GA112

Sound Level Meter
with
Octave Filters

Thank you for buying a Castle product, I am sure you will find both the goods and the service to be of the highest quality but if not, then please feel free to write to me personally and I will ensure that your needs are dealt with immediately.

This manual is designed to show you the operation of the goods you have purchased and a very brief insight into acoustics itself. If you would like to become a competent person in the eyes of the law, then you may like to know more about our Competent persons training course for the Noise at Work Regulations.

It is my intention for Castle Group Ltd to provide a complete range of Noise and Vibration products and Services of the highest standard. If you would like to know more about any of our other products and services then please complete the reply paid card in this manual and return it to us for prompt action or telephone on +44(0)1723 584250.

Simon Bull

Sales and Marketing Director

Precautions

Operate the unit only as described in this manual.

- The GA112 is a precision instrument. Protect the instrument from shocks and vibrations.

- Use only the microphone/preamplifier as supplied with the unit. Take special care not to touch the microphone top as it can easily be damaged.

- Ambient conditions for operation of the unit are as follows : temperature range - 10°C to +50 °C, relative humidity 30 to 90%.

- Protect the unit from water, dust, extreme temperatures, humidity, and direct sunlight during storage and use. Also keep the unit away from air with high salt or sulphur content, gases, and stored chemicals.

- Always turn the unit off after use. Remove the batteries from the unit if it is not to be used for a long time (a week or more) . When disconnecting the cable, always unscrew the plug and do not pull the cable.

- Clean the unit only by wiping it with a soft, dry cloth or, when necessary, with a cloth lightly moistened with water. Do not use any solvents, cleaning alcohol or chemical cleaning agents.

- Take care that no conductive objects such as wire, metal scraps, conductive plastics etc. can get into the unit.

- Do not try to disassemble or alter the unit. Otherwise type certification will become invalid. In case of an apparent malfunction, do not attempt any repairs. Note the condition of the unit clearly and contact the supplier or Castle Group direct.

NOTE
Castle Group sound level meters are electronic instruments and should be handled accordingly. Damage caused by misuse, abuse and leaking batteries is not covered by the warranty. If the instrument fails to function correctly, firstly check the condition of the batteries. When changing the batteries, replace all three at any one time. In order to conserve battery life do not leave the instrument turned on when not in use.

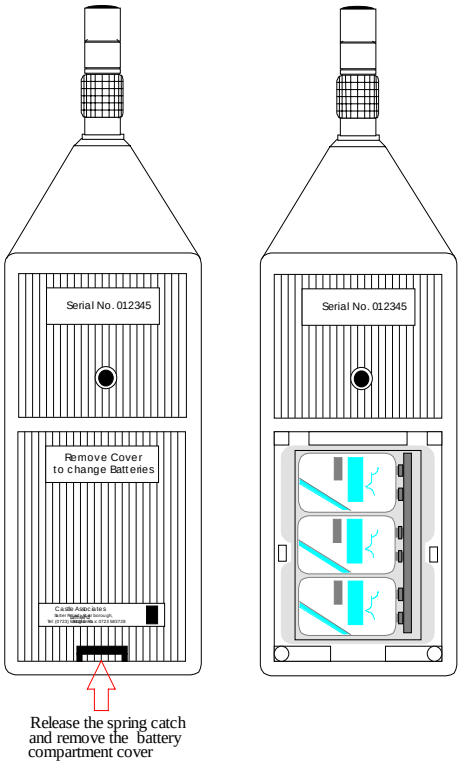
CONTENTS

Instrument Introduction

The instrument covered by this handbook is an analogue sound level meter built into our award winning, tough die-cast body, which is both stylish and ergonomically designed. The instrument has ‘A’ weighting and ‘LIN’ (linear) frequency responses as well as a set of ten octave band filters. The filter’s ‘AUTO’ facility allows a chart recorder to display the results of a noise spectrum analysis. ‘SLOW’, ‘FAST’ and ‘PEAK’ responses are available. A maximum hold button, ‘MAX’, allows the accurate recording of the ‘maximum rms’ of a transient noise event. The instrument conforms to the relevant sections of BS5969, IEC651, ANSIS1.4, BS2475 and BS EN60651 standards.

Battery Installation

To prepare the equipment for service batteries must first be fitted. Remove the lower rear black plastic 'clip in' cover by pushing the locking clip at the foot of the instrument upwards and push the cover out; this will expose the battery compartment. Connect three new 6D22 type batteries, preferably heavy-duty types which give greater economy and are less prone to leakage, to the snap conductors ensuring correct polarity and making sure that each stud is a firm fit. Replace the battery cover and push the retaining clip firmly home. The instrument is now ready for calibration and use.



Preparation of Equipment and Controls

Power/Weighting Switch

This is a three-position switch labelled OFF-A-LIN. In the OFF position all power is removed from the instrument. The 'A' position allows sound levels to be measured with 'A' weighting, (see figure 1). For a linear or 'flat' frequency response the LIN is used.

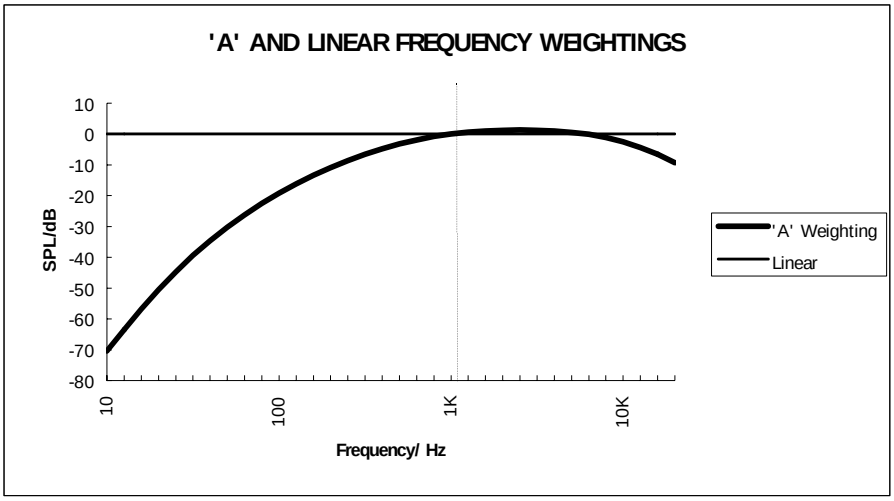


Figure 1 – 'A' weighting curve

Battery Check Button

A push button labelled BATT is provided to allow periodic checking of the battery condition. A meter deflection in the area marked 'BATT' shows the batteries are in good condition.

Peak/Slow/Fast Switch

This three position slide switch, labelled SLOW-FAST-PEAK, determines the damping coefficient of the analogue meter. The SLOW position sets the instrument for the standardised 'slow' meter response with a time constant of 1 second. In the fast setting the instrument has a time constant of 125ms for the standardised fast meter response. When the meter is used in the PEAK mode, the meter has minimum damping and allows quick acting transient sounds to be shown.

Maximum Hold Button

The MAX button is a momentarily acting push button which holds the maximum sound level whilst the button is depressed. Once the button is released the meter returns to normal operation. This facility is very useful for capturing the maximum rms sound level of transient sound events.

Filter Mode Switch

The octave band filters can be used by placing the switch in either the MAN or the AUTO position. When in the OUT position the meter operates as a normal sound level meter with a 'linear' ('flat') or 'A' weighted response. When using the filters the 'A' weighted response can also be used if desired.

The filters can be used in two different modes, MAN or AUTO. In the MAN (or manual mode), the centre frequency of the filters is changed by depressing either of the select buttons, 'frequency up' or 'frequency down'. The frequency of the filter currently in operation is displayed by means of ten LED's (light emitting diodes) , positioned on the front panel.

Ten standard centre frequencies are used 31.5Hz, 63Hz, 125Hz, 250Hz, 500Hz, 1kHz, 2kHz, 4kHz, 8kHz and 16kHz. These allow the engineer to gain a clearer 'picture' of the frequency distribution of the noise. Typical responses of these filters are shown below (Figure 2). A memory facility is provided to allow the user to switch the filters 'in' and 'out' and still remain on the same frequency.

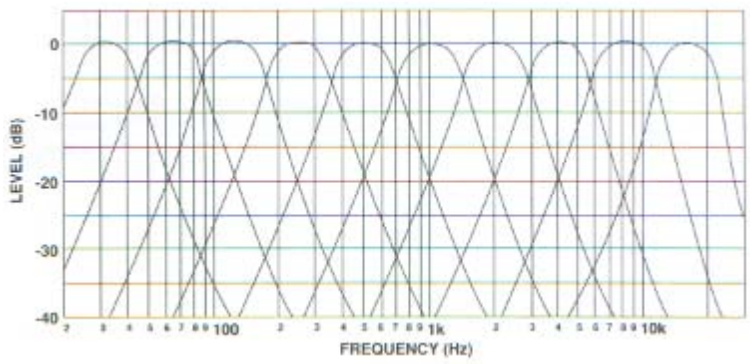


Figure 2 – Filter Responses

The filter's AUTO mode facility allows a chart recorder to give an octave band plot for a 'hard' copy of the noise spectrum. The frequency control buttons are assigned different 'roles' in this mode, labelled RESET and START-STOP.

Depressing the RESET button at any time causes the filter frequency to reset to the lowest centre frequency, 31.5Hz. By depressing the START-STOP button once, the filter will step up through all the frequencies in turn, staying on each frequency for 3 to 4 seconds. This allows enough time for the meter circuitry and chart recorder to settle. Immediately after depressing the START-STOP button, and between each change of frequency, a short downward stroke is drawn onto the chart recorder to enable each octave band sound level to be separated and therefore clearly seen.

By depressing the START-STOP button a second time, the filter will stop on it's current frequency. If the filter is left running in the AUTO mode when it reaches the highest centre frequency, it will remain there until the reset button is depressed.

Ranging Buttons and LED Indicators

The range of the instrument is indicated by a series of five LED's. To change the range 'up', depress the button marked with an up arrow, to change the range 'down', the button marked with a down arrow is depressed. The five base ranges on the GA112 are shown below (figure 3).

GA112	
Base range	Meter range
30dB	30-60dB
50dB	50-80dB
70dB	70-100dB
90dB	90-120dB
110dB	110-140dB

Figure 3 – Table of available ranges

As can be seen from the table above, a 10dB overlap occurs between the ranges, this means that if a meter reading in the bottom 'third' is observed the range can be changed down.

Generally it is better to select a range which gives you the greatest deflection on the meter. However if the meter reading passes full-scale deflection, or the overload LED (found in the lower right corner of the meter) indicates an overload, the instrument must be changed up a range.

Calibration Control

This is a screwdriver-adjusted control, which alters the input sensitivity of the instrument. A small flat bladed screwdriver, no larger than 2mm, should be used when calibrating the instrument. Calibration should only be carried out in conjunction with a known sound source.

Output Socket

This socket is designed for use with chart recorders and similar equipment. A 3-pin LEMO connector (type FGGOB303CLAD52Z) must be used to connect external equipment.

Overload LED

This indication is on the meter scale and warns when the selected range is exceeded. In such an overload situation, frequency analysis is distorted as the signal is clipped. Generally this can be avoided be choosing a higher range.

Please note the overload indicator detects the overload conditions in all critical points of the instrument and it is possible to have such a situation without a high reading shown on the analogue meter.

Calibration

The calibrator recommended for use with the GA112 is the Castle GA607, a dual level calibrator which supplies 94dB and 104dB (relative to 20 uPa pressure) at a frequency of 1kHz.

Procedure

1 Turn ‘on’ the instrument by switching it into ‘A weighting’ mode and check the conditions of the batteries by depressing the BATT button.

2 Place the filter control switch in the OUT position, ideally the response switch should be placed in the FAST position.

3 Turn the calibrator on to the 94dB and check that the battery status is as per the calibrator manual. A 1kHz tone should be audible at this time.

4 Position the calibrator firmly over the microphone using a “clockwise” twist.

5 Place the meter on its 70dB range and adjust the CAL control until the meter reads 94dB.

6 If using the Castle GA607 calibrator, it is also possible to check the sound level meter on its 90dB range, switch the calibrator to the 104dB position and check that the reading is within 0.4 dB. This serves as a cross check for the type 1 instrument.

7 Two additional tests can be carried out in order to establish correct calibration of the instrument. Firstly at the 1kHz calibration frequency, switching the instrument to the LIN weighting mode, this should give the same sound levels as the ’A’ weighting mode (within 1dB).

Secondly by keeping the weighting in the LIN mode and putting the filter into the MAN mode (as detailed on pages 8 & 9), on its 1kHz centre frequency, the calibration should be within +0.5dB and –1dB.

Measuring Sound Levels

Use as a normal sound level meter

1 Turn on the meter by selecting the ‘A’ weighting or LIN response, and switch the filters OUT.

2 Check the battery voltage and the calibration of the sound level meter.

3 Select the 110dB range.

4 Point the instrument towards the source of the sound to be measured.

5 Progressively step down the ranges until a reading in the upper two thirds of the meter scale is obtained.

6 If it proves difficult to read the meter because of excessive or unsteady needle movement, switch the response to SLOW.

7 Record the sound level reading as the meter deflection (between 0 and 30), plus the selected range, in dB’s if LIN or in dB (A)’s if ’A’ weighted.

Eg. A sound level of 94.0dB(A) would appear as a needle deflection of 24, while using the unit on 70dB range.

Measuring Maximum Sound Levels

1 Turn on the meter by selecting A weighting or LIN response, and switch the filters OUT.

2 Check the battery voltage and the calibration of the sound level meter.

3 Select a suitable range so that the maximum expected sound level would be registered on the meter without causing it to go off the scale. By trying several ranges the most suitable will soon be found.

4 Set the response switch to FAST or PEAK.

5 Point the instrument towards the source of the sound to be measured.

6 Press the MAX button and hold it down until the transient sound has occurred and the meter has reached its maximum value. The button must be held until the reading has been recorded, as once the button is released the meter returns to normal operation.

Use of Filters for Octave Band Analysis

1 Turn on the meter by selecting ‘A’ weighting or LIN response and switch the filters to MAN.

2 Check the battery voltage and calibration of the sound level meter.

3 Select the lowest filter frequency (31.5Hz) and the 100dB range.

4 Point the instrument towards the source of the sound to be measured.

5 Progressively step down the ranges until a reading in the upper two thirds of the meter scale is obtained.

6 Record the reading and select the next centre frequency. Repeat the measuring procedure until the highest filter frequency (16kHz) is reached.
It is possible to switch the filter OUT and back to MAN again and still maintain the last selected centre frequency.

7 With the results obtained an octave band plot can be drawn. This plot gives the spectrum of the noise source being measured, from which the nature and cause of the noise can be determined and cured.

Use of the Output Socket

The GA112 is equipped with a three-pin lemo connector on the right hand side of the instrument. The connector provides an AC and a DC signal output (see figure 4).

The AC output is a logarithmic output and is direct representation of the sound present at the microphone. This output is actually suitable for recording the noise by means of a tape recorder for analysis at a later date. A full-scale deflection on the meter corresponds to a 120mV rms signal into a 10kohm loading.

The DC output is a linear signal suitable for chart recorders. A voltage of 1.5V is given for a full-scale deflection on the meter, zero on the meter corresponds to approximately zero volts. The DC output is designed to drive a load of 10kohm.

A suitable connector for the lemo socket is the, LEMO type FGGOB303LAD52Z.

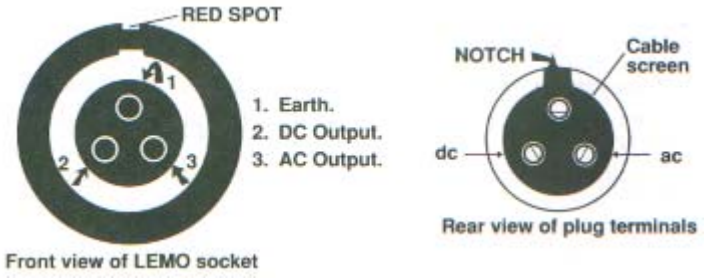


Figure 4 – LEMO socket connections

When using a chart recorder the following settings can be used as an initial guideline: -

Paper speed (or X-axis travel) 0.5cm/sec.
Sensitivity (or Y-axis travel) 200mV/cm (using 180mm paper)

The following procedure can then be used: -

1 Connect the chart recorder (or X-Y plotter) to the sound level meter.

2 With the filters switched OUT measure the sound level .

3 Keeping the meter on the same 'range' switch the meter to the AUTO mode. Press RESET and the 31.5Hz LED should be lit.

4 Start the chart recorder moving and when ready press the START/STOP button once. A downward 'stroke' of recorders pen will indicate where the start was, and also each change of frequency.

5 When the filter has reached the top (16kHz) frequency it will remain there. To repeat the procedure depress the RESET button in order to start from 31.5Hz fre quency again. Pressing the START-STOP button during the stepping procedure will STOP the filter on its current centre frequency, pressing the button once more will START the stepping once more. The START-STOP button therefore acts as an effective 'pause' facility.

Note
The horizontal (or X-axis) is logarithmic frequency in Hz, or kHz corresponding to the ten filter centre frequencies as indicated on the front panel of the sound level meter. The vertical scale (or Y-axis) is in dB's and therefore linear. Some calibration and setting up of the chart recorder will be necessary if direct readings are to be taken from the rulings on the chart recorder paper.

Instrument Description

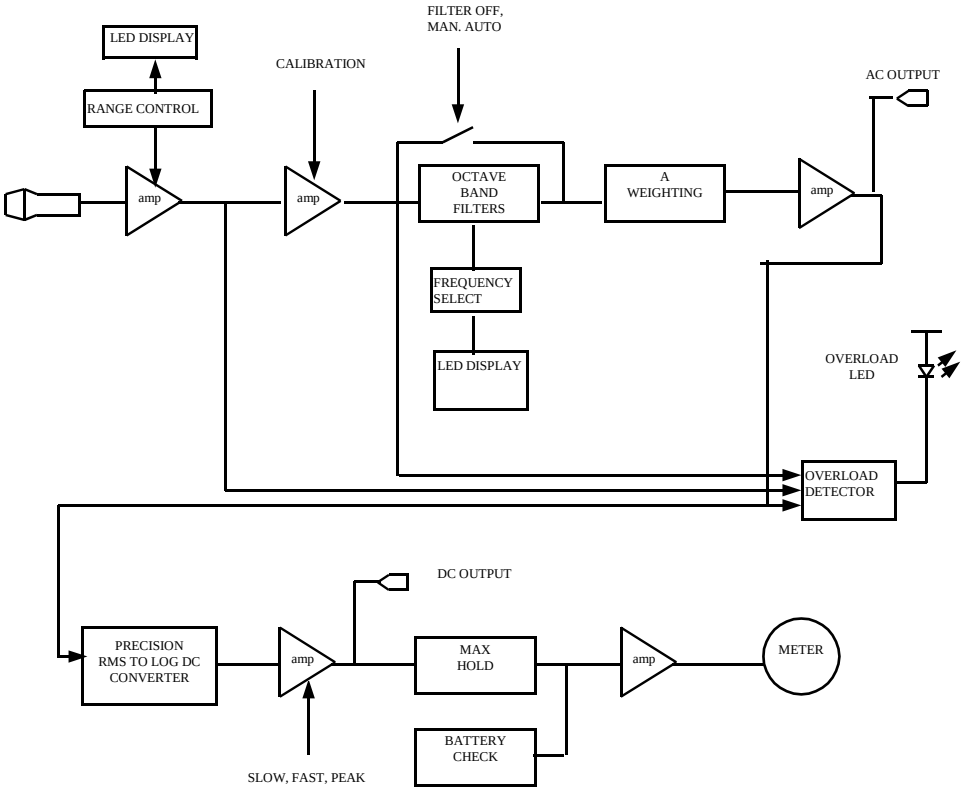


Figure 5 – Block diagram of instrument

Circuit Description

The AC voltage coming from the microphone is amplified in three amplifier stages. The first stage being an ultra-low noise pre-amplifier, this is followed by an amplifier variable gain for calibration. These amplifiers also form the ranging circuit calibrated in 20dB steps. Range changing logic selects the desired attenuation and controls the gain of the pre-amplifiers, indicating the range on a series of LED's. This is then fed into a series of octave band filters which can be switched in and out when required and then through the 'A' or LIN weighting network. The frequency changing logic selects the filter frequency and displays it by way of LED's.

This signal is passed to the true rms converter and logged. This is then converted to a linear signal in order to drive the meter, which is linearly scaled in dB. A maximum hold facility is used to maintain the maximum meter deflection while readings are being taken and a battery check facility also drives the meter in order to monitor the condition of the batteries.

Environmental Effects

The GA112 is designed for operation between the temperature limits of –10°C to +50°C. The unit may be stored, without batteries, between –20°C and +60°C, but should not be subjected to temperatures beyond these ranges for long periods.

The instrument may be subjected to continuous vibration of up to 3g without damage.

Technical Specification

Measuring Range

Range	Measuring Range	Max. Peak Level
30	30-60dB	73dB
50	50-80d|B	93dB
70	70-100dB	113dB
90	90-120dB	133dB
110	110-140dB	153dB

Detector

Characteristics:	RMS
Signal to noise ratio:	>5dB at bottom scale
Crest factor capability:	13dB at FSD

Frequency weighting

'A'	to BS EN 60651
LIN	to BS EN 60651

Time weighting

Slow	to BS EN 60651 Type 1
Fast	to BS EN 60651 Type 1
Peak	Onset time 2.3mS as specified by BS EN 60651

Display

Type:	Analogue moving coil meter with overload LED indication.
Scale:	0 to 30dB mirrored linear scale with battery condition indication and overload indication.

Display Parameters

Sound Pressure Level either ‘A’ or Linear weighted with or without Octave Band Filters. Battery condition indication.

Filters

Built in Octave Band Filters	to BS EN 61260 : 1996
Filter centre frequencies	31.5Hz, 63Hz, 125Hz, 250Hz, 500Hz, 1kHz, 2kHz, 4kHz, 8kHz, 16kHz.
Switch selectable	OFF/MANUAL/AUTO.

Overload

Positive overload condition shown when Crest Factor is exceeded (see also description on page 11).

Output Socket

AC Output:	120mV rms for FSD. Output impedance approx 600ohm. Load impedance 10kohm or more. Short circuit protected.
DC Output:	1.5V for FSD. Output impedance approx 600ohm. Load impedance 10kohm or more. Short circuit protected.
Connector:	Lemo FGG0B303CLAD52Z

Microphone/Preamp

Pre-polarized ½” (12.7mm) Condenser Microphone

Sensitivity	12mV/Pa
Capacitance	15pF
Preamp output impedance	550R

Calibration

Acoustic using GA607 (or GA602) at 94 dB or 104db at 1 KHz
Potentiometer adjustment.

Batteries

Type:	3xPP3
Life:	>40 hours at 3hrs/day
	>12 hours continuous

Temperature

Operating range:	-10oC to +50oC
Storage without batteries:	-20oC to +70oC
Effect of temperature:	<0.5dB from –10oC to +50oC

Humidity

Operating range:	30% RH to 90%RH
Effect of humidity:	<0.5dB

Vibration

A 40Hz 1m/s vibrating force produces <0.5dB error.

Magnetic field

80A/m (1 Oersted) at 50Hz produces <0.5dB error

Standards

BSEN60651
IEC651 Type1
BS5969 Type 1

Overall Dimensions and Weight

280x85x60mm
800g with batteries

Accessories available

KA003 Attaché style carry case with tripod*
KA005 Shoulder bag carrying Case
GA607 Dual level acoustic calibrator 94dB and 104dB at 1kHz

*Tripod purchased separately

Warranty and After Sales Service

Castle Group design and manufacture precision instruments, which if treated with reasonable care and attention should provide many years of trouble free service.

In the event of a fault occurring, during the warranty period, the instrument should be returned to Castle Group Ltd, in its original packaging, or to an authorised agent. Please enclose a clear description of the fault or symptom.

Details of the warranty cover are available from Castle Group Ltd or an authorised agent.

All instruments are designed to meet rigid British and International Standards. An annual calibration is recommended to ensure that these high standards are maintained. This is particularly important for cases in which instrument readings are to be used in litigation or compliance work.

For warranty and service return to:

The Service Department
Castle Group Ltd
Salter Road
Cayton Low Road Industrial Estate
Scarborough
North Yorkshire
YO11 3UZ

Telephone	UK:	(01723) 584250
	INT:	44 1723 584250
Fax	UK:	(01723) 583728
	INT:	44 1723 583728

Any misuse or unauthorised repairs will invalidate the warranty.

Damage caused by faulty or leaking batteries is not covered by the warranty.