Operating Manual

Pocket Vibration Meter Range

GA2002

&

GA2003

www.castlegroup.co.uk

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 Noise at Work Reulations. You can visit www.castle-training.com to find out more.

It is my intention for Castle Group Ltd to provide a wide range of technical health and safety products and Services of the highest standard. If you would like to know more about any of our other products and services then please telephone on +44(0)1723 584250 or visit www.castlegroup.co.uk

Simon Bull
Managing Director

Copyright

Precautions

- Only operate the instrument as described in this manual.
- These are precision instruments, protect from shocks and vibrations.
- Ambient conditions for the operation of the unit are as follows:-

  Temperature: -10°C to +50°C

  Relative Humidity: 25 to 90%
- Protect the unit from extremes of temperature and humidity, direct sunlight and air with a high salt or sulphur content.
- Always turn the unit off after use. Remove the batteries from the instrument when not in use.
- Do not use any solvents or cleaning agents on the instrument. Use only a soft dry cloth or a soft cloth lightly moistened with water when necessary.
- Do not allow any conductive objects, such as wire or metal particles to enter the unit.
- Do not try to disassemble the instrument or attempt any repairs as this will invalidate your warranty. Take a note of the condition of the instrument and contact your authorised Castle service station.
- To ensure continued precision performance of your instrument have it checked and serviced at regular intervals.

Contacting Castle Group

This manual contains complete operating instructions for the Castle Pocket Vibration Meter range, read it carefully and you will quickly become familiar with your instrument and its operation.

If you do encounter problems with the operation of your instrument please feel free to contact customer support with your enquiry on: -

Telephone:	+44 (0)1723 584250
Fax:	+44 (0)1723 583728
Website:	www.castlegroup.co.uk
Email:	techsupport@castlegroup.co.uk sales@castlegroup.co.uk

Contents

Introduction

Thank you for purchasing your product from Castle Group Ltd.

The Castle Pocket Vibration Meter range has been designed to deliver cost effective vibration measurement solutions.

Your instrument can cater for various degrees of experience with it being simple to to operate and interprate the measurement results.

Using the Manual

In the course of this manual a named button written in **BOLD** means press that button E.g. **OK** means press the OK button

Notes Before Use

Due to the compact screen it has not been possible to fit the full notation for velocity units and the value, so the units displayed as ms^{-1} are actually millimeters per second or mms^{-1}.

There is a slight delay between switching the unit off and it turning off, this is while your data is backed up. If the power switch is pressed during this delay your settings may be lost.

Holding your finger on a key will mean the key is pressed successively as far as the instrument is concerned. To avoid confusion when using the keypad, press the keys firmly and release them quickly.

If using the instrument with a magnet make sure you have removed the keeper (metal disc covering the magnet) from the magnet before use.

Measuring Vibration

It is advisable to validate your instrument prior to, and after taking measurements using a known vibration source such as the Castle GA606 Vibration Calibrator.

To ensure measurements are as accurate and as repeatable as possible always ensure that your cable is tightened securely to your accelerometer and that the accelerometer is mounted as securely and as flush as possible to the vibration source. The trailing cable of the accelerometer should also be attached to the vibration source without creating a potential hazard for the operator or other people. Where practicable it may be beneficial to permanently attach the accelerometer cable.

Where possible always mount the accelerometer as near to the centre of where the operator holds and grips the vibration source. In reality this is not always possible and the best compromise must be achieved.

Measurement durations are not governed but as a rule of thumb use an absolute minimum time period of 15 seconds for Hand Arm Vibration. It is recommended depending on the process that a minimum period of 3 to 15 minutes is used for Hand Arm vibration. These increased durations will undoubtedly increase the accuracy and repeatability of your measured results.

The vibration is measured in one axis only and once all axes have been individually recorded you will have to assess how long the operator is exposed to the machine.

Taking the Vector sum acceleration is the preferred method of calculating vibration dose although it is not the only option. It is possible to look at the Dominant Axis. This means that once you have taken the X, Y and Z readings you may take the largest one providing that it is larger than the other axes by a factor of two or more.

The parameter A(8) is actually the partial vibration dose based on 8 hours. It is calculated as follows: -

$$A_i(8) = a_{h,w}\sqrt{\frac{t}{8}}$$

This parameter is given by the GA2003 providing the measurement period is equal to the duration of the work.

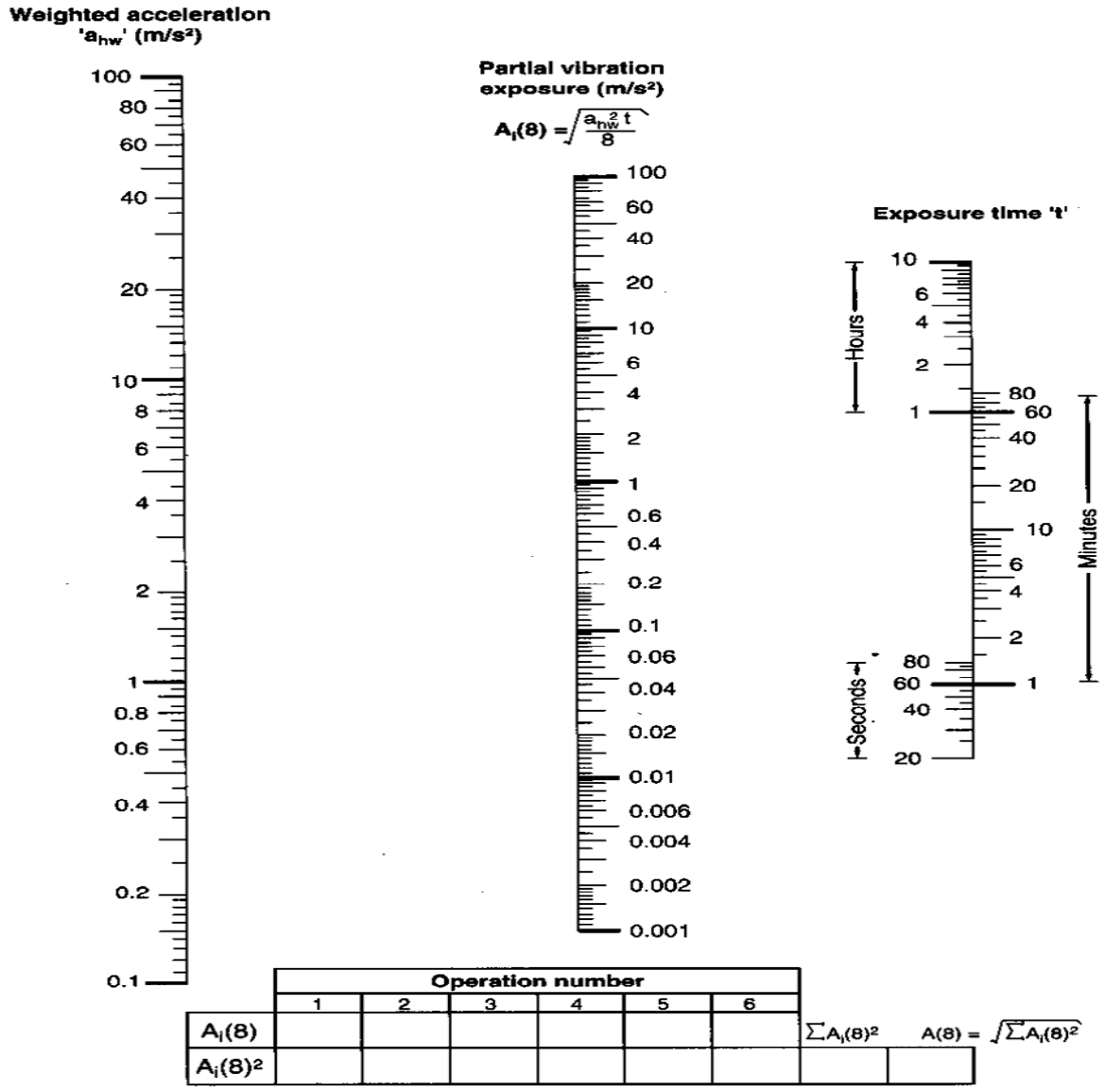
Alternatively the AV (Linear Average Value) may be used in the above equation ($a_{h,w}$) and the time (t) is the daily exposure time for this operation where i is the reference for the individual measurement and 8 is for the 8 hour day.

The result of this equation is the contribution to daily exposure and the reason that this is used is to give a measurement to each of a number of processes that may be carried out in one day. To calculate the overall daily exposure from a set of partial exposures, the following equation is used: -

$$A(8) = \sqrt{A_1(8)^2 + A_2(8)^2 + A_3(8)^2}$$

Where $A_1(8)$, $A_2(8)$ and $A_3(8)$ are the partial vibration exposure values for each vibration source.

The nomogram shown below can also be used instead of the previous calculation.

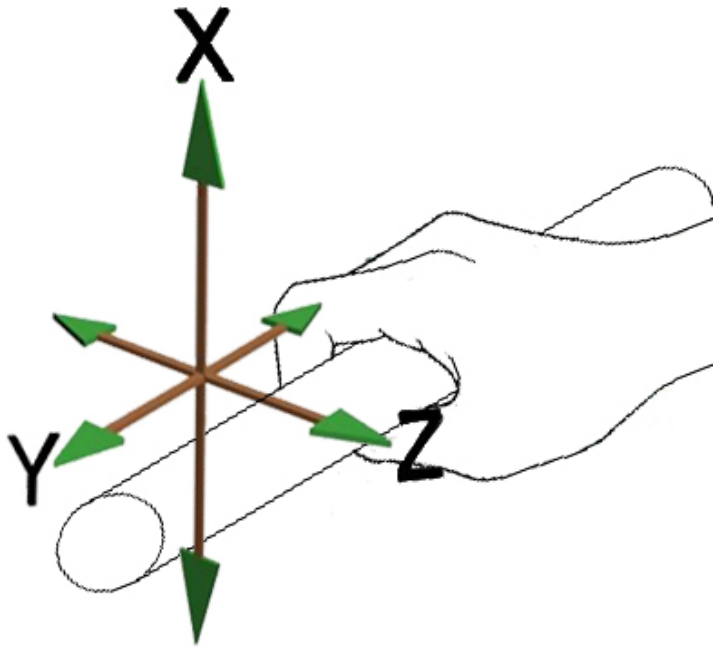


1) For each exposure, draw a line connecting weighted acceleration with exposure time. Read off the partial vibration exposure, $A_i(8)$, given by the point where the line crosses the centre scale.
2) Square and add all partial vibration exposures.
3) Square root result to give daily vibration exposure.

Hand ARM (HARM) Vibration Direction

For Hand Arm vibration (GA2003 Only), the three axes being measured can be measured in any orientation; however it is recommended that the suggested axes indicated in the figure below are used. If this is not possible, then choosing other axes orientation is permissible and will not affect your measured data.

In all cases it is strongly recommended to make notes on the axes used relative to the vibration source. This information will be required if vibration control is to be implemented on the vibration source.



Transducer Mounting

If your Pocket Vibration meter is supplied with a spike probe this can be used for the interface of the transducer to the vibration source.

Mounting of the single axis accelerometer to the vibration source can also be achieved by tapping a stud into the vibration source and attaching the accelerometer to the stud. Alternatively the stud may be adhered to the device with an adhesive that dries rigid. Castle Group Ltd can supply a glue and stud pack if required, (order code K01215).

Vibration Level

For ease of use and where high levels of vibration may occur, the Pocket Meter Vibration Range has been designed with 2 operating ranges.

Before you record measurements take the time to ensure you have selected the optimum range for the process being recorded.

Generally the optimum range is generally the lowest range that can be selected that does not produce an overload condition for the process being monitored.

Where high levels of vibration are encountered the meter may register an overload and in these circumstances the meter will display that this has occurred. In such cases you will need to select a higher range to accommodate the higher peak levels.

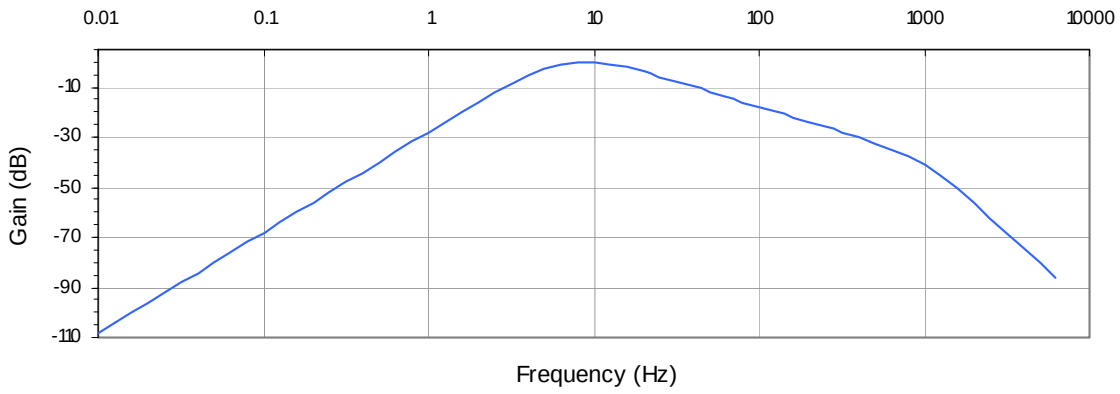
If the vibration levels are too low for the range selected then the meter will display an under range condition. Under these circumstances you will need to select a lower range.

Frequency Weighting

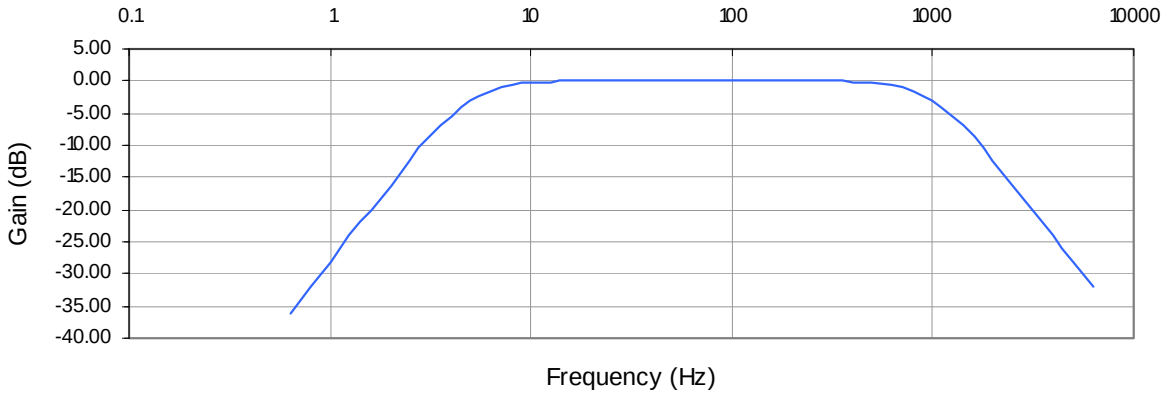
Vibration damage to the hand occurs when the hand absorbs the majority of the vibration energy. If the vibration is slow, the wrist and arm joints will damp the vibration energy. If the vibration is fast, the skin of the hand will absorb the energy. In between, the hand itself absorbs vibration energy.

The HARM filter (GA2003 Only) selects the most harmful frequencies to a human. The value given using the HARM filter displays not how much the machine is vibrating but how much vibration is being absorbed by the hand.

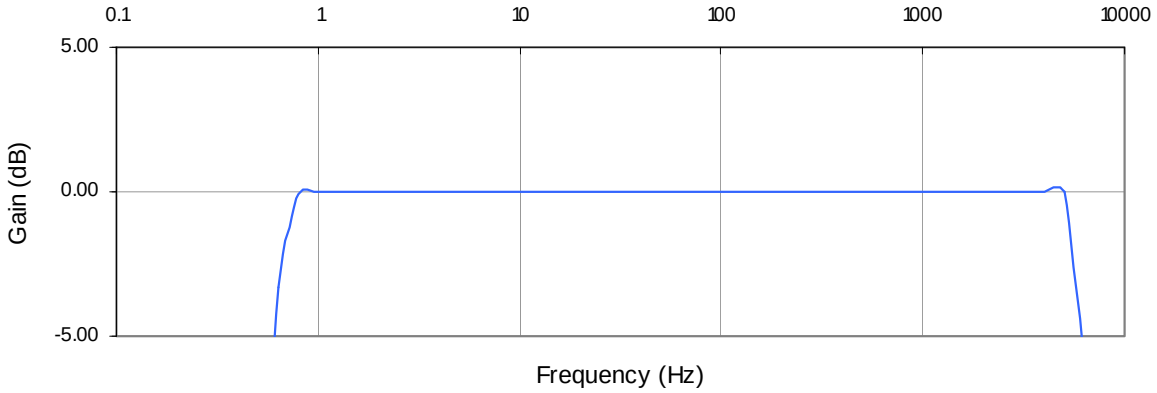
The HARM frequency response is shown graphically below: -



Both instrument types have a mechanical filter which has a flat pass band useful for machine monitoring. The frequency response is shown below: -



The GA2002 model has a linear frequency weighting filter which does not attenuate any vibration regardless of frequency. The frequency response is shown below: -



Battery Installation / Check

To prepare the equipment for use a heavy duty alkaline battery type 6LR61 should be fitted, such as a Procell/Duracell MN1604, Ever Ready 6LF22 Gold Seal, or equivalent.

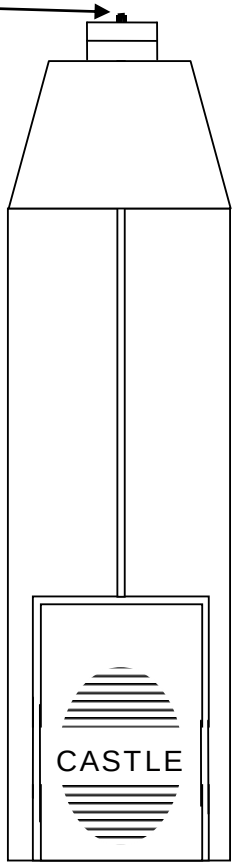
The battery door is located on the bottom left hand side of the instrument. Open the battery door cover by sliding the cover downward towards the bottom of the instrument. The cover will now swing open exposing the battery compartment. Insert the battery observing the correct polarity as marked on the case wall.

Close the battery compartment door by reversing the procedure above. The instrument is now ready for calibration and use.

The battery condition can be checked at any time by pressing the **STATUS** key twice. The battery condition indicated by a series of vertical bars – 4 bars shows a fully charged battery, while1 bar shows one that is almost flat. It is recommended that the battery should be replaced if only 1 bar is displayed.

Fitting the Accelerometer

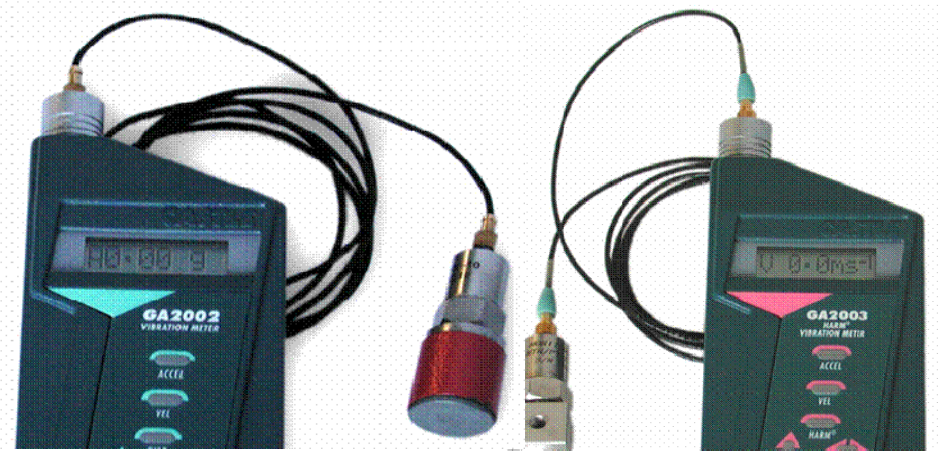
Accelerometer cable connection point



To remove the accelerometer and cable, grip the collar of the cable connector and gently turn the collar anti-clockwise to undo.

To remove the accelerometer from the cable, grip the accelerometer and gently turn anti-clockwise. Take care when performing both operations that the cable is not twisted.

GA2002 **GA2003**



Switching the Instrument On & Off

Press and release the **POWER** button once and the instrument turns on. Allow the instrument to scroll through its start-up sequence before pressing any other button; this will take approximately 3 seconds.

Please do not press any other key during the start up sequence as data loss may occur

When the instrument has been turned on and completed its start up procedure, the meter will display the last parameter it was measuring at the time it was switched off.

To switch the instrument off, press and release the **POWER** button once. There is a slight delay between switching the unit off and it turning off, this is while your data is backed up.

(Status) Button

Repeat press this button to display the following information on your instrument: -

Operating State (RUNNING or PAUSED)
Battery Level
Instrument Version Number

All functions can be held so that they do not update by pressing the **Left/Right Arrow** key whilst the display shows RUNNING. During this period the screen displays PAUSED.

For normal operation of the instrument to continue press the **Left/Right Arrow** key once more and the screen display RUNNING.

(Parameter) Buttons

Depending on your instrument model the following integration methods are available: -

Method	Description
Acceleration	A vector quantity which is the rate of change of velocity with respect to time. Displayed in g on the GA2002 and in m/s^2 (metres per second per second) on the GA2003. (g is the acceleration due to gravity on the earth's surface and defined as 9.80665 m/s^{-2})
Velocity	The speed at which an object travels in a particular direction. Displayed in mms^{-1} (millimetres per second) .
Displacement	A measure of the movement incurred on an object from a resting position. Displayed in µm (micro metres).

Performing a mathematical integration function on Acceleration gives Velocity whilst integrating Velocity gives Displacement.

Press the following buttons on the specified instrument to operate using the stated method: -

Method	Instrument	Button
Acceleration	GA2002, GA2003	ACCEL
Velocity	GA2002, GA2003	VEL
Displacement	GA2002	DISP

The GA2003 has a parameter button HARM, press this to use the frequency weighting curve used in legislation for Hand Arm Vibration.

Changing or Viewing Instrument Settings

Setup Screen

The setup screen tells you the following information: -

- The detector the instrument is using
- The parameter the instrument is measuring
- The filter the instrument is using
- The operating range of the instrument

Detector

The detector determines if the instrument is measuring the running rms (Root Mean Square) value or the peak value.

If rms is selected then the display shows RMS.
If peak is selected then the disply shows PK.

Depending on the instrument type and the inetegration method selected, the running rms is calculated as shown below: -

Running rms Acceleration (g) GA2002	$Arms := \frac{\sqrt{\frac{1}{\theta}\cdot\int_{t-\theta}^{t}(a_w)^2(ta)\,d(ta)}}{9.807}$ (g) t = instantaneous time (seconds) θ = integration time of the measurent (seconds) $a_w(ta)$ = instantaneous acceleration value (ta) = time (seconds)

Running rms Acceleration (ms^{-2}) GA2003	$Arms := \sqrt{\frac{1}{\theta}\cdot\int_{t-\theta}^{t}(a_w)^2(ta)\,d(ta)}$ (ms^{-2}) t = instantaneous time (seconds) θ = integration time of the measurent (seconds) $a_w(ta)$ = instantaneous acceleration value (ta) = time (seconds)

Running rms Velocity (Metric)	$Vrms := \int \left[\sqrt{\frac{1}{\theta} \cdot \int_{t-\theta}^{t} \left(a_w\right)^2 (ta)\ d(ta)} \right] d(tv) \qquad \left(mms^{-1}\right)$ t = instantaneous time (seconds) θ = integration time of the measurent (seconds) a_w(ta) = instantaneous acceleration value (ta), (tv) = time (seconds)

Running rms Displacement (Metric)	$Drms := \int \int \left[\sqrt{\frac{1}{\theta} \cdot \int_{t-\theta}^{t} \left(a_w\right)^2 (ta)\ d(ta)} \right] d(tv)\ d(td) \qquad (mm)$ t = instantaneous time (seconds) θ = integration time of the measurent (seconds) a_w(ta) = instantaneous acceleration value (ta), (tv), (td) = time (seconds)

Peak is calculated as follows: -

Peak	The peak level of the instantaneous acceleration, velocity or displacement over the measurement period

Parameter

The available parameters with associated screen description are shown below: -

Screen Display	Parameter Description
H	Current HARM vibration level
AV	Current vibration level average (LAV – Linear Average Value)
A8	Partial Daily Exposure Level (GA2003 Only) The amount of vibration exposure measured expressed as an 8 hour daily exposure
mx	Maximum Arms level reached over the measurement period

Filter

The available filters with associated screen description are shown below: -

Screen Display	Parameter Description
mc	Mechanical Filter
Ln (GA2002 Only)	Linear Filter
HM (GA2003 Only)	HARM Filter

For a description of the filters refer to the section **Frequency Weighting**.

Range

The available ranges with associated screen description are shown below: -

Screen Display	Range
L	Low Range (High Sensitivity)
H	High Range (low Sensitivity)

Always select the lowest range that does not produce an overload condition for the process being monitored.

Viewing the Setup Screen

View the setup screen by repeat-pressing the appropriate **Parameter** button [*ACCEL, VEL, DISP, or HARM*].

Due to the screen size the information is abbreviated to fit on the screen. As an example, if the screen displays: -

RMSAVmcH

The instrument has the following settings: -

Detector = rms
Parameter = Current vibration level average
Filter = Mechanical Filter
Range = High Range

Changing Settings within the Setup Screen

To change any setting press the **ENTER** button.

The selected setting flashes indicating that this setting can be changed.

Press the **UP** / **DOWN** ⇳ button to cycle through the available options for that particular setting.

Press the **LEFT**/**RIGHT** ⇔ button to cycle through the available settings and repeat as required.

To return to the previous screen press the **ENTER** button.

Storing Data

To store the value you are currently viewing press the ENTER button.

A message appears informing you which location the data has been stored to. This location is useful to remember when reviewing logged values.

Reviewing / Clearing Stored Data

To review or clear data stored in memory press the **FUNCTION** button.

The **LEFT** / **RIGHT** arrow button selects between VIEWER and DELETE.

Viewing Data

To view data from memory select VIEWER and press the **UP** / **DOWN** button. The screen will read VIEW 1.

If you wish to view record 1 press the **LEFT** / **RIGHT** arrow button.

To view the settings associated with the record press the **LEFT** / **RIGHT** arrow button again.

Select other records by pressing the **UP** / **DOWN** button.

Clearing Data

To clear data from memory select DELETE and press the **UP** / **DOWN** button. The screen will read DEL 1.

To clear the record press the **ENTER** button. You will be asked to confirm your decision.

To confirm press the **ENTER** button and wait until the display changes. Press any other button to abort.

To select other records press the **LEFT** / **RIGHT** button.

Calibration

Calibration should be performed using a VE-10 vibration calibrator which produces a output of 10ms^{-2}.

The instrument should be set to the following: -

- Acceleration
- Linear
- Low range

Warranty and After Sales Service

Castle Group Ltd 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: +44 (0)1723 584250
Fax: +44 (0)1723 583728
Email: techsupport@castlegroup.co.uk
Web: www.castlegroup.co.uk

Any misuse or unauthorised repairs will invalidate the warranty.

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

EC Declaration of Conformity

CE The CE marking of the Castle Pocket Vibration Meter range indicates compliance with the EMC Directive.

Castle Group Ltd declares that the: -

- *GA2002 and GA2003 range of Vibration Meters*

have in accordance with the following Electromagnetic Compatibilty Directives: -

- *SI 2005/281*
- *2004/108/EC*

been designed and manufactured to meet the following tests: -

- *Radiated Emissions:* *EC 61000-6-3:2005 + IEC 61000-6-4:1995*
- *ESD:* *IEC 61000-6-2:2005*
  Levels: ±4kV(C) , ±8kV(A)
- *RF EM Amplitude Mod:* *IEC 61000-6-2:2005*
  Level 10 V/m

No differences in radio frequency emissions are apparent between operating modes of multipurpose instruments.

No performance or function degradation is noticeable whilst subject to electrostatic discharge or a.c power frequency and radio frequency fields under any operating mode with the meter. Greatest susceptibility to a.c power frequencies at 180° to source.

We hereby declare that the instruments named above have been designed to comply with the relevant sections of the above referenced specifications, and that the above named instruments comply with all essential requirements of the specified Directives.

Technical Specification

Temperature:		Operating range: -10 to +50°C Storage without batteries: -20 to +70°C Effect of temperature: < 0.5dB from -10 to +50°C
Effect of Humidity:		< 0.5dB from 30%RH to 90%RH
Display:		Digital 1 x 8 alphanumeric Digit size 7mm x 5mm
Overall Dimensions:		135 x 62 x 30mm
Weight:		250g with batteries
Ranges:	**low**	Acceleration 0.01 to 10g *(GA2002 only)* Acceleration 0.1 to 100ms^{-2} *(GA2003 only)* Velocity 0.1 to 100mms^{-1} Displacement 1 to 100µm *(GA2002 only)* Harm 0.01to 100ms^{-2} *(GA2003 only)*
	High	Acceleration 1 to 100g *(GA2002 only)* Acceleration 10 to 1000ms^{-2} *(GA2003 only)* Velocity 1 to 1000mms^{-1} Displacement 10 to 1000µm *(GA2002 only)* Harm 1 to 1000ms^{-2} *(GA2003 only)*

Memory: Non – volatile E2PROM memory which holds calibration data plus storage of 9 spot results

Keypad: 9 key tactile keypad

Parameters: Acceleration, Velocity, Displacement (GA2002 Only)

Filters: Mechanical, Linear, HARM

Detectors: RMS, Peak

Displays: RMS, Lmax, Lpeak,
Overload indication (flashing display)
Battery condition indication
Low battery (Flashing alternate display)
Hi / Lo range

Calibration: Calibration offset accessed from the keypad and stored in the non-volatile memory

Accelerometer KD1001 Piezo-electric (nominal 10pc/g)

Accessories

GA606	Vibration Calibrator
KD1001	HARM Basic Accelerometer *^
KD1004	HARM Standard Accelerometer
KD1202	Mounting Studs (pack of 5)
KD1203	High Strength Magnetic Mount
KD1204	Standard Magnetic Mount *
KD1205	Large Spike Probe
KD1206	Small Spike Probe *
KD1207	General Purpose Transducer Block ^
KD1212	Cable Ties (pack of 100)
KD1213	Environmental Ground Spike
ZL1094-M	Strong Microdot – Mirodot Cable (30cm)
ZL1094-M12	1.2m Microdot cable *^
ZL1094-M30	3.0m Microdot cable
KA013	Pocket Meter Carry Case *^

*Supplied as standard with GA2002
^ Supplied as standard with GA2003

Instrument Disposal

The symbol shown here can be found on your instrument and means that the product is classed as electrical or electronic equipment and should be disposed of at the end of its life separately to your commercial or household waste.

The Waste of Electrical and Electronic Equipment Directive (2002/96/EC) has been established to help reduce the influx on landfill sites and effectively treat hazardous substances by using best practices for the recovery and recycling of products.

There are various collection systems in place within the EU for the disposal of your product. To find the nearest UK waste recyling point in your area, enter your postcode in the website www.recycle-more.co.uk

For more information please contact your local authority, the dealer where you purchased your product or Castle Group Ltd.

Instrument Details

For your records and for future correspondance with Castle Group Ltd regarding your instrument, please complete the following details: -

Instrument Model

Instrument Serial Number

Purchase Date

Disclaimer

Whilst every effort is made to ensure the accuracy and reliability of both the instrument described and the associated documentation, Castle Group Ltd makes no representation or warranties as to the completeness or accuracy of this information.

Castle Group Ltd assumes no responsibilty or liability for any injury, loss or damage incurred as a result of misinterpreted or inaccurate information.

Any documentation supplied with your product is subject to change without notice.