Vexo S - (GA2006S)

Single Axis Vibration Meter

Operating Manual

www.castlegroup.co.uk

Vexo S

Single Axis Vibration Meter Operating Manual

Published by Castle Group Ltd

Castle Group Ltd
Salter Road
Scarborough
North Yorkshire
YO11 3UZ, UK

Copyright © Castle Group Ltd 2012

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the copyright holder.

Printed in the UK

Rev A

HB/2006/010/EL

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 vibration 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 Human Vibration. You can visit **www.castletrainingacademy.com** to find out more.

Castle Group has become the leading supplier of solutions for health and safety, environmental compliance and plant maintenance and monitoring, with an ever expanding offer comprising equipment for sale or rent, residential or in-house training courses, consultancy services and equipment calibration. If you would like to know more about any of our other products and services then please visit **www.castlegroup.co.uk** or telephone us on **+44(0)1723 584250**.

Simon Bull
Managing Director

Note: for '**Getting Started**' section please turn to Chapter 4

Precautions

- Only operate the instrument as described in this manual.
- These are precision instruments, protect from shocks and physical extremes.
- 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.
- 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 Vexo S Vibration Meter, 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

CHAPTER 1 14

Introduction 14
Vexo S (GA2006S) – Single Axis Machine Monitoring Vibration Meter14

CHAPTER 2 15

Accelerometer Type, Removal and Fitting 15
Accelerometer Type 15
Vexo S – Single Axis Accelerometer (KD1011) 15
Attaching & Removing the Accelerometer 16

CHAPTER 3 17

Measuring Vibration 17
Machinery Vibration Introduction 17
Condition Monitoring 17
Vibration, Measurement and Mounting 18
- **Acceleration** 18
- **Velocity** 18
- **Displacement** 18

Predictive Maintenance Program 22
Detection 22
Analysis 23
Correction 23
Under Range & Overload Conditions 24
Under Range Condition 24
Overload Condition 24

CHAPTER 4 25

Getting Started 25
Keypad Layout 27
Powering Your Vexo Meter 28
Battery Indicator 29
Recharging the Battery Pack 30
Switching Your Vexo Meter On/Off 31

CHAPTER 5 32

Menu Structure 32
Menu Options 34
Range 34
Files 35
Open All 35
Open Today's 36
Open 7 Days 37
Delete Single File 38
Delete All Files 39
Settings 40
Freq Wgt 40
Units 40
Brightness 41

Auto Dim 41
General 42
Time 42
Date 43
File Naming 43
Meter 44
Reset 44
Configuration 45
Mode 45
Show Results 45
Alarms 46
Information 46
Calibration 47
Measurement 47
Sensitivity 50

CHAPTER 6 51

Using the Vexo S 51
Stop State 51
Record State 52
Playback 53
Show Results - On 54
Alarms - On 55
Under Range Indicator 56
Overload Indicator 57
Parameters 58
Xrms 58
Xeq 58
Xmax 58
Peak 58
Pk-Pk 58
CFmax 58
Modes 59
Bearings 59
Machine 61
Pump 62
User 64

CHAPTER 7 65

Downloading Saved Recordings to a PC 65

CHAPTER 8 66

Accessories 66

CHAPTER 9 67

Technical Specification 67
Applicable Standards 67
Noise Floors 67
Accelerometer 67
Normal Operating Mode 68
Overload & Under Range Triggering Points 68
Level Ranges 68
Frequency Weightings 69

W_{FL} : Flat Response 69
W_{LP} : Low Pass Response 70
W_{HP} : Low Pass Response 71
Electrical Signal Input 72
Maximum Electrical Signal Input For No Damage 72
Environmental Stabilization Time 72
Warm up Time 72
Settling Time 72
Temperature Operating Range 72
Effect of Air Temperature 73
Effect of Surface Temperature 73
Real Time Clock 73
Digital Signal Processing 73
Analogue to Digital Converter & Microcontroller 73
Display 73
Memory 73
Overload 74
Size and Weight 74
Connections 74
Download 74
Wiring Configuration - Micro USB 'B' Socket 74
Battery Recharge 74
Batteries 75
Input Signal 75
Wiring Configuration – 3 Pole Jack Socket 3.5mm 75
EC Declaration of Conformity 76

CHAPTER 10 77

Function Equations 77

CHAPTER 11 80

Customer Instrument Support 80
Warranty and After Sales Service 80
Disclaimer 82
Instrument Details 82

Table of Figures

Figure 1 – Vibration Direction 20
Figure 2 – Keypad Layout 27

Castle Group Ltd

If you want to keep up to date with the latest in health and safety, you should attend a Castle FREE seminar. These are run around the country and cover a wide range of topics. Packed with the latest information and delivered with the help of practical demonstrations, these seminars are a great way to really learn something at the same time as collecting cpd points! Go to the website below to find the lasts dates and venues and to see video clip samples.

www.need2know4free.com

Dedicated to professionals in Health and Safety, Environmental Compliance and Plant Maintenance Engineering, Castle set out to help you in a way that suits you best. We can provide or rent equipment, train you and your staff or we can carry out work on your behalf. We can even mix it up to suit your way of working.

- Measuring and Monitoring Instruments
- Equipment Rental
- Database and Data-management Software
- Training Courses and In-house Provision
- Calibration and Repair of Monitoring Equipment
- Consultancy for Health, Safety, Environment and Engineering Solutions
- Online Knowledge

www.castlegroup.co.uk

HEALTH AND SAFETY

Compliance with legislation and mitigation of claims is really what health and safety is about for most companies. That is how we are set up to help you; Our training courses are all geared to that end as is any equipment we might supply or rent to you. If you need us in person, we'll be there too! Call NOW on 01723 584250 and get your health and safety compliance on-track, the way you want to do it! There are many issues you might like us to have a look at

- Noise and Vibration at Work
- Audiometry
- HAVS Health Surveillance
- Health Screening
- Air Sampling and Gas Detection
- Indoor Air Quality
- Airflow
- EMF Testing and Monitoring
- Portable Appliance Testing (PAT)
- General Compliance and Risk Assessment

ENVIRONMENTAL COMPLIANCE

In an increasingly sensitive atmosphere to environmental issues, businesses have to be careful. Neighbours are increasingly aware of theirs 'right' to complain and the environmental agencies are looking for industry to clean up its act. Simply call us on 01723 584250 if you have any environmental compliance issues and we will work with you to find the best way forward.

- Noise for Planning
- Complaint Management
- Ground-Bourne & Building Vibration
- Stack-Emissions Monitoring
- Environmental Air Sampling
- Water Quality Testing

MAINTENANCE AND DIAGNOSTICS

Production plant needs maintenance and if this can be done only when needed, then cost savings can be huge. Condition monitoring offers the ability carry out predictive maintenance so shut-down is only when you plan it and only when it's needed. It is very simple to work out if this is the right approach for your business, so give us a call on 01723 584250 so we find out how much you could save!

- Vibration Monitoring Systems
- Vibration Meters
- Temperature Monitoring System
- Thermometers
- Thermal Imaging
- Diagnostic Vibration Analysis
- Tachometers
- Inspection Endoscopes

Services

Castle Training Academy

Competence and Compliance training is essentially all about obtaining the knowledge and skills required to get the job done. This is precisely how Castle courses are set out, with a high degree of practical 'hands-on' experience mixed with some background theory and a lot of job-specific information and discussion. If this doesn't whet the appetite, then there is also a fully inclusive dinner on the first nigh – perfect for getting to know some of your peers! You can see a full list of courses on our website.

- Health and Safety Compliance Courses
  - Noise, Vibration, COSHH, Asbestos
- Health Surveillance Courses
  - Audiometry, Lung Function, HAVS
- Environmental Monitoring Courses
  - Noise, Vibration, Air Quality
- Diagnostic Engineering Courses
- Maintenance and Monitoring Courses

In-house and Bespoke Training

The benefits of in-house training can be extensive. Training can be tailored to your company, the timing can be made to suit your needs, you get to keep your staff on-site and you can train many people at one go!

You can pick any of our standard courses, a shortened version as an awareness session or a toolbox talk, or you can design your own course covering a large range of topics. Visit our website for a list of ideas!

Castle Consultancy

Sometimes, the comfort of using an independent expert can be extremely valuable, whether that be for short-term help, Engineering project work, or an on-going support contract. Castle consultants are always at the top of their game and are waiting to hear from you. Have a look at our website or call on 01723 584250.

- Noise and Vibration, COSHH Assessments
- Light, Temperature, EMF Assessments
- Environmental Monitoring
- Expert Witness
- Diagnostic Engineering
- Engineering Control Solutions
- Risk Management
- Health Surveillance Services
- Health and Safety 'Department' Support Service

Castle Care

Maintaining calibrations on measuring equipment is absolutely essential to the integrity of your data. At Castle, we can calibrate virtually anything you have that can measure. We pride ourselves in fast-as-possible turnaround times and can normally give up-front prices for almost any equipment. Whether you have an anemometer, or a 'zero-g' accelerometer, then call us for a price on 01723 584250.

- If it Measures, and can be done - we'll Calibrate it
- UKAS Certificates Available
- Multiple levels of Calibration

Equipment Types Covered

- Air quality meters
- Air sampling pumps
- Air sampling calibrators
- Anemometers
- Audiometers
- Balances/Scales
- Barometers
- Dosemeters
- Electrical test equipment
- Force meters
- Gas Detectors
- Hygrometers
- Light meters
- Manometers
- Moisture meters
- Noise meters
- Pressure meters
- Sound level meters
- Sound analysers
- Strain gauges
- Tachometers
- Thermometers
- Thermo-hygrometers
- Thickness meters
- Timers
- Vibration meters
- Vibration analysers
- Weighing equipment

Castle Contract

If peace of mind for equipment calibrations is important to you – and it should be, then check out our contract calibration deals. We will give you discounted, fixed-annual-pricing for selections of equipment and we will undertake to ensure calibration is maintained to your schedule. This is designed to take all the hassle out of equipment calibration.

- Maintain Instrument Calibrations
- Hassle-Free Administration
- Discounted Calibration Fees
- Single-Source Supplier

Castle Rent

Rental is a great way to have the use of measurement equipment without having to own it – especially is capital budgets are tight or it tax is an issue. If you need a short term solution, additional equipment to boost your capabilities or if contract-based tax deduction is important, then Rental could well be the way to go. Go to our website to find the huge range of equipment we have available.

You might also like to make use of our ex-rental purchase as a way of keeping your equipment costs down.

- Easy on Cash-Flow
- Short or Long Term Rentals
- Let the Taxman Pay on Contracts
- Try Before You Buy
- 4 weeks for the Price of 3!
- No On-going Maintenance

If it exists - we'll even source equipment for you!

www.castlegroup.co.uk

01723 584250

Chapter 1

Introduction

Vexo S (GA2006S) – Single Axis Machine Monitoring Vibration Meter

Thank you for purchasing your product from Castle Group Ltd.

The Vexo S single axis machine monitoring vibration meter brings simplicity, looks, value for money and power to the world of vibration monitoring.

Regular maintenance monitoring of machinery with a vibration meter can help stop excessive downtime and major repair costs later on. The Vexo S is a powerful single axis vibration meter designed to ensure your machine condition monitoring and fault diagnostics are effective.

The instrument has three modes of operation, Machine Monitoring, Bearing Analysis and User defined. Adhering to the current versions of ISO 10816 parts 1, 3 and 7 has never been easier.

It boasts a clear easy to read colour LCD and has full data logging capabilities with fast USB downloading to your laptop or PC. The Vexo incorporates internal Flash memory to store all your recordings and the data can then be transferred to the supplied software Vibdata LITE using the supplied USB cable or viewed onscreen.

Not only does the Vexo S vibration meter have all these features in a small and ergonimc case but it is also supplied with a rechargeable battery pack featuring the latest NiMH technology which incorporates extremely low self discharge.

Every part of the Vexo has been thoughtfully designed. The case, accelerometer and cable are all rugged for industrial use and the meter is extremely easy to use with a simple three button operation, all you virtually need do is press the power button and start recording.

With the Vexo S, machine monitoring has become even easier.

Chapter 2

Accelerometer Type, Removal and Fitting

The accelerometer for use with the Vexo S produces a Voltage Output proportional to the signal being measured.

The table below shows the output voltage and specifications for the accelerometer where g is the acceleration due to gravity on the Earth's surface and is defined as 9.80665 ms^2.

Acceleration is measured in metres per second per second (m/s/s) which can be written as either of the following: -

- ms^{-2}
- m/s^2

Accelerometer Type

Vexo S – Single Axis Accelerometer (KD1011)

Accelerometer Type	Output Voltage	Operating Range	Frequency Response
Single Axis	100mV/g	±20g	2 to 10000Hz ±10%

KD1011 Single Axis Accelerometer

Attaching & Removing the Accelerometer

Locate the jack socket on the instrument and gently push the 3 pole jack plug of the accelerometer cable into the jack socket.

To remove the accelerometer cable from the instrument, gently pull the jack plug from the instruments jack socket.

Removal of the accelerometer can be achieved with the instrument powered on or off.

Chapter 3

Measuring Vibration

Machinery Vibration Introduction

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, available separately.

It is inevitable that most machinery will vibrate and therefore will have been designed to withstand long periods of normal smooth operating vibration without cause for concern, however if the operating vibration of the machine increases becoming excessive or rough then this could lead to expensive breakdowns and cause production to cease.

To combat this condition monitoring can be used as part of a predictive maintenance program.

Condition Monitoring

Predictive maintenance is a process to help establish the condition of any equipment or machinery and in doing so help predict when any maintenance of this equipment should be performed and prevent expensive breakdowns.

Monitoring of the equipment or machinery condition is commonly known as Condition Monitoring and is widely used in industry as it can be very effective.

It is a process of repeat measurements that monitor the condition of a machine over time. The measurements of which will be taken from the same location and with the same load on the machine.

The course of monitoring for a specific machine starts from a known normal (smooth) operational state and the repeated measurements taken over a period of time will show any gradual deteriation of working order.

To a certain extent human perception can be used for condition monitoring but with modern machinery, which may be operated unattended or even sound proofed, it becomes more and more difficult for operators to detect through experience alone. To this end it is becoming industry standard to use measuring equipment for this purpose.

Vibration measuring equipment is ideal for this as any change in the vibration level monitored indicates that the machine is operating under different condiditions to normal smooth operation.

The Vexo S was designed specifically for this purpose.

Vibration, Measurement and Mounting

Every machine that has some form of movement in its operation will transmit vibration through it. The directions of such vibrations are dependant on the machine type and determined by whether the machine has rotating parts or not.

Vibration is a repeated oscillation of a surface about a rest position. How often this occurs in one second is named the vibration frequency measured in cycles per second (Hz).

In most circumstances the machine vibration will consist of various frequencies mixed together and the measuring instrument must be capable of measuring within these frequency boundaries.

The amount of vibration (how rough or smooth the vibration is) is expressed by its vibration amplitude and can be measured in three different ways which are: -

- **Acceleration**
  Acceleration is a vector quantity and is the rate at which an object changes its velocity with respect to time.

  In order to have acceleration the object must be either speeding up or slowing down.

  As the object or machinery vibrates it will move from one location to another and this movement increases and decreases in speed (velocity) continuously at a rate determined by the machines operating frequency.

- **Velocity**
  Velocity is the speed at which the machine or object travels.

  The Velocity signal is created by integrating the Acceleration signal.

- **Displacement**
  Displacement is the distance the machine or object travels from its stationary position.

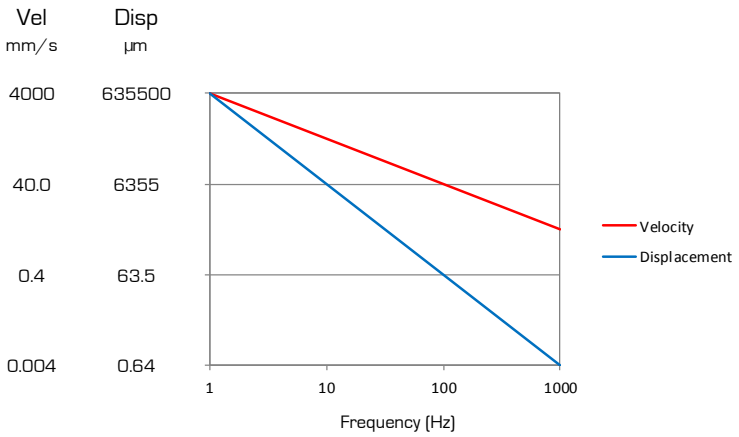
  Peak displacement is the distance of one direction of movement whereas peak to peak displacement includes the distance of the opposite directional movement. The Vexo S always measures peak to peak displacement.

  The Displacement signal is created by integrating the Acceleration signal twice.

Please be aware that the integral (Velocity) and double integral (Displacement) of the Acceleration signal are frequency dependant meaning that as the input vibration frequency increases the output signal decreases.

See the graph below to determine the output signal level relative to input frequency: -

Dynamic Range



The instrument is supplied as standard with a hand held spike probe which attaches to the accelerometer. The probe can then be used for quick measurements without the need for preparing fixed measuring points. The handheld probe will however give the least repeatable measurements and least accuracy due to the variabilites in the contact between probe and machine. It is essential that the user responsible for measuring the data becomes proficient in its use to ensure the most repeatable and accurate results possible using this method.

Consideration of the mass of the machine should also be taken into account and should be at least 9 times greater than that of the accelerometer, including spike probe if used.

For best results and repeatable measurements the accelerometer should be fixed securely to the measuring point using either a high strength magnetic mount or for permanent measuring point fixtures using glue and stud packs, both of which are available separately. See Accessories for details.

If using studs, mounting of the single axis accelerometer to the vibration source is achieved by tapping a stud into the vibration source and then attaching the accelerometer to the stud. Alternatively the stud may be adhered to the device with an adhesive that dries rigid.

In all cases the correct mounting of the accelerometer is cruicial for accurate, meanginful and repeatable measurements. Always mark the location and measure in the exact same point.

The measurement points should not be chosen randomly. Machinery vibration generally radiates through machine bearings and hence measuring points should be situated on or as close as possible to the bearing housing.

It is recommended to have more than one measuring point each located at various positions around the machine to aid in identifying mechanical issues.

Do not use weak flexible areas such as machine cover panels for measuring points.

Vibration direction should also be considered and can be a combination of either radial or axial vibration.

Consider the shaft bearing housing shown below from both the front and top elevations: -

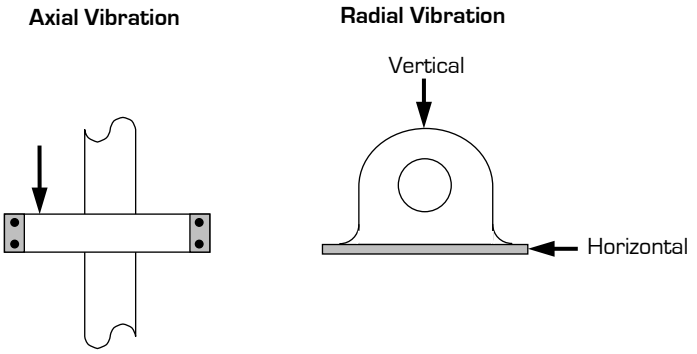


Figure 1 – Vibration Direction

Radial vibration would be evident from machinery with imbalanced rotating parts such as a motor. As the motor rotates the imbalance pulls the motor outward causing a higher vibration than normal operating conditions. The vibration force would also be transmitted through to the rotating shaft and therefore seen in the bearing housings supporting the shaft. Radial vibration travels outwards from the shaft and therefore should be measured horizontally and vertically.

Abnormal radial measurements taken horizontally are generally vibrations caused through imbalance whereas if taken vertically are often issues with the machine mounting or the structure of the machine itself.

Axial vibration travels in either direction along the shaft. Bent shafts or misalignment of bearings or the shaft coupling device can cause higher machine vibration measurements. Ensure flanges are not overloaded to reduce the chance of misalignment issues.

To measure the correct direction, mount the accelerometer so that the resulting vibration travels up through the accelerometer.

The severity of the vibration level measured will be proportional to any amount of misalignment, imbalance or bending of the shaft.

Remember '**Condition Monitoring**' ... you need to devise a regular monitoring schedule for your machinery that enables you to ascertain and repair many costly machine faults before they occur.

Your Vexo S instrument is a tool to aid in this condition monitoring, it is not a tool that gives detailed fault analysis by using techniques such as fast fourier transforms. Used correctly with trained personnel it will give a good early indication as to where faults may be occurring and allow you to plan scheduled corrective maintanence.

It is then down to the experience of the engineers to determine and repair the fault or if required analyse the vibration fault even further using specialsed monitoring equipment to determine the exact location of the problem.

Predictive Maintenance Program

In general your vibration predictive maintenance program will consist of the following steps: -

1. Detection
2. Analysis
3. Correction

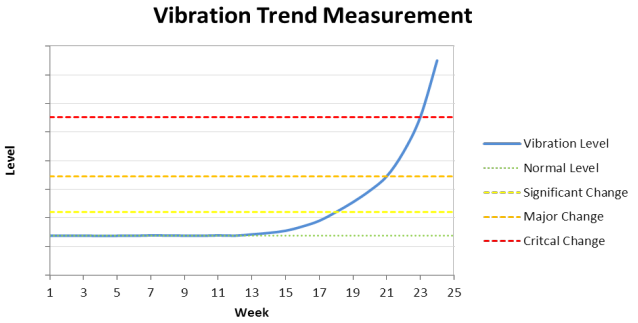
Detection

This first step of your predicitive maintenance program involves measuring the vibration levels for each machine at the marked locations using your Vexo S meter.

Measurement frequency depends on the machinery and its operation but in general monthly readings will suffice, however it may be necessary to take more frequent readings for more critical machinery.

The measurement is then downloaded into the supplied software and if the registered version is being used the results can be trended to instantly see any change in vibration levels for that specific machine.

The example graph below shows trending analysis for a particular machine using weekly measurement frequency.



In practice whislt the machine is operating under normal vibration levels then only routine maintenance should be required.

When the first significant change in vibration level is discovered then minor repairs to the machine maybe required.

If a major change in vibration level is discovered then again repairs maybe required and a major service should be planned.

Reaching the critical change in vibration level will likely require an immediate shutdown of the machine to undertake major repairs and to complete a service.

Analysis

The next step of your predicitive maintenance program after detecting any machinery complications will be to identify the problem with the machine.

It may be necessary to use more specialized monitoring equipment to determine the vibration signature of the fault and exactly pinpoint the location, however if as discussed vibration readings are recording in all three directions: -

1. Axial
2. Radial – Horizontal
3. Radial – Vertical

Then this maybe be sufficient data to determine the more common machinery problems and there location.

Correction

The last stage of the predicitive maintenance program after detection and analysis will be to correct (repair) the found problem.

With early detection and analysis the correction can be planned in advance for a convienent time to ensure minimum disruption and minimum cost.

Under Range & Overload Conditions

Under Range Condition

An under range condition occurs when the vibration level is equal to, or lower than the bottom of the current range the meter is set to. If this condition occurs then the UR (Under Range) indicator will be displayed on your instrument. In such circumstances it is highly recommended to change to a lower range with a higher sensitivity as your meter will be out of specification.

The under range indicator will remain on for a minimum of 2 seconds or while the under range condition remains.

Placement of the under range indicator can be found under **Under Range Indicator** in **Chapter 6**.

See **Technical Specification** for a complete list of Under Range triggering points.

Overload Condition

An overload condition occurs when either the peak signal starts to exceed the signal handling capability of the specialised amplifier circuitry or if the vibration level exceeds the top of the selected range by 5%. If the vibration source saturates the input circuitry or is 5% greater than top of the selected range an Overload condition occurs and an OL (Overload) indicator is displayed on your instrument.

If an overload condition occurs it is highly recommended to change to a higher range with a lower sensitivity as your meter will be out of specification.

The overload indicator will remain on for a minimum of 2 seconds or while the overload condition remains.

Please be aware that the selected frequency weighting may attenuate the displayed signal level below the overload triggering point but an overload can still occur. This is because the overload operates from the unweighted input signal.

Placement of the overload indicator can be found under **Overload Indictor** in **Chapter 6**.

See **Technical Specification** for a complete list of Overload triggering points.

Chapter 4

Getting Started

The Vexo S instrument has three states of basic operation: -

- Stop State
- Record State
- Playback

Whilst the instrument is in the Record State the vibration activity is analysed and all parameters available on your instrument are calculated.

The data captured can be saved to the internal flash memory and viewed onscree or downloaded to Castle's vibration analysis software **Vibdata LITE** or **VibdataPro** as and when required.

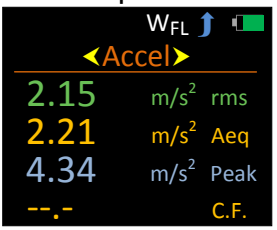
To Start or Stop a recording press the following key

Whilst the instrument is in the Stop State, calculations are displayed on screen but are not stored in flash memory, with the exception of Crest Factor which is only calculated when the instrument is recording.

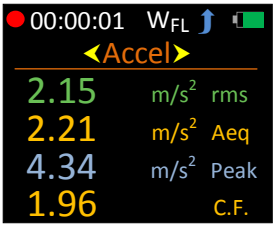
Alarm screens are only available at the end of a recording or when viewing a saved recording. The option to display Alarms must also be set to On.

During Stop State it is possible to change the Settings and undertake Calibration of the instrument. Stop State, Record State and playback can easily be distinguished: -

Stop State

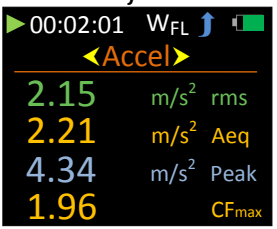


Record State



Record State shows Record Symbol and Time Recorded

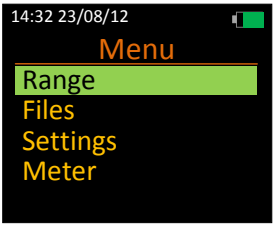
Playback

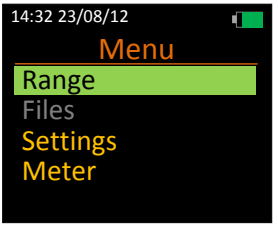


Playback shows Play Symbol and Total Time Recorded

Whilst in Stop State press to open the Main Menu. This key is also used to step back to the previous screen.

With the Main Menu screen open, use to scroll down the list of available options: -





If the instrument has no files saved then the Files option is not selectable

Press to select the required option. Note that a recording cannot be started from within the Main Menu.

Some options may also have further sub-menus where further options are available. Again use the key to scroll through the available options.

The menu structure is described in detail in **Chapter 5**.

Please be aware that your Vexo S instrument has a built in battery saving function that automatically dims the display. Any key can be pressed to exit this power saving function. See **Auto Dim** in **Chapter 5** for more details.

Keypad Layout

Please note that some keys have a dual function.

Figure 2 – Keypad Layout

Powering Your Vexo Meter

Your Vexo meter is powered from a Castle rechargeable 2.4V NiMH battery pack. The battery pack employs the latest battery technology for maximum battery life between instrument uses.

The battery compartment is located on the underside of your instrument. Open the battery door by sliding the cover downwards towards the bottom of the instrument.

The cover can now be removed exposing the battery compartment and battery pack if fitted.

To fit a battery pack, plug the battery pack into the connector and insert the battery pack at an angle as shown below: -

Push the raised end of the battery pack downwards as indicated until the battery pack sits comfortably in place.

Ensure battery cabling does not overlap or obstruct where the battery door is inserted.

Battery Indicator

Your Vexo meter is equipped with a four stage battery level indicator and is visible in the top right hand corner of all screens.

With a fully charged battery pack the indicator with a full Green bar is displayed and as the battery pack discharges the relevant indicator is displayed.

The approximate values are 100%, 75%, 50% and 25%

When the battery pack is below 10% it will flash Red indicating that the battery pack is flat and requires a recharge.

When the battery pack is below 4% it will automatically power the unit down and save any data if the instrument is in **Record State**.

Recharging the Battery Pack

With a battery pack inserted and your instrument switched off plug your supplied charging unit into the DC socket indicated below: -

The Vexo instrument will not operate while the battery pack is charging and will immediately switch off when the charger is plugged in to the DC socket, even if the charger is not switched on. This is normal.

If the unit switches off due to the charger plug being inserted then no settings or recordings will be saved.

A completely discharged battery pack may need several hours to become fully charged.

Observe the LED on the charging unit to determine the charging cycle.

LED Colour	Mode	Output
Yellow	No Battery	6.4V
Yellow	Initialisation	30mA
Orange	Fast Charge	1.3A
Green/Yellow	Top-off Charge	160mA
Green	Trickle Charge	30mA
Orange/Green	Error	30mA

When the charging unit displays a constant Green LED then charging is complete.

For safety only use the charging unit and battery pack supplied by Castle.

Switching Your Vexo Meter On/Off

To turn on your instrument press and hold the Power On/Off key for approximately two seconds.

Your meter will display the start-up screen and initialise any saved settings.

The start-up screen is shown below: -

Once the start-up sequence is complete the instrument is placed in its **Stop State** displaying the parameter measuring screen.

To turn off your instrument press and hold the Power On/Off key for approximately three seconds and the following screen will be displayed: -

Release the Power On/Off key to shut down.

Your Vexo meter is also equipped with an automatic shut down if no key is pressed for 3 minutes after power on.

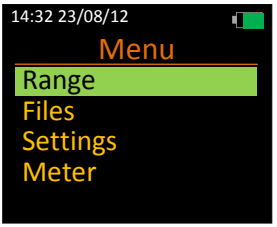
If any key is pressed after the instrument is turned on then the automatic shutdown will not occur.

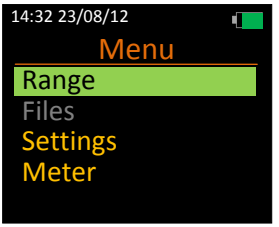
Chapter 5

Menu Structure

Whilst in Stop State press to open the Main Menu. This key is also used to step back to the previous screen.

With the Main Menu screen open, use to scroll down the list of available options: -



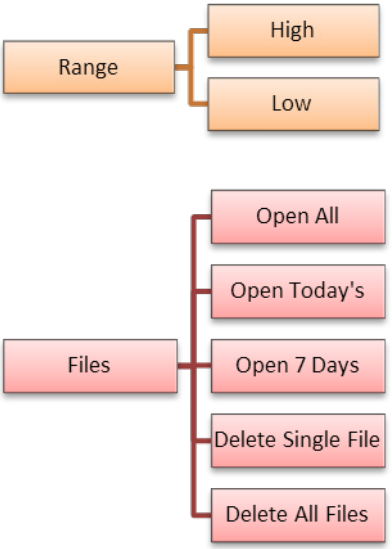


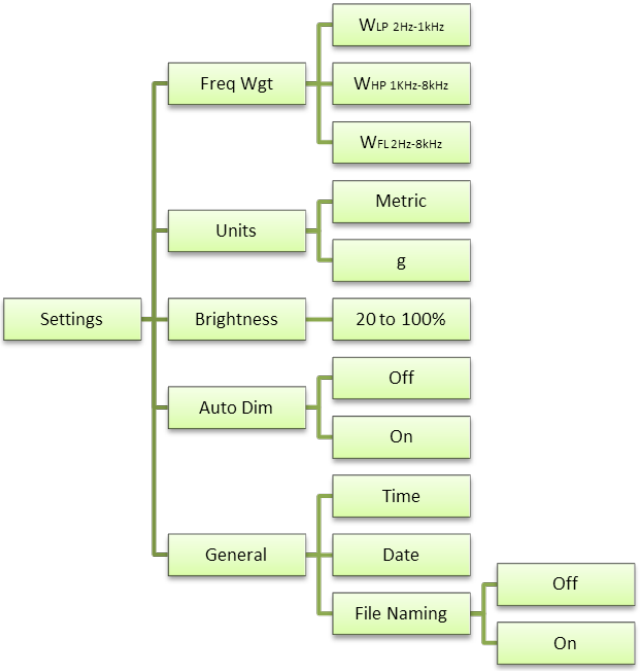
If the instrument has no files saved then the Files option is not selectable

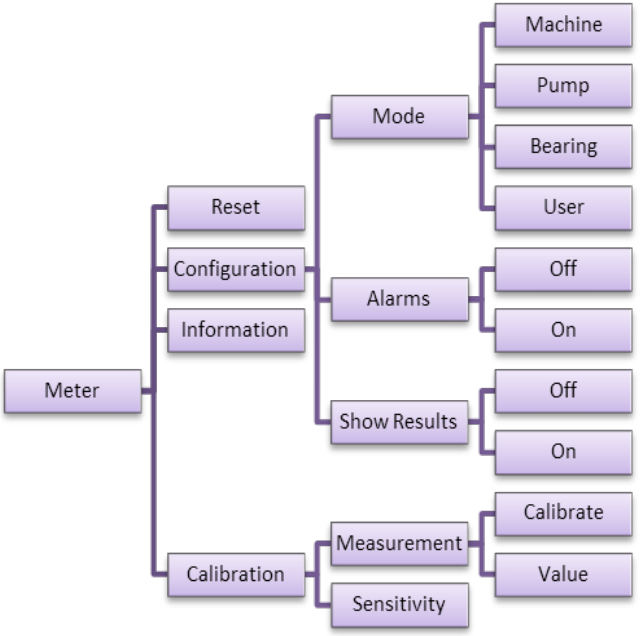
Press to select the required option. Note that a recording cannot be started from within the Main Menu.

Some options may also have further sub-menus where further options are available. Again use the key to scroll through the available options.

The complete menu structure is shown below: -




Settings
Freq Wgt
WLP 2Hz-1kHz
WHP 1KHz-8kHz
WFL 2Hz-8kHz
Units
Metric
g
Brightness
20 to 100%
Auto Dim
Off
On
General
Time
Date
File Naming
Off
On

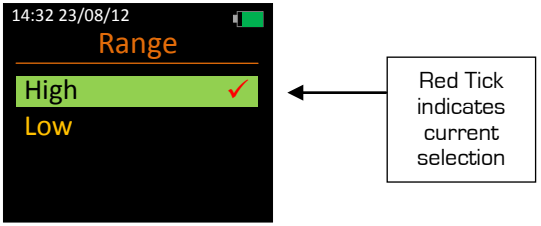

Meter
Reset
Configuration
Information
Calibration
Mode
Machine
Pump
Bearing
User
Alarms
Off
On
Show Results
Off
On
Measurement
Calibrate
Value
Sensitivity

Menu Options

Each Menu option is described fully below: -

Range

Select this option to change the measuring range of your Vexo instrument.



Use the key to highlight the required option and press to select. The range will be selected and the previous menu screen will be displayed.

Range details are as follows: -

Acceleration:

Range	(m/s²)	(g)
High	0.05 – 200.0	0.0051 – 20.4
Low	0.005 – 20.00	0.00051 – 2.04

Velocity:

Range	(mm/s)
High	0.6 – 2500
Low	0.06 – 250

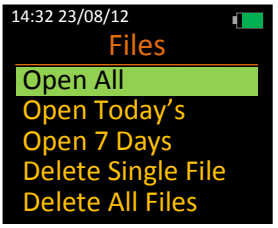
Displacement:

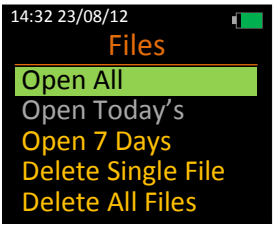
Range	(um)
High	40.0 – 165000
Low	4.0 – 16500

Press to return to the previous screen without making a selection.

Files

Select this option to manage saved recordings on your Vexo instrument.





If no files have been recorded today or in the last 7 days then these options will not be selectable

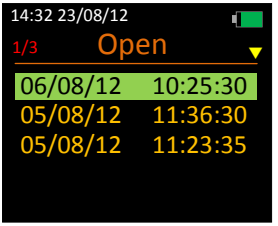
Use the key to highlight the required option and press to select.

Press to return to the previous screen without making a selection.

Open All

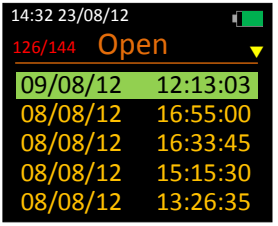
Select this option to show all saved recordings on the instrument. Recordings are listed by file name, date and time order showing the most recent first.

The file number and amount of recorded files are also shown in Red: -



Use the key to highlight the required file and press to open it.

If more than 5 files exist then use the key to scroll through the available recordings: -



Press to return to the previous screen without making a selection.

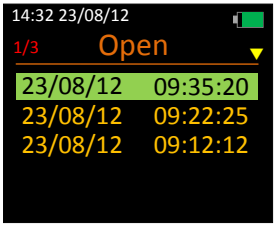
Open Today's

Select this option to show all saved recordings made today on the instrument.

The recordings are listed by file name, date and time order showing the most recent first.

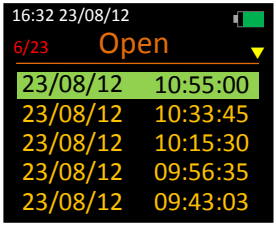
Note that this option is not selectable if no recordings have been made today.

The file number and amount of recorded files are also shown in Red: -



Use the key to highlight the required file and press to open it.

If more than 5 files exist then use the key to scroll through the available recordings: -



Press to return to the previous screen without making a selection.

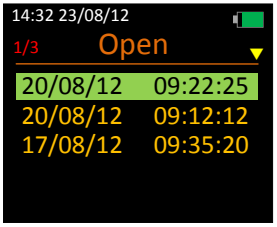
Open 7 Days

Select this option to show all saved recordings made in the last 7 days.

The recordings are listed by file name, date and time order showing the most recent first.

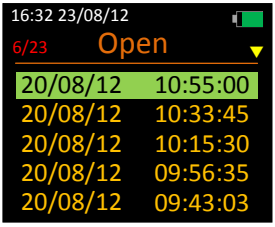
Note that this option is not selectable if no recordings have been made in the last 7 days.

The file number and amount of recorded files are also shown in Red: -



Use the key to highlight the required file and press to open it.

If more than 5 files exist then use the key to scroll through the available recordings: -



Press to return to the previous screen without making a selection.

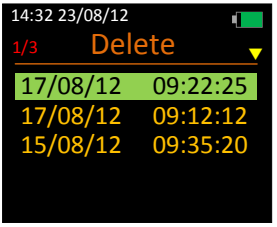
Delete Single File

Select this option to delete an individual file from the instruments flash memory.

Deleted files cannot be recovered.

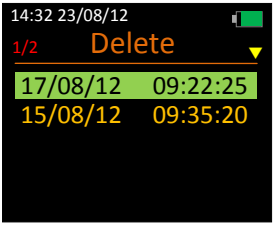
The recordings on the instrument are listed by file name, date and time order showing the most recent first.

All recordings will be available for selection and the file number and amount of recorded files are shown in Red: -

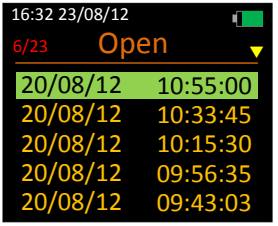


Use the key to highlight the required file and press to delete it.

The selected file will be immediately deleted: -



If more than 5 files exist then use the key to scroll through the available recordings: -

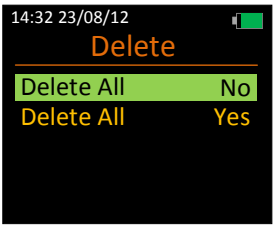


Press to return to the previous screen without making a selection.

Delete All Files

Select this option to delete all recordings from the instruments flash memory.

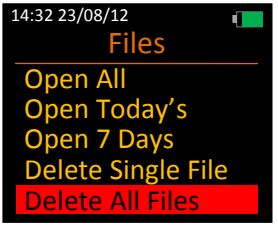
Proceed with caution as deleted files cannot be recovered: -



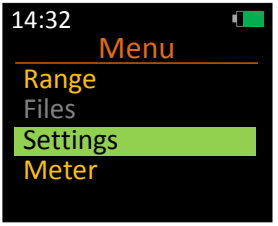
Use the key to highlight the required option and press to proceed.

Select No or press to return to the previous screen without deleting any files.

Select Yes to delete all saved files. Delete All Files will be highlighted red: -

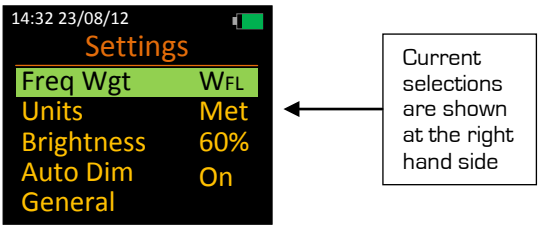


When all files are deleted the Main Menu is displayed: -



Settings

Select this option to manage settings on your Vexo instrument.

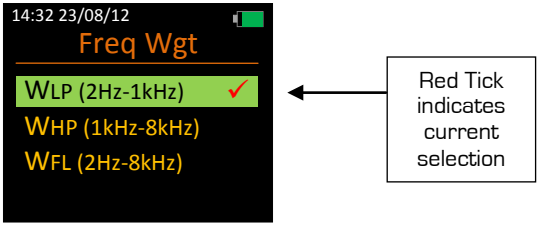


Use the key to highlight the required option and press to select.

Press to return to the previous screen without making a selection.

Freq Wgt

Select this option to change the frequency weighting of your Vexo instrument.

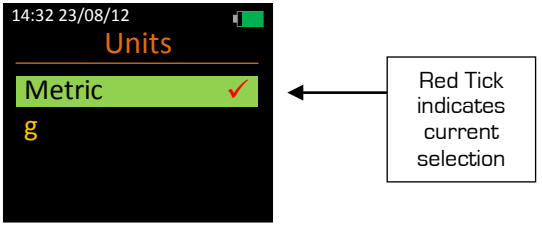


Use the key to highlight the required option and press to select. The unit will be selected and the previous menu screen will be displayed.

Press to return to the previous screen without making a selection.

Units

Select this option to change the units of measure of your Vexo instrument.

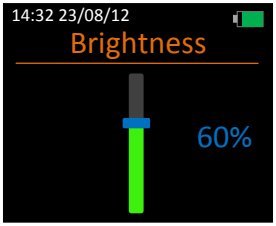


Use the key to highlight the required option and press to select. The unit will be selected and the previous menu screen will be displayed.

Press to return to the previous screen without making a selection.

Brightness

Select this option to change the display brightness of your Vexo instrument. Battery life is increased using lower brightness.



Use the key to change the brightness level and the press to return to the previous screen with the selected brightness level.

The display brightness can be adjusted between 20% and 100% in 20% steps.

Press to return to the previous screen without altering the brightness level.

Note that the brightness may be affected by the Auto Dim function - see below.

Auto Dim

Select this option to determine if your Vexo instrument should use the Auto Dim function or not.

The Auto Dim function is a battery saving feature that automatically reduces the display brightness of all screens to 10% if no key has been pressed for 30 seconds.

For optimum battery life, the Auto Dim should be switched **On**.

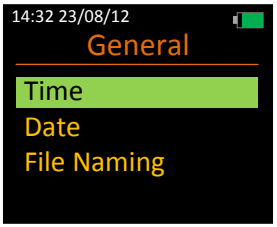
Use the key to highlight the required option and press to select. The option will be selected and the previous menu screen will be displayed.

Press to return to the previous screen without making a selection.

Whilst the Auto Dim feature is active press any key to deactivate it and return to the selected brightness level.

General

Select this option to open another menu level of General options.



Use the key to highlight the required option and press to select.

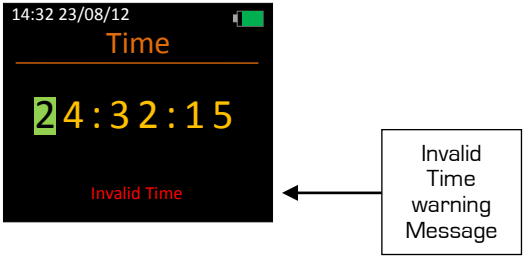
Press to return to the previous screen without making a selection.

Time

Select this option to change the time stored on your Vexo instrument.

Use the key to change the value highlighted then press to move the highlight to the next position.

If an invalid time is selected the warning message **Invalid Time** will be displayed in red.

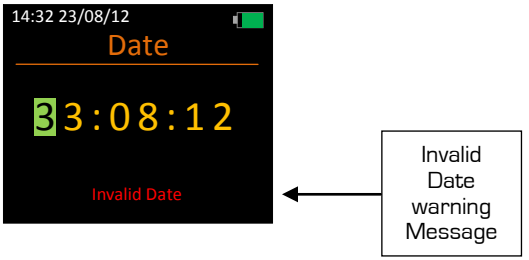


Press to return to the previous screen with any valid changes made.

Date

Select this option to change the date stored on your Vexo instrument.

Use the key to change the value highlighted then press to move the highlight to the next position. If an invalid date is selected the warning message **Invalid Date** will be displayed in red.



Press to return to the previous screen with any valid changes made.

File Naming

Select this option to determine if your Vexo instrument should store File Names with saved recordings or not.

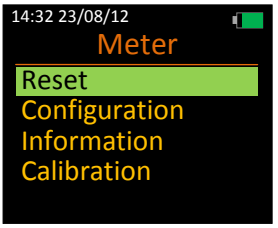
A file name must be entered when ending a recording if this option is turned on.

Use the key to highlight the required option and press to select. The option will be selected and the previous menu screen will be displayed.

Press to return to the previous screen without making a selection.

Meter

Select this option to change operational configuration settings, calibrate your instrument and view system information.

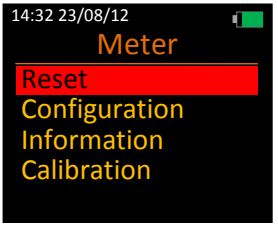


Use the key to highlight the required option and press to select.

Press to return to the previous screen without making a selection.

Reset

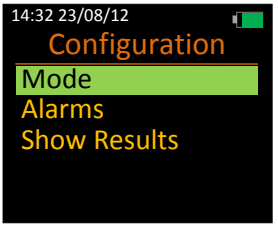
Select this option to reset all measurement parameter values.



The highlight turns red for 3 seconds to indicate that a reset has been performed.

Configuration

Select this option to change operational configuration settings.

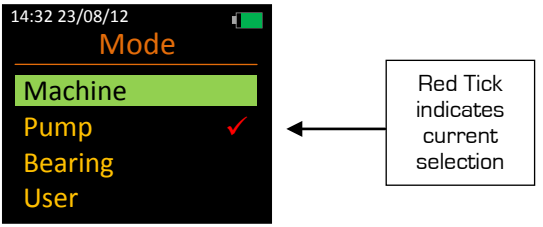


Use the key to highlight the required option and press to select.

Press to return to the previous screen without making a selection.

Mode

Select this option to set the user Mode of your Vexo instrument.

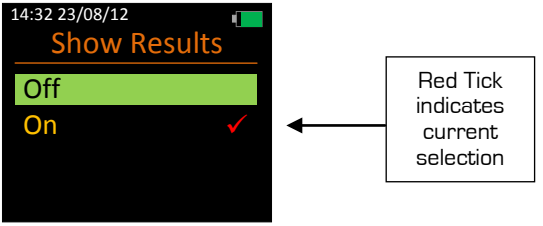


Use the key to highlight the required option and press to select.

Press to return to the previous screen without making a selection.

Show Results

Select this option to determine if your Vexo instrument should display calculated results after ending a recording.

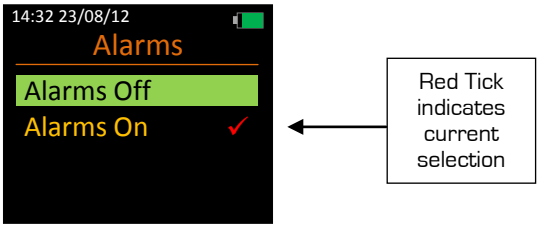


Use the key to highlight the required option and press to select.

Press to return to the previous screen without making a selection.

Alarms

Select this option to determine if your Vexo instrument should display alarm screens after ending a recording.



Use the key to highlight the required option and press to select.

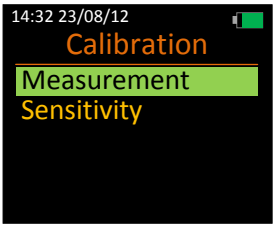
Press to return to the previous screen without making a selection.

Information

Select this option for instrument details.

Calibration

Select this option to calibrate your Vexo instrument using accelerometer sensitivity figures or using a calibrator.

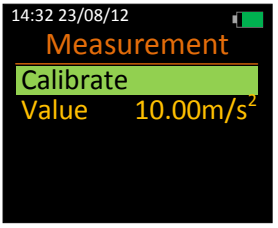


Use the key to highlight the required option and press to select.

Press to return to the previous screen without making a selection.

Measurement

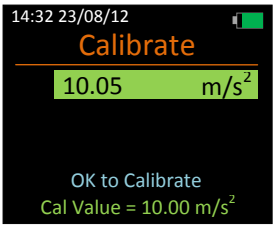
Select this option to choose between calibrating your Vexo instrument using a calibrator and selecting the output level of the calibrator.



Use the key to highlight the required option and press to select.

Press to return to the previous screen without making a selection.

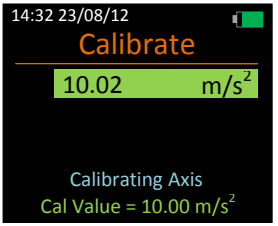
Select this option to calibrate your Vexo instrument using a calibrator.



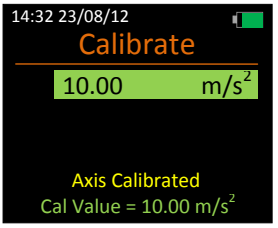
Attach the accelerometer to the calibrator such that the vibration travels through your chosen Axis.

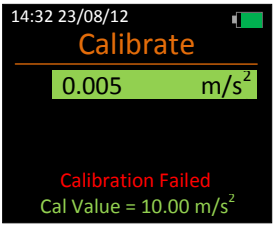
Use the key to highlight the relevant axis and press to select ensuring your calibrator is also switched on.

Calibration takes 15 seconds to complete.



If calibration is successful Axis Calibrated will be shown in Yellow for 5 seconds or if the calibration fails Calibration Failed will be displayed in Red for 5 seconds.





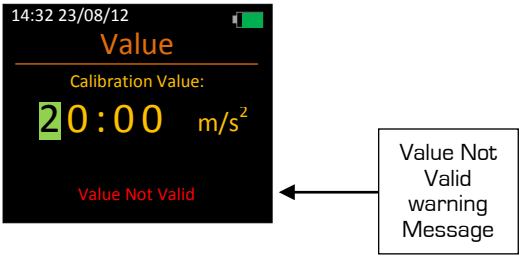
Press to return to the previous screen.

Select this option to change the value that your vibration calibrator outputs in m/s^2.

Use the key to change the value highlighted then press OK to move the highlight to the next position.

Valid levels are between 9.00 and 11.00 m/s^2.

If an invalid value is selected the warning message **Value Not Valid** will be displayed in red.

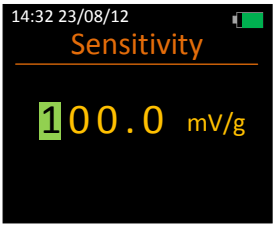


Press to return to the previous screen with any valid changes made.

Select this option to set the sensitivity value for each axis that has been supplied with your accelerometer.

No vibration calibrator is required for this option.

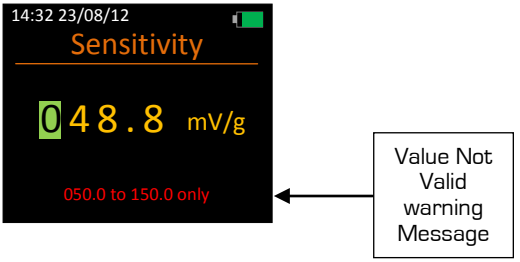
Press to return to the previous screen with any valid changes made.



Use the key to change the value highlighted then press to move the highlight to the next position.

Valid sensitivites are between 50.0 and 150.0 mv/g.

If an invalid value is selected the warning message **050.0 to 150.0 only** will be displayed in red.



Press to return to the previous screen cancelling any changes made.

Chapter 6

Using the Vexo S

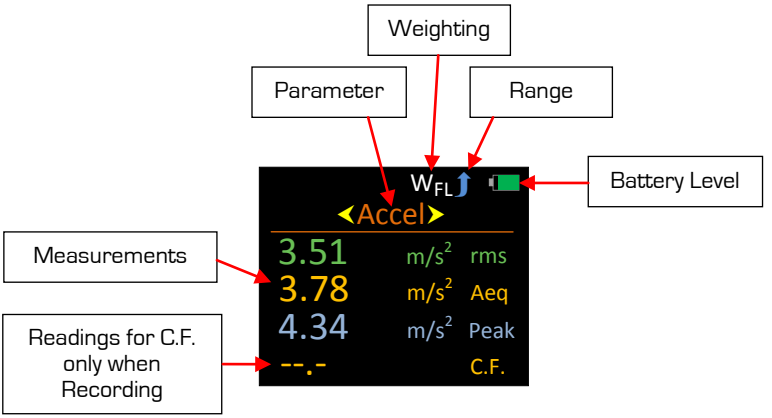
The Vexo S instrument has three states of basic operation: -

- Stop State
- Record State
- Playback

Stop State

This is the default state of the Vexo S instrument and whilst in this state limited calculations are displayed on the instruments screen but no values are recorded in the internal flash memory.

It is only possible to change Settings and undertake Calibration of the instrument whilst in Stop State. Exposure Points are not available when in Stop State.



Use the key to scroll through the available integration methods (Acceleration, Velocity or Displacement). The availability is dependant on the selected Mode of the instrument.

The parameters available in Stop State are: -

- Arms, Vrms, Drms
- Aeq, Veq, Deq
- Peak or Pk-Pk for Displacement

Weighting and the range can be changed through the Main Menu.

To start a recording (Record State) press the key at any time.

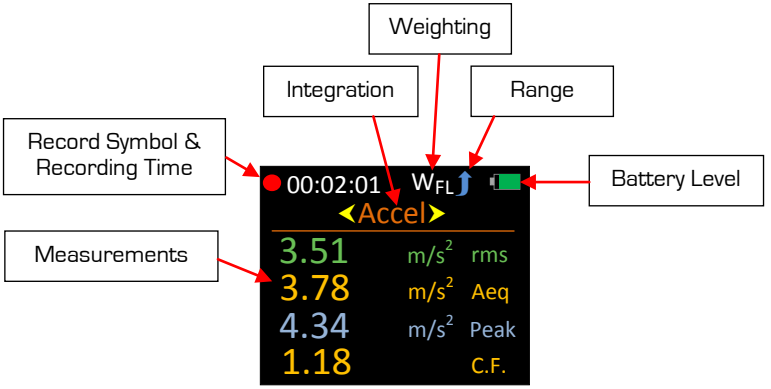
Record State

Whilst the instrument is in the Record State the vibration activity is analysed and all parameters available on your instrument are calculated.

Record State is easily identified by the Record Symbol and the Recording Time in the top left hand corner of the screen.

It is not possible to enter the Menu system or turn the instrument off whilst in Record State.

Only parameters with the integration method selected in Stop State are available and recorded.



The parameters available in Record State are **one** set of the following: -

Acceleration
Arms
Aeq
Peak
Crest Factor

Velocity
Vrms
Veq
Peak
Crest Factor

Displacement
Drms
Deq
Peak to Peak
Crest Factor

To end a recording press the OK key. If File Naming is turned on then you will be prompted to enter a file name. See page 43 for more information.

The data is saved to the internal flash memory. If Show Results or Alarms are turned on, then the instrument will automatically display the relevant parameters.

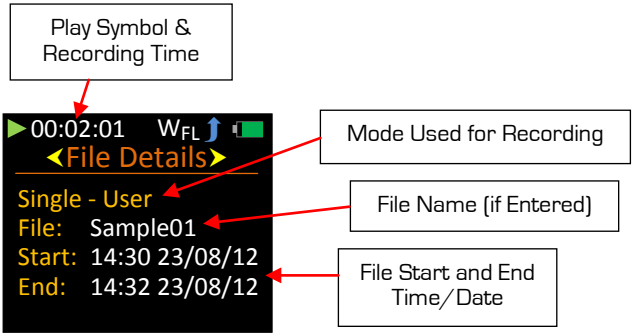
If neither of the above are turned on then the instrument is placed back into Stop State.

Recordings saved on your instrument will not be lost if the battery pack is removed.

Playback

Playback is identified by having a green play symbol in the top left hand corner and is where a recorded file is opened to be viewed on screen.

When Playback is started manually, all parameters are available to view including Exposure Points, even if Exposure Points are turned off.



Scroll through the available parameters using the key.

The parameters / screens available whilst in Playback Mode are (depending on Mode selected): -

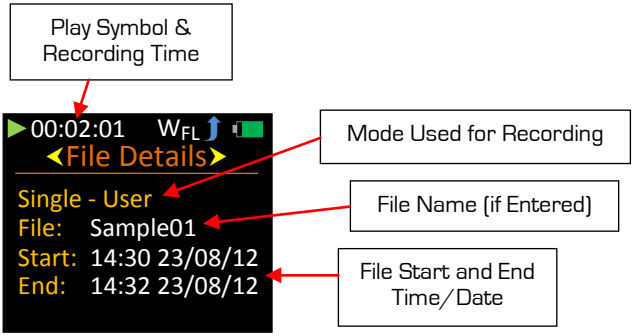
- File Details
- Amax, Vmax, Dmax
- Aeq, Veq, Deq
- Peak or Pk-Pk
- CFmax
- Alarm Screens

Exit Playback by pressing either or and the instrument is placed into Stop State.

Show Results - On

When a recording is stopped and the option Show Results is turned on then the instrument will automatically enter Playback and display the recorded parameters.

Playback is identified by having a green play symbol in the top left hand corner.



Scroll through the available parameters using the key.

The parameters / screens available whilst in Playback Mode are (depending on Mode selected): -

- File Details
- Amax, Vmax, Dmax
- Aeq, Veq, Deq
- Peak or Pk-Pk
- CFmax
- Alarm Screens ← Only Available if Alarms are On

Exit Playback by pressing either or and the instrument is placed into Stop State.

Alarms - On

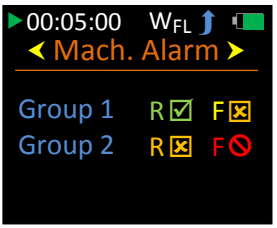
When a recording is stopped and the option Alarms is turned on then the instrument will automatically enter Playback and display the Alarm Screen for the following modes: -

- Machine
- Pump
- Bearing

See **Show Results – On** if Show Results are also turned on.

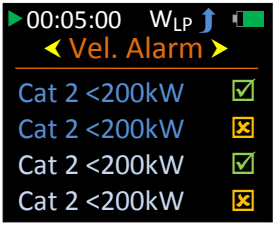
Playback is identified by having a green play symbol in the top left hand corner.

Machine Mode

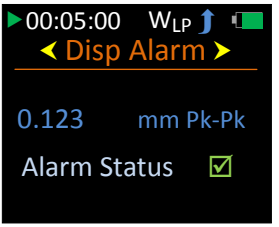


Pump Mode

Integration = Velocity

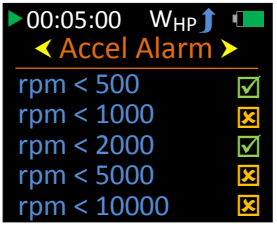


Integration = Displacement

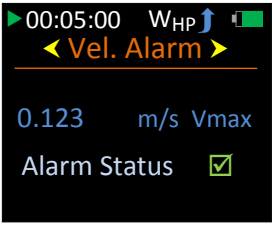


Bearing Mode

Integration = Acceleration



Integration = Velocity



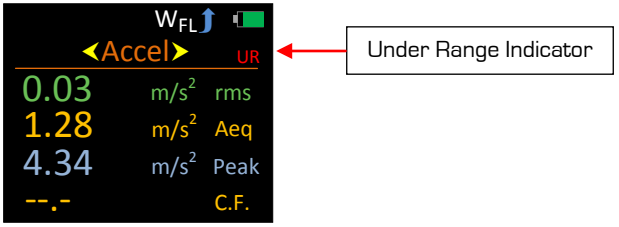
Exit Playback by pressing either or and the instrument is placed into Stop State.

Under Range Indicator

The Vexo S has an Under Range indicator which is visible in Stop State or Record State.

Unlike overload, the under range condition is not saved with the recording and is therefore not available in Playback.

The under range indicator '**UR**' is placed in red under the battery indicator when the condition occurs: -



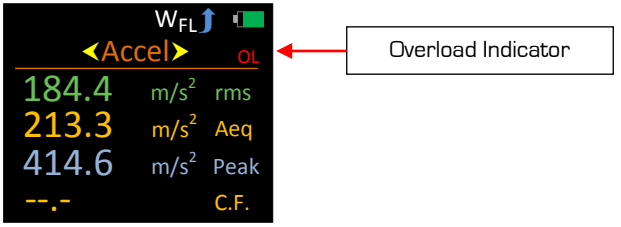
The under range indicator remains on for a minimum of 2 seconds or whilst the under range condition remains.

Overload Indicator

The Vexo S has an Overload indicator which is visible in Stop State, Record State and Playback.

Unlike under range, the overload condition is saved with the recording and is therefore also available in Playback.

The overload indicator '**OL**' is placed in red at the far right of each axis where the condition occurs: -



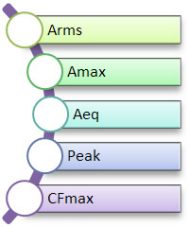
The overload indicator is latched on but it is possible to remove the latched overload indicator during Stop State by selecting Reset under Meter from the Main Menu.

The overload indicator cannot be reset during Record State or Playback.

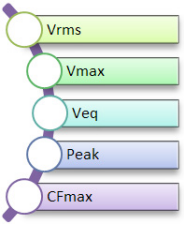
Parameters

The parameters that are recorded and displayed on your Vexo S instrument are as follows: -

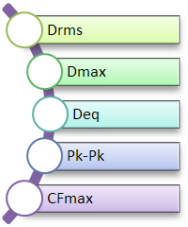
Acceleration



Velocity



Displacement



Note Amax, Vmax and Dmax are only available by downloading files.

Parameters measured as Acceleration are identified as Acceleration with a preceding 'A', Velocity with a preceding 'V' and Displacement with 'D'.

Brief descriptions of each parameter are given below and for full mathematical descriptions see **Chapter 10**, **Function Equations**.

Xrms

The Xrms is the frequency weighted, running RMS (Root Mean Square) acceleration, velocity or displacement value. (where X = A, V or D). Note Xrms is displayed during Record State but Xmax is recorded.

Xeq

The Xeq is the time averaged and frequency weighted acceleration, velocity or displacement value. (where X = A, V or D).

Xmax

The Xmax is the maximum Xrms level reached. (where X = A, V or D).

Peak

Peak is the highest peak level of the frequency weighted instantaneous acceleration or velocity.

Pk-Pk

The Pk-Pk is the highest peak to peak level of the frequency weighted instantaneous displacement.

CFmax

CFmax is the highest Crest Factor reached and is the ratio between the Peak or Peak to Peak and the Xrms value. (where X = A, V or D).

Modes

The Vexo S has the following Modes for different applications: -

- Bearings
- Machine
- Pump
- User

Select the mode by selecting **Meter** then **Configuration** from the menu system.

Bearings

Select this mode for bearing monitoring which allows recording in either Acceleration or Velocity and is fixed to the frequency weighted filter WHP.

Whilst in Stop State use the key to scroll between Acceleration and Velocity, the recording will be based on the selection.

The Bearings Alarm uses three colour coded symbols to instantly show on the display the state of the alarm.

The symbols and associated colour coding are as follows: -

Alarm Symbols and Colour Coding			
OK	**Alert**	**Warning**	**Danger**
☑	☑	☒	⊘

Alarms for Bearing mode are based on the following: -

	Acceleration, Unit = g			
RPM	**OK**	**Alert**	**Warning**	**Danger**
500	0.1	0.2	0.5	1.5
1000	0.2	0.4	1	3
2000	0.4	0.8	2	6
5000	1	2	5	15
10000	2	4	10	30

	Acceleration, Unit = m/s^2			
RPM	**OK**	**Alert**	**Warning**	**Danger**
500	0.98	1.96	4.90	14.70
1000	1.96	3.92	9.80	29.41
2000	3.92	7.84	19.61	58.83
5000	9.80	19.61	49.03	147.09
10000	19.61	39.22	98.06	294.19

	Velocity, Unit = g		
	OK	**Warning**	**Danger**
V_{max} (mm/s)	< 1.0	1.0 – 2.0	> 2.0

Machine

Select this mode for machine monitoring which is fixed to the frequency weighting WFL measuring Velocity.

The Machine Alarm uses three colour coded symbols to instantly show on the display the state of the alarm.

The symbols and associated colour coding are as follows: -

Alarm Symbols and Colour Coding			
OK	Alert	Warning	Danger
☑	☑	☒	⊘

Alarms for Machine mode are based on the following: -

Unit	Group 1		Group 2	
mm/s	Rigid	Flexible	Rigid	Flexible
> 11.0				
7.1 – 11.0				
4.5 – 7.1				
3.5 – 4.5				
2.8 – 3.5				
2.3 – 2.8				
1.4 – 2.3				
0 – 1.4				

Pump

Select this mode for pump monitoring which allows recording in either Velocity or Displacement and is fixed to the frequency weighted filter WLP.

Whilst in Stop State use the key to scroll between Velocity and Displacement, the recording will be based on the selection.

The Pump Alarm uses three colour coded symbols to instantly show on the display the state of the alarm.

The symbols and associated colour coding are as follows: -

Alarm Symbols and Colour Coding			
OK	Alert	Warning	Danger
☑	☑	☒	⊘

Alarms for Pump mode are based on the following: -

Unit	Velocity, Category 1	
mm/s	<200kW	>200kW
> 7.6		
6.6 – 7.6		
5.0 – 6.6		
4.0 – 5.0		
3.5 – 4.0		
2.5 – 3.5		
0 – 2.5		

Unit	Velocity, Category 2	
mm/s	<200kW	>200kW
> 9.5		
8.5 – 9.5		
6.1 – 8.5		
5.1 – 6.1		
4.2 – 5.1		
3.2 – 4.2		
0 – 3.2		

Unit µm (Pk – Pk)	
0 – 50	
50 – 80	
80 – 130	
> 130	

User

Select this mode for general purpose vibration monitoring which allows recording in Acceleration, Velocity or Displacement.

Any of the three available frequency weighting filters can be selected which are: -

- WLP
- WHP
- WFL

Whilst in Stop State use the key to scroll between Acceleration, Velocity and Displacement, the recording will be based on the selection.

No alarm screens are used whilst in User Mode.

Chapter 7

Downloading Saved Recordings to a PC

Using the supplied software VibdataLITE or VibdataPro (available separately) it is possible to download the stored recordings on your meter to your PC allowing the data to be viewed and printed in professional reports.

Communication between a PC and your Vexo meter is made via the USB connector at the top of your instrument. The correct Castle Vexo USB driver will need to be installed on your PC, and is automatically installed whilst installing VibdataLITE.

To ensure data does not become corrupt please ensure that Stop State is selected on the instrument before downloading saved recordings.

1. Ensure the Vexo instrument is **OFF**
2. Connect the Vexo instrument to the PC via the USB lead
3. Switch the Vexo instrument **ON**

Your Vexo instrument is now ready to download data into VibdataPro.

For comprehensive instructions please refer to the VibdataPro user manual.

Chapter 8

Accessories

GA606	Vibration Calibrator
KA010V*	Carry Case for Vexo and Accessories
KD1011*	Single Axis Accelerometer
KD1202	Mounting Studs (Pk 5)
KD1203	High Strength Mag Mount
KD1206*	Removable Spike Probe
KD1215	Glue Studs & Glue (pack of 5)
PC009**	VibdataPro Vibration Analysis Software
01VIBBATT*	2.4V 2100mAh NiMH Battery Pack
01PSU5*	NiMH Battery Pack Recharger
01ZL1065-01	AC Output Cable (1 metre)
01ZL1097-01*	Single Axis Accelermeter Cable (1 metre)
01ZL1108-01*	USB Download Cable (1 metre)

* supplied with the Vexo S
** upgrade from supplied Vibdata LITE

Chapter 9

Technical Specification

Applicable Standards

BS ISO 10816-1 : 1995 + A1 : 2009
BS ISO 10816-3 : 2009
BS ISO 10816-7 : 2009

Noise Floors

Range m/s^2 rms	
Low	**High**
0.002	0.02

Accelerometer

Specification	KD1011
Output Voltage	100mV/g ±20%
Operating Range	±20g
Frequency Response	2 to 10000 Hz ±10%
Resonant Frequency	>22kHz
Weight	115 grams (excluding probe)
Operating Temperature Range	-55°C to 85°C -65°F to 185°F
Electrical Noise Floor	0.003g pk
Transverse Sensitivity	5%
Maximum Shock	5000g pk

Normal Operating Mode

Fitted with Single Axis accelerometer KD1011

Overload & Under Range Triggering Points

Points when calibrated with an accelerometer of sensitivity 100.0mV/g

Acceleration : Metric m/s^2		
RANGE	**UR**	**OL**
LOW	< 0. 05	> 20.0
HIGH	< 0.50	> 200.0

Acceleration : g		
RANGE	**UR**	**OL**
LOW	< 0.0051	> 2.04
HIGH	< 0.051	> 20.4

Velocity : Metric mm/s		
RANGE	**UR**	**OL**
LOW	< 0.6	> 250.0
HIGH	< 6.0	> 2500

Displacement : Metric µm		
RANGE	**UR**	**OL**
LOW	< 40.0	> 16500
HIGH	< 400.0	> 165000

Level Ranges

Acceleration : Metric	
LOW	0.005 – 20.0 m/s^2
HIGH	0.05 – 200.0 m/s^2

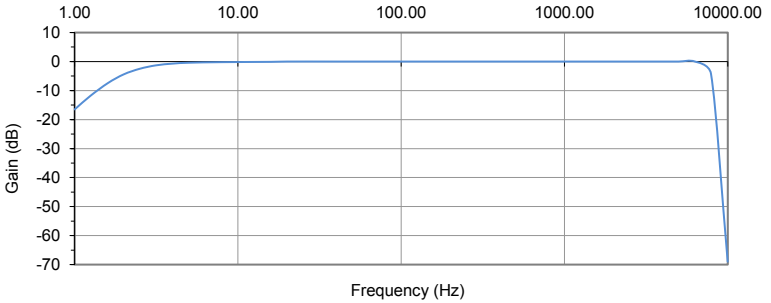
Acceleration : g	
LOW	0.00051 – 2.04g
HIGH	0.0051 – 20.4g

Velocity : Metric	
LOW	0.06 – 250 mm/s
HIGH	0.6 – 2500 mm/s

Displacement : Metric	
LOW	4.0 – 16500 µm
HIGH	40.0 – 165000 µm

W_{FL} : Flat Response

Filter Frequency Response: -



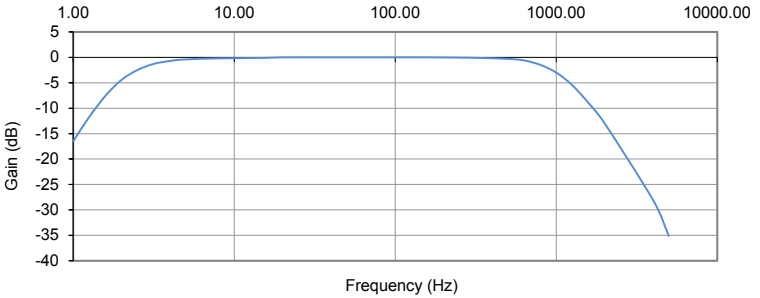
Deviations re 160Hz in dB and tolerances required for a typical Vexo S instrument: -

Frequency (Hz)	W_{FL}	Tolerance
1	-16.5	±1.5
1.25	-11.8	±1.5
1.6	-7.4	±1.5
2	-4.4	±1.5
2.5	-2.5	±1.5
3.15	-1.3	±1.5
4	-0.7	±1.5
5	-0.4	±1.5
8	-0.2	±1.5
16	-0.1	±1.5
20	0.0	±1.5
40	0.0	±1.5
80	0.0	±1.5
160	0.0 REF	±1.5

Frequency (Hz)	W_{FL}	Tolerance
315	0.0	±1.5
500	0.0	±1.5
630	0.0	±1.5
800	0.0	±1.5
1000	0.0	±1.5
1250	0.0	±1.5
1600	0.0	±1.5
2000	0.0	±1.5
4000	0.0	±1.5
5000	0.0	±1.5
6300	0.0	±1.5
7900	-4.2	±1.5
10000	-69.0	±1.5

W_{LP} : Low Pass Response

Filter Frequency Response: -



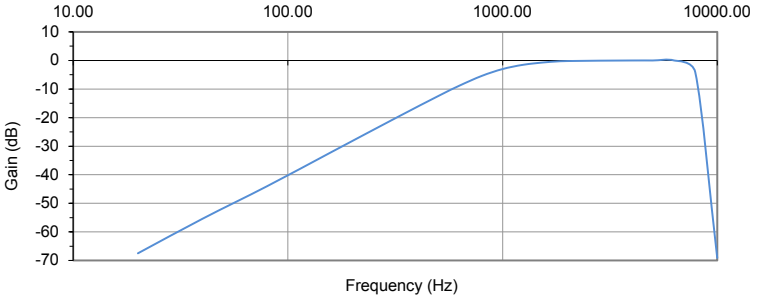
Deviations re 160Hz in dB and tolerances required for a typical Vexo S instrument: -

Frequency (Hz)	W_{LP}	Tolerance
1	-16.5	±1.5
1.25	-11.8	±1.5
1.6	-7.4	±1.5
2	-4.4	±1.5
2.5	-2.5	±1.5
3.15	-1.3	±1.5
4	-0.7	±1.5
5	-0.3	±1.5
8	-0.1	±1.5
16	0.0	±1.5
20	0.0	±1.5
40	0.0	±1.5

Frequency (Hz)	W_{LP}	Tolerance
80	0.0	±1.5
160	0.0 REF	±1.5
315	-0.1	±1.5
500	-0.3	±1.5
630	-0.6	±1.5
800	-1.5	±1.5
1000	-3.0	±1.5
1250	-5.4	±1.5
1600	-9.1	±1.5
2000	-13.0	±1.5
4000	-28.1	±1.5
5000	-35.1	±1.5

W_{HP} : Low Pass Response

Filter Frequency Response: -



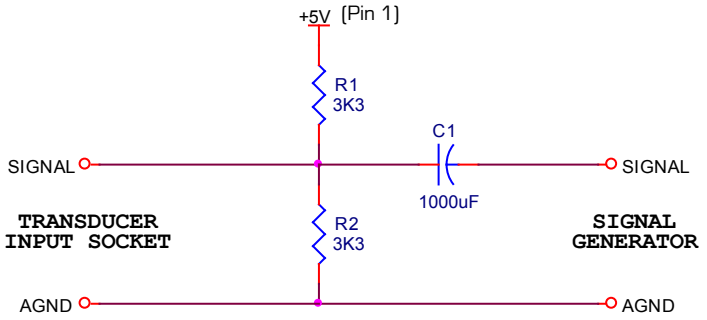
Deviations re 4kHz in dB and tolerances required for a typical Vexo S instrument: -

Frequency (Hz)	W_{HP}	Tolerance
20	-67.5	±1.5
40	-55.4	±1.5
80	-44.0	±1.5
160	-32.0	±1.5
315	-20.3	±1.5
500	-12.5	±1.5
630	-8.8	±1.5
800	-5.4	±1.5
1000	-3.0	±1.5
1250	-1.5	±1.5
1600	-0.6	±1.5
2000	-0.2	±1.5
4000	0.0_{REF}	±1.5
5000	0.0	±1.5
6300	0.0	±1.5
7900	-4.1	±1.5
10000	-69.1	±1.5

Electrical Signal Input

Electrical signals at frequencies >2Hz can be applied to the Vexo S instruments by interfacing a suitable signal generator with an output impedance of 600Ω to the Input Socket.

Each individual axis shall be subject to the following circuitry, (see Signal Wiring).



Maximum Electrical Signal Input For No Damage

5 Volts (Peak to Peak)

Environmental Stabilization Time

30 minutes

Warm up Time

≤ 2 minutes

Settling Time

It is recommended that a calculation settling period of ≥30 seconds is allowed for in any recording.

Temperature Operating Range

-10°C to +50°C

Effect of Air Temperature

Accuracy better than ±5% over the range -10°C to +50°C

Effect of Surface Temperature

Accuracy better than ±4% over the range -10°C to +50°C

Real Time Clock

Day, Month, Year, Hour, Minute and Seconds at ±2ppm accuracy per day

Digital Signal Processing

Direct processing using digital recursive filters (infinite impulse response)

Analogue to Digital Converter & Microcontroller

ADC: Word Length: 24 bits, Sampling Rate: 16kHz

Processor Operating Frequency: 25MHz (max.)

Display

OLED Module (160x128 pixels) with 262,144 colours

Refresh Rate ≤ 500mS

Displayed parameter at each update interval is the value at the time of the update interval.

Memory

2Mb On-board FLASH allowing up to 992 recordings to be saved.

Overload

Positive overload warning when the input circuit saturates.

Size and Weight

Dimensions: (H):117mm (without Cable) x (W) :78mm x (D): 24mm

Weight: 182g approximately (including batteries)

Connections

Download

USB 1.0 or 2.0 compatible.

Wiring Configuration - Micro USB 'B' Socket

Download	
Pin Number	Description
1	Vcc
2	D-
3	D+
4	Not Connected
5	Ground

Battery Recharge

Powered from a nominal AC supply using Mascot 2116, 2 cell battery charger

Centre Terminal: 0V

Outer Terminal: +V

Batteries

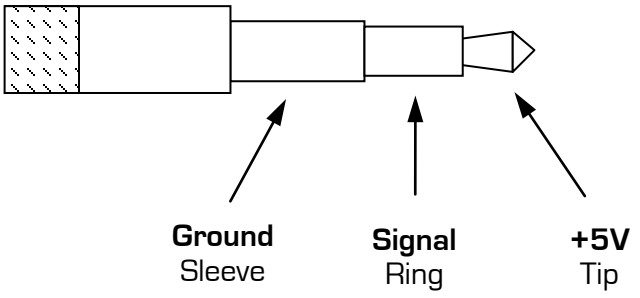
Real Time Clock:	CR1220 Lithium Battery (Factory Fitted)
Life Expectancy:	Approximately 2 years
Main:	2100mAh NiMH Battery Pack
Life Expectancy:	10 hours continuous use (approx.)
Min Battery Level:	1.8V DC

Input Signal

Wiring Configuration – 3 Pole Jack Socket 3.5mm

Input		
Pin Number Socket (3.5mm)	Description	Mating Plug (3.5mm)
1	+5V	Tip
2	GND	Sleeve
3	Signal	Ring

Mating Plug Diagram: -



EC Declaration of Conformity

The CE marking of the Castle Vexo Vibration Meter indicates compliance with the EMC and Low Voltage Directive.

The C-Tick marking of the Castle Vexo Vibration Meter indicates compliance with EMC requirements for Australia and New Zealand.

We, Castle Group Ltd declare that the: -

- *Vexo H and Vexo S range of Vibration Meters*

have in accordance with the following Electromagnetic Compatibility Directives: -

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

been designed and manufactured to meet the following tests: -

• *EMC Emissions:*	*EC 61000-6-3:2007+A1:2011* *EN61326-1:2006* *CISPR 22:2008* *EN55022:2006+A1:2007* *FCC Rules, Part 15 2003 Class B*
• *EMC Immunity:*	*IEC 61000-6-2:2005* *EN61326-1:2006* *Levels: ±4kV(Contact) , ±8kV(Air)*
• *RF EM Amplitude Mod:*	*IEC 61000-6-2:2005* *Level 10 V/m*

No performance or function degradation is noticeable whilst subject to electrostatic discharge or a.c power frequency and radio frequency fields under any operating condition with the meter and no differences in radio frequency emissions are apparent between operating modes where appropriate.

Approved cables for use with Castle Vexo meters to comply with these specifications: -

Cable	Order Code	Length
Vexo to PC (USB)	01ZL1108-01	1m

The technical file for the above is maintained at Castle Headquarters.

I 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.

Simon Bull
Managing Director
Castle Group Ltd, Salter Road, Scarborough, North Yorkshire, YO11 3UZ
August 2012

Chapter 10

Function Equations

The following table describes mathematically how the functions available on the Vexo Vibration Meter are calculated. All calculations displayed are subject to rounding and/or truncation.

Function	Equation
Acceleration (Metric)	$Aeq := \sqrt{\frac{1}{T} \cdot \int_0^T (a_w)^2 \cdot (ta)\, d(ta)} \quad (ms^{-2})$ T = total integration time (seconds) $a_w(ta)$ = instantaneous acceleration value (ta) = time (seconds)
Acceleration (g)	$Aeq := \frac{1}{9.807} \cdot \sqrt{\frac{1}{T} \cdot \int_0^T (a_w)^2 \cdot (ta)\, d(ta)} \quad (g)$ T = total integration time (seconds) $a_w(ta)$ = instantaneous acceleration value (ta) = time (seconds)
Running rms Acceleration (Metric)	$Arms := \sqrt{\frac{1}{\theta} \cdot \int_{t-\theta}^t (a_w)^2 (ta)\, d(ta)} \quad (ms^{-2})$ t = instantaneous time (seconds) θ = integration time of the measurement (1 second) $a_w(ta)$ = instantaneous acceleration value (ta) = time (seconds)
Running rms Acceleration (g)	$Arms := \frac{1}{9.807} \cdot \sqrt{\frac{1}{\theta} \cdot \int_{t-\theta}^t (a_w)^2 (ta)\, d(ta)} \quad (g)$ t = instantaneous time (seconds) θ = integration time of the measurement (1second) $a_w(ta)$ = instantaneous acceleration value (ta) = time (seconds)

Function	Equation
Velocity (Metric) If 'g' is selected as the unit, Velocity is still displayed in Metric	$Veq := \int \left[\sqrt{\frac{1}{T} \cdot \int_0^T (a_w)^2 \cdot (ta)\, d(ta)} \right] d(tv) \cdot 10^3 \quad (mm/s)$ T = total integration time (seconds) $a_w(ta)$ = instantaneous acceleration value (ta), (tv) = time (seconds)
Displacement (Metric) If 'g' is selected as the unit, Displacement is still displayed in Metric	$Deq := \int \int \left[\sqrt{\frac{1}{T} \cdot \int_0^T (a_w)^2 \cdot (ta)\, d(ta)} \right] d(tv)\, d(td) \cdot 10^6 \quad (\mu m)$ T = total integration time (seconds) $a_w(ta)$ = instantaneous acceleration value (ta), (tv), (td) = time (seconds)
Running rms Velocity (Metric) If 'g' is selected as the unit, Velocity is still displayed in Metric	$Vrms := \int \left[\sqrt{\frac{1}{\theta} \cdot \int_{t-\theta}^{t} (a_w)^2 (ta)\, d(ta)} \right] d(tv) \cdot 10^3 \quad (mm/s)$ t = instantaneous time (seconds) θ = integration time of the measurement (1 second) $a_w(ta)$ = instantaneous acceleration value (ta), (tv) = time (seconds)
Running rms Displacement (Metric) If 'g' is selected as the unit, Velocity is still displayed in Metric	$Drms := \int \int \left[\sqrt{\frac{1}{\theta} \cdot \int_{t-\theta}^{t} (a_w)^2 (ta)\, d(ta)} \right] d(tv)\, d(td) \cdot 10^6 \quad (\mu m)$ t = instantaneous time (seconds) θ = integration time of the measurement (1 second) $a_w(ta)$ = instantaneous acceleration value (ta), (tv), (td) = time (seconds)

Function	Equation
Peak	Peak = The maximum peak level of the weighted instantaneous acceleration or velocity over the measurement period
Peak to Peak	Pk – Pk = The maximum peak to peak level of the weighted instantaneous displacement over the measurement period
Maximum rms Level (Acceleration)	Amax = The maximum Arms level reached over the measurement period
Maximum rms Level (Velocity)	Vmax = The maximum Vrms level reached over the measurement period
Maximum rms Level (Displacement)	Dmax = The maximum Drms level reached over the measurement period
Crest Factor (Acceleration)	$CF := \frac{Peak}{Aeq}$ Peak = The running highest peak level of the weighted instantaneous acceleration achieved over the measurement period Aeq = The running acceleration value over the measurement period
Crest Factor (Velocity)	$CF := \frac{Peak}{Veq}$ Peak = The running highest peak level of the weighted instantaneous velocity achieved over the measurement period Veq = The running velocity value over the measurement period
Crest Factor (Displacement)	$CF := \frac{PkPk}{Deq}$ PkPk = The running highest peak to peak level of the weighted instantaneous displacement achieved over the measurement period Deq = The running displacement value over the measurement period

Chapter 11

Customer Instrument Support

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 unlikely event of a fault occurring with your product during the warranty period, the instrument should be returned in its original packaging to Castle Group Ltd or to an authorised agent. Please enclose a clear description of the fault to ensure your instrument is dealt with as quickly as possible.

Any misuse or unauthorised repairs will invalidate your warranty.

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

Details of the warranty cover are available upon request from Castle Group Ltd or your authorised agent.

All instruments designed and manufactured by Castle Group Ltd adhere to strict British and International standards. To ensure your instrument remains compliant with these standards it is highly recommended that your instrument is returned annually for calibration.

Annual calibration is particularly important for cases in which instrument readings are to be used in litigation or compliance work.

For warranty or service please return your instrument to: -

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

Question	Answer
The instrument will not power on.	Recharge or replace the battery pack.
The Instrument is not responding on all or individual axis to inputted vibration levels.	Turn the instrument Off, wait 10 seconds to allow the instrument to reset and then turn back On.
	Check the cable for possible damage or incorrect attachment to the transducer or instrument.
The instrument is displaying unexpected readings in one or more modes of operation.	Are the sensitivity values entered correctly?
	Ensure the transducer is fitted securely to the source of vibration.
	Ensure cable is securely fastened.
The overload indicator is permanently on.	Change to a higher range.
The overload indicator comes on before the top of the range is reached.	The overload indicator will also be shown if the input amplifier is saturated. This is possible even if the displayed vibration reading on your instrument is below the top of the selected range because of the applied frequency weighting filter.

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 responsibility 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.

Instrument Details

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

Instrument

Instrument Serial Number

Transducer Serial Number

Software Version Number

Purchase Date

Index

A

Acceleration 15
Accelerometer
  Fitting 16
  Removing 16
  Sensitivity 50
  Specifications 15, 67
  Type 15
Accessories 66
Alarms 46, 55
  Bearing Mode 55
  Machine Mode 55
  Pump Mode 55
Analysis 23
Auto Dim 41
Axial Vibration 20

B

Battery
  Indicator 29
  Pack 75
  Recharging 30
Battery Indicator 29
Battery Pack 75
Brightness 41

C

Calibration 47
  Calibrate 48
  Measurement 47
  Value 49
Condition Monitoring 17
Configuration 45
Connections 74
Correction 23
Customer Support 80

D

Date 43

Delete
All Files 39
Single File 38
Detection 22
Disclaimer 82
Download Recordings 65

E

EC Declaration 76
Electrical Noise 67

F

File Naming 43
Files 35
Playback 53
Frequency Weighitng 40
Frequency Weighted Filters 69
Frequency Weightings 69
Function Equations 77

G

General 42
Getting Started 25
Keypad Layout 27

I

Indicator
Overload 57
Under Range 56
Information 46
Input
Electrical Signal 72
Maximum Electrical Input Level 72
Wiring Configuration 74
Instrument Details 82
Introduction 14

K

Keypad Layout 27

L

Level Ranges 68

M

Machinery Vibration Introduction 17
Measuring Ranges 68
Memory 73
Menu
  Options 34
    Files 35
      Delete All Files 39
      Delete Single File 38
      Open 7 Days 37
      Open All 35
      Open Today's 36
    Meter 44
    Range 34
    Settings 40
      Brightness 41
      Frequency Weighting 40
      General 42
        Date 43
        File Naming 43
        Time 42
      Meter
        Calibration 47
          Calibrate 48
          Measurement 47
        Configuration 45
          Alarms 46
          Mode 45
          Show Results 45
        Information 46
        Reset 44
      Units 40
  Structure 32
Menu Options 34
  Alarms 46
  Brightness 41
  Calibrate 48
  Calibration 47
  Configuration 45
  Date 43
  File Naming 43
  Files 35

Frequency Weighting 40
General 42
Information 46
Measurement 47
Meter 44
Mode 45
Range 34
Reset 44
Settings 40
Show Results 45
Time 42
Units 40
Menu Structure 32
Meter 44
Mode 45

N

Noise Floor 67

O

On / Off Key
Location 27
Using 31, 34
Open
7 Days 37
All 35
Playback 53
Today's 36
Overload 24, 57, 68, 74

P

Parameters 58, 59, 61, 62, 64
Playback 53
Power
Battery Pack 75
Powering Your Vexo Meter 28
Predictive Maintenance Program 22

R

Radial Vibration 20
Range 34
Ranges 68
Recharging the Battery Pack 30

Record State 52
Reset 44

S

Sensitivity 50
Settings 40
Settling Time 72
Show Results 45, 54
Stabilization Time 72
Standards 67
Stop State 51
Switching Your Vexo Meter Off 31
Switching Your Vexo Meter On 31

T

Technical Specification 67
Temperature Operating Range 72
Time 42
  Settling 72
  Stabilization 72
  Warm Up 72
Transducer Mounting
  Single Axis 18
Turn Off 31
Turn On 31

U

Under Range 24, 56, 68
Units 40
Using the Vexo S 51

V

Velocity 15
Vexo USB Drivers 65
VibdataLITE 65
Vibration
  Axial Vibration 20
  Measuring 17
  Radial Vibration 20

W

Warm Up Time 72
Warranty 80