allow the meter to run for a while and press RUN/PAUSE again to end the study. The FUNCTION key may now be used to review the results.

Although the Model 1900 will maintain accurate calibration over a long period of time, the calibration should be checked and the meter slightly adjusted, if necessary, before each use. To check the calibration of the Model 1900, perform the following procedure using a Quest Calibrator.

1. Turn the Calibrator ON. If optional, set the frequency to 1 kHz. Note the SPL of the calibrator.
3. Insert the microphone fully into the calibrator adapter ring, if required for the size microphone in use.
4. Slowly place the Calibrator onto the adapter/microphone.
5. Using the FUNCTION key, set the Model 1900 to read SPL and set the weighting, response and range as appropriate. Note: SPL must be one of the display options enabled in the Setup Menu.
6. Use a screwdriver to adjust the calibration control, located through the small hole on the left side of the meter, until the display matches the calibration level.

Storing the Calibration Value

The model 1900 can store the time, date and SPL of a calibration, which will be included in the printout and in downloaded data for each study. Enter the PARA Setup Menu and go to CAL by pressing the following keys:

SETUP,
a or « to " PARA ",
ENTER,
a or « to " CAL "

The meter will display current SPL. Perform a calibration as directed in the previous section. Range and weighting keys will be operational, but the response time will be set to FAST. When the reading on the display is correct, press ENTER to store. The display will briefly read " CAL_{OK} " and return to the "PARA" menu display. The calibration SPL, time and date are now stored. Press SETUP to return to the measurement displays, such as SPL.

2. ABOUT THE METER

2.1 The Display

The LCD display provides the user with the selected measurement and the current measurement parameters. The measurement range, as well as instrument status such as low battery (BAT), RUN (-), PAUSE (%), and OVERLOAD (OL) is also displayed. The numeric display normally updates every second, while the bargraph provides a continuous indication of the sound level.

The bar indicator portion of the display always indicates the current SPL (Sound Pressure Level). The range of the bar indicator is the same as that of the instrument and is indicated by the numbers on either side of the bargraph. Each segment of the bargraph represents 2 dB.

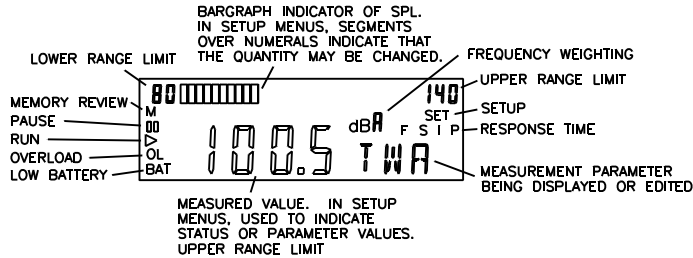


Figure 3 Model 1900 Display

2.2 Keypad Functions



Press this key to turn the meter on. After a warmup period of several seconds, the meter is ready to use. Pressing and holding this key for five seconds until "OFF_{OFF}" is displayed, and then releasing, will turn the meter off.



Momentarily pressing this key turns the LCD backlight on for several seconds. Pressing and holding for 3 seconds will turn the backlight on until the switch is again pressed to turn it off.

Note: Leaving the backlight on for extended periods will reduce battery life.



Press this key to begin a study, which automatically increments the memory location counter by 1. The number of the location appears on the display briefly after pressing RUN. Pressing RUN/PAUSE again ends the study and stores the data in that memory location.



Press the Δ or ∇ to increase or decrease the 60dB measuring range in 10dB steps. Pressing this key while in RUN ends the current study and begins a new study. When this happens, the memory location will momentarily appear on the screen so that the operator may make note of his time and location for that study. (Key locked out while in Session mode and RUN.)

While inside the SETUP menus, the RANGE key may be used as UP and DOWN arrows for incrementing or decrementing numeric values.

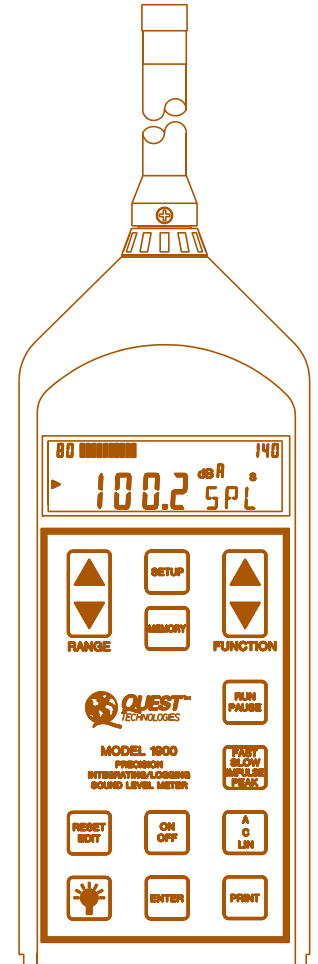


Figure 4 Model 1900 Meter



Press this key to select the time averaging from the four choices of FAST, SLOW, IMPULSE or PEAK. A display annunciator indicates the response by displaying " F ", " S ", " I " or " P ". Pressing this key while in RUN mode will end the current study and begin a new study. (Key locked out while in Session mode and RUN.) Refer to section 6.8 for details on time averaging.



Press this key to cycle the frequency weighting through the choices of A, C or Linear. The choice is shown by a letter following 'dB' in the display (A, C or L). Pressing this key while in RUN mode will end the current study and begin a new study. (Key is locked out while in Session mode and RUN.)



Press FUNCTION ^a or « to select any of the following displays that have been selected via the SETUP key:

SPL, LEQ (LAVG), TWA, LMAX, LMIN, LN1, LN2, LN3, LN4, LDN, CNEL, % OL time, exposure in Pa2S or Pa2H, LPK, SEL, elapsed TIME (min/sec), elapsed TIME (hour/min), LLOG (LAVG or LEQ last logged - this value updates every logging interval), BATT, or TAKM. If the C-A

option is installed, C-A Leq or Lavg may also be displayed. Refer to section 3.1, Measured Quantities.

While in RUN mode, the display shows the current value for the study. While in PAUSE mode the final value for the previous study is displayed. SPL will always show the current 1 second MAX according to the response selected (F/S/I/P). While in PAUSE, if selecting quantities such as LMAX, LEQ, etc. after the meter has been RESET (had it's memory cleared) the display will show "----".

FUNCTION is also used while in the setup mode as an up/down arrow key for selecting menus or parameters.



While in PAUSE mode, press SETUP to access one of five Setup Menus which allow the user to define the operation of the meter. There are many quantities that may be displayed, logged or printed, and most users will not be interested in all of them. SETUP allows the user to select only the items of interest, for example SPL, LAV and L10, excluding all others. The five menus are:

COMM	Communications Parameters
PARA	Measurement Parameters
PRNT	Data to be Printed
LOG	Data to be Logged
DISP	Data to be Displayed

Refer to section 3.3 for details on meter SETUP.



This key is used to group studies stored in memory into a File for printout, and to review individual studies stored in memory. While in PAUSE, press MEMORY to display " FILE ". Press ENTER to group the previously stored studies into a File. Pressing FUNCTION ^a or « causes " XX_{LOC} " to be displayed, where XX is the number of the last study (as in memory LOCation #XX). Press ENTER to

display a measured quantity such as LAV. The FUNCTION key may be used to display other quantities (LMAX, SEL, etc.). Press ENTER again to return to the " XX_{LOC} " display. The function key may be used to increment or decrement memory locations. If incrementing past the last location the display will read " 1 LOC ", or the first study. If 10,000 or more studies have been performed, the display will read " XXXX_{LOC} ". Press MEMORY again to exit study review. (Refer to section 3.2 for more details)

Pressing MEMORY while in RUN briefly displays the number of the current memory location (study number and session number).



Press this key while in PAUSE to print all studies in memory to a parallel printer or computer. Press this key while in Memory Review to print only the study currently under review. To interrupt a printout, press again.



The ENTER key is used in SETUP to enter or exit any of the five setup menus. When changing a numeric value in the PARA menu, it will store that value and turn off the bar graph segments above that parameter.



This key has two functions. While in SETUP, it is used to turn on or off display, logging or print choices, or to cycle through certain parameter selections (3>4>5>6>3....dB exchange rate for example). When not in setup (i.e. in PAUSE), pressing and holding RESET/EDIT will clear the internal memory.

2.3 Output Jacks

DC - The Sound Pressure Level (SPL) over the 60 dB range selected is linearly represented by a 0 to 1 volt DC output. Zero volts is equal to the bottom of the range and 1 volt is equal to full scale. This output is provided for connecting to a 0 to 1 volt input data acquisition system or chart recorder. See section 4.4 "Chart Recording" for details.

AC - This jack provides an amplified, weighted AC signal. Full scale output (SPL) equals 3.16VAC.

COMM - The COMM jack is used for direct connection to an RS-232 compatible device such as a personal computer via the supplied cable. An optional Parallel Interface Module is used to connect to a parallel printer.

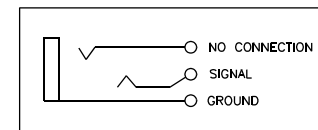


Figure 5. Output Jack Connections

3. OPERATING PROCEDURE

Pressing the ON/OFF key will turn the meter on. The initial display is " 1900_{128K} " where 128k bytes is the amount of memory installed. The next display, " X.X_{REV} " shows the revision of the installed firmware. A 5 second warmup will follow, and the display will read " 5_{MMUP} " counting down to " 1_{MMUP} ". If the logging memory has been filled, the display will read " FULL_{MEM} " for those 5 seconds. If this occurs, reset the unit before performing any studies.

3.1 Measured Quantities

The FUNCTION switch steps through the following possible measurements performed by the model 1900. This list may be shortened as desired via the DISP Setup Menu. Refer to section 3.3 "Setup Menus" for details.

- SPL - Sound Pressure Level will be displayed, with the selected weighting and response characteristics. The value displayed is the maximum SPL during the previous second. (SPL is also always shown in the display bar indicator.)
- LEQ - The average integrated sound level accumulated while in the RUN mode is shown in the numeric display. LEQ indicates that a 3dB exchange rate was used for the measurements.
- LAVG - The same type of measurement as LEQ, except that a 4, 5 or 6dB exchange rate was used. The display will be correct for the exchange rate selected.
- TWA - Time Weighted Average. The average level accumulated during a study, but calculated with an eight hour integration time.
- LMAX - The Maximum SPL obtained while in the RUN mode is shown in the numeric display. With PEAK response selected, this functions as a Peak Hold.
- LMIN - The Minimum Sound Pressure Level obtained while in the RUN mode is shown in the numeric display.

- LN - The SPL exceeded for N% of the time during a study. Four user selectable values are calculated. The default values are L5, L10, L50 and L90. The values may be changed in the PARA Setup Menu.
- LDN - Day/Night Sound Level. The average sound pressure over a 24 hour study, with additional factors for time of day. Sound pressures between the hours of 10 pm and 7 am are increased by 10dB prior to being averaged. A 3dB exchange rate should be used and is generally assumed. If an exchange rate other than 3dB is selected via the Setup Menu, LDN will not be calculated and " ----_{LDN} " will be displayed.
- CNEL - Community Noise Exposure Level. The average sound pressure over a 24 hour study, with additional factors for time of day. Sound pressures between the hours of 7 pm and 10 pm are increased by 5dB prior to being averaged. Sound pressures between the hours of 10 pm and 7 am are increased by 10dB prior to being averaged. A 3dB exchange rate should be used and is generally assumed. If an exchange rate other than 3dB is selected via the Setup Menu, CNEL will not be calculated and the display will show " ----_{CNEL} ".
- %OL - Percentage of time during the study that an overload (OL) condition occurred. Overload indicates that the signal has exceeded the measuring range.
- PA2S - Sound Exposure in Pascal-squared seconds or Pascal
PA2H - -squared hours, switching from Pa2S to Pa2H at 3600 Pa2S. The display will show " ----_{PA2} " if the exchange rate is not 3dB.
- SEL - The Sound Exposure Level is the constant sound level which, if lasting for one second, would deliver the same amount of acoustical energy as that accumulated over the entire study.
- RTMS or RTHM - The total RUN time will be displayed. Time may be displayed in MIN:SEC and HRS:MIN. The MIN:SEC display for a study that lasts over one hour will wrap around to 00:00. The HRS:MIN display will count to 99:59 and then wrap around to 00:00 but the actual time will be stored in memory.

LPK -	The Peak Level. The output of a second peak detector may be viewed as LPK or logged. The frequency weighting is independent of the main RMS detector and may be set in the PARA setup menu as 2PK. The selection of whether or not to log peaks is made in the LOG Setup Menu. The weighting selection (A, C or LIN) is made in the PARA Setup Menu. While viewing LPK the weighting of the second peak detector is displayed, and the Weighting and Response keys are disabled.
LLOG -	The LEQ (or LAVG) last logged during a study. Data is logged at a user defined interval. This feature may be used to display a timed LEQ for the previous logging interval. This display updates at the end of each logging interval. The display will show " ---- _{LLOG} " if LEQ is not being logged.
TAKM	The time integration of individual Taktmaximal values. Taktmaximal is the maximum level (L_{MAX}) encountered over either a 3 or 5 second interval. 3 or 5 second Taktmaximal is selected in the PARA Setup Menu. Individual Taktmaximal (L_{MAX}) values may be logged by setting the logging interval to 3 or 5 seconds in the LOG Setup Menu. Taktmaximal measurements are required by some countries' noise regulations. A Taktmaximal measurement calculates a higher average level for highly impulsive sounds than does a LEQ measurement. TAKM is affected by the Exchange Rate and should be run with an Exchange Rate of 3dB.
BATT	Displays the voltage of the weaker of the two 9 volt batteries to give an indication of remaining life. The low battery indication (BAT) on the display occurs at approximately 6.8 volts.
LC-A	An optional second RMS detector may be used to provide a simultaneous C-A weighted LEQ or LAVG of the measured sound. Refer to section 3.6 "C-A Option".

Acoustic Study Options

An acoustic **Study** is a set of measurements performed over a user defined period of time, referred to as the **Run Time**. The study begins at the **Start Time** and ends at the **Stop Time**. Each study is stored in a consecutively numbered **Memory Location** which is displayed briefly at the beginning of each study. Consecutive studies may be grouped into a **File**. When printing data, each File will have its own individual header, which makes it easier to locate related groups of data in the printout. Alternately, place the meter in **Session Mode** to create a cumulative summary of the data from consecutive studies with identical measuring parameters.

Up to five quantities may be logged at user defined time intervals. Final summary data for all measured quantities is also stored for each study.

The study may be initiated and ended in several ways (refer to Figure 6):

Manual Study - Press RUN/PAUSE to begin a study, causing the RUN indicator to light. " X_{LLOC} " will be displayed briefly, where X is the number of the current memory location. Press RUN/PAUSE again to end the study, causing the PAUSE indicator to light.

NOTE: During a study, pressing a key to change a parameter such as weighting, range or response time will stop the current study and, after a brief settling time, begin a new study.

Manual Timed Study - Press RUN/PAUSE to begin a study. If a Programmed Run Time duration has been set and enabled in the Parameter (PARA) setup menu, the study will run for this time duration and automatically stop. The study may be interrupted by pressing the PAUSE key.

Auto Timed Study - An Auto ON time and date must be set and enabled in the setup menu and the meter must be turned OFF. When the internal clock/calendar reaches this time and date, the meter will turn on and begin a study. The duration of the study will be that of the Programmed Run Time stored via the setup menu. At the end of the study, the unit will PAUSE and turn itself OFF. The study may be interrupted by depressing the PAUSE key.

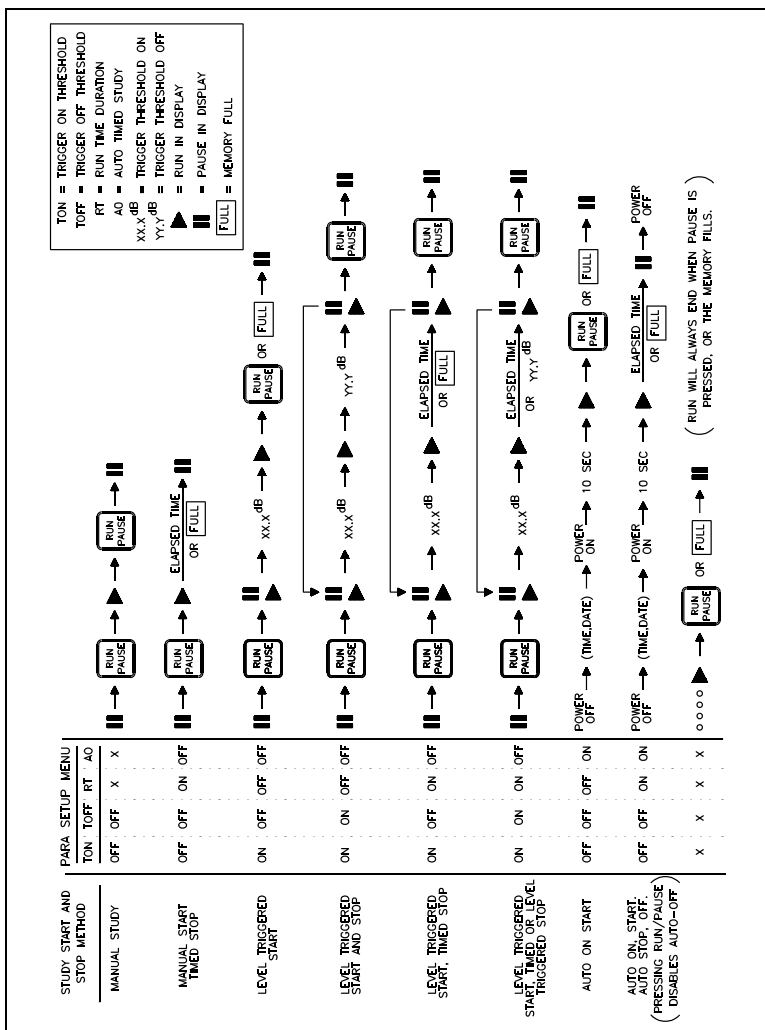


Figure 6 Manual and Automatic Study Options

Threshold Triggered Study - A Trigger Threshold ON level in dB must be set and enabled in the setup menu. While in PAUSE mode, press RUN to arm the meter. If the SPL reaches the desired level a study will begin. The study will end in one of three ways. If a Trigger Threshold OFF level in dB is set, the study will end when the SPL falls to this level. (Note: This level cannot be greater than the Trigger Threshold ON level.) If a Programmed Run Time duration is enabled, the study will last for the specified length of time unless the OFF level is reached. If the SPL is still above the ON level a new study will begin. The study may be interrupted by pressing PAUSE.

NOTE: Both Threshold Triggered and Auto Timed studies may not be enabled simultaneously. While in the Setup Menu, one may not be enabled without first disabling the other.

Filter Controlled Study - Each time the filter band on the optional bandpass filters (OB-100 or OB-300) is changed, either manually or automatically, the current study is ended and, after a brief settling time, a new study will begin.

NOTE: For long term unattended measurements where the possibility of power interruption exists, it is recommended that the meter be set up to run shorter term consecutive studies, such as one hour threshold-triggered studies with a Trigger Threshold ON level sufficiently low to always retrigger at the end of the hour. If power is interrupted during a RUN, all data for that study will be lost. The data from previous studies will be retained.

File Creation (Grouping Studies)

It may be desirable to separate a group of studies into a File. For example, if several studies were performed at a single site using various weightings, response times or filters, you might wish to separate the printout of these studies from that of a similar group of studies performed at a different site. Grouping consecutive studies into a File accomplishes this. A File is created after performing the last study to be grouped, and prior to beginning the first study of the next group.

To create a File, press MEMORY while in Pause mode. " FILE " will appear in the display. Press ENTER. This will group all studies performed since the last File was created into a new File. When printing data, each File will have a Header section to separate it from the previous File. Refer to Figure 7.

File creation is not available if the meter is set to run in session mode. Refer to the next section.

Session Mode (Combined Studies)

To obtain a cumulative measurement of consecutive studies (which must have identical measurement parameters), enable Session mode in the Parameters Setup Menu. (The meter must first have its memory cleared by performing a RESET.) A Session consists of individual studies stored in their memory locations with the addition of an overall summary of all of those studies. Any number of consecutive studies may be grouped into a Session. For example Session 1 might consist of studies 1 through 5, session 2 might consist of studies 6 through 9 and session 3 might consist of studies 10 through 31.

Pressing RUN after performing a RESET begins Session 1 and Study 1 (memory location 1). A session is closed in one of four ways:

- 1) Press MEMORY , then RESET
- 2) Change a measurement parameter such as weighting or exchange rate while in PAUSE (Weighting, Response and Range keys are locked out while in RUN only in Session mode)
- 3) Change the state of an optional bandpass filter. This may be done in either RUN or PAUSE.
- 4) Turn the meter off. This session cannot be reopened.

After closing a session, the next time RUN is pressed will begin the next session and study. Measurements for individual studies cannot be viewed while measuring Session mode. The displayed data is for the overall session. Individual studies can be viewed by reviewing data in memory. (Refer to section 3.2)

Viewing Measured Results

While performing a study (unit is in RUN mode) the FUNCTION key may be used to view the various measurements as they are occurring. Only measurements selected via the DISP Setup Menu will be available for viewing. If the meter is in Session mode, the value displayed will be the overall summary for the entire session. The displayed value will be updated each second, except for LLOG which is updated each logging interval as selected in the Setup menu. Pressing the MEMORY key during a study will briefly display " XX_{LOC} ", where XX is the current memory location. If the meter is in Session mode, pressing MEMORY will briefly display " XX_{SESS} " followed by " XX_{LOC} " to indicate the current session and memory location.

While the unit is in PAUSE mode, the FUNCTION key may be used to view the results of the previous study, or the results of the current session if the meter is in Session mode. The exceptions to this are SPL, which always shows the current SPL updated once per second, and LLOG, the value of which is not displayed. Again, only measurements selected via the Setup Menu will be available for viewing.

While in PAUSE mode, any change to range, weighting or response will make the data from the previous study or session available only by reviewing its memory location. Turning on the optional bandpass filter or changing its frequency will also cause this to happen.

3.2 Reviewing Memory Locations

The results of all currently stored studies are available by pressing the MEMORY key. The memory review process is slightly different depending upon whether or not Session mode was used to create the data in memory.

If Session mode was not enabled, pressing MEMORY will cause " FILE " to appear in the display (refer to File Creation). Press the FUNCTION ^a or « key. This will display the memory location of the last study performed. For example " 19_{LOC} " would indicate that the last study was the 19th study stored in memory. The ^a or « keys are used to select other memory locations. Pressing « would select " 18_{LOC} ", but pressing ^a would wrap around to the first study and select " 1_{LOC} ". Refer to Figure 7.

If Session mode is enabled, pressing MEMORY will display " XX_{SESS} ", which is the last session completed (a currently open session cannot be viewed in memory). The FUNCTION arrow keys select the desired session. The RANGE arrow keys select either individual memory locations of studies within that session or the overall session data.

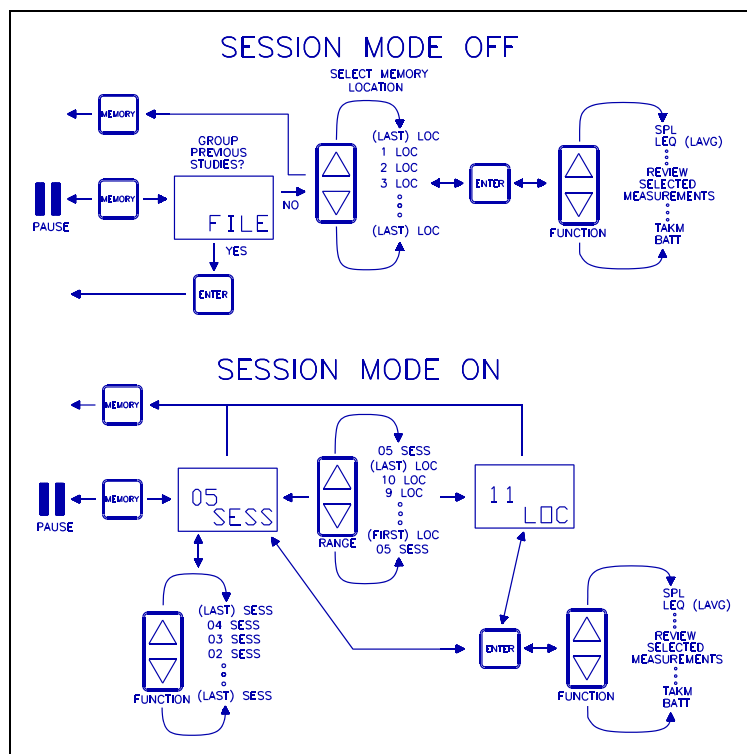


Figure 7 Reviewing Data Stored in Memory

Once the memory location of the desired study is selected, press ENTER to view the measurement results. The measurement parameters such as range, weighting and response will be shown in the display and the " M " indicator will be lit. If an optional bandpass filter was used during the study, the frequency will be briefly displayed. Use the FUNCTION key to select the measurements of interest. Only measurements currently selected via the Setup menu will be available for viewing, but these can be changed at any time by going back to the Setup menu. Pressing ENTER will return to the memory location or session number display. Pressing MEMORY returns to Pause mode.

The data in the memory location being reviewed may be printed using the PRINT key. Refer to section 4.4, "Printing Data". Data logged during a study may be viewed by printing the Time History portion of the printout.

Memory Capacity

The number of studies (memory locations) that can be created is limited by the amount of memory. The amount of data that is logged, if any, during a study will also fill the available memory. Logging data every second will fill memory faster than logging every minute. Session mode will also use more memory due to the extra summary information that must be stored. If the memory fills during a study, the unit will PAUSE and display " FULL ".

In addition to the problem of filling the memory, the total amount of energy accumulated during a study can cause the unit to overflow, causing calculation errors. This is dependent upon the range setting and how high the SPLs are during the study. This can be determined from the value of SEL at various exchange rates as follows:

Exchange Rate	Maximum SEL Without Overflow
3 dB	150 dB + Range
4 dB	200 dB + Range
5 dB	250 dB + Range
6 dB	301 dB + Range

For example, with an exchange rate of 3dB on the 60 - 120 dB range, the maximum SEL without overflow would be 150 dB + 60 dB = 210dB.

The following chart shows approximate time available versus logging rate and number of items logged for the standard 128Kbyte memory. Maximum number of studies with no data logged: 796 for 128k memory.

Logging Rate	Number of items logged						
	1	2	3	4	5		
1 second	21 hr	10.5 hr	7 hr	5 hr	4 hr	1	0
3 seconds	2.6 dy	1.3 dy	21 hr	15 hr	12.5 hr		
5 seconds	4.4 dy	2.2 dy	1.4 dy	1.1 dy	21 hr		
seconds 8.7 dy	4.4 dy	2.8 dy	2.2 dy	1.7 dy			
15 seconds	13.3 dy	6.5 dy	4.4 dy	3.3 dy	2.6 dy		
30 seconds	26 dy	13.2 dy	8.7 dy	6.6 dy	5.3 dy	2	hours
1 minute	53 dy	26 dy	17.6 dy	13.3 dy	10.5 dy		
3 minutes	159 dy	79 dy	53 dy	39 dy	31 dy		
5 minutes	265 dy	132 dy	88 dy	66 dy	53 dy		
10 minutes	1.3 yr	265 dy	176 dy	132 dy	106 dy		
15 minutes	2.2 yr	1 yr	265 dy	198 dy	159 dy		
30 minutes	4.3 yr	2.2 yr	1.3 yr	1 yr	318 dy		
1 hour	8.6 yr	4.3 yr	2.9 yr	2.2 yr	1.7 yr		
17 yr	8.6 yr	5.7 yr	4.3 yr	3.4 yr			
4 hours	34 yr	17 yr	11.6 yr	8.6 yr	6.9 yr		
8 hours	69 yr	34 yr	23 yr	17 yr	13.9 yr		
24 hours	209 yr	104 yr	69 yr	52 yr	41 yr		

If the 512K memory option is installed, the above times would increase by a factor of 4.

The total number of logged items (LEQ, LMAX, LPK, L10 or L90) possible can be calculated by the following formula:

$$\# \text{ of logged items} = 2/3 [M - (144 \times \# \text{ of studies}) - (3072 \times \# \text{ of studies with stats logged})]$$

where M = 114687 w/ 128k memory or 507903 w/ 512k memory. The total run time is calculated by multiplying the number of logged items by the logging rate divided by the number of items logged.

Erasing Stored Data

To erase the data in the memory locations, the meter must be in the Pause mode. Press and hold the RESET/EDIT key for five seconds. The display will read "5_{RST}", count down from 5 to 1, and "----RST" will be displayed. The memory is now cleared and the next study will be stored in memory location 1.

3.3 Setup Menus

The operation of the model 1900 may be customized through the Setup menus. While in PAUSE mode, pressing the SETUP key lights the SET annunciator in the display and allows access to the various menus. Pressing the FUNCTION^a or « keys selects from among the five Setup menus. Once the desired menu is displayed, pressing the ENTER key enters that menu and displays the first item that may be modified. Refer to figures 8 - 11. The five menus are:

- DISP - Displayed Data, or the measurements that may be viewed by pressing FUNCTION while in RUN or PAUSE.
- LOG - Logged Data and Logging parameters, or which measurements are logged, where the data is stored and how often the data is stored.
- PRNT - Printout format, or printout data presentation.
- PARA - Measurement Parameters, or variables affecting the way a measurement is performed. These include thresholds, percentage values for LN, peak detector weighting, etc. as well as clock/calendar setting and calibration value storage.
- COMM - Communications parameters for using the COMM port.

The key sequence to exit a Setup Menu is the reverse of the one used to enter the menu.

DISP Setup Menu (Displayed data) Refer to Figure 8

Press SETUP and the FUNCTION^a or « keys until "DISP" is displayed. Pressing ENTER gets you into the Display Setup Menu and will, for example, display "on_{SPL}". You may now choose whether or not SPL will be among the active displays by pressing RESET/EDIT, which toggles between "on_{SPL}" and "off_{SPL}". Pressing FUNCTION « cycles to the next selection, "on_{LAV}" which may be turned on or off with the RESET/EDIT key. The displayed quantities that are selected in this manner are:

SPL (Sound Pressure Level), LEQ or LAVG (Equivalent Level), TWA (Time Weighted Average), LMAX (Maximum Level), LMIN (Minimum Level), LN1, LN2, LN3, LN4 (% Exceedance Levels), LDN (Day Night Level), CNEL (Community Noise Exposure Level), %OL (Percent Overload Time), PA2S or Pa2H (Exposure), LPK (Peak Level), SEL (Sound Exposure Level), RTMS (Run Time MIN:SEC), RTHM (Run Time HR:MIN), LLOG (Last LEQ Logged), BATT (Battery Voltage), TAKM (Taktmaximal) and/or LEQ (LAVG) C-A if the C-A option is installed. (TAKM and LC-A cannot both be enabled.)

Press ENTER to exit the DISP Setup Menu, displaying "DISP". The FUNCTION^a or « keys may now be used to select another Setup menu.

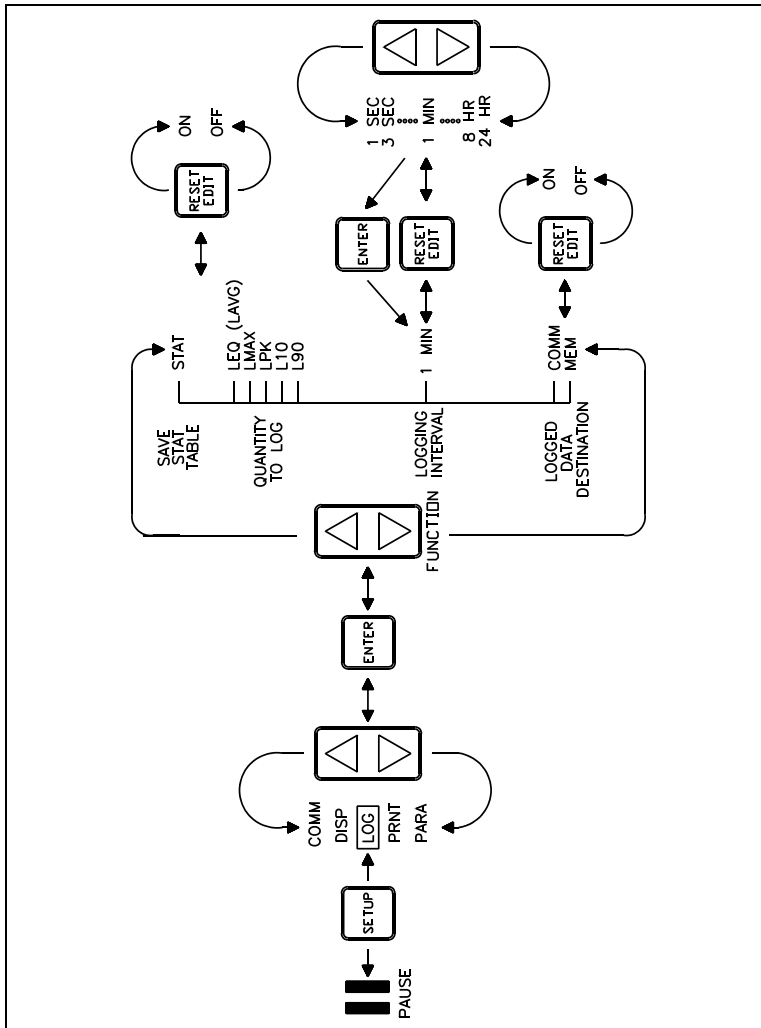


Figure 9. Log Setup Menu

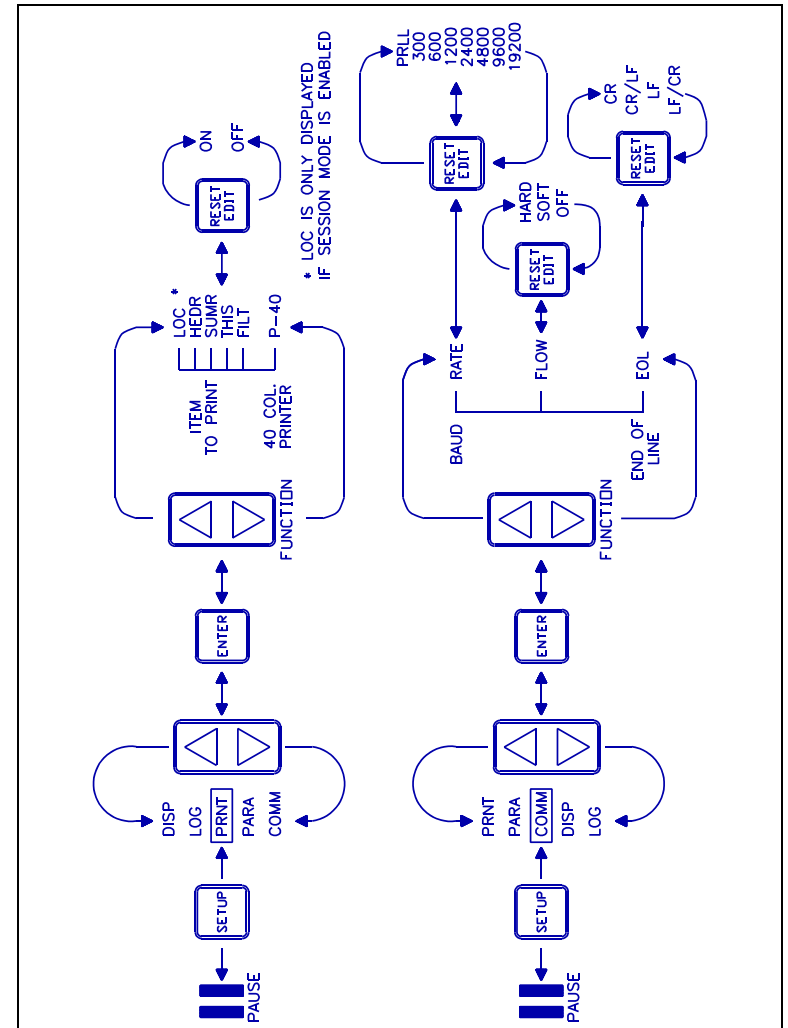


Figure 10. Print and Communications Setup Menus

PRNT Setup Menu (Data to be printed) Refer to Figure 10

After pressing SETUP, the ^a or « arrow keys may be pressed until PRNT is displayed. The data presentation for the printout may be selected in the Print setup menu. Pressing ENTER gets you into the menu and will, for example, display "on_{HDR}". You may now choose whether or not the header is included in the printout. Pressing EDIT/RESET toggles between "on_{HDR}" and "off_{HDR}". Pressing FUNCTION cycles to the next selection, "on_{SUMR}", which is turned on or off in the same way. The printout options are:

- HEDR - Header, on or off
- SUMR - Summary of all measurements, on or off
- THIS - Numeric Time History, on or off
- FILT - Filter Data Grouping, on or off. Data collected using an optional bandpass filter may be grouped under a common header (ON) or printed as an individual study (OFF).
- P-40 - Compressed print mode. This will fit the printout onto a small 40 column printer.
- LOC - Print individual memory locations along with session data (Session mode only)

A sample printout is shown in Section 4.4, "Printing Data".

COMM Setup Menu (Communications parameters) Refer to Figure 10

While in SETUP, press the FUNCTION key to display "COMM". Press ENTER to access the Communications Setup Menu where the following selections involving data communications are made:

- BAUD - Baud Rate. Choice of 300, 600, 1200, 2400, 4800, 9600, 19200 baud or parallel printer output (PRLL).
- FLOW - Flow control or handshaking. Select HARDware, SOFTware or OFF. This is important for transfers of large amounts of data to prevent lost data.
- EOL - End of Line Characters. Choice of :
 - Cr (carriage return)
 - CrLF (carriage return and line feed)
 - LF (line feed)
 - LFcr (line feed and carriage return)

Cycle through these parameters by pressing the ^a and « keys. Press the RESET/EDIT key to change the values. Pressing ENTER returns to the "COMM" display. Refer to section 4, Communications, for more information.

PARA Setup Menu (Measurement parameters) Refer to Figure 11

After pressing SETUP, the ^a or « keys may be pressed until PARA is displayed. Pressing ENTER gets you into the Measurement Parameter setup menu, where the following parameters may be set:

- ER - Exchange Rate selection of 3, 4, 5 or 6dB. Changing this parameter from 3dB changes LEQ to LAVG for all displays.
- TH - Threshold level for averaging (set dB level from 0 to 180, or turn off). If the threshold is enabled, the meter will not integrate SPL below the threshold.
- LNx - Four selectable exceedance (LN) values (X = 1 through 4). For each LN_x, set N from 1 to 99 in 1% increments.
- Ton - Threshold Trigger ON level (set dB level from 0 to 180 or turn off). Sets Threshold triggered study initiation level.
- ToFF - Threshold Trigger OFF level (set dB level < or = Threshold Trigger ON level). Sets Threshold triggered study termination level (this is overridden if Programmed Run Time Duration is enabled).
- RTHM or RTMS - Programmed Run Time Duration in Hours/Minutes or Minutes/Seconds (set hours/minutes/seconds, or turn off). Sets study length for manual, threshold, or Auto-On initiated study. 99 hour, 59 minute 59 second maximum. Setting to 00:00:00 will default to OFF.

- AOMD, AOHM or AOMS - Auto-On Time in Month/Day, Hours/Minutes or Minutes/Seconds (set hours/minutes/seconds, or turn off). Sets time to automatic

YEAR, MODY or HRMN - Clock/Calendar (Set year, month/day, hours/minutes). 24 hour military time format is used.

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tes.

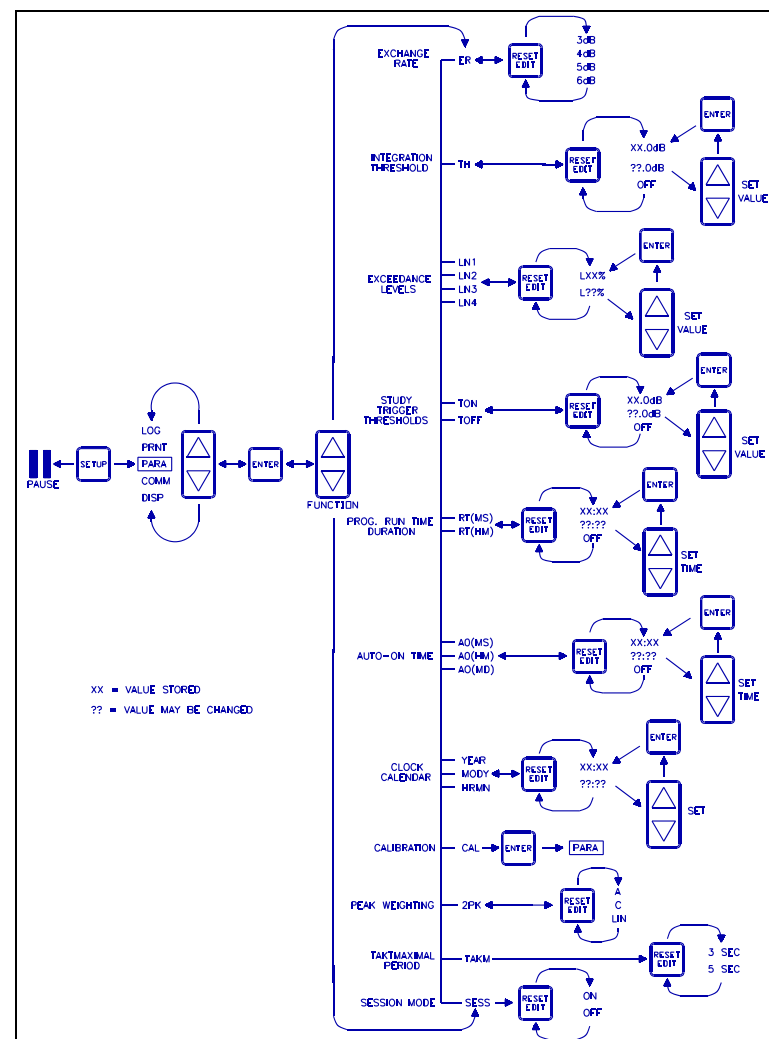


Figure 11. Parameter Setup Menu

CAL - Calibration Value. Stores calibration value for SPL and peak detector. SPL calibration value and time and date of calibration will appear on the printout. The instrument's range settings may be adjusted to compensate for microphones that differ in sensitivity from the standard mics. Refer to section 5.1 "Calibration" for details.

2PK - Select Weighting of Second Peak Detector (A, C, LIN) used for LPK display or for logging data.

TAKM - 3 or 5 second L_{MAX} for Takmaximal measurements.

SESS - Session mode ON or OFF. ON combines consecutive studies into a cumulative summary. See section 3.2 for details. If there is data in memory, this cannot be changed without first resetting the unit.

The user cycles through these parameters by pressing the $\uparrow$ and $\leftarrow$ keys. Pressing the EDIT/RESET key allows the user to change the values or enable/disable the parameter. When setting numeric values the bargraph sections above the quantity to be changed will be lit. The $\uparrow$ and $\leftarrow$ keys are used to change numeric values. Pressing ENTER stores the value. Pressing ENTER again returns to the "PARA" display.

Typical Setups

OSHA NOISE COMPLIANCE

Threshold = 90dB	Exchange Rate = 5dB
Weighting = A	Response = Slow

OSHA HEARING CONSERVATION

Same as above except with Threshold = 80dB

DEPARTMENT OF DEFENSE NOISE COMPLIANCE

Threshold = 80dB	Exchange Rate = 4dB
Weighting = A	Response = Slow

IEC NOISE MONITORING

Threshold = OFF	Exchange Rate = 3dB
Weighting = A	Response = Slow

TAKTMAXIMAL

Weighting = A	Response = Fast
TAKM = 3 or 5 Seconds as desired, with Logging Interval set to 3 or 5 seconds to log TAFts as LMAX values if LMAX is enabled in LOG Setup Menu	

3.4 Overload Detection

While viewing SPL the overload indicator (OL) is displayed whenever the incoming signal saturates (overloads) the circuitry. If the OL indicator is on, increase the RANGE until the OL condition is removed. If an OL condition occurs while in the RUN mode, the OL indicator will light and remain on for the duration of the study.

The percentage overload time is a display option that may be enabled via the DISP setup menu and then selected using the FUNCTION key. The overload time will also be printed on the hard copy printout. While reviewing a study stored in memory, the OL indicator will remain on if an overload occurred during that study. Percentage overload time may be useful in determining the validity of a study during which overload occurred. A small percentage indicates that the data is fairly accurate, while a larger percentage indicates that significant errors occurred.

An overload will also be indicated while logging to the serial port or printing a time history of a study. For each logging interval that contained an overload condition, OL will print at the end of that line of data.

3.5 Battery Replacement

The BAT indicator in the display means that one or both 9V batteries is weak and should be replaced. Make sure the meter is turned off when replacing the batteries. Use a phillips head screwdriver to remove the battery cover on the rear of the unit. Remove the old batteries and replace with fresh alkaline batteries.

A lithium coin cell (type CR2032) is accessible through the battery compartment. This battery maintains the data memory, clock/calendar and setup information when the meter is turned off. A dead lithium cell will cause the meter to lose information stored in the setup menus, the serial number and any data. As long as the meter is turned on, this information will not be lost. If the meter is to be turned off while changing the lithium cell, retrieve any data stored in the meter and make note of setup parameters as these will be erased. Refer to figure 2.

1. Remove the 9 volt batteries from the battery compartment. Using a fingernail or other thin non-metallic object, push the bottom edge of the battery toward the top (microphone end) of the meter until it comes out of the holder.
2. Insert the new lithium cell, edge first and **+ side up**, into the top of the holder. Press the bottom edge of the battery toward the top of the meter until it snaps into the holder.

3. Reinstall the 9 volt batteries, turn the unit on and re-enter any setup information, including the serial number. The serial number is entered via an ASCII command through the COMM jack (refer to section 4.3, Remote Control). **Note:** Calibrate the meter before performing any measurements. Peak detector and C-A calibration is lost when the battery is removed. Refer to section 5.1.

Note: Due to intrinsic safety requirements for use in hazardous locations, the model 2900 UL does not have a user replaceable lithium battery. Safety approvals are indicated by a label on the meter and the serial number prefix CE. If your model 2900 has UL safety approval, consult your dealer or the factory for lithium cell replacement.

3.6 C-A Measurements : Second RMS Option

The C-A option provides a second RMS circuit which allows simultaneous measurement of both C and A weighted sound pressure levels for evaluation of hearing protectors and other noise reduction devices. C-A LEQ (or LAVG) is indicated by "XX.X_{LC-A}" on the display. Note: If a threshold is set, it affects both C and A, which may cause large values for C-A if the levels are at or near the threshold. (See PARA Setup Menu regarding thresholds)

The C-A option is enabled by entering the Display Setup Menu (DISP). Press the FUNCTION ^a or « key to display "OFF_{C-A}". Press RESET/EDIT to change to "ON_{C-A}". Refer to section 3.3.

C-A LEQ (or LAVG) will only be displayed under the following conditions:

1. A weighting must be selected. If C or Linear weighting is selected by pressing the A/C/LINEAR key, the display will show "----_{LC-A}". Bandpass filters should not be used while performing C-A measurements. Also, PEAK response is not available.
2. The Response must be set to FAST, SLOW or IMPULSE. PEAK response is not allowed, otherwise the display will show "----_{LC-A}".

Note that battery current is increased when the C-A measurement is enabled. To prolong battery life, do not enable C-A unnecessarily.

4. COMMUNICATIONS

DEFINITIONS

PARALLEL MODE: Data is passed along multiple wires simultaneously. This is used for sending information to parallel printers.

SERIAL MODE: All of the data is passed along a single wire in a 'serial' stream. This mode is used when sending information to a computer or serial printers. RS-232 is a type of serial mode communication.

BAUD RATE: Baud rate is the speed at which serial communications take place, measured in bits per second. The baud rate options for the model 1900 are 300, 600, 1200, 2400, 4800, 9600, and 19,200. The higher the baud rate, the faster the communication. When trying to pass information from an instrument to a computer or serial printer, both must be set for the same baud rate. (Baud rate settings have no effect on parallel printing.)

COM PORT: Abbreviated name for a serial communications port on a computer (also called RS232 port). Most PCs have between 1 and 4 serial ports referred to as COM1, COM2, etc... This is where the cable from the meter connects to the PC. The COM ports generally will take the form of either a 25 pin male (has pins instead of holes) connector or a 9 pin male connector.

4.1 RS-232 Serial Interface

The COMM jack on the side of the model 1900 provides direct connection to a computer's COM port with the serial communications cable (#056-999) provided. To connect to a serial printer or similar device, a 25-pin male to male gender changer is required. The pinout of the COMM jack is shown in figure 12.

The model 1900 may be controlled under RS-232 control by sending ASCII commands from a computer. Measurement results may be requested and received from a remote location.

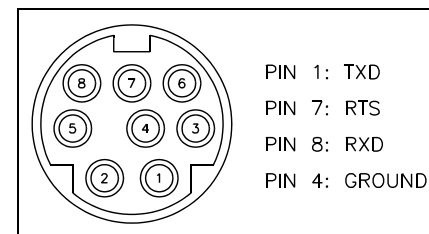


Figure 12. COMM Jack Pinout for RS-232 Communication

The communications parameters for the ASCII data byte are the following:

1 start bit
8 data bits
1 stop bit
No parity (disabled)

Baud rate and flow control must be set the same for both the 1900 and the RS-232 device connected to it (RATE and FLOW as set in the COMM Setup Menu). Refer to section 3.3 COMM Setup Menu.

There are three common problems when using COM ports.

1. The ports are often not labelled, making it difficult to determine which port is connected.
2. The printer output port on the computer is a 25 pin female. Adding an extra 'converter' cable to the serial cable and plugging it into the printer port will not work.
3. Often some other device, such as a mouse, is plugged into the COM port. If that is the only COM port then the mouse must be disconnected and the PC possibly must be reconfigured.

4.2 Downloading Data

Data stored in the model 1900 may be downloaded to a personal computer. Several methods are available.

The Quest Sound Manager software package provides an easy method of receiving data from the meter. Data presentation options include tabular or graphical form. In addition, remote control and access to all operating parameters is possible via an easy to use menu driven interface.

By using the RS-232 port on a PC and a communications package such as Procomm or Windows Terminal, the printout from the meter may be received and stored as a file. The 1900 must be set for serial operation and the settings (Baud rate, etc.) must match that of the PC. The serial communications cable must be connected between the meter and the PC. Pressing the PRINT key will cause the meter to print to the PC.

Downloading Using Windows™ TERMINAL

Microsoft® Windows™ has a communications program under the ACCESSORIES icon called **TERMINAL**. Instructions on how to use TERMINAL are located in the Windows™ manuals.

Open TERMINAL. For TERMINAL, the communications settings are found by first selecting SETTINGS, then COMMUNICATIONS. Select the desired COM (serial) port and the baud rate. The baud rate must match the BAUD selected in the 1900's COMM Setup Menu. TERMINAL also needs the following information in its setup:

data bits = 8 stop bits = 1
parity = none flow control = *must match the 1900*

To save the downloaded data to a file, use the following procedure. After the communication settings are made:

1. Select TRANSFERS, then select RECEIVE TEXT FILE.
2. Enter a file name with the ending ".TXT".
3. Press the PRINT key on the 1900. PRN will appear in the 1900's display.
4. When complete, PRN will disappear from the 1900's display. Select TRANSFERS, then STOP in the TERMINAL program.
5. Exit TERMINAL.
6. The file has been saved and can be opened with a word processor or editor such as Windows'™ NOTEPAD. (Remember which directory the file was saved in. The default for Terminal is the WINDOWS directory.)

4.3 Remote Control and Data Collection

Serial communications options for the model 1900 depend upon the operating mode of the instrument. Certain functions are available depending upon whether the unit is in RUN or PAUSE mode, or whether or not logging to the COMM port has been selected.

While in PAUSE, any function available by a front panel key press (except MEMORY) may be duplicated via an ASCII command. A "data request" command will provide the same data that would be presented on the display if the FUNCTION key were pressed to select that display. For example, requesting LEQ would result in receiving the LEQ from the previous study. Requesting SPL would result in a single reply of the current 1 second MAX SPL.

While in RUN, and if logging to the COMM port is selected, the only command that would be allowed would be PAUSE. Other commands will be ignored. At short logging intervals such as 1 and 5 seconds, and especially at slower baud rates, frequent communication with the unit would be difficult, as it would be sending data almost constantly. This mode of operation is useful for remote data collection of logged parameters. The model 1900 will provide the following output:

SAMPLE #	LEQ	LMAX	L10	L90	LPEAK
1	85.4	85.5	85.4	84.9	92.1
2	85.6	85.7	85.5	85.0	89.7
3	85.8	86.5	85.6	85.0	94.0
4	85.7	85.6	85.5	84.9	89.8
5	89.5	90.5	89.3	87.2	94.8 OL

While in RUN and not logging to the COMM port, the model 1900 will respond to "data request" commands for display functions by sending the measured quantity, requested data and Run Time if requested. Any quantity may be requested, regardless of what has been selected in the DISP Setup menu. For example:

ASCII command	Reply
LEQ	LEQ = 93.4dB
TIME	TIME = 14:02:34
LEQR	LEQ = 93.6dB @ 0:12:25
LN1 (LN1=L10)	L10 = 47.3dB
SPL	SPL = 98.6dB
SPL	SPL = 103.5dB

NOTE: If the model 1900 is set to log data to the COMM port, it must be connected to another device, especially if hardware (HARD) flow control has been selected in the COMM Setup Menu. The meter may appear to malfunction when RUN/PAUSE is pressed to begin a study, as it needs a signal back from the device that it is connected to in order to operate properly. When this happens, the display will freeze and the keypad will be inoperative. Properly connecting the serial cable between the meter and the other device will restore normal operation.

On units with software revision 1.3 and higher: If the above condition exists, the meter will automatically change the flow control option to NONE, preventing an apparent lockup condition. The flow control option may need to be reset prior to using the COMM port for serial communications.

ASCII Commands

The following is a list of commands used to control the model 1900 via RS-232.

Data Request Commands - Returns the current value plus OL if an overload has occurred during the study. If in session mode, session data will be returned. If an R is included where an asterisk (*) is shown, the current Run Time will also be returned. (Do NOT include the * in the command string)

SPL
LEQx* x = 1 or blank. Returns current LEQ or LAVG. The 1 will return the C-weighted LEQ value if the C-A board is installed and enabled.
LAVGx* x = 1 or blank, see above. Returns current LEQ or LAVG.
TWA*
LMAX returns the value of LMAX and the time that it occurred.
LMIN returns the value of LMIN and the time that it occurred.
LNx x = 1, 2, 3 or 4. Returns the selected Lxx value.
LDN*
CNEL*
%OL
PA2H* returns the value of Exposure in Pa2S or Pa2H.
SEL*
RT returns elapsed study run time - HH:MM:SS
LPK returns the value of LPK and the time that it occurred.
LLOG returns the value LLOG and the logging time interval.
C-A returns C-A LEQ or LAVG if C-A board is installed and enabled.
BATT returns the voltage of the weaker battery.
MEM returns the current (or last if in PAUSE) memory location.
TAKM returns the integrated Taktmaximal value

Operating Status Commands - Change or request the settings of measurement parameters and unit operation. Sending the command with no value for 'x' returns the current setting.

WGTX x = A, C or L; sets weighting to 'x' if in PAUSE.
RESX x = F, S, I or P; sets response to 'x' if in PAUSE.
RNGX x = 20, 30, 40, etc. to set range if in PAUSE.
PARA returns the current settings for Run/Pause, range, weighting, response time, integration threshold, exchange rate, peak weighting, bandpass filter frequency.
BLON turns on the display backlight.
BLOFF turns off the display backlight.
FILT returns current bandpass filter frequency, or NONE.

The following commands will be executed only in PAUSE mode.

Setup Commands - Duplicates the functions available inside the setup menus. Omitting parameters w, x, y, or z will return the current setting. Refer to Section 3.3 for details on setting the following parameters.

LOGxy Sets quantities to log. x = L for LEQ or LAVG
x = M for LMAX
x = P for LPK
x = 1 for L10
x = 9 for L90
y = ON to enable logging, y = OFF to disable logging.

LINTxy Sets the logging interval. xx = 2 digit number from the values allowed for logging interval, y = H, M or S for hours, minutes or seconds.

LMEEx Enables or disables logging to internal memory. x = 0 for off, x = 1 for on.
LCOMx Enables or disables logging to the COMM port. x = 0 for off, x = 1 for on.

BAUDxxxxx sets the baud rate for serial communications.
xxxxx = 1200, 2400, 4800, 9600 or 19200.

PRLL sets communications for a parallel printer.

FLOWx enables or disables flow control for RS-232.
x = H for Hardware, x = S for Software, x = N for none

EOLxx sets the end of line character for serial communications, either carriage return, line feed or a combination of the two. xx = C, CL, L or LC where C = carriage return and L = line feed.

PRNxy sets the items to print. x = H for header, x = S for summary, x = T for time history, x = F for filter grouping, x = L for printing location data along with a session summary. y = Y to enable, y = N to disable.

ERx sets the exchange rate. x = 3, 4, 5 or 6.

THxxx sets the integration threshold. xxx = 0 to 180
THON enables the integration threshold.
THOFF disables the integration threshold.

LNxyy sets the exceedance levels of interest. x = 1, 2, 3 or 4 to select which exceedance level to set. yy = 1 to 99 to set the percent value.
TONxxx sets the study trigger threshold for beginning a study. xxx = 0 to 180.

TONON enables the threshold triggered study feature.
TONOFF disables the threshold triggered study feature.
TOFFxxx sets the study end threshold level. xxx = 0 to 180.
TOFFON enables the study end threshold level.
TOFFOFF disables the study end threshold level.

PRTDxx:yy:zz sets the programmed run time duration where xx = hours, yy = minutes, zz = seconds.
PRTDON enables the programmed run time duration feature.
PRTDOFF disables the programmed run time duration feature.

AOTvv:ww:xx:yy:zz sets the auto on time. vv = month, ww = day, xx = hour (0 to 24), yy = minutes, zz = seconds.
AOTON enables the auto on feature.
AOTOFF disables the auto on feature.

TIMExx:yy sets the clock where xx = hours (0 to 24), yy = minutes

DATExx/yy/zzzz sets the calendar. xx = month, yy = day, zzzz = year.

2PKx sets the weighting of the second peak detector.
x = A, C or L.

TAKx sets the Taktmaximal period. x = 3 or 5 (seconds)

SESSION enables Session mode. (must RESET unit first)
SESSOFF disables Session mode. (must RESET unit first)

?M returns a list of the measurement commands.
?S returns a list of setup commands

Function Commands

OFF turns the unit off. Caution: unit cannot be turned on via remote control. Enable Auto On with a valid date and time, or use the ON/OFF key to turn the unit on.

PRINTxxxxx returns the printout of a specific memory location. xxxxx = 1 to 99999 to specify the memory location. If x is omitted all memory locations will print.

PRINTSxxxxx returns the printout of a specific session if the meter is in Session mode.

RESET clears the memory.

@SAXxxxxxxxx stores the meter's serial number, where xxxxxxxxxx is the serial number on the back panel.

RUN places unit into RUN mode.
PAUSE places unit into PAUSE mode.

Messages Returned From the Meter

FULL indicates internal memory is filled. The meter should be reset before beginning another study.

C-A OPTION NOT INSTALLED returned when a request has been made for a reading from an option which is not installed.

C-A DISABLED indicates that the C-A option is installed, but not turned on in the DISP Setup Menu.

4.4 Printing Data

The model 1900 may be connected to either a parallel or serial (RS-232) printer by using the proper cable and adapter. Data may also be printed directly to a PC by using a communications package such as Procomm or Windows Terminal. The printout contains the information from each study, or an individual study including:

1. All measurement parameters (Range, Weighting, etc.)
2. Data Summary of all measured parameters (LEQ, LMAX, etc.)
3. Start, Stop and Run Times and OL Time in %

The information printed will be that selected in the Print (PRNT) Setup Menu (Refer to section 3.3). See the following two pages for a sample printout. The printout sections selected in the setup menu are labeled on the sample printout for clarity.

To connect the model 1900 to a parallel printer, the 056-875 Parallel Interface is required. The 8 pin miniature DIN connector plugs into the COMM jack on the side of the meter. The 36 pin flat cable connector plugs into the printer. The meter must be set for parallel operation (PRLL option for RATE, located in the COMM Setup Menu - Refer to section 3.3).

The meter and the printer should all have their power switches turned ON. The meter must be in either Pause or Memory Review mode. Pressing the PRINT key will start the printout. The printout will contain either of the following:

- 1) If the meter is in the Memory Review mode, only the data stored in the memory location selected will print. If in Session mode and the overall Session summary data is selected for viewing, that summary data will print out. The data for the individual studies will print if selected in the Print Setup menu by turning on the LOC, or memory location, option.
- 2) If the meter is in normal Pause mode, all studies stored will print. Studies that were made using an optional bandpass filter will print according to the selection made at the FILT option in the PRNT Setup Menu.

To interrupt a printout, press PRINT again. Disconnect the interface from the printer before turning the model 1900 off.

The model 1900 can be connected to a serial (RS-232) printer or a PC by using the serial interface cable provided with the meter. A 25-pin male to male gender changer will be required for connection to the printer. The printer's communications parameters must match that of the model 1900. Refer to the preceding section.

Some printers can work either in serial or parallel mode. The printer must be set up for one or the other. Simply plugging into the correct connector is not sufficient. Refer to the printer's manual. THE 1900 HAS A SEPARATE CABLE FOR CONNECTING TO A PARALLEL PRINTER. THE SERIAL CABLE **CANNOT** BE ADAPTED TO WORK WITH A PARALLEL PRINTER.

SAMPLE PRINTOUT

(HEADER SECTION)

QUEST TECHNOLOGIES
1900 Noise Integrating/Logging Sound Level Meter
Unit Version Number: 1.01 Serial Number: QS2100035
Name _____
Work Area _____
Comments _____

Meter Calibration: 114.0dB 17-DEC-94 @ 08:38:55
Calibrator: _____
Serial Number _____ Calibration Date _____

(SUMMARY SECTION)

STUDY 1
Notes _____

Measuring Parameters:		Weighting		A	Time Constant		Slow
Range	40-110dB	Exchange Rate	3dB		Peak	Weighting	LIN
Threshold	OFF						
Session Started	15-JAN-94 @ 10:56:38	Session Stopped	15-JAN-94 @ 10:58:42			Run Time	
Peak Level	102.6dB		15-JAN-94 @ 10:56:42			00:02:00	
Max Level	88.0dB		15-JAN-94 @ 10:56:43				
Min Level	73.4dB		15-JAN-94 @ 10:57:12				
Overload	0.0%						
LEQ	80.5dB	SEL(3)	115.1dB	TWA	41.0dB	Pa2Hr	0.5
LDN	82.6dB	CNEL	83.5dB	TAKM3	81.6dB		
L10	87.2dB	L25	84.6dB	L50	78.2dB	L90	74.0dB

SAMPLE PRINTOUT (continued)

(GROUPED FILTER DATA SECTION)

Measuring Parameters:						
Range	70-110dB					
Threshold	OFF					
	Weighting		LIN	Time Constant	Slow	
	Exchange Rate		3dB	Peak Weighting	LIN	
Filter Summary: Model 08-50/100 Octave Filter Set - Serial No.						
#	Freq(Hz)	Leq	Max	Sel	Start-time	Run-time OL-%
2	31.5	75.6	77.3	85.4	11:00:09	0:00:09 0.00%
3	63	82.1	84.1	92.7	11:00:20	0:00:11 0.00%
4	125	90.8	107.3	102.8	11:00:33	0:00:10 0.50%
5	250	87.8	89.7	98.4	11:00:45	0:00:11 0.00%
6	500	89.7	91.6	100.9	11:00:58	0:00:13 0.00%
7	1000	87.5	89.0	97.1	11:01:13	0:00:09 0.00%
8	2000	87.2	88.6	97.5	11:01:24	0:00:12 0.00%
9	4000	84.1	86.0	83.0	11:01:38	0:00:11 0.00%
10	8000	83.5	86.0	89.5	11:01:52	0:00:10 0.00%
11	16000	82.9	84.1	92.5	11:02:04	0:00:11 0.00%

(TIME HISTORY SECTION)

LOGGING (1 Sec)	LEQ	LMAX	LPK	L10	L90
Study 1					
10:56:39	100.6dB	101.3dB	102.5dB	101.7dB	78.7dB
10:56:40	100.8dB	101.4dB	102.8dB	101.7dB	78.7dB
10:56:41	99.6dB	97.5dB	100.3dB	96.7dB	72.7dB
10:56:42	100.7dB	102.8dB	103.4dB	98.7dB	74.7dB
10:56:43	100.6dB	100.5dB	102.3dB	101.7dB	78.7dB
10:56:44	100.8dB	101.8dB	103.4dB	101.7dB	78.7dB
10:56:45	99.6dB	97.5dB	104.3dB	96.7dB	72.7dB
10:56:46	100.7dB	100.8dB	102.4dB	98.7dB	74.7dB
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.

4.4 Chart Recording

The Model 1900 has a DC output that is linearly related to the 60 dB measurement range as follows:

Bottom of Measuring Range = 0 VDC output
Top of Measuring Range = 1 VDC output
60dB per 1 volt or 16.67 mVDC per dB.

This output, capable of driving up to 100 feet of shielded or twisted pair cable, is intended for use with a 0 to 1 volt DC input chart recorder that has an input impedance greater than 20K ohms. It is also suitable for use with a variety of data acquisition devices.

Refer to Figure 13, Chart Recording of SPL. Connect the Model 1900 to the chart recorder input. Observe proper polarity. Use a 1 kHz acoustic calibrator, preferably 94 dB, to calibrate the chart recorder as follows:

1. Turn the meter to ON. Set the meter RESPONSE to FAST, and RANGE to 80-140dB.

NOTE: If an adapter is needed to mate the microphone size to the calibrator coupler, insert it fully into the calibrator.

2. Place the calibrator fully onto the microphone with the calibrator turned off. The meter should read less than 80 dB which provides 0 volts DC at the DC output. Adjust the zero control on the recorder so that the pen indicates a relative dB of 0.
3. Turn the Calibrator ON to produce 94 dB (or the level specified on the label) at 1 kHz. Set the 1900 dB RANGE for the highest bar graph level without causing an overload. The recorder pen should rise to the correct relative dB. (54 if the calibrator level is 94 dB and the dB RANGE is set to 40 to 100.) A small adjustment may be needed. Use the zero adjust to do this.
4. Be sure to document all chart recorder settings and meter settings when taking measurements.

Note that any range position can be set on the Model 1900 and the 60 dB span of the meter range will always correspond to the full 60 dB range on the chart recorder. Quest Chart paper # 58-653 has a 60dB scale, and will

provide an
easy to
read
recording.

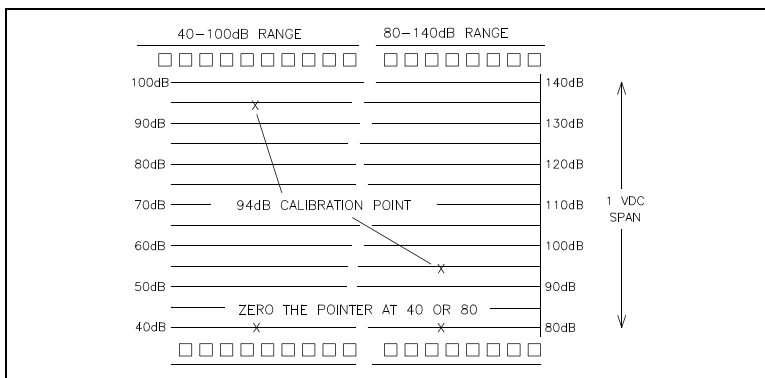


Figure 13. Chart Recording of SPL

5. GENERAL SOUND MEASUREMENT PRACTICES

Before taking measurements with the Model 1900, there is a series of quick checks that should be performed. After switching the unit ON, check for the BAT indicator in the display. Replace the batteries if needed.

Although the Model 1900 will maintain accurate calibration over a long period of time, the calibration should be checked and the meter slightly adjusted, if necessary, before each use.

When performing integrating measurements, press the RUN/PAUSE key, making sure "I" is indicated in the display. If the meter is in the RUN mode and you want to change Weighting, Response or Range, it is a good idea to stop accumulating data by entering the Pause mode. This will eliminate electrical switching noise from affecting your study, especially when using SLOW or IMPULSE response. To do this, press the RUN/PAUSE key again and "I" will disappear from the display. Change the desired settings, and then press RUN again to begin a new study. It is always a good idea to document all measurement conditions and meter settings for possible future needs. If a printer is used, the settings will all appear on the printout.

5.1 Calibration

To check the calibration of the Model 1900, perform the following procedure using a Quest Calibrator.

1. Check that the BAT indicator is not on, indicating that one or both of the batteries is weak.
2. Turn the Calibrator ON. If optional, set the frequency to 1 kHz. Note the SPL of the calibrator.
3. Insert the microphone fully into the calibrator adapter ring, if required for the size microphone in use.
4. Slowly place the Calibrator onto the adapter/microphone.
5. Using the FUNCTION key, set the Model 1900 to read SPL and set the weighting, response and range as appropriate. Note: SPL must be one of the display options enabled in the Setup Menu.
6. Use a screwdriver to adjust the calibration control, located through the small hole on the left side of the meter, until the display matches the calibration level.

NOTE: Most calibrators are affected by changes in altitude and barometric pressure. The rated SPL is set at standard barometric pressure at sea level (760 mm Hg). Consult your calibrator manual for correction factors.

Storing the Calibration Value

The model 1900 can store the time, date and SPL of a calibration, which will be included in the printout and in downloaded data for each study. Enter the PARA Setup Menu and go to CAL by pressing the following keys:

SETUP,
a or « to " PARA ",
ENTER,
a or « to " CAL "

The number in the display is the current SPL. Calibrate as directed in the previous section. Range and weighting keys will be operational, but the response time will be set to FAST. When the reading on the display is correct, press ENTER to store. The display will briefly read " CAL_{pk} " and return to the "PARA" menu display. The calibration SPL, time and date are now stored.

NOTE: When ENTER is pressed to store the calibration value, the logging peak detector and C-A option (if installed) are also calibrated. This should be done whenever the lithium battery is replaced. As the peak detector is most accurate over the upper portion of the range, the calibration value should be in the upper half of the range used for calibration. It is important to not disturb the meter during this time, as this may cause a high peak reading and

result in bad peak data.

Calibrating A Microphone with A Different Sensitivity

The model 1900 covers a 30 - 140dB measuring range when using the standard 0.52" microphones (39 - 50 mV/Pa). The operating range may be adjusted to read correctly for other microphones. For instance, using a microphone that has 10dB lower sensitivity, the meter can be set to cover the range of 40 - 150dB.

While in the CAL portion of the PARA Setup Menu, apply the calibration tone to the microphone and verify that the meter will not calibrate to the proper level. Adjust the calibration control so that the display shows a difference from the desired reading of +/- 10dB or a multiple of 10dB. Press The RESET/EDIT key.

" CAL+ " will appear in the display. The RANGE key may now be pressed to adjust the reading in increments of 10dB, adjusting the overall operating range by the same amount. When the reading is correct, press ENTER to store the calibration value.

5.2 Meter / Microphone Placement

Whenever possible, the meter should be tripod-mounted in a relatively open area to minimize reflections from your body or other large reflective structures. Avoid placement against a wall or in a corner. If body reflections are of concern, a microphone extension cable may be used to separate the preamplifier from the meter for better microphone placement. When taking measurements while holding the meter in your hand, keep your arm fully extended.

When using a random incidence or pressure microphone, point it approximately 70 degrees to the direction of the sound. If using a free-field microphone, point it directly at the noise source (0 degrees).

5.3 Background Noise

Background noise can cause considerable error in measurement when its level is close to that of the noise source of interest. When it is not possible to eliminate or reduce the background noise, use the curve shown in Figure 14 to correct for the effect of the background noise on the measurement.

5.4 Wind Screen Effects

To prevent measuring errors caused by wind blowing across the microphone, the use of a windscreen is recommended. The wind screens will reduce wind effects and will also help protect the microphone under dusty, oily, or humid conditions. Acoustic attenuation effects of the WS-7 (for .52" mic) and the WS-3 (for 1 inch mic) windscreens are shown in Figure 15.

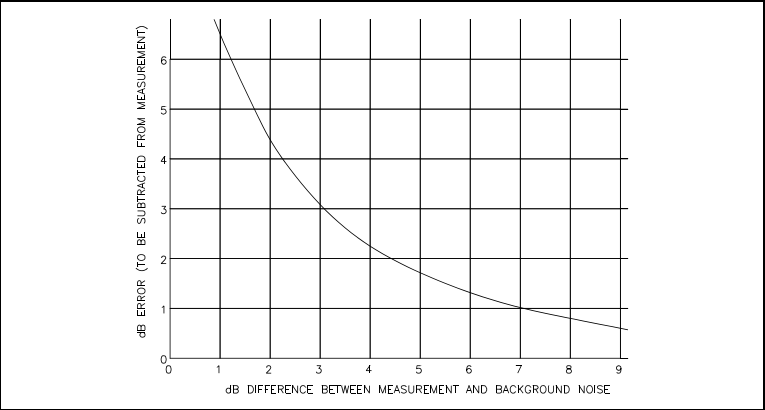


Figure 14 Effect of Background on Measurement

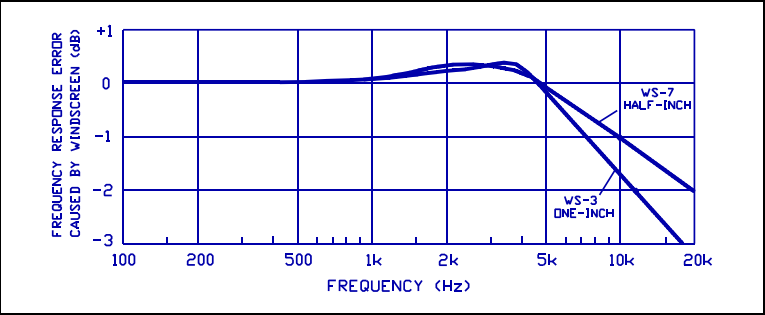


Figure 15. Acoustic Effect of Windscreens

6. TECHNICAL INFORMATION

6.1 Principles of Operation

The Quest Model 1900 uses low noise, low power circuitry to ensure long battery life, maximum stability, and superior reliability over a wide range of environmental conditions. Figure 16 is a block diagram of the 1900's internal operations.

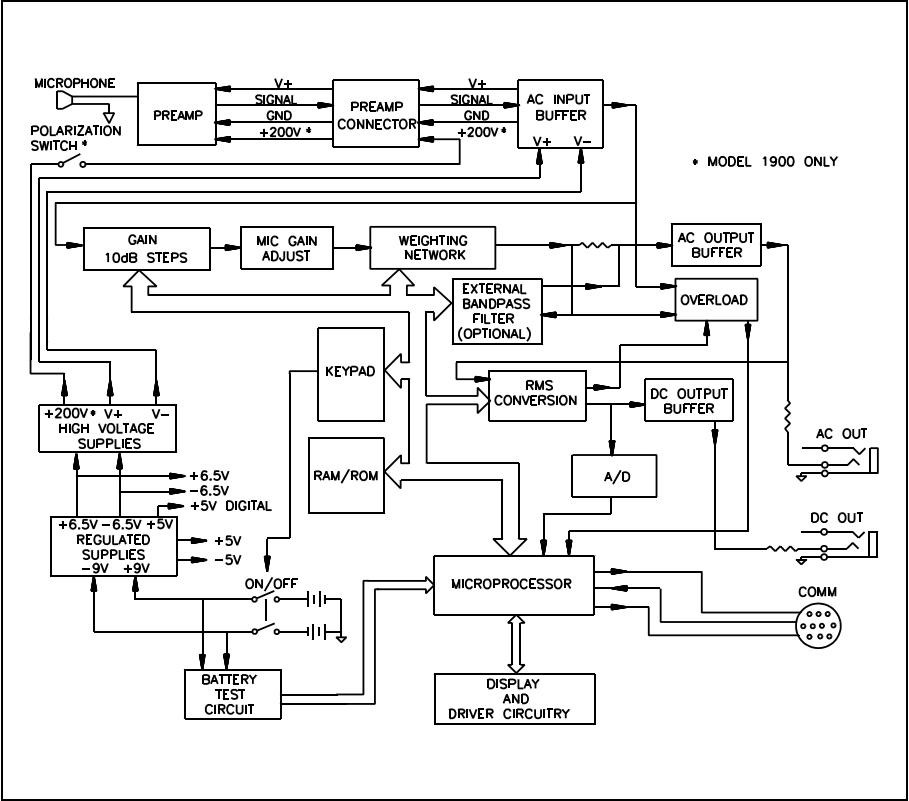


Figure 16. Block Diagram of the Model 1900

6.2 Microphones - Model 1900

The Model 1900 is normally supplied with a 0.52" microphone of either the free field or random incidence (pressure) type. Either prepolarized (electret) or condenser types may be used. The electret microphone does not require the 200 volt polarization that can be supplied by the model 1900. Refer to section 1.1.

The microphone screws directly onto the preamplifier which, in turn, connects directly to the meter. The preamplifier converts the high output impedance of the microphone into a low output impedance, allowing the microphone to drive up to 100 feet of cable for remote operation.

Typical microphones used with the 1900 include the following:

QE4146	1/2-inch freefield, prepolarized	39.8 mv/Pa	(25-145dB)	
QE4170	1-inch pressure, 200V polarized	50 mv/Pa	(10-150dB)	
QE4160	1/2-inch pressure, 200V polarized	50 mv/Pa	(20-145dB)	
QE4150	1/2-inch freefield, 200V polarized	50 mv/Pa	(20-145dB)	
QE4140	1/2-inch pressure, 200V polarized	16 mv/Pa	(35-160dB)	QE4110
1/4-inch	freefield, 200V polarized	3.5 mv/Pa	(60-175dB)	
QE4120	1/4-inch pressure, 200V polarized	1.3 mv/Pa	(60-175dB)	
QE4846	1/2-inch freefield, prepolarized	40 mv/Pa	(25-140dB)	

Typical microphone response curves for the Models QE4846 and QE4170 are shown in Figures 17 and 18 respectively.

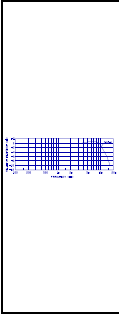


Figure 18. Typical Frequency Response - Model QE4170 Microphone

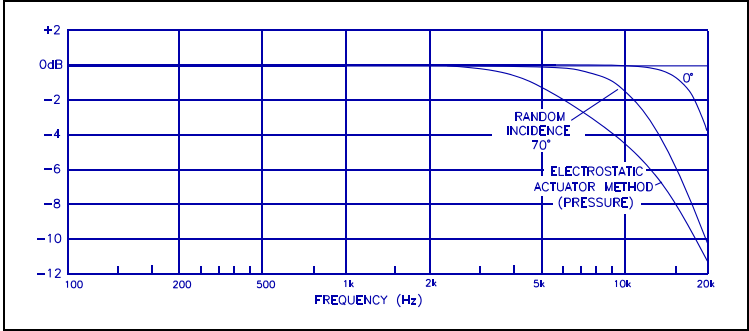


Figure 17 QE4846 Microphone Response

6.3 Microphone - Model 2900

The model 2900 is designed to accept a prepolarized (electret) microphone, Model QE7052. The impedance of this microphone is 18pF. The microphone screws directly onto the preamplifier, model 056-852. Typical response for the QE7052 is shown in Figure 19.

6.4 Preamplifier Input Characteristics

The input impedance of the preamplifier affects both the low frequency response and the microphone attenuation as shown

in Figures 20 and 21. The approximate microphone capacitances for the 1/2 inch and one inch microphones are 18pf and 60pf respectively.

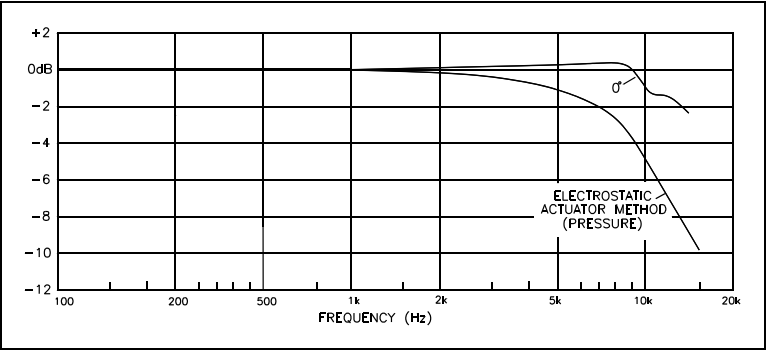


Figure 19. QE7052 Microphone Response

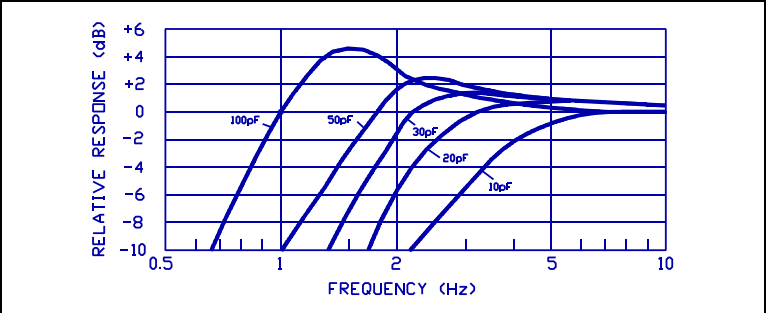


Figure 20. Effect of Microphone Output Capacitance on Preamplifier Low Frequency Response

6.5 Microphone Preamplifier Extension Cables

The preamplifier is removable by unscrewing the black plastic collar below the preamplifier housing. Extension cables of up to 100 feet in length can be connected between the preamplifier and meter. Quest Electronics offers the following lengths of remote cables:

- # 59-733 ICM-10 10 Ft. Remote Cable.
- # 59-734 ICM-50 50 Ft. Remote Cable.

The calibration level at 1kHz and below is affected by less than 0.1 dB with the insertion of a cable. Therefore, there is no need to recalibrate when the cable is added. Maximum output at high frequencies is affected by long cable lengths. This effect is shown in Figure 22.

6.6 Input Buffer Circuitry

The high impedance

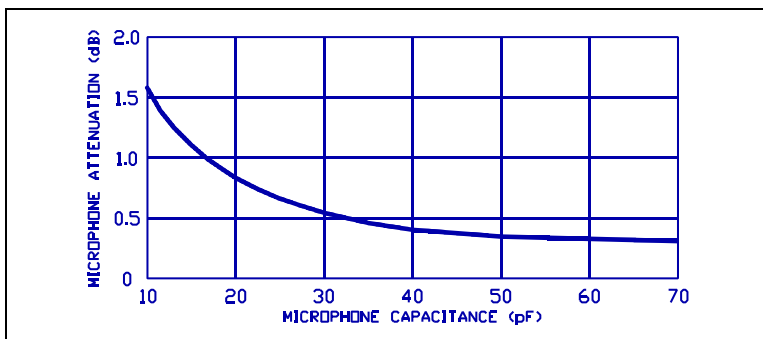


Figure 21. Microphone Output Attenuation Caused by Input Capacitance of Preamp

input circuitry (1 Megohm in series with 0.1 MFD) of the model 1900 will accept up to a 10 volt RMS signal. The model 2900 will accept up to 4 volts RMS. With the microphone and preamplifier removed, other transducer devices (such as the Quest Model VI-90 Vibration Integrator) can be connected to give a dB readout on the meter.

To remove the preamplifier unscrew the black plastic collar below the preamp housing. Note that when connecting other input devices to the Model 1900, the 200 volt microphone polarization switch located inside of the battery compartment should be turned OFF for safety. Only use pins 1 and 3 for the AC signal input. NEVER connect to pins 2 and 4.

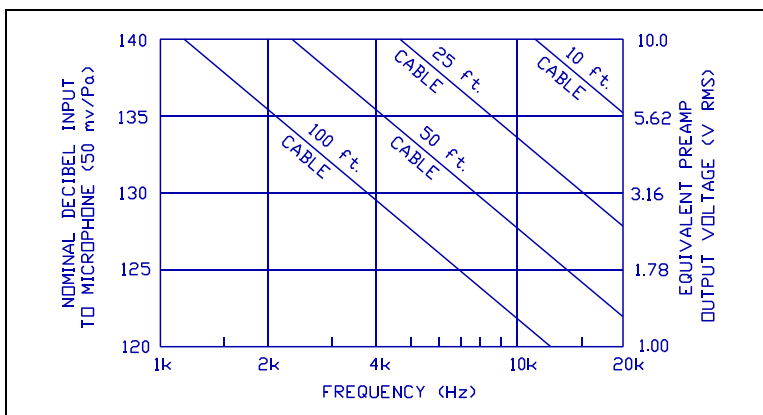
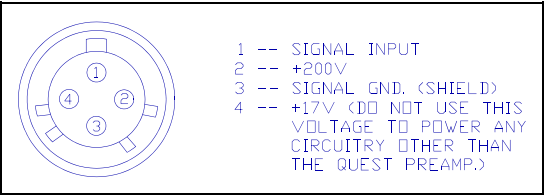


Figure 22. Frequency/Amplitude Limitations with Extension Cables

To input an electrical signal requires a special connector, Quest part number 14-739. Figure 23 shows the function of each of the pins within the meter input connector.



6.7 Weighting Characteristics Figure 23 Meter Electrical Input (Direct)

The weighting characteristics (frequency response) for A, C, and LINEar are shown in Figure 24. The A weighting response emulates the response of the human ear and is used for most industrial and community noise measurements. C weighting is often used for measuring noise reduction in hearing protectors and for other scientific purposes. The "LINEar" weighting has a flat frequency response over the range of human hearing and is useful in many applications such as audiometric analysis. It is also used when taking octave and 1/3 octave measurements.

6.8 Internal Electrical Noise

The maximum measurable SPL of the 1900 Meter is 140 dB with a sinusoidal input. (120 dB if measuring a complex signal with a 20 dB crest factor.) With optional microphones the upper range can be extended to 180 dB.

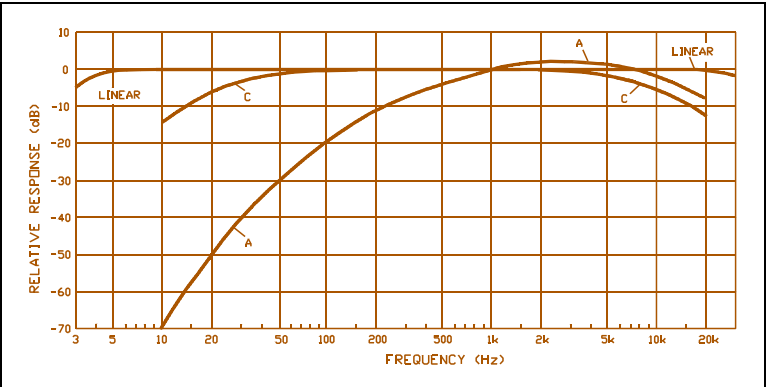


Figure 24 Weighting Characteristics

When used with either the OB-100 or OB-300 filter (octave mode), the specific minimum measurable SPL's when using either the Model QE4170 or the Model QE4146 microphone are shown in the following tables. The inherent noise level is typically at least 5 dB below the RMS values shown in each table. Noise Floor values were determined by substituting an equivalent electrical impedance in place of each microphone.

Model QE4170, 1 Inch Microphone (equivalent impedance = 56pF):

Octave Band	Weighting		
	A	C	LIN
All Pass	20dB	27dB	39dB
31.5 and 63	16dB*	22dB	25dB
125 and 250	16dB*	18dB	20dB
500 and 1K	16dB*	16dB*	16dB*
2K and 4K	16dB*	16dB*	16dB*
8K and 16K	16dB*	16dB*	16dB*

* 11.6dB is the lowest SPL indicated by the instrument, therefore measurements below 16dB are of questionable accuracy.

Model QE4146, 0.52 Inch Microphone (equivalent impedance = 18pF):

Octave Band	Weighting		
	A	C	LIN
All Pass	27dB	36dB	45dB
31.5 and 63	16dB*	31dB	33dB
125 and 250	16dB*	26dB	26dB
500 and 1K	18dB	20dB	20dB
2K and 4K	16dB*	16dB*	16dB*
8K and 16K	16dB*	16dB*	16dB*

Values for the model 2900's QE7052 Type 2 microphone will be approximately 2 dB higher than those for the QE4146.

6.9 Tone Burst Response

Figures 25 through 29 show the meter's tone burst response to sinewave inputs of varied burst duration. The four available time constants are:

SLOW RESPONSE (1000 msec time constant) Figure 25.
Decay Rate = 4.35 dB per second.

FAST RESPONSE (125 msec time constant) Figure 26.
Decay Rate = 34.7 dB per second.

PEAK RESPONSE (50 microsecond time constant) Figure 27.

IMPULSE RESPONSE (35 msec rise time constant with a decay rate of 2.9 dB/sec) Figures 28 and 29.

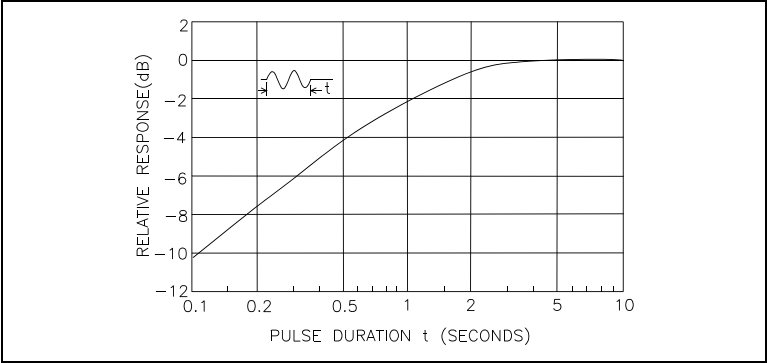


Figure 25. SLOW Response

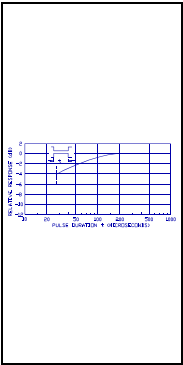


Figure 27.
PEAK Response

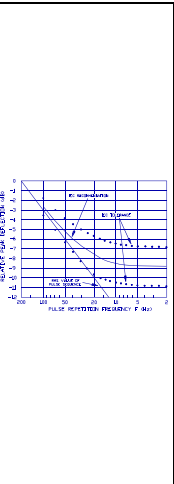


Figure 29.
IMPULSE
Response to
Repeated
Impulses

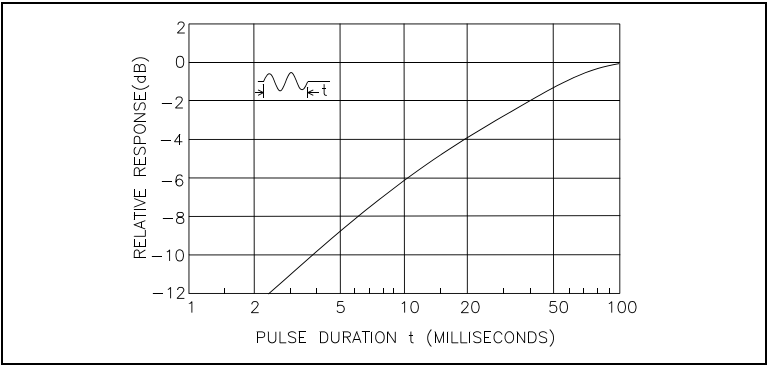


Figure 28. IMPULSE Response

7. SPECIFICATIONS

Standards: Model 1900 : Type 1 ; Model 2900 : Type 2 A N S I
S1.4-1983, IEC 651-1979, IEC 804-1985.

Measurement Range: 20 - 140dB in 7 60dB ranges with standard microphone. Model 1900 only: display range may be shifted upward in 10dB steps to 60 - 180dB by using optional microphones. The second peak detector operates over the range of -40 to +10dB relative to the top of the selected measurement range.

Display: 4 Digit Liquid Crystal Display with an additional Quasi-Analog 60 dB indicator in 2 dB increments. Level display indicates to 0.1 dB resolution. Time display indicates either Min:Sec or Hr:Min. Annunciators are included for Battery Check, RUN, Pause, and Overload Indication.

Measurements Performed: Sound Pressure Level (SPL), Equivalent Level (LEQ or LAVG), Time Weighted Average (TWA), Maximum Level (LMAX), Minimum Level (LMIN), Percentile Levels (LN), Day/Night Level (LDN), Community Noise Exposure Level (CNEL), Overload Time (%OL), Exposure (PA2H), Sound Exposure Level (SEL), Taktmaximal (TAKM), and Run Time (RTxx). Optional C-A module allows simultaneous C-A weighted measurement of LEQ (or LAVG).

Automatic Measurement Modes: Programmed Run Duration, Level Triggered Run/Pause, Clock/Calendar Triggered Power on and run for programmed run duration.

Minimum Measurement: Meter only, with Model QE4146 Microphone -- 27 dBA. Various Weightings with an Octave Filter Set refer to Section 6.8. The minimum measurement varies depending on the filter frequency selected.

Maximum Measurement: With Model QE4146 Microphone -- 120 dB with 20 dB Crest Factor. (140 dB if measuring a sinusoidal signal.) Overload indication will occur if upper range is exceeded. Optional microphones may raise the upper measurement limit.

Frequency Weighting Networks: A, C, and Linear. When using a filter set, any one of the weightings may be selected.

Meter Response: Slow, Fast, Impulse, and Peak. (The Peak onset time constant is less than 50 microseconds). Peak measurements may be made in either A, C, or Linear Weighting. A second peak detector is included for logged measurements.

Microphones: Removable 1/2 inch prepolarized condenser (electret) microphone is standard. Optional 1/2 inch, one inch, and other microphones are available for the model 1900 only.

Preamplifier: Directly accepts 0.52" microphone, other sizes with proper adapter. Removable, the preamp will drive up to 100 feet of cable with negligible signal loss. (See Figure 22.)

Model 1900: Preamplifier model 056-856. The input impedance is greater than 1 gigaohm in parallel with 2 pF.

Model 2900: Preamplifier model 056-852. The input impedance is greater than 1 gigaohm in parallel with 47 pF.

Polarization (1900 only) : Regulated 200V DC (+/- 2%) for use with condenser microphones. The voltage must be manually switched off when using prepolarized condenser (electret) microphones.

Meter Input: The input impedance is 1 Megohm in series with 0.1uF.

Model 1900: Maximum sinusoidal input voltage = 10V RMS

Model 2900: Maximum sinusoidal input voltage = 4V RMS

AC Output: 3.16 V RMS at full scale (60 dB). (3.8 V RMS maximum) The output impedance is 3.2K ohms. Connected equipment should have an input impedance of > 10K ohms. The output can be shorted without damaging the meter or changing the meter reading.

DC Output: 0 to 1.00V DC; 60 dB span. Each 0.167V change equals 10 dB. Output impedance is 1000 ohms. Connected equipment should have an input impedance of > 10K ohms. The output can be shorted without damaging the meter or changing the meter reading.

COMM Output: RS-232 serial output to printers or computers.

Selectable data rates of 1200 through 19200 baud. ASCII character format. Parallel printer output with optional interface

module.

Frequency Range: 4 Hz (-3dB) to 50 kHz (-3dB) on linear weighting, meter only. (Subject to microphone limitations.)

Reference Range: 60 to 120 dB Range setting

Reference SPL: 114 dB

Reference Frequency: 1 kHz

Reference Direction: 0 Degree when using a Free Field Microphone. Sound is arriving from directly in front of the microphone diaphragm. (A Normal line extending from the center of the microphone diaphragm.)

Detector: True RMS

Detector Pulse Range: 63 dB

Detector Measuring Range: 40 dB from the lower range limit (when measuring a signal with a 20 dB Crest Factor). The extra 20 dB (40 to 60) on top of the measuring range produces the 20 dB Crest Factor capability .

Primary Indicator Range / Linearity Range: 60 dB (The range as shown by the Range Indicators on either side of the bargraph). Tested with a sinusoidal signal input.

Level Linearity: Inside the Primary Indicator Range. It is tested on the Reference Range (60 to 120 dB) with a sinusoidal input signal. Tolerance is +/- 0.7 dB referenced to 94 dB.

Overload Indication: OL in the display indicates a momentary overload while viewing SPL. OL stays lit while viewing data from a study.

Attenuator Accuracy: Referred to the Reference Range and the Reference SPL. Within 0.5 dB from 31.5 Hz to 8 kHz. Within 1.0 dB from 20 Hz to 12.5 kHz.

Warm-up Time: 30 seconds.

Integration Time (Settling Time): 1 minute when measuring a short impulse. 5 seconds when integrating a constant input signal.

Accuracy: Within 0.5 dB at 25°C; Within 1.0 dB over the temperature range of -10°C to +50°C.
2nd Peak Detector: within 1.5dB from -40 to +10dB relative to the top of the measurement range.

Memory Capacity: Standard 128K: allows logging of 5 quantities at 1 second intervals for up to 4 hours.
Optional 512K upgrade: allows logging of 5 quantities at 1 second intervals for up to 18 hours, 30 minutes.
Decreasing the number of logged quantities or increasing the logging time interval increases available logging time capacity proportionately.

Temperature Range: Operating: -10°C to +50°C. Accuracy is within +/- 0.5 dB.
Storage (less batteries): -20°C to +60°C
Do not exceed the Storage Temperature Range because possible damage to the unit may result.

Operating Humidity: Over a range of 30 to 90% relative humidity, the accuracy is within +/- 0.5 dB. Do not exceed 95% relative humidity because possible damage to the unit may result.

Effect of Magnetic Fields: A magnetic field of 1 Oersted (80A/m) at 60Hz produces a maximum reading of 40 dB on Linear Weighting.

Effect of Electrostatic Fields: Negligible as long as the protection grid is kept on the microphone.

Batteries: Two 9-volt alkaline batteries (NEDA 1604A) recommended.

Battery Life: Typical operating time for meter alone and for individual operating conditions which increase operating current. Combinations of these conditions will further reduce operating time.

	<u>1900</u>	<u>2900</u>	<u>2900UL</u>
Meter only	20 hours	29 hours	24 hours
w/ 200 Volts On	18 hours	n/a	n/a
w/ Backlight On	13 hours	19 hours	11 hours
w/ Filter	8 hours	11 hours	3 hours
w/ C-A Option On	17 hours	24 hours	15 hours

Tripod Mount: A threaded insert on back of the meter accepts a standard 1/4-20 tripod mounting screw.

Size: 3.3 x 8.2 x 1.8 inches (84 x 208 x 47mm) not including the height of the preamp.

Weight: 23 oz. (654g) including the preamp and batteries.

Note: Specifications subject to change.

8. ACCESSORIES

- 056-981 QC-10 Calibrator; 114dB at 1000 Hz Output
- 056-982 QC-20 Calibrator; Selectable 94dB or 114dB at 250 Hz or 1000 Hz Output
- Calibrator Microphone Adapters
 - 056-990 0.52" diameter
 - 056-988 1/4" diameter
- 059-344 WS-7 Windscreen for 0.52" microphone (package of 3)
- 058-115 WS-3 Windscreen for 1" microphone (package of 3)
- 056-877 C-A Measurement Option (Factory Installed)
- 056-887 512K Memory Option (Factory Installed)
- 059-045 TP-1 Tripod (Larger - will not fit in carrying case)
- 059-046 TP-2 Tripod (Smaller - fits in carrying case)
- 056-875 Parallel Printer Interface
- 056-999 Serial Interface (RS-232 to PC) cable
- Preamplifier Remote Cables
 - 059-899 ICM-2 Microphone Cable (2 foot length)
 - 059-733 ICM-10 Microphone Cable (10 foot length)
 - 059-734 ICM-50 Microphone Cable (50 foot length)
- 059-703 Input adapter: Female BNC to 0.52" microphone thread, with 18pF capacitance. Allows direct electrical signal input to the meter.
- Quest Suite for Windows PC support software
- 056-709 DC Power Supply Module: Accepts 12-16VDC input to power the meter and optional filter.

9. INTRODUCTION TO THE MODELS OB-100 and OB-300

The Quest Model OB-100 Octave Filter and OB-300 1/3 - 1/1 Octave Filter are plug-in modules containing a bandpass filter with a selectable center frequency. The OB-100 meets the most stringent requirements of ANSI S1.11-1986 and IEC R225-1966 for octave band filters. The OB-100 is a full octave bandwidth active filter with ten selectable center frequencies from 31.5 Hz to 16 kHz. The OB-300 meets the most stringent requirements of ANSI S1.11-1986 and IEC R225-1966 for octave and third octave band filters. The OB-300 is an active filter with 33 selectable center frequencies from 12.5 Hz to 20 kHz when in the 1/3 mode and 11 selectable center frequencies from 16 Hz to 16 kHz when in the 1/1 mode. The filters may be operated manually, or can automatically step through each consecutive band at a user selectable rate.

Primary uses include frequency analysis for product noise emission, material acoustics, community noise, audiometer calibration and analysis of audiometric rooms.

10. ABOUT THE FILTER

10.1 Filter Controls

POWER Switch: A three position slide switch:

OFF -- Disconnects the filter circuitry from the attached sound level meter. With this switch in the off position, the filter does not use power from the meter batteries.

MANUAL -- Filter frequency selection is performed with two push buttons (START Buttons - $\uparrow$ and $\downarrow$).

AUTO -- Unit automatically cycles through the desired filter frequencies while storing sample information for each frequency during the RUN mode.

START (UP and DOWN Arrows)

Allows the user to step through the different bandpass filters. The two buttons allow manual frequency control (in MANUAL Mode) or frequency direction control (in AUTO Mode).

-20 dB

When this button is pressed, the output of the filter is amplified by 20 dB and then fed back to the sound level meter. Therefore, 20 dB has to be subtracted from the meter reading when using this button. **NOTE:** This button should not be pressed during a study, as it will result in incorrect data.

TIME

A screwdriver adjustment controls the automatic cycle time of each filter frequency from approximately 5 to 30 seconds.

MODE Switch (OB-300 only)

Selects either the 1/3 octave filter set (33 frequencies) or the 1/1 octave filter set (11 frequencies).

10.2 Filter Connector

The 30 pin connector on the top of the filter is used for connecting the filter to the sound level meter. Figure 30 shows the pinout for the filter connector.

1. 1 .
OPERATING
PROCEDURE

The Model 1900 becomes an Octave Band Analyzer with the addition of the OB-100 Octave Filter Set or a 1/3 Octave Band analyzer with the addition of the OB-300 Filter Set.

The two units are connected together with the long captive screw provided with the filter box. The operating considerations for the Model 1900 (Section 3.1) are basically the same when using the filters with the meter.

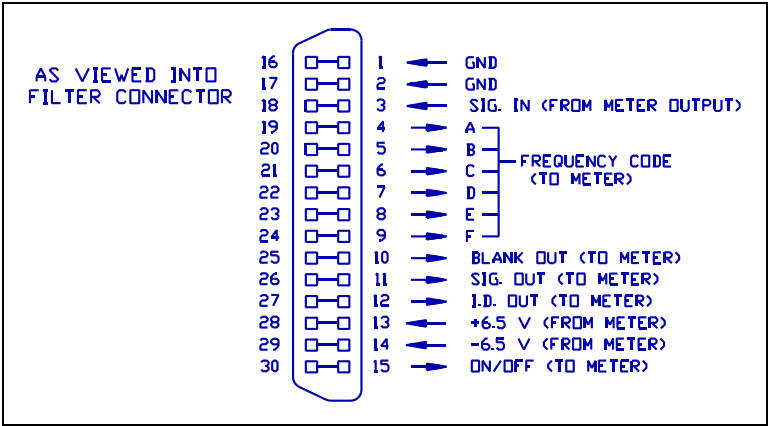


Figure 30. External Filter Connector

11.1 Operational Check

The Model 1900 should be calibrated as outlined in the meter section of the manual (Section 5.1) while the filter module is OFF. The filter has a fixed gain of approximately 1 (0 dB) at each center frequency and requires no adjustment. After the meter is calibrated, check the filter for proper operation as follows:

1. Read the calibrator 1 kHz output level. Set the meter dB RANGE switch so that the calibrator level will indicate within the upper 20 dB of the meter display. Set the RESPONSE switch to FAST, WEIGHTING switch to LIN and MODE switch to SPL. Turn the POWER switch to ON.
2. Set the filter's switch to MANUAL. If using an OB-300 set the MODE switch to 1/1. Then use the UP or DOWN arrow buttons on the filter to select the 1 kHz filter.
3. Place the calibrator (and adapter if needed) onto the microphone. Turn the calibrator ON. A meter reading that is very close to the level listed on the calibrator should result. An error of +/- 0.5 dB is acceptable. This is due to the center frequency filter tolerance of +/- 0.5 dB maximum.
4. Change the filter frequency to 500 and read the display. Then change to 2k and read the display. At both frequencies the readings should be 19 to 23 dB less than the 1 kHz calibrator level.
5. Change the filter frequency to 1k and the meter dB RANGE so that the meter reads 20 to 40 dB less than full scale. Press and hold the -20 dB button on the OB-100. The meter reading shall rise approximately 20 dB to verify that the -20 dB button functions.
6. Remove the calibrator. The analyzer is now ready to use.

11.2 Taking a Measurement

1. Turn the meter POWER switch ON. The meter will turn on in the Pause mode.
2. Set the RANGE to 80 - 140 dB. Set the RESPONSE to FAST, WEIGHTING to LIN (see note below), and the MODE switch to SPL.

NOTE: Note that the filter response can be in series with either A, C, or LIN. However, LIN is generally used when taking octave band measurements.

To minimize settling time following a filter band change, FAST response is generally recommended, especially if frequent filter band changes will be made.

3. Turn the filter's POWER switch to MANUAL to activate the filter.

If a measurement other than SPL is selected, the display will not show a value, as no study has been stored under the current conditions (filter ON).

4. Select the desired filter band by pressing the UP or DOWN arrow buttons. Press the RANGE ^a or « keys so that the display reads approximately 20dB below the top of the range.

MANUAL Filter Operation

Place the meter into the Pause mode using the RUN/PAUSE key. Select the first frequency of interest. Current SPL may be viewed on the display. If a study is desired, press the RUN/PAUSE key to enter the Run mode. The memory location number will show briefly on the display and the meter will begin accumulating data. Remain in Run mode for the required amount of time necessary to obtain a valid sample. Press RUN/PAUSE to enter the Pause mode, change to the next frequency of interest and enter RUN/PAUSE again, etc. Repeat this process for all frequencies of interest. Each successive RUN will increment the memory location counter.

AUTO Filter Operation

Place the meter into the Pause mode using the RUN/PAUSE key. If desired, press RESET to clear all internal memory. Set the meter for FAST response time to minimize its settling time after the filter switches frequencies. Select the first frequency of interest. (Be sure that the TIME adjustment is set to the desired filter cycle time.)

Slide the filter POWER switch to AUTO. To start the sampling sequence, place the meter into the RUN mode and immediately press the proper direction button. (The ^a button causes the frequency to cycle to the next higher frequency, the « button causes the frequency to cycle to the next lower frequency.) Each time the filter band changes, a new study is initiated and the memory location counter will increment. A brief period of time will occur between studies to allow for measurement settling time.

When the last frequency of interest has completed its cycle time, slide the filter POWER switch to MANUAL and immediately place the meter into the Pause mode.

11.3 Reviewing the Data

Each filter band measurement is treated as a separate study, the same as if RUN and PAUSE had been pressed to initiate and end a study. Each study is stored in a sequential memory location. To review the data, the meter must be in the Pause mode. When entering a memory location to review data, the filter frequency band will be displayed briefly (example: " 6300_{Hz} "). Review stored data as outlined in section 3.2.

12. TECHNICAL INFORMATION - OB-100

The OB-100 conforms to ANSI S1.11-1986, Order 3, Type 2, Sub-type C and IEC R225-1966. The normalized passband characteristic of a typical octave filter response is depicted in Figure 31.

The OB-100 filter is flat within 0.5 dB in the passband, with the 3 dB down points at approximately .707 f_c and 1.414 f_c where f_c is the center frequency of the band chosen. The $f_c/2$ and $2f_c$ frequencies are down by approximately 21 dB with the decade points ($f_c/10$ and $10f_c$) down by greater than 70 dB.

The block diagram of the OB-100 is shown in Figure 33.

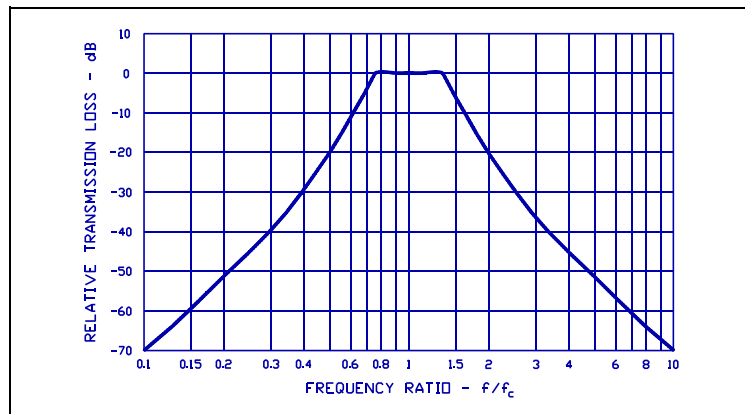


Figure 31. Typical OB-100 Filter Response

13. SPECIFICATIONS - OB-100

Standards: ANSI S1.11-1986, Order 3, Type 2, Sub-type C and IEC R225-1966.

Center Frequencies: 10 frequencies from 31.5 Hz to 16 kHz.

Frequency Selection: Full manual control or automatic sequential stepping through each frequency.

Power Source: Sound Level Meter.

Size: 3.3 x 2.8 x 1.8 inches (84 x 71 x 47mm)

Weight: 6 ounces (170 grams)

14. TECHNICAL INFORMATION - OB-300

The OB-300 conforms to ANSI S1.11-1986, Order 3, Type 2, Sub-type C and IEC R225-1966. The normalized passband characteristics of both the 1/1 and 1/3 filter responses are depicted in Figure 32.

The 1/1 filters are flat within 0.5 dB in the passband, with the 3 dB down points at approximately 0.707 f_c and 1.414 f_c where f_c is the center frequency of the band chosen. The $f_c/2$ and $2f_c$ frequencies are down by approximately 21 dB with the decade points ($f_c/10$ and $10f_c$) down by greater than 70 dB.

The 1/3 filters are flat within 0.3 dB in the passband, with the 3 dB down points at approximately 0.89 f_c and 1.12 f_c where f_c is the center frequency of the band chosen. The $f_c/2$ and $2f_c$ frequencies are down by approximately 50 dB.

The block diagram of the OB-300 is shown in Figure 33.

15. SPECIFICATIONS - OB-300

Standards: ANSI S1.11-1986, Order 3, Type 2, Sub-type C and IEC R225-1966.

Center Frequencies: (1/3 Mode) 33 frequencies from 12.5 Hz to 20 kHz. (1/1 Mode) 11 frequencies from 16 Hz to 16 kHz.

Frequency Selection: Full manual control or automatic sequential stepping through each frequency.

Power Source: Sound Level Meter.

Size: 3.3 x 4.2 x 1.8 inches (84 x 107 x 47mm)

Weight: 9 ounces (255 grams)

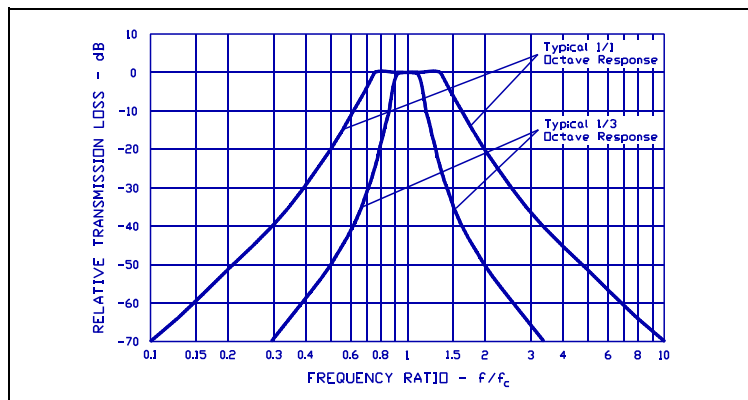


Figure 32. Typical OB-300 Filter Response

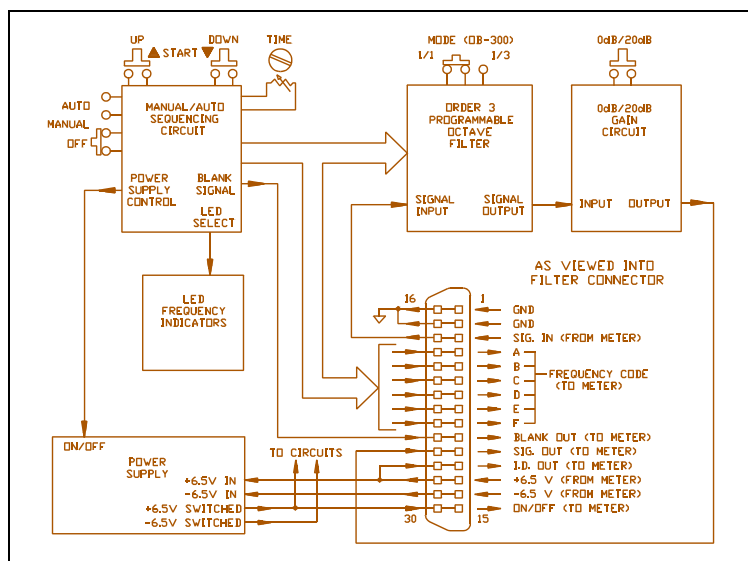


Figure 33. Block Diagram of Models OB-100 and OB-300

QUEST SERVICE AND WARRANTY POLICY

Service Policy

The Quest product you have purchased is one of the finest acoustic instruments available. It is backed by our full one year warranty which seeks complete customer satisfaction. This is your assurance that you can expect prompt courteous service for your equipment from the entire Quest service organization.

Should your Quest equipment need to be returned for repair or recalibration, please contact the Service Department at 1(800)245-0779 (USA) or Fax (414)567-4047 for a Return Authorization Number. The RA number is valid for 30 days, and must be shown on the shipping label and purchase order/cover letter. If you are unable to return instruments in that time call for a new RA number. Send it prepaid and properly packed in the original shipping carton directly to Quest Technologies, 510 S. Worthington St., Oconomowoc, WI 53066 U.S.A.

Repair or replacement work done under warranty will be performed free of charge, and the instrument will be returned to you prepaid. Your copy or a photocopy of the Quest Registration Card will serve as proof of warranty should the factory require this information.

If for any reason you should find it necessary to contact the factory regarding service or shipping damage, please direct your calls or letters to the attention of the Service Manager, Quest Technologies, (414) 567-9157 or (800) 245-0779. Office hours are from 8 AM to 5 PM (Central Standard Time) Monday through Friday.

Warranty

Quest Technologies warrants our instruments to be free from defects in materials and workmanship for one year under normal conditions of use and service. For U.S.A. customers we will replace or repair (our option) defective instruments at no charge, excluding batteries, abuse, misuse, alterations, physical damage, or instruments previously repaired by other than Quest Technologies. Microphones, sensors, printers and chart recorders may have shorter warranty periods. This warranty states our total obligation in place of any other warranties expressed or implied. Our warranty does not include any liability or obligation directly resulting from any defective instrument or product or any associated damages, injuries, or property loss, including loss of use or measurement data.

For warranty outside the U.S.A., a minimum of one year warranty applies to the same limitation and exceptions as above with service provided or arranged through the authorized Quest sales agent or our Quest European Service Laboratory. Foreign purchasers should contact the local Quest sales agent for details.