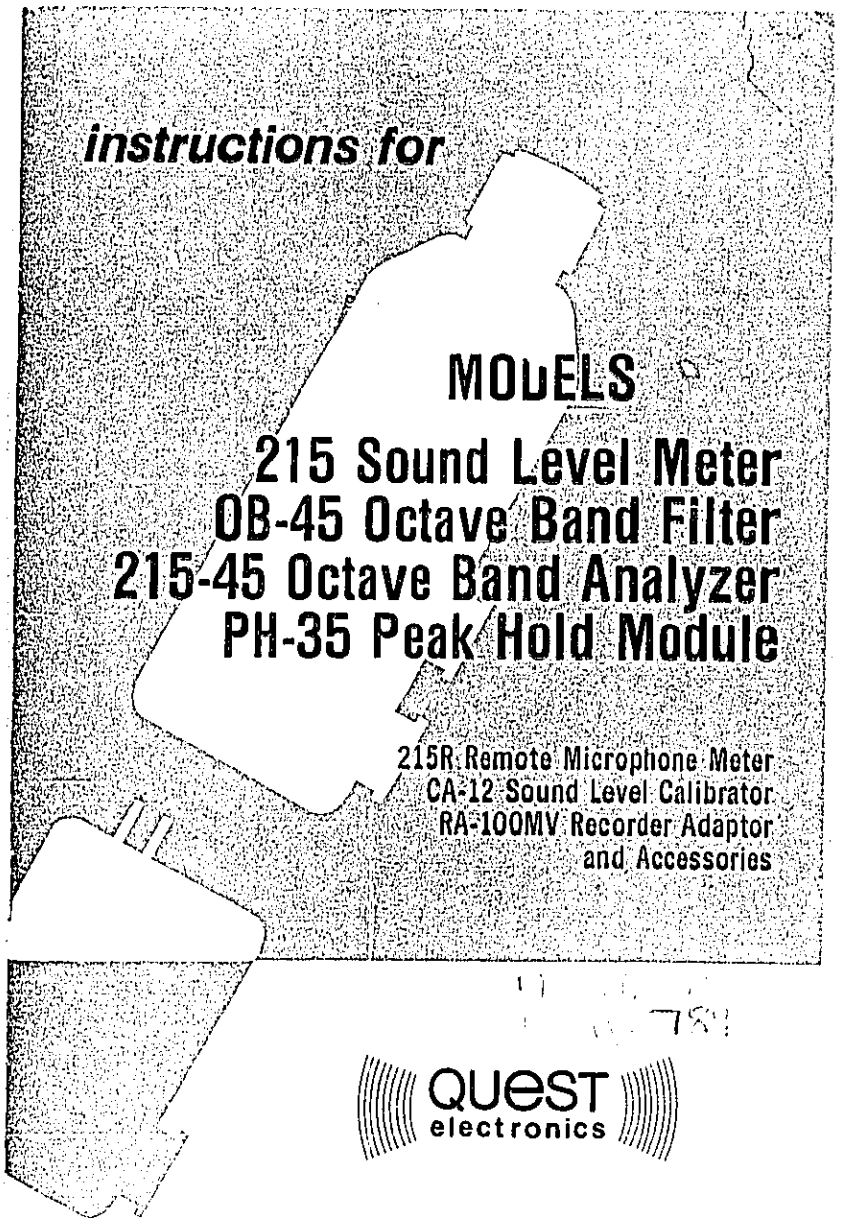
instructions for
MODELS
215 Sound Level Meter
OB-45 Octave Band Filter
215-45 Octave Band Analyzer
PH-35 Peak Hold Module
215R Remote Microphone Meter
CA-12 Sound Level Calibrator
RA-100MV Recorder Adaptor
and Accessories
QUEST
electronics

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Revised January, 1978

MODEL 215
SOUND LEVEL METER

GENERAL DESCRIPTION

Figure 1.

The Quest Model 215 is a general purpose sound level meter that conveniently and accurately measures sound in virtually any environment: industry, transportation, construction, mining, airport — anywhere there is noise. Calibration of audiometers is also a primary use. The 215 is designed to meet or exceed ANSI Standard S1.4-1971 for type 2 instrumentation and IEC-R123. The unit has a dynamic range from 30 to 140dB (re $20\mu N/M^2$). It can be used with the Model OB-45 Octave Band Filter to form the Octave Band Analyzer, Model 215-45 and with the PH-35 Peak Hold Module to form the Peak Hold Meter, Model 215-35. A linear (flat) response selection is provided as well as A, B, and C weighted scales.

The 215 meter has a fixed microphone configuration mounted directly to the top of the unit. The 215 is also available with remote microphone capability which is denoted by the letter "R" at the end of the meter model number, ie., 215R. Remote microphone capability must be built into the meter during manufacture. A mating connector is incorporated in the removable part which also includes the microphone and pre-amplifier. Because the pre-amp is effectively an impedance reducer, any length of microphone cable up to 100 feet can be used without affecting the overall accuracy or performance of the meter.

SPECIFICATIONS

Sound Level Range: 30 to 140 dB (re $20\mu N/M^2$). Sound Level Meter is accurate to within 1.0 dB up to 146 dB SPL without notable distortion. Maximum readable dB as a function of weighting network vs. frequency is reduced by the decibel difference between Flat (Linear) response and the dB level of the weighting curve vs. frequency.

Standards: Meets ANSI S1.4-1971, type 2 and IEC-R123

Frequency Response: A, B, and C weighted scales; linear (flat) scale

Meter Response: Taut-band type meter with FAST or SLOW selectable response.

"Slow" Response: With a pulse of 1000 Hz sinusoidal signal applied for 0.5 seconds, the maximum reading is between 2 and 6 (typical 3.5) decibels less than steady state level. Maximum overshoot for all frequencies between 63 Hz and 8 KHz is 1.6 dB (typical 0.5) measured at 4 dB below full scale.

Frequency Range: 20 to 10,000 Hz

Electrical Output: Approximately 1.2 volts at full scale behind 1000 ohms. For connection use a Switcheraft type 780 Tini-plug or equivalent. Electrical output jack (AC OUT) can be shorted without causing a meter reading error greater than 0.1 dB. Output impedance from the jack is 1000 ohms.

Crest Factor: 13 dB on all range positions except for the 130 dB range where crest factor is 6 dB (146 dB limit).

Detector: Square Law-type, Quasi-RMS.

Calibration: At 1000 Hz using the Quest CA-10, CA-11, or CA-12 Calibrator, or any other high quality acoustical calibrator that can accept the microphone size.

Microphone: High quality PZT ceramic, omnidirectional, 1.125 in. dia.

Temperature Range: Operation: -10°C to +50°C
Storage (less batteries): -40°C to +65°C
Coefficient of Sensitivity: 0 to 0.03 dB/°C at 6 dB below full scale meter reading.

Operating Humidity: 0% to 95% relative humidity produces less than 0.5 dB variation in SLM reading.

Effect of Magnetic Field: At field strength 1 oersted (80 AT/M), 50-60 Hz produces less than 40 dB indication measured with C scale weighting at maximum sensitivity meter orientation. The equivalent A-weighted response to a 1 oersted, 60 Hz magnetic field is negligible. The equivalent A-weighted response to a 1 oersted, 400 Hz magnetic field is approximately 50 dB with the meter oriented for maximum indication.

Effect of Vibration: When the sound level meter with attached microphone is placed on a surface having an acceleration of 0.1g, the highest meter indications not influenced by background noise are 49 dBA at 63 Hz, 72 dBA at 250 Hz, and 83 dBA at 1000 Hz. A similar test with the microphone replaced with an equivalent impedance yields no meter indication.

Batteries: Two NEDA 1604 standard type 9V transistor radio battery, Burgess 2U6, Eveready 216, or equivalent. Operating life is approximately 70 hours. (Battery life is affected by temperature -- which depends on battery used. Consult manufacturer's data for specific battery at 4 milliamp drain level. Cold temperatures at freezing or below greatly reduce effective battery life.)

Tripod Mount: 1/4-20 threaded insert in rear cover accepts standard tripod mounting screws.

Dimensions: Case: 6 x 2-1/2 x 1-5/8 inches
Overall: 7 x 3 x 2-1/8 inches

Weight: 19 ounces including batteries.

Construction: Solid state integrated circuitry in rugged aluminum housing.

ACCESSORIES

Accessories available for use with the 215 meter include the OB-45 Octave Band Filter Set, CA-12 Calibrator, EC-9A Earphone Coupler, PII-35 Peak Hold Module, RA-100MV Recorder Adaptor, WS-3 Windscreen, and TP-1 Tripod.

CONTROLS

ON-OFF-BAT Switch — A 3-position rocker switch to turn instrument on and off and to check battery condition.

FAST-SLOW Switch — A 2-position rocker switch to select fast or slow meter response.

dB RANGE Switch — A 10-position rotary switch, graduated in 10 dB increments from 40 to 130, to select sound level range.

WEIGHTING Switch — A 5-position rotary switch to select A, B or C scale weighted response, or LIN (linear — no weighting) response. In the EXT (external) position the switch provides for using the OB-45 Octave Band Filter and the PII-35 Peak Hold Module with the sound level meter.

A.C. OUT Jack — An output jack that furnishes an AC voltage of the noise wave that has been conditioned by the weighting or filter position selected and is proportional to the meter reading. The jack accepts a Switchcraft, type 780-Tini-plug or equivalent. This output can be used for magnetic tape or chart recording purposes. When recording with a DC chart recorder, the Quest Model RA-100MV recorder adaptor is necessary to convert the AC signal to DC.

External Connector — A standard 6-pin Cinch-Jones type connector provides for connecting the meter to the Quest OB-45 Octave Band Filter and the PH-35 Peak Hold Module. The pins on this connector are identified in Figure 2.

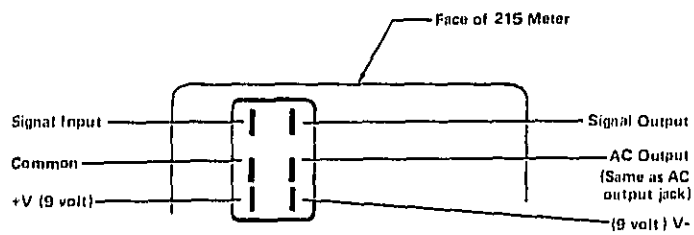

Figure 2. External Connector Pins

Calibration Adjustment — A screwdriver adjustment located near the external connector on the bottom of the unit that varies the amplifier gain to calibrate the instrument.

PRINCIPLES OF OPERATION

General

The 215 Sound Level Meter uses an omnidirectional ceramic microphone buffered by a high impedance FET input stage. The electronics utilize solid state integrated circuitry for maximum stability, reliability and low noise operation. A block diagram of the 215 is shown in Figure 3.

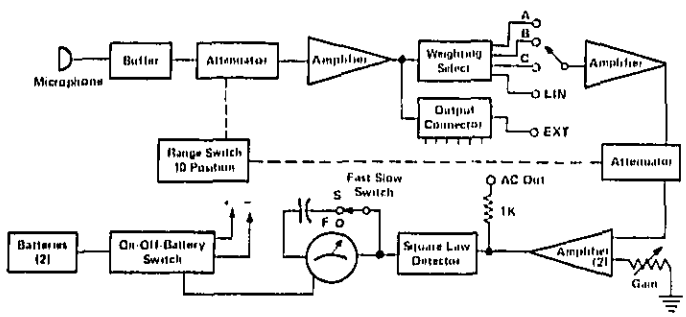

Figure 3. 215 Sound Level Meter Block Diagram

Selection of Weighting Characteristics

The Model 215 offers A, B, and C weighting scales as well as linear (non-weighted) response. In most cases the scale selected will be specified by the test being made or the regulation being followed. For example, most industrial noise regulations require "A" scale measurements. The linear scale can be used when the Model 215 is being used with a tape recorder or a real time analyzer. The standard weighting characteristics for the Model 215 are shown in Figure 4.

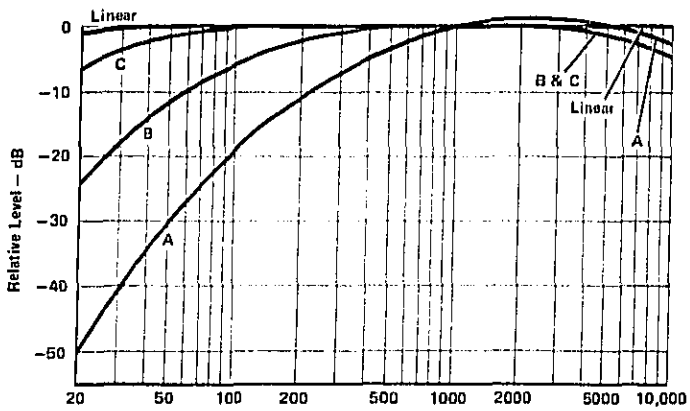

Figure 4. Frequency Response Weighting Characteristic

Microphone Characteristics

The microphone used in the 215 Sound Level Meter is a Shure type 401 ceramic omnidirectional unit. Overall diameter is 1.125 inches (2.86 cm). Typical sensitivity is 59 dB below 1 volt per microbar measured at 400 Hz. Figure 5 is a diagram of typical microphone response for both perpendicular and random incidence.

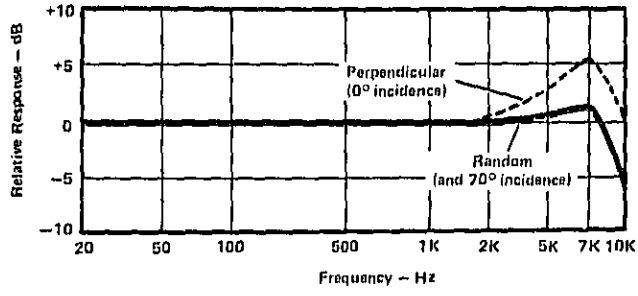

Figure 5. Type 401 Microphone Response — Perpendicular and Random Incidence

INTERNAL ELECTRICAL NOISE

Table 1 on the next page shows the internal noise level of the 215 meter with the meter set at "C" scale weighting. The noise levels are typical and are determined by subtracting the readings shown from the reading of the meter at full scale deflection. The figures are shown for each position of the dB RANGE selector switch at each octave band and at broad band (all pass). Noise levels on "A" weighting are further reduced because of its attenuation characteristic. The internal noise is always at least 27 dB below the full scale reading and all readings can thus be made without excessive noise problems.

OPERATING PROCEDURE

General

To obtain readings of maximum accuracy, hold the instrument away from you at an angle of approximately 70° from the horizontal. Under certain conditions slightly less accurate readings may result from pointing the microphone directly at the noise source. This can be noted from the Microphone Response chart.

Table 1. Internal Electrical Noise Levels of the Model 215 Sound Level Meter (in dB below full scale deflection).

		RANGE SELECTOR SWITCH POSITION									
		40	50	60	70	80	90	100	110	120	130
BROAD BAND (ALL PASS)		27	37	46	54	53	54	55	55	55	55
OCTAVE BAND CENTER FREQUENCY – Hz	31.5	48	57	67	75	78	80	80	80	80	80
	63	44	54	64	72	76	77	77	77	77	77
	125	41	51	61	70	73	75	75	76	76	76
	250	39	49	59	69	71	73	73	73	73	73
	500	38	48	58	68	69	70	70	70	70	70
	1K	37	47	57	67	66	67	68	68	68	68
	2K	36	46	56	64	65	65	65	65	65	65
	4K	34	44	54	63	62	63	64	64	64	64
	8K	34	44	54	63	61	62	63	63	63	63

The 215 is designed to be hand-held. If the unit is placed on any hard surface such as a table-top, check to see that no significant mechanical vibration exists which might yield false meter readings. The microphone will pick up vibration as if it were sound.

Before each use of any battery-powered instrument, the condition of the battery should be checked to assure proper operation. On the Model 215 the batteries are tested by moving the ON-OFF-BAT switch to the BAT position, and checking that the meter pointer deflects to the heavy green line marked BATTERY CHECK. If the meter deflection is below this area, the batteries must be replaced before any measurements are taken.

Basic Operation

Before turning the meter on, set the dB RANGE selector at or above the expected sound pressure level. Choose the desired weighting characteristic and select fast or slow meter response. Then move the ON-OFF-BAT switch to the ON position. The instrument is now ready to make sound level measurements.

Maximum readability and accuracy are obtained with the meter pointer deflected to the higher part of the meter scale. When possible, therefore, select the range to produce a reading between 0 and +10 on the meter.

The scale readings are added to or subtracted from the dB range level selected. For example, if the range selector is set at 80 dB, and a meter reading of +8 is indicated, then the sound level measured is 88 dB. Similarly, if the meter needle is at -5 dB for the same range selector setting, a noise level of 75 dB is indicated. In the latter case, better readability will result if the 70 dB range is selected. In this case the needle will point to +5 dB, again yielding the measurement of 75 dB.

Most meter readings can and should be taken with the slow meter response because the meter needle is more stable and easier to read. The fast response is intended for measurement of short duration noises, such as moving vehicles or impulsive sound, where the noise is not present sufficiently long to obtain the maximum reading in the slow response mode. Keep in mind that for very short duration impulse noise even the fast response mode may not be fast enough to indicate the true peak noise level.

Effect of Operator's Presence

Any object or surface can act as a reflector for sound. An operator close to a sound level microphone can also be a reflector, causing a reading error. When the sound to be measured is directional, the sound level reading can be affected by the relative position of meter and observer. The meter should not be held between the noise source and the observer because of sound reflections from the body. The meter should be held away from the body or mounted on a tripod with microphone pointed upward almost perpendicular to noise source (70° from path), keeping the body out of the noise path.

Effect of Background Noise

If the sound level from a particular source is to be determined, all surrounding sources of noise should, as nearly as possible, be reduced or eliminated. When it is not possible to eliminate surrounding noise, the curve shown in Figure 6 may be used to correct for the presence of this noise.

Use With Windscreen

To prevent wind blowing across the microphone and causing the erroneous measurement of sound level, use the Model WS-3 microphone Windscreen with the sound level meter. The windscreen is made of reticulated polyurethane foam for the reduction of ambient wind effects, and can also protect the microphone under dusty, oily or humid conditions. The screen is simply pushed onto the microphone when needed. Acoustic attenuation effect of the windscreen on the meter reading is small and is shown in Figure 7.

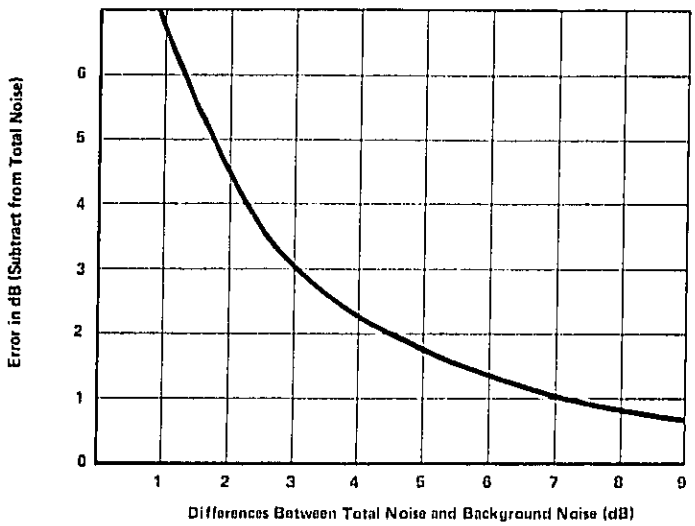

Figure 6. Effect of Background Noise on Measurements

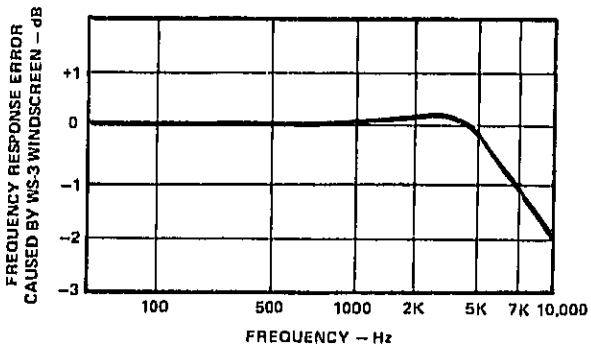

Figure 7. Acoustic Effect of WS-3 Windscreen on Model 215 Sound Level Meter

EXAMPLE OF OSHA NOISE EXPOSURE MEASUREMENT (Based on Proposed Standard 1975)

Using the 215 Sound Level Meter to determine OSHA compliance in a *constant* noise environment is a simple task. Merely read the sound level with A scale weighting at each worker's station. Record the date, reading and worker-station. From Table 2 determine the permissible length exposure for the measured noise level.

For a varying noise environment continuous measurements must be taken over the work day, and the following formula must be solved to determine worker exposure:

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \ldots \frac{C_n}{T_n} \leqq 1 \text{ for total permissible exposure}$$

where C is the length of time at a particular measured noise level, and T is the time per day permitted at that noise level (from Table 2).

Table 2. OSHA Permissible Noise Exposure

Length of Exposure – (T) (Hrs/Day)	Equivalent Maximum Noise Level (dBA)
(16)	(85)
8	90
6	92
4	95
3	97
2	100
1½	102
1	105
½	110
¼ or less	115

In order to use the Quest 215 or any other sound level meter in a varying noise environment, many noise measurements should be made at the workers station — enough so that the readings are representative of the workers exposure. All noise levels must be read, and the duration at each level noted. As many as 30 or more readings may be necessary to account for all the noise variations. However, in this example we assume that only four basic noise levels are present and that the duration of each is shown on next page. The maximum exposure time (T) for each reading is also shown.

Measurement Duration (C)	Average dBA Measured	Maximum Exposure Time (T)
1 Hr.	92	6
1 Hr.	100	2
4 Hrs.	90	8
2 Hrs.	83	–

It is assumed that the noise levels remain relatively constant during the intervals between measurements. Some judgment may be required in making such an assumption.

Substituting these values in the formula gives the following result:

1 Hr @ 92 dBA = 1/6; 1 Hr @ 100 dBA = 1/2;
4 Hrs @ 90 dBA = 4/8; 2 Hrs @ 83 dBA = 0.

Summing the exposure fractions yields

1/6 + 1/2 + 4/8 + 0 = 1.17

Since 1.0 is the maximum allowable value, the computation indicates that workers in this area were over-exposed by 17%.

It is obvious that in a changing noise environment the above procedure can be very complex, time-consuming, costly. In such environments it is suggested that the Quest M-7 Noise Dosimeter be used rather than a sound level meter. The M-7 automatically accumulates all variations in noise and produces a continuous readout of the percentage of permissible exposure. No operator or calculations are required.

BATTERY REPLACEMENT

Batteries should be replaced whenever a battery test gives a low indication on the meter. To replace batteries, remove the rear cover plate by unscrewing the retaining screws. The batteries are located in the upper section of the unit. Carefully remove the used batteries and replace them with two new 9-volt batteries, Burgess 2U6 or equivalent.

CAUTION

The batteries must be replaced with the ON-OFF-BAT switch in the OFF position to avoid possible damage to the unit.

CALIBRATION OF MODELS 215 AND 215R SOUND LEVEL METERS

The 215 meter is factory calibrated, and with proper care should retain its accuracy. It is recommended, however, that the meter be checked periodically with the CA-12 or CA-15 Calibrator preferably in the same environment in which sound level measurements are to be taken (OSHA specifies daily calibration if you use the results for record). Proceed as follows.

Figure 8.

1. First turn on the 215 or 215R Sound Level Meter and check the battery level indicator. Replace batteries if indicator is below green "good battery" level.

2. Push the meter switch to ON and select the 100 dB range position.

3. (CA-12): Switch on the CA-12 Calibrator and check battery level indicator. Replace batteries if indicator is below green "good battery" level.

(CA-15): Set the Model CA-15 Calibrator OFF-FREQUENCY switch to 1000 Hz. If a tone is heard, the Calibrator output is accurate and proper.

4. Carefully insert the meter microphone into the calibrator coupler. If the Model 215R Sound Level Meter is used with a microphone extension cable, then calibration is performed with the microphone mounted on the extension cable. Be sure microphone is inside coupler resting flush on the inner rim. Turn on the calibrator. The 110 decibel output of the calibrator should produce a full scale +10 reading on the meter for whichever weighting scale is used. All weighting readings are the same at 1000 Hz. Note the correction in calibrator output due to altitude effects explained in the NOTE on page 13 for the CA-12; or see "Altitude Effects" on page 8 of the CA-15 Instructions.

5. If reading is off slightly, insert a small screwdriver in the small hole on the bottom of the meter and slowly adjust the CAL adjust until the meter reads correctly.

6. Change the selector switch to the 110 dB position on the meter and note the needle should drop to the zero position on the meter dial.

7. Meter is now calibrated and ready for use.

NOTE

Effects of atmospheric pressure on the 215 meter are negligible. However, calibrator sound levels are affected by elevation above sea level. The actual sound output of the CA-12 calibrator is 0.1 dB less than the 110 dB rating for each 2000 feet of elevation above sea level. For example, at 6000 feet elevation the calibrator produces only 109.7 dB. The meter should then be set at 109.7 dB.

The small adaptor ring furnished with the CA-12 Calibrator or 215-12 Meter-Calibrator Kit is used only for checking other sound level meters with 1" microphones. This adaptor is not used with the 211A or 211FS or 215 meters.

If another calibrator with a frequency other than 1000 Hz is used, the equivalent "A" scale sound level must be known to set the 215 meter properly. If the "A" scale level is not known, calibrate the 215 meter with the WEIGHTING switch in the LIN (linear) position.

MODEL OB-45
OCTAVE BAND FILTER SET

GENERAL DESCRIPTION

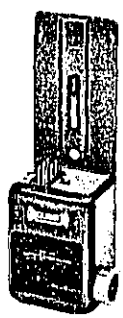

Figure 9.

The Quest Model OB-45 Octave Band Filter is a plug-in module containing a selectable set of filters. It is used primarily with the Quest Model 215 Sound Level Meter forming the Model 215-45 Octave Band Analyzer. The OB-45 meets the most stringent requirements of ANSI S1.11-1971 for Octave Band Filters. The unit contains nine selectable filter ranges from 31.5 Hz to 8 KHz center frequencies with full octave band width. Primary uses include frequency analysis for audiometric rooms and audiometer calibration, community noise, product noise emission, and structural and material acoustics. Active filters are employed throughout permitting the high accuracy and small size configuration.

SPECIFICATIONS

Frequency Range: Nine ranges, 31.5 Hz to 8 KHz center frequencies, full octave band width.

Filter Transmission Effectiveness: Approximately 20 dB down per octave from center frequency.

Standard: Meets ANSI S1.11-1971 for type E, Class II Filter Sets.

Input: (From 215 Sound Level Meter) 0 to 4 volts rms, 20 Hz to 10 KHz.

Output: (To 215 Sound Level Meter) 0 to 4 volts rms, output impedance less than 1 ohm.

Power Source: No internal power source. Battery voltage is obtained from the 215 Sound Level Meter through the connector.

Operating Temperature: -10° to +50°C

Operating Humidity: 0-95% relative humidity.

Connector: Six-pin Cinch-Jones type.

Size: 3 x 3-1/2 x 2-1/8 inches with back cover extending to 8-inch length.

Weight: 9 ounces.

Construction: Solid state integrated circuitry in rugged aluminum housing.

CONTROLS

FREQUENCY Band Selector — A nine-position rotary switch to select the octave band filter desired from 31.5 Hz to 8 KHz. (31.5, 63, 125, 250, 500, 1K, 2K, 4K, 8K Hertz).

External Connector — A six-pin Cinch-Jones type connector for electrical connection to the 215 Sound Level Meter. The pins on this connector are identified in Figure 10.

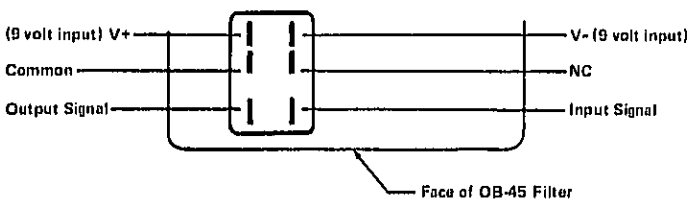

Figure 10. External Connector Pins

PRINCIPLES OF OPERATION

The OB-45 is a Class II Octave Band Filter set conforming to ANSI S1.11-1971 specifications. The normalized passband characteristics of the filters are depicted in Figure 11.

The filters are flat within 1 dB in the bandpass, with the 3 dB down points at .707 F_O and 1.414 F_O where F_O is center frequency of the band chosen. The $F_O/2$ and the $2F_O$ magnitudes are down by approximately 18.5 dB with the decade points down by greater than 60 dB.

The block diagram of the OB-45 showing the signal input from the 215 Sound Level Meter through the filters and back to the Sound Level Meter is illustrated in Figure 12.

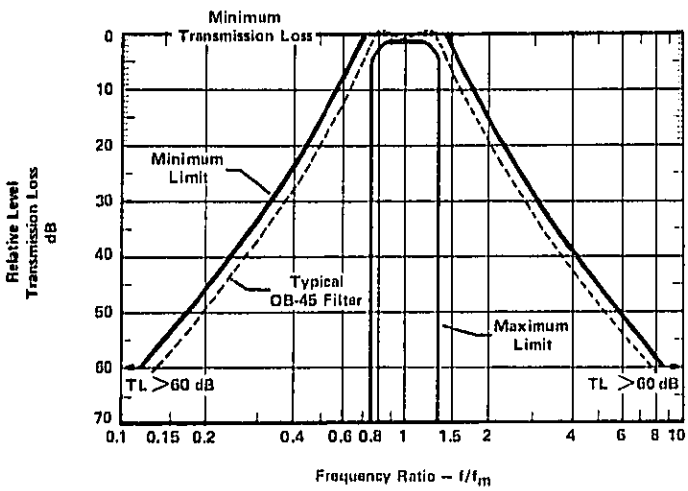

Figure 11. Normalized Amplitude Response – Octave Band Filter Class II

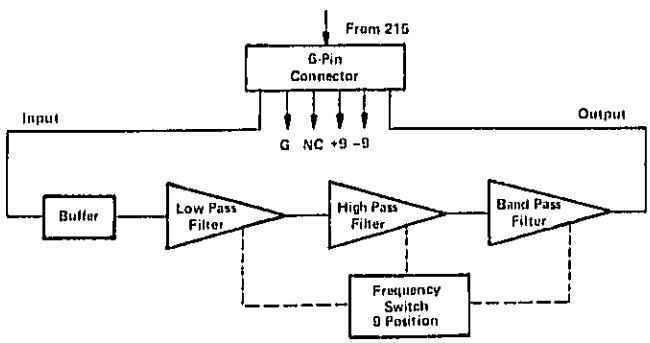

Figure 12. OB-45 Octave Band Filter Set Block Diagram

MODEL 215-45
OCTAVE BAND ANALYZER

GENERAL

The Model 215-45 Octave Band Analyzer is made up of the 215 Sound Level Meter and the OB-45 Octave Band Filter Set. The preceeding instructions for these two units should be read before the following instructions in that all the procedural information for the meter and filter set is applicable to the Analyzer. The two units are connected together through the six pin connector, and are locked together with the separate thumb screw provided. The rules of holding the unit away from the body, or on a tripod, are the same as for the 215 Sound Level Meter.

OPERATING PROCEDURE

1. Switch the 215 Sound Level Meter to the BAT position and check to see that the meter needle deflects into the green area. If the needle does not reach the green area, replace batteries.

2. Check the operation of the analyzer as outlined on Page 18.

3. Set the dB RANGE selector and FAST-SLOW switch on the 215 as appropriate for the noise being measured.

4. Set the WEIGHTING switch on the 215 to EXT (external). This switch position, and only this position, electrically engages the OB-45 Filter.

5. If you wish to determine all frequency bands of noise present, start with the OB-45 FREQUENCY selector at 31 Hz.

6. Turn the 215 to ON and you will be reading noise in the 31 Hz band only. Adjust dB RANGE selector on the 215 to obtain the best scale reading on the meter and then record the reading.

7. Repeat step 6 for each of the frequency bands to 8 KHz. These readings can be plotted on a chart of dB vs. centerband frequency.

8. If you wish to know overall noise unweighted, set the weighting switch to LIN (linear). You will then be reading all-pass flat response which is the noise sum of all the bands measured.

9. Turn the 215 switch to OFF when you have finished.

NOTE

Under certain circumstances it is possible to overload the internal amplifier and cause a slight error in some readings. A small error (in most cases negligible) can be developed *only* when the overall linear response noise level exceeds 126 dB RMS, *and* you are trying to read octave band levels on the 70 dB range position or lower. Noise above 126 dB will be clipped at that level when you use the 70 dB range position or lower. This clipping action causes squaring of the wave peaks and introduces small amounts of harmonic frequencies which actually may not be present. The amount of error at worst case is less than 1% of the overall noise, and thus for most applications is not a concern. In a similar manner overall noise above 136 dB will be clipped when reading octave bands on the 80 dB range or lower.

OPERATIONAL CHECK

The 215 meter should be calibrated alone using the Quest CA-12 Calibrator as outlined on Page 10. With the 215 calibrated, connect it to the OB-45, and lock them together with the thumb screw provided. The 215 meter was designed so that the calibration screw is not accessible when the meter is attached to the OB-45; the meter therefore can not be adjusted when it is attached to the OB-45. The OB-45 has a fixed input to output voltage ratio of one and therefore has no external adjustments. Check the operation of the 215-45 Analyzer as follows:

1. Set the 215 meter to the 100 dB range position, and the OB-45 frequency band to 1000 Hz (1K).

2. Using the CA-12 Calibrator (110 dB at 1000 Hz) insert the microphone into the Calibrator and turn both units ON. With the meter set at A, B, C or LIN position, a full scale deflection (+10) should be obtained.

3. Move the WEIGHTING selector to EXT to engage the OB-45. The meter reading should still be almost +10 but may be as much as 0.5 dB lower than full scale because of the contour of the filter in the bandpass zone (see Figure 11).

4. Next move the FREQUENCY selector to 2 KHz and then to 500 Hz. In both positions the meter reading should drop 18 to 19 dB (see Figure 11).

5. Remove the calibrator, and the analyzer is ready to use.

MODEL PH-35 PEAK-HOLD MODULE and MODEL 215-35 PEAK-HOLD METER

GENERAL DESCRIPTION

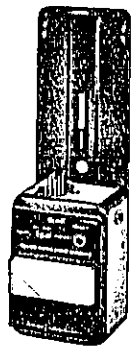

Figure 13. PH-35 Peak-Hold Module

The PH-35 Peak-Hold Module is an attachment to the 215 Sound Level Meter (becoming the Model 215-35 Peak-Hold Meter) for the measurement of peak sound levels. It is connected to the 215 in the same manner as the OB-45 Octave Band Filter. The PH-35 has three modes of operation: FAST RESPONSE peak-hold, IEC IMPULSE hold, or IMPACT peak-hold, selectable by a three position switch. In the FAST response position, the meter will hold the highest rms reading attained by the sound level meter in the normal FAST response mode. This mode is generally used for applications such as vehicle pass-by and aircraft fly-over measurements. In the IEC IMPULSE position, the meter will hold the maximum rms level for any impulse with risetime as defined by the International Electrotechnical Commission IEC R-179A. In the IMPACT position the meter measures and holds the true peak of any sound presented to the microphone. This mode is primarily for OSHA impact limitation measurements (linear scale). The unit features high resolution readings with a 10dB over-range button enabling the operator to read levels 10dB above full scale.

SPECIFICATIONS

When used with the 215 Sound Level Meter, the peak-hold meter meets all requirements of ANSI S1.4-1971 type 2. Range selection and controls are set by the 215 Sound Level Meter.

Input Voltage: 0 to ± 6v peak from 215 Sound Level Meter.

Peak-Hold Range: 30 to 146dB as selected by the 215 Sound Level Meter.

Modes: 1) FAST response maximum hold
2) IEC IMPULSE hold
3) IMPACT (peak) hold

Rise Time: *FAST Response Mode: 125 milliseconds
IEC IMPULSE Mode: 35 milliseconds
OSHA IMPACT Mode: less than 50 μ seconds

Hold-Decay Rate: less than .01dB/second (all modes)

Power Source: Obtains ± 9v from batteries located in 215 meter

Size: 2-1/2 x 3-1/2 x 2-1/8 inches with extended back cover to 8 inches.

Weight: 10 ounces

Construction: Solid state integrated circuitry in rugged aluminum housing.

*The FAST response of the 215 meter meets the requirements for type 2 meters in ANSI S1.4-1971. The PH-35 electronic FAST response meets the more stringent response requirement for type 1 instruments and the IEC R-179A for precision meters. The PH-35 actually has a slightly faster response than the 215 meter movement.

CONTROLS

FAST-IEC IMP-IMPACT Mode Switch — A 3-position slide switch to select the response mode to be held: fast response rms peak, IEC impulse rms peak, or OSHA type impact (absolute peak).

RESET Switch — A momentary push button switch located next to the Mode switch. Depressing the button will discharge the hold circuit and cause the meter reading to drop to the ambient level.

+10dB Switch — A momentary push button switch located on the side of the instrument. Depressing the switch extends the range of the instrument by 10dB. This allows the operator to read levels up to 10dB beyond the full scale range selected on the 215 for events which result in a greater than full scale meter reading.

External Connector — A six-pin connector provides electrical interface with the 215 Sound Level Meter. The pins of this connector are identified in the following diagram:

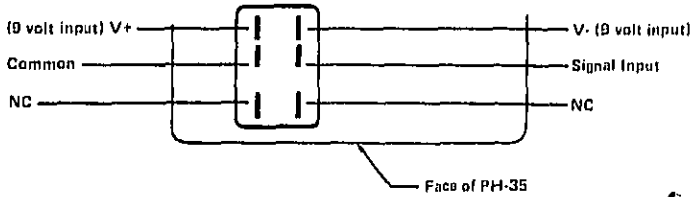

Figure 14. External Connector Pins

PRINCIPLES OF OPERATION

The PH-35 Peak-Hold Module is designed to allow accurate measurement of impulsive noise and impacts (peaks) as well as to hold a fast response reading on the Sound Level Meter to give an operator more time to read noise levels for such occurrences as vehicle pass-by and aircraft fly-over.

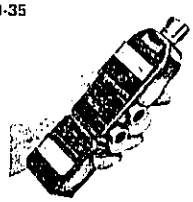

Figure 15. 215-35 Peak-Hold Meter

The block diagram of the PH-35 is shown below. The PH-35 consists of an absolute value detector to allow readings for peaks of either polarity, a square law detector with varying time constant for impulse or fast response readings, a hold circuit with reset, and a 10dB sensitivity change to increase the dynamic range.

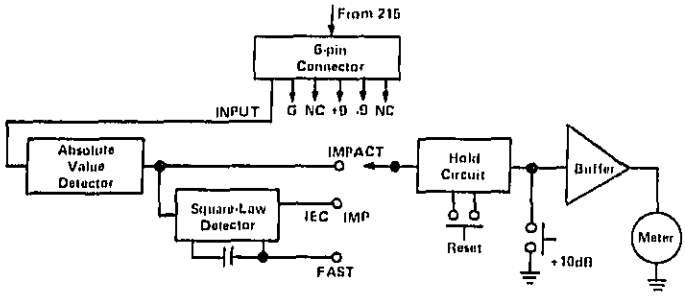

Figure 16. Block-Diagram PH-35 Peak-Hold Module

OPERATING PROCEDURE FOR 215-35 PEAK-HOLD METER

Read the instructions for the 215 along with the first part of PH-35 instructions before proceeding.

1. Connect the PH-35 to the 215. Lock the units together using the knurled thumb screw provided.

2. Set the dB RANGE selector and WEIGHTING switch on the 215 for the measurement to be made. (Do Not Set On EXT Position.)

3. Set the three-position slide switch to select the mode of operation: FAST hold, IEC IMPULSE or IMPACT (peak) hold.

4. Switch the 215 to the BAT position and check to see that the meter needle deflects into the green area. If the needle does not reach the green area, replace the batteries in the 215. Move the switch to ON.

5. Check the PH-35 meter dial. If the meter needle is not at or near the left hand rest position, press the reset button until the needle is in this position.

NOTE

Caution is advised when taking measurements with the PH-35. Any noise at the microphone will be read and retained. Brushing against the microphone or bumping the case may cause the meter to "peg"; the meter must then be reset before a measurement can be made. Switching controls or range can also "peg" the meter.

6. Hold the 215-35 Peak-Hold Meter (215 plus PH-35) in the same way as the 215 when making measurements. (See instructions for 215 Sound Level Meter.)

7. After making a measurement, record the result and depress the reset button to prepare for the next measurement. If the impulsive sound has caused the meter to go beyond full scale, press the +10dB button on the side of the instrument and take the reading again, adding 10dB to the indicated reading.

NOTE

When using the peak-hold module, set the weighting selector on the 215 to "A" scale or "LIN", depending on the measurement being made. Usually "A" scale is used for FAST peak-hold, while LIN response is used for OSHA IMPACT. The peak-hold will not function on the EXT. position.

CALIBRATION

The PH-35 is calibrated at the factory and with proper care should retain its accuracy. It is recommended, however, as with all sound measuring instruments, that the calibration be checked periodically with a sound calibrator. Proceed as follows:

1. Check the calibration on the 215 Sound Level Meter as outlined in the 215 instructions, with the weighting selector set properly for the measurement to be made.

2. Attach the PH-35 to the 215. If you are using the CA-12, 110dB Calibrator, set the dB RANGE switch on the 215 to 100dB and the ON-OFF-BAT switch to ON.

3. Set mode switch on PH-35 to either FAST or IEC (Not IMPACT). Depress and hold the RESET button. Insert the microphone into the calibrator coupler as in the 215 calibration procedure. The reading on the PH-35 should be full scale (110dB) as on the 215.

NOTE

If the mode switch is set to the IMPACT position, the meter will read 3dB higher than the FAST or IEC mode because the absolute peak level is being read rather than the rms value.

4. If there is some variation in the readings, insert the small screwdriver in the hole on the right side of the PH-35 module below the +10dB button, and slowly adjust the slotted pot until the PH-35 reading is the same as the 215 reading.

5. The 215-35 is now calibrated and ready for use.

ACCESSORIES

MODEL CA-12 SOUND LEVEL CALIBRATOR

DESCRIPTION

Figure 17.

The Quest CA-12 Sound Level Calibrator is a self-contained unit that quickly and precisely verifies the accuracy of microphones and sound measuring instruments. The Calibrator generates a reference sound level at precisely 110 dB and 1000 Hz.

The unit is battery operated and therefore fully portable. The CA-12 is primarily a field instrument for on-the-spot accuracy checks of sound level meters, noise dosimeters and other microphone instruments.

The CA-12 consists of a stable 1000 Hz oscillator, amplifier stage, magnetic acoustic transducer, and a coupler that accepts the standard 1-1/8 inch diameter microphone. A separate adaptor is also provided to accomodate a 15/16 (one inch) diameter microphone. Other adaptors to accommodate smaller microphones can also be used.

The Calibrator employs solid state integrated circuitry that provides accurate and stable performance. The block diagram (Figure 18) shows the basic operating sections of the unit. Regulation against battery drain is inherently provided in the electronics.

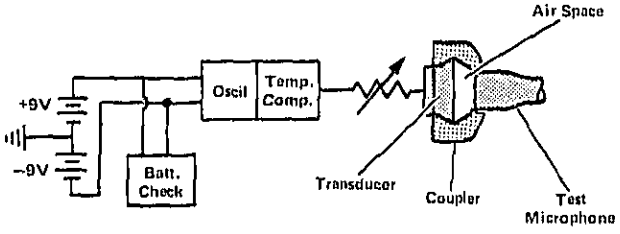

Figure 18. CA-12 Calibrator Block Diagram

SPECIFICATIONS

Acoustic Output

Frequency: 1000 Hz ± 3%.

Sound Pressure Level: 110 dB reference $20\mu N/m^2$.

Accuracy: ± 0.5 dB (23°C, 760 mm Hg).

Temperature Range: 0 to 50°C operating, -40 to +65°C storage (batteries removed).

Temperature Coefficient: 0 to 0.01 dB/°C.

Altitude Effects: Approximately 0.1 dB decrease for each 2000 feet increase in altitude from sea level to 12,000 feet elevation, or comparable atmospheric pressure change (approximately every 50 mm of Hg decrease).

General

Power Source: Two 9V transistor batteries NEDA 1604, Burgess 2U6 or equivalent. Battery life approximately 100 hours.

Operating Temperature: 0° to 50°C.

Construction: Rugged aluminum housing.

Case Size: 4 inches by 2-3/8 inches diameter.

Weight: 13 oz. including batteries.

OPERATION

The CA-12 Calibrator is designed to check the accuracy of many types of sound instruments, not only Quest manufactured equipment. Quest instruments commonly use the standard 1-1/8-inch diameter ceramic microphone which fits directly into the calibrator coupler cavity. For other microphones with smaller diameters, an adaptor must be used. The next most common size microphone is the 1-inch (actually 15/16 inch). When testing an instrument with a 1-inch microphone, the adaptor ring (furnished) must first be inserted in the coupler. This keeps a close tolerance fit around the microphone head. Be sure the microphone fits down inside the adaptor and rests on the lower rim. This rim supports the microphone and forms the necessary inner seal.

OPERATING PROCEDURE

NOTE

For calibration specifically of the Quest model 215 or 215R Sound Level Meter, see page 12 of this manual.

1. Set Calibrator ON-OFF switch to ON. A 1000 Hz tone should be heard.

2. Check battery indicating meter to be sure needle enters into the green "good battery" area. If needle stays in red area, replace batteries.

3. (Skip this step if the microphone to be measured is 1-1/8 inch diameter.) Insert the proper sized microphone adaptor, inner rim down, into the calibrator coupler cavity.

4. Carefully insert the microphone into the calibrator coupler. Be sure microphone is down inside the coupler resting flush on the lower coupler rim. If the Model 215R Sound Level Meter is used with a microphone extension cable, then calibration is performed with the microphone mounted on the extension cable.

CAUTION

Rapid insertion or withdrawal of the microphone may damage the microphone or the transducer in the coupler because of the rapid change in pressure on the diaphragms.

5. Proceed to verify the instrument accuracy by comparing the 110 dB output level of the calibrator to the instrument reading. Note the correction in calibrator output due to altitude effects given below. Adjust the sound level meter sensitivity as necessary.

6. When calibration has been made, carefully remove the microphone and turn calibrator to OFF.

BATTERY REPLACEMENT

To replace batteries, remove two screws from face plate on bottom of calibrator. Slide off face plate and outer shell to expose batteries.

ALTITUDE EFFECTS

Most calibrators including the CA-12 are affected by altitude. The transducer diaphram within the calibrator creates the sound as it vibrates against the air. When the air is thinner (at higher elevations) a lower sound level is produced.

The CA-12 is calibrated to produce 110 dB at sea level. When the unit is operated above sea level a slightly lower sound level is emitted depending on altitude. For each 2000 feet of elevation above sea level the CA-12 produces 0.1 dB less than the 110 dB rating. As an example, the calibrator will only emit 109.7 dB at the city of Denver (6000 feet elevation). Therefore, a sound level meter should be set at 109.7 dB, not at the rated 110 dB.

CA-12 CALIBRATION

The CA-12 Calibrator was precisely calibrated in the Quest laboratory with special acoustical instrumentation traceable to the U.S. Bureau of Standards. The CA-12 is very stable, but since it is used to calibrate other equipment, it should be periodically checked with laboratory standards. It is recommended that the Calibrator be returned to the factory at least once each year for recalibration, or whenever there is a question about its accuracy.

MODEL RA-100MV RECORDER ADAPTOR
(for DC Input Chart Recorders)

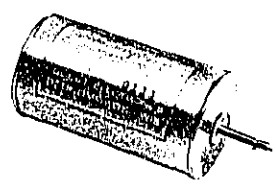

Figure 19.

The Model RA-100MV Recorder Adaptor converts the AC output electrical signal from the Quest 211A, 211FS or 215 Sound Level Meters to a DC signal for chart recording purposes. With this adaptor module the sound level meters can be used with 100 millivolt high impedance input DC recorders for such purposes as short or long term industrial noise monitoring, scientific analysis or vehicle noise level monitoring.

RA-100MV Specifications

Input voltage: 0-1.8V RMS AC from Quest 211A, 211FS, or 215 Sound Level Meters.

Output voltage: 100 millivolts DC, adjustable.

Response: Slow

Range: Approximately 25 dB

Tracking linearity: near log; tracks same as Sound Level Meter scale.

Power Source: None, passive module

Size: 2 x 1-1/8 dia. inches

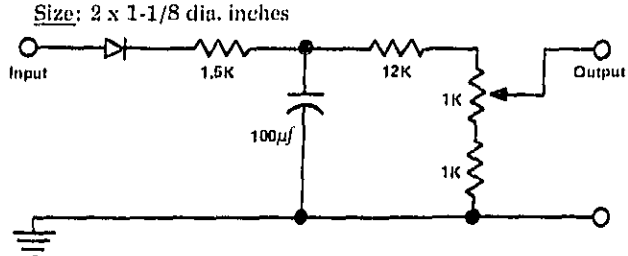

Figure 20. Model RA-100MV Schematic Diagram

Using the RA-100MV Adaptor

Insert RA-100MV adaptor directly into the AC output jack of the Quest 211A, 211FS or 215 Sound Level Meter. A separate output plug and cable is furnished, but a longer cable may be installed by user if desired. Use twisted pair cable. For long runs in excess of 10 feet use co-axial cable. Attach cable to the DC recorder input. Switch units on and calibrate the system using a known noise source or an acoustic calibrator such as the Quest CA-12 or, preferably the CA-10 or CA-11. The CA-10 and CA-11 have 8 selectable sound levels from 85 to 115 dB, and a calibration trace can thus be obtained at 5 dB increments across the entire chart.

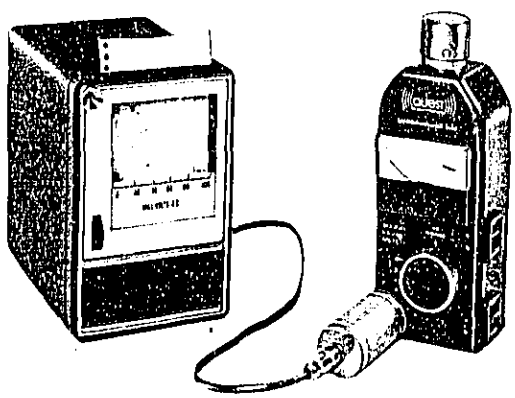

Figure 21.

Assuming you are using a CA-10 Calibrator insert the microphone of the Sound Level Meter into the calibrator. Set the range switch on the meter to 100 dBA and set the CA-10 to 110 dB position. Chart recorder should deflect to full scale reading. If it does not, adjust RA-100MV recorder adaptor with small screwdriver to obtain exactly full scale deflection on the chart. Next switch the CA-10 to 105 dB. The trace should move down to almost 1/2 scale (.54). Wait a few seconds to record and then switch CA-10 to 100 dB. Repeat for the 95, 90, and 85 dB positions. The resulting calibration trace should look approximately as that shown in Figure 22 with tracing displacement as noted.

YOU CAN NOW SET ANY RANGE POSITION DESIRED ON THE SOUND LEVEL METER NOTING THAT FULL SCALE DEFLECTION ON THE CHART WILL BE WHATEVER FULL SCALE DEFLECTION IS ON THE METER.

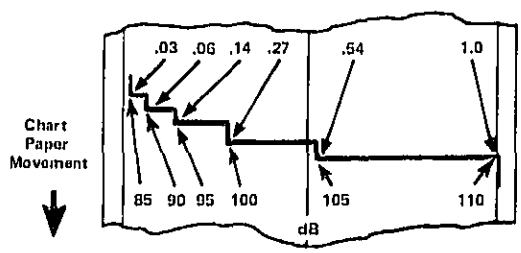

Figure 22. Calibration Trace from Sound Level Meter with Full Scale Deflection on 100 dB Range Position

If you are calibrating with the CA-12 Field Calibrator simply use the 100 dB range position on the sound level meter. This will produce full scale reading on the meter, and should also produce full scale deflection on the chart recorder. When the chart recorder reads full scale your calibration trace is now as shown in the diagram above.

If you are using the Quest 211A Sound Level Meter, you will be recording dBA slow. If you are using the 211FS or 215 meters you will be recording dBA, dBC slow, or whatever weighting is selected.

Recommended 100 millivolt Chart Recorders for use with the RA-100MV adaptor are as follows:

Rustrac series 400, Gulton Industries
Esterline-Angus series 601 or "miniservo" MS401
MFE Corp series M-12
and many others

Suggested chart speed for most applications is approximately 1/2 inch per minute.

MODEL WS-3 WINDSCREEN

Refer to Page 8 for instructions on using the windscreen with the 215 Sound Level Meter.

Figure 23.

MODEL TP-1 TRIPOD

The TP-1 is an extendable tripod with a maximum height of 55 inches from the floor. The closed length is 21 inches. The tripod is intended for use with any of the sound level meters Models 211, 211FS, or 215, and with the 215-15 Octave Band Analyzer as a whole unit.

Figure 24.

MODEL EC-9A EARPHONE COUPLER

The EC-9A is a 6cc earphone coupler used for audiometer calibration. It is similar to the NBS type 9A Coupler. The EC-9A fits Quest sound level meters (1.125 inch diameter microphones), and mates with standard earphone with MX-41/AR cushions. Actual volume is 5.64 cm^3 including the volume added by microphone.

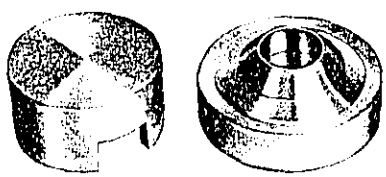

Figure 25.

EC-9A Coupler (on right)
Shown with W-450 Weight

MODEL AS-1545 AUDIOMETRIC CALIBRATION STAND

The Audiometric Calibration Stand provides support for the 215-45 Octave Band Analyzer when used for audiometer calibration. Figure 26 shows the analyzer mounted in the stand. The Stand will accommodate the standard earphones as well as earphones built into earmuffs such as Amplivox Audiocups and Auraldomes without removing the earphone from the muff.

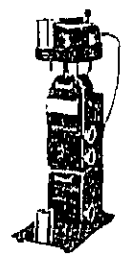

Figure 26.

QUEST SERVICE AND WARRANTY POLICY

SERVICE POLICY

The Quest product you have purchased is one of the finest performing pieces of Sound Measurement Equipment 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 service, send it prepaid and properly packed in the original shipping carton directly to Quest Electronics, Division of La Belle Industries, 510 S. Worthington, Oconomowoc, Wisconsin 53066. Please include a written explanation of the problem and indicate the serial number of your Quest instrument. Place this information in an envelope and attach it to the instrument.

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 Electronics, 414/567-9157. Office hours are from 8 AM to 5 PM Monday through Friday.

Malinda - $52 ea.
(Mary)

WARRANTY POLICY

Quest Electronics warrants this unit to be free from defects in materials and workmanship under normal conditions of use and service. Should this unit prove to be defective within one (1) year after delivery to the original purchaser, we will replace or repair this unit free of charge excluding BATTERIES.

This protection is exclusively yours as the original purchaser but does not cover equipment subjected to misuse, negligence, accident or which has been repaired or altered outside of the factory Service Department.

To properly register your unit with the factory, completely fill out both portions of the two (2) part Registration Card and mail the self-addressed card to the factory within fifteen (15) days of the date of purchase. Be sure to retain the Customer's Copy for your own records. Warranty repair service is available directly from the factory.

This warranty states our total obligation and liabilities in place of all other warranties expressed or implied by other persons. We expressly deny any power or authority on the part of any person to incur or assume for us any other liability in connection with the use of any Quest manufactured equipment. Our Warranty does not include any liability or obligation directly or indirectly resulting from the defective unit or any associated delays.

SERVICES NOT COVERED BY WARRANTY

The Quest factory will continue to provide the normal services of repair and recalibration of any Quest equipment out of warranty. Any of the above services required during the warranty period but not associated with defective materials or workmanship, will be performed at the prevailing rates for parts and labor.

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