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vbSeries

Instrument Reference Guide

Revision 13/10/06

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Section 1: Introduction

This Instrument Reference Guide is the companion manual to the Ascent Software Reference Guide. This book has been formatted to allow you to quickly and easily learn how to use your vb instrument. Please keep this book for future reference and read it before operating your vb instrument.

If you any have questions not answered by this manual or would like to make a suggestion, please contact us at our website, www.commtest.com.

Note: Although this document makes use of common vibration analysis concepts, it is not intended as a comprehensive guide or training manual. Please ensure you have the relevant knowledge and experience to carry out the procedures described. It is essential to follow all appropriate safety precautions when working near rotating machinery.

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Standard Features

- DSP for fast, accurate calculations
- 24-bit A/D converter providing high-precision measurements
- Displacement, velocity, and acceleration measurements
- Frequency and time domain measurements
- 8.5 MB non-volatile memory capable of storing up to 8192 recordings (32 MB for vb3000)
- Time and date stamped recordings
- PROFLASH upgradable vb firmware
- Temperature compensated graphical LCD (Liquid Crystal Display) with 240 x 128 pixels and electroluminescent LCD backlight
- 1500 mAh Ni-Cad (Nickel-Cadmium) battery pack
- Battery charger and conditioner
- RS232 interface to communicate with your PC
- Ascent Windows-based Vibration Analysis Software with exception reporting, data trending, alarm bands, orders display, fault frequency analysis, harmonic and sideband cursors, true peak approximation, notes, photographic image attachments and multiple chart modes
- Tachometer input for speed and phase measurements
- Balancing analysis: single in vb1000 and single or dual plane in vb2000 and vb3000 only
- Route and off-route recording modes

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Standard Kit Items

- Protective boot with strap
- Power transformer (13.5 ± 1.5) V DC, 1 A output
- DC car adapter 12 V DC output
- USB Ascent security dongle (parallel dongle available on request)
- USB to serial adapter
- Data-transfer cable
- Accelerometer ICP® type
  (1 x for vb1000/vb1000v, 2 x for vb2000/vb3000)
- Accelerometer coiled cable
  (1 x for vb1000/vb1000v, 2 x for vb2000/vb3000)
- Accelerometer magnetic mounting base
  (1 x for vb1000/vb1000v, 2 x for vb2000/vb3000)
- Ascent Vibration Analysis Software on CD-ROM
- Instrument Reference Guide
- Software Reference Guide
- Quick Start Guide
- Warranty card
- QA card
- Carry bag

Included with vb1000v

- Reflective tape
- Non-contact tachometer sensor
- Adjustable tachometer stand with magnetic mount
- Tachometer extension cable (2 meters)

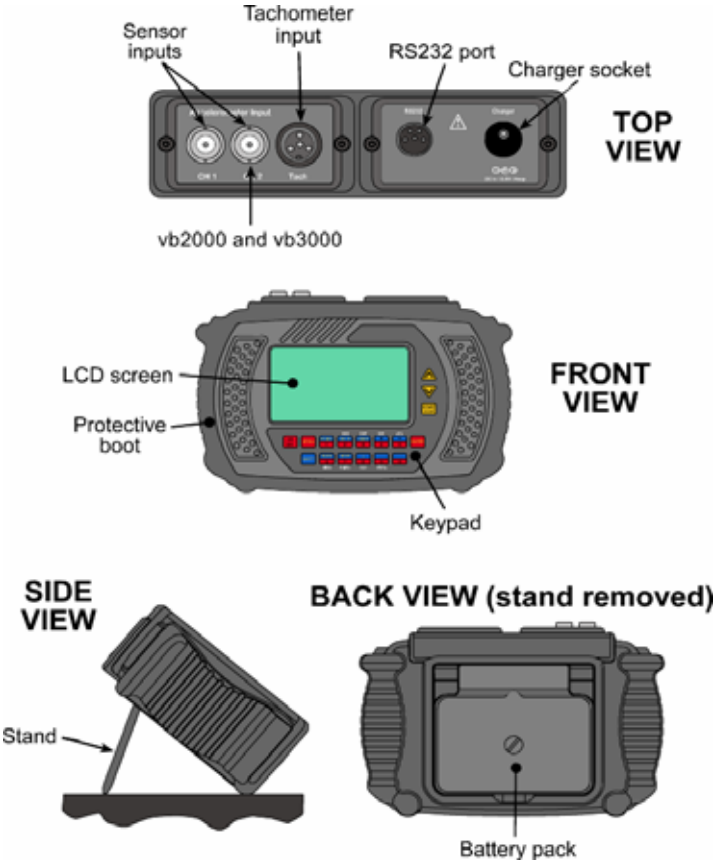
Balancing Kit Items

Included with vb1000, vb2000 and vb3000

- Reflective tape
- Non-contact tachometer sensor
- Adjustable tachometer stand with magnetic mount
- Tachometer extension cable (2 meters)
- Accelerometer straight cable (5 meters) x 2
- Carry bag

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Summary of Parts



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Instrument Icons


The instrument is in spectra recording mode.


The instrument is in spectra review mode.


The instrument is in route mode.


The instrument is waiting for the hardware to stabilize before taking a measurement.


There is a note attached to this item.


This item is tagged.


Only some items have been tagged on this machine, point or direction/axis.


Indicates this item is part of a route.


Only some items have been selected for a route on this machine, point, or direction/axis.


One or more recordings have been taken within this machine, point, or direction/axis.


This machine structure has been defined (name, point, direction/axis and parameter set), but no recordings have been taken.


The instrument is communicating with a PC through the Ascent software.


This machine has balancing data saved with it.


A delta symbol used to show the frequency or time difference between two peaks of a spectrum.


Indicates that the circumference arc of the rotor is being used as a weight position reference for balancing.


Indicates that a fixed number of attachment points are being used as a weight position reference for balancing.


Indicates that degrees are being used as a weight position reference for balancing.


The halt after recording 'relaxed' baseline warning is active.


The halt after recording 'tight' baseline warning is active.


This parameter set is used with a keypad schedule entry.


The battery is running low and needs charging.

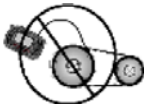
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Precautions

Please read and understand this section before operating your instrument. Heed all warnings and recommendations to prevent data loss, data inaccuracy, damage to the instrument, or injury to yourself.



Do not attach sensors to any object with a high potential voltage i.e. a voltage that exceeds 50 V DC or 32 V AC or the 'safety extra low voltage' (SELV) defined by your local power authority.



Ensure the cables and bootstrap cannot become entangled with any rotating or moving machinery.



Do not bring any objects sensitive to magnetic fields (e.g. cardiac pacemakers, credit cards, floppy disks, video tapes, audio cassette tapes, mechanical watches) near the magnetic mounting bases.



Do not operate the instrument in an explosive environment.



Charge the battery pack up to at least 30% capacity before taking a recording. If using the instrument for 4 hours or more, first ensure that the battery pack is fully charged.

Constantly charging the battery when it is not fully drained will create a 'Memory' effect and eventually shorten the amount of charge that the battery can hold.



Do not detach the battery pack from the instrument for more than 2 hours as data and settings may be lost from the instrument.

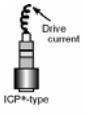


Ensure that the battery pack is securely fastened (but not over-tightened) to the instrument before operating.

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Transfer data stored in the instrument to a PC before reprogramming the instrument. PROFLASHING the instrument instrument with new firmware may erase all data stored in the instrument.



When using an ICP® type accelerometer, ensure that the drive current is turned on otherwise the measurements will be incorrect.



Mount the sensor properly before taking measurements or recordings. Otherwise, the data will be incorrect and/or inconsistent.



To clean the instrument use a mild detergent diluted in warm water. Do not use abrasive or polishing substances, hydrocarbons, petrochemicals or solvents as they degrade the plastic.



Do not place the vb instrument or the magnetic mounting base in a hot place where the temperature exceeds 140 °F (60 °C). Otherwise, the battery pack or magnet will degrade.



Although the instrument has a rugged construction, do not expose it to wet conditions or store it in a damp place where the relative humidity exceeds 95%.



If the instrument malfunctions, return it to an authorized dealer. Do not attempt to repair the instrument yourself, as this will invalidate the warranty.



Use only an approved instrument power transformer 13.5 V ± 1.5 V DC, 1 A output, center positive) and ensure its voltage and frequency rating matches that of your mains AC power.

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Operating Overview

The instrument can be used to perform the following tasks:

- Taking live measurements for onsite analysis of vibration spectra and waveforms
- Recording of vibration data for transferral to a PC
- Single and dual plane balancing

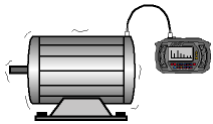
Onsite Analysis (Measure Mode)

Vibration spectra and waveforms are measured and analyzed onsite. This is suitable for one-off investigations and involves these steps:

- Measurement parameters are set on the instrument.

  Domain = frequency
  Spectral lines = 1600
  f max = 1000Hz
  ... etc.

- The spectrum or waveform is measured and analyzed onsite.



- The data is recorded to memory (optional).



- The data is transferred to a PC for further analysis (optional).



See Onsite Analysis (page 28) for more information.

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Recording

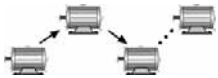
Vibration recordings are taken for all monitored machines and then transferred to a PC for analysis.

The instrument guides the person taking the recordings through a pre-defined data recording sequence. This is to simplify the task and minimize mistakes. The data recording sequence is contained in a recording 'route'. A recording route is created on a PC then transferred to the instrument (see the Ascent *Software Reference Guide*, for instructions). The use of recording routes is particularly useful if a large number of machines are routinely monitored. The following steps are involved:

- A recording route is created on a PC then transferred to the instrument...



- Data for each item on the recording route is sequentially collected, guided by the instrument.



- The collected data is then transferred to a PC for analysis.



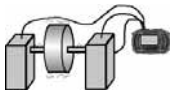
See Recording Data (page 81) and Using Routes (page 89) for more information.

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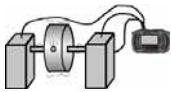
Balancing

Rotating mass imbalance problems are analyzed and corrected onsite. A rigid rotor can be balanced in one or two planes. The following steps are involved:

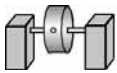
- An initial measurement of the imbalance is taken.



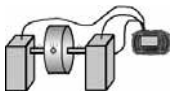
- A trial weight is attached to the balancing plane and another measurement is taken. For dual plane balancing, the same is done for the second plane also.



- Correction weights are attached to the balancing planes as recommended by the instrument.



- A measurement is taken in each plane to confirm that the rotor is balanced. Any residual imbalance can be removed via trim balancing.



See Balancing Rotors (page 123) and Balancing Walk-through (page 145) for more information.

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Section 2: Basic Operation

This section describes how to perform basic operations on your instrument.

You will learn to:

- Power up the instrument
- Navigate through initial screens
- Select an option
- Display and use pop-up menus
- Enter and edit text and numbers
- Record and review numeric data
- Set up sensors

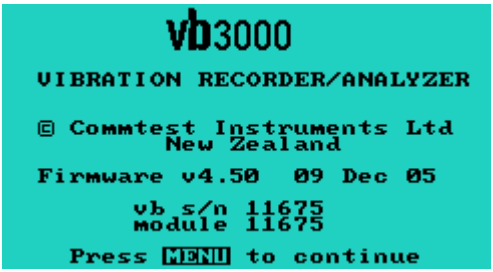
Caution: Read Precautions (page 6) before operating your instrument.

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Powering Up

- Press the ON OFF key to power up the instrument or turn it off.

The following screen is displayed at power up.



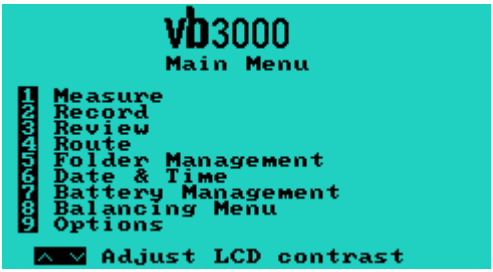
The displayed firmware version and creation date will reflect the currently installed firmware in your instrument. Updated firmware versions can be downloaded from www.commtest.com.

- To continue to the Main Menu press MENU

Main Menu

The Main Menu provides access to the instrument's main operational tasks.

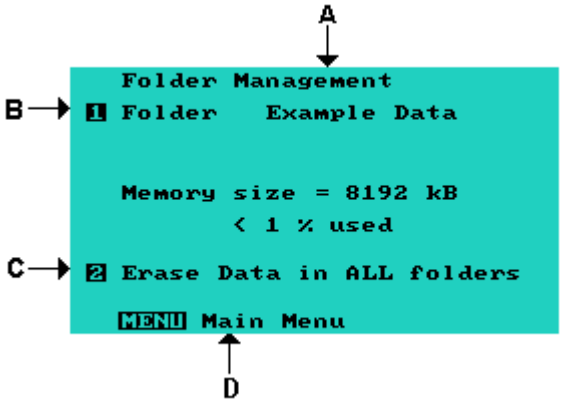
- To access this menu press MENU twice (from most screens).



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Menu Navigation

Most screens found on the instrument follow a standard format, making menu navigation easy and intuitive. The following diagram shows the components of a typical screen:



A The menu title is displayed at the top of each screen.

B The name of the currently selected folder/route/machine etc is displayed.

C Navigation of all menus is accomplished by pressing the key corresponding to the number or word beside the menu item e.g. pressing HELP 2 will display the Erase Data Menu.

D Pressing the MENU key will either open the Main Menu, return you to the previous screen or display a pop-up menu (depending on your current location). Key prompts are displayed at the bottom of each screen as needed.

Pressing and holding down the SHIFT key together with a number key will access the function labeled on the **upper** command of that key e.g. pressing SHIFT + LIGHT 3 allows you to toggle the LCD backlight on and off.

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Returning to a Previous Screen

- From most menus, press SHIFT + BACK 6 to return to the previous screen.

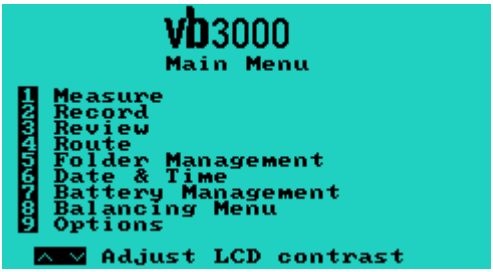
Pressing the MENU key will also normally return you to the previous screen (or the Main Menu depending on your current location).

Selecting an Option

- Press the numbered key that corresponds to the option you want.

Example:

- Press RESET 1 to select the Measure option from the Main Menu.



You may need to press ^ or v to highlight an option and then press ENTER to select the option.

Example:
To select a frequency maximum of 1000 Hz:

- Press v to scroll down and highlight this option.



- Press ENTER to select this option.

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Displaying Pop-up Menus

- Wherever MENU··· appears at the bottom of the screen, you can press MENU to display a pop-up list of all the available options for the current menu.

In the following example, pressing MENU in the Select Machine Menu displays these options:

1 Tag (tag or untag this machine)
2 Edit (change the name of the machine)
3 Notes (add, view or erase notes)
4 Route (make this machine part of a route)
5 Erase (delete this machine and its recordings from memory)
6 Copy (create a copy of this machine)



The number beside each menu item indicates a key that must be pressed to perform that function e.g. pressing BACK 6 will copy the currently selected machine.

These functions can all be accessed *directly* e.g. with the Select Machine Menu displayed, pressing BACK 6 will copy the currently selected machine without having to display the pop-up menu. The pop-up menus are used as a reminder of commonly used functions so that you do not have to memorize the number key for each function.

- The pop-up menu will disappear automatically within a few seconds or you can cancel it by pressing ENTER
- To keep the pop-up menu on screen, hold down MENU

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Entering Text and Numbers

To enter text or numbers press the corresponding number/character key. As with a mobile phone, the character options for each key are displayed with subsequent key presses (e.g. the first press of the '3' key displays '3', the second press displays 'D', the next press displays 'E' etc). The cursor will advance automatically after a short pause so that the next character can be entered.



Names can be up to 16 characters long in upper or lower case. To enter or edit names:

- Press the key that has the required characters displayed above it until the correct character appears above the flashing cursor.

Example:
To enter the word FAN

- Press LIGHT 3 four times until the F displays.



The cursor advances automatically after a short pause.

- To enter the letter A, press HELP 2 twice until the A displays.



- Press BACK 6 three times to display an N.



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- Press > 0 twice to enter a space between words if required.
- Press ENTER to save when you have finished entering or editing your text.

Entering Numerical Values

To enter numerical values press the appropriate number key. It is not necessary to enter decimal points as they are placed automatically.

Example:
To enter the value 7.5

- Press NEXT 7 > 0.07
- Press — 5 > 0.75
- Press > 0 > 7.50
- To clear an incorrect entry press > 0 until the value is reset to zero.

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Other Name Editing Commands

MENU — Cancels the current edit screen and retains the original name.

SHIFT + > 0 — Moves the cursor forward.

SHIFT + < 9 — Moves the cursor backward.

> 0 + > 0 — Inserts a 0 at the current cursor position or deletes the character at the cursor position.

SHIFT + + 4 — Inserts a space at the current position.

SHIFT + – 5 — Deletes the character at the current position.

SHIFT + RESET 1 — Clears all the characters to the right of the cursor.

 — Changes the currently selected letter to uppercase if it is currently lowercase.

 — Changes the currently selected letter to lowercase if it is currently uppercase.

 — Scrolls through the various symbols if the cursor is in a space.

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Supported Sensor Types

The instrument can take measurements using a wide range of sensors. The sensitivities and types of measurement that can be taken by each sensor are summarized in the following table.

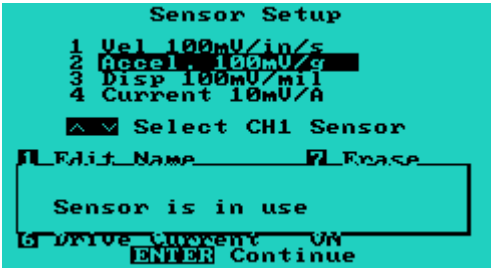
Note: Velocity, displacement and current sensor types are only applicable to the vb3000 instrument.

Sensor Type	Sensitivity	Measurement Types
Accelerometer	mV/g 8.5-2300	Acceleration Velocity Displacement
Velocity Sensor	mV/in/s 8.5-2300 mV/mm/s 0.34-90.55	Velocity
Displacement Sensor (or prox probe)	mV/mil 8.5-2300 mV/µm 0.34-90.55	Displacement
Current Sensor	mV/amp 0.1-2300	Current

You can define your sensors either in the Ascent software or the instrument. For information on how to set up a sensor using the instrument see Specifying Sensor Settings (page 76).

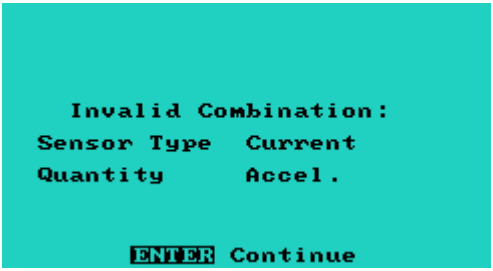
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Note: Once a sensor has been defined as a particular sensor type e.g. accelerometer, you will not be able to change the sensor's details to a different type *if* it has been used to take recordings that are still stored in the instrument. The vb instrument will associate the stored measurements with the sensor that was used to record them and display a 'Sensor is in use' message. If you need to change a sensor's type for any reason, erase all the associated recordings in the instrument first.



Invalid Combinations

When you set the parameters for a measurement you cannot choose settings that conflict with the type of measurement you are trying to create e.g. if you are measuring acceleration you cannot select a current sensor. If you try to take the measurement the instrument will display an 'Invalid Combination' message and no measurement will be taken.



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Mounting Sensors

Your choice of sensor mounting will affect the accuracy and therefore the repeatability of vibration measurements.

For optimal measurement results, accelerometers and velocity sensors *should* be mounted using a threaded stud or adhesive mounting pad and stud rather than relying on magnets. Permanent mounting of accelerometers is described in Permanent Mounting (page 22). These instructions can also be applied to velocity sensors.

Tachometers, displacement sensors, prox probes and current sensors should be mounted according to the manufacturer's instructions.

Accelerometer Setup

Plug the connector of the accelerometer into the vb instrument accelerometer input. Now screw the accelerometer into the magnetic base and attach to the measurement point ensuring it is:

- Attached to a sturdy, rigidly mounted and non-flexible structure, where vibration from the rotating part of the machine will be accurately transmitted. Avoid attachment to sheet metal, guards, or any machine structure which is not closely coupled to the source of vibration in the spinning rotor as the vibration of such a structure will be different to the vibration source.

- Attached to a structure which is at least 10 times heavier than the accelerometer itself. Do not mount the accelerometer on lightweight motors or similar parts as the weight of the accelerometer will distort the vibration signal. Use a smaller accelerometer for small structures.

- Attached as closely as possible to, and in line with, the centerline of the bearings to avoid distorted signals.

- Securely attached to the mounting surface. The surface should be flat and smooth where the accelerometer makes contact. Attachment can be either using the supplied

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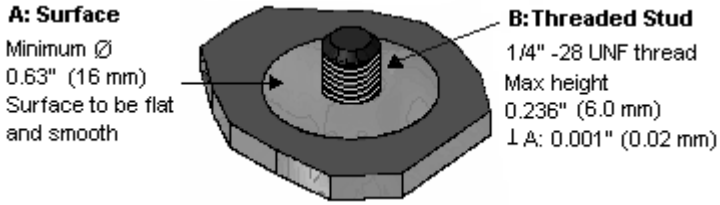
magnetic accelerometer base or via a threaded stud on the machine surface. The accelerometer should not move independently of the machine part it is attached to.

- Oriented correctly as vibration can differ greatly with respect to direction.
- Attached to exactly the same position as before if this is an ongoing study of a particular measurement point (mark the position if necessary).
- Clear from other cables and not twisted, kinked or tangled.

Permanent Mounting

To mount using the stud method, prepare a mounting spot on the machine following the specifications shown in the diagram.

- Unscrew the magnetic base from the accelerometer and screw onto the threaded stud. Use of thread locking compound is suggested.



Stud Mounting Spot

Caution: Do **not** use a wrench to tighten the accelerometer as this will damage the sensor.

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Tachometer Setup

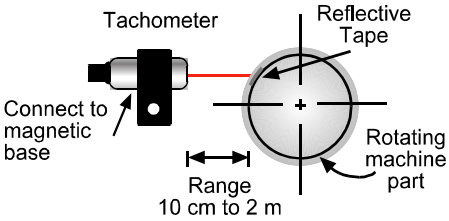
The tachometer provides the instrument with information on the speed of rotation and the angle at which the rotor is vibrating. The angle is measured from a fixed reference mark on the rotor and is called the ‘phase angle’. To balance a rotor it is necessary to consider not just the amplitude of vibration but also the phase angle. The amplitude shows the severity of the imbalance and the phase angle indicates the geometry of the imbalance.

To set up the laser tachometer:

- Locate the drill hole in the tachometer and screw this onto the end of the mounting base movable arm.
- Plug the cable socket into the tachometer connecting pins then turn the locking ring to make a secure connection.
- Locate the tachometer input on the instrument and attach the other end of the cable to this.
- Stop the rotor.
- Cut out a small strip of the supplied reflective tape, approximately 5 mm x 15 mm (0.2" x 0.5").
- Stick the reflective tape to a machine part that rotates at the rotor speed e.g. the shaft. This trigger spot should provide a pronounced increase in reflection as it passes under the tachometer light beam. The tape width must be **at least** double the diameter of the light beam spot.
- Mount the tachometer magnetic base to a stationary portion of the machine, convenient to the trigger spot.

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- Position the sensor slightly away from the centerline of the rotating machine part in order that it is not 'blinded' by reflections from the surface of the machine part. The sensor should be positioned within the measurement range shown in the following diagram.



Warning: The laser tachometer is a class 2 laser product. Do **not** stare into the laser beam.

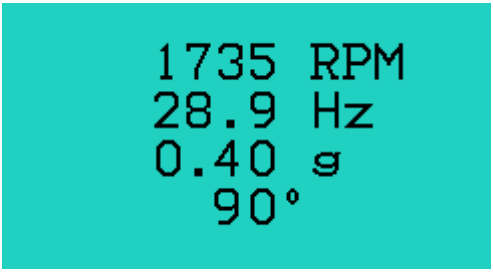
- From the Main Menu, press RESET 1 Measure.
- Press + 4 Tachometer Display.



- Start the rotor and wait till it is at normal running speed.

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- Now test if the tachometer will trigger. Press START STOP to display the running values screen. (The instrument will beep if it cannot detect a tachometer signal and a 'No tach. signal' message will display).



- Ensure a stable RPM is displayed on the screen. This indicates that the tachometer is triggering reliably. If the RPM does not stabilize, adjust the position of the sensor.

- To return to the Main Menu press ENTER then press MENU twice.

Using a Strobe

If you have a strobe light with an output signal it should be possible to connect it to the tachometer input of the instrument (however, there are many strobes on the market with different types of output signal and connectors). If your strobe light has a BNC connector and gives a TTL output (0 to 5) V you can purchase a suitable cable from Commtest Instruments Ltd via your distributor.

For other types of connectors and signals please consult the FAQ (Frequently Asked Questions) articles on the Commtest website www.commtest.com.

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Tach Signal from a Keyphasor®

If your machine has a proximity-probe based tachometer sensor (e.g. Keyphasor®), this can be used as the tach signal for your vb instrument. The sensor should have a buffered front-panel BNC output, to ensure the vb instrument's measurements can't interfere with pre-existing speed measurements. Keyphasor® tach cables can be purchased through your local Commtest reseller for this purpose.

The Keyphasor® proximity sensor gap should be adjusted so the driver box output is -8 V +/- 2 V (i.e. -6 V to -10 V) when the sensor is over the shaft. This is the normal mid-range position for these sensors. When the sensor is over the keyway its output will be -14 V to -22 V, depending on its make and model.

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Tips for Taking Measurements

- Measurements should always be taken using the machine operating mode that is typical for that machine (the typical load and running speed). This is to ensure that the loads on the components, such as bearings, are the same as those that define their wear. For multi-operating mode machines it is best to take measurements when the loads on the bearings are at a maximum and to take all future measurements in the same mode.

- When taking the measurement, try not to lean on the machine and do not put heavy objects (e.g. heavy tool boxes) on it since this will change the vibratory behavior of the machine.

- If there are machines operating nearby that might affect the vibration of the machine you are measuring, stop those surrounding machines if possible.

- In addition to the measurements that you will be taking, if possible, stop and listen to the sound of the machine; look for loose bolts and oil leaks; take note of any machine parts that are vibrating visibly; feel for hot bearings and manually ‘feel’ the vibration (e.g. with a screwdriver) to look for symptoms that might later aid vibration analysis. This should be done only if it is safe to do so.

- If you have a stroboscope (not included in the vb kit) you may wish to use it to ‘freeze’ rotating shafts, belts, couplings etc to observe their operating shapes and relative speeds in order to look for symptoms that might later aid vibration analysis.

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Section 3: Onsite Analysis - Measurement Menu

This section describes the procedures for measuring vibration and performing onsite analysis.

You will learn to:

- Take frequency domain measurements (spectra)
- Take time domain measurements (waveforms)
- Take demodulation measurements
- Use the tachometer to gather speed, amplitude and phase data
- Perform time synchronous averaging
- Perform bump tests
- Take run-up and coast-down measurements
- Take cross channel phase measurements
- Store measurements
- Analyze measurements
- Customize the default measurement menus
- Change the on-screen display options of your instrument

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Walk-through: Taking Measurements in Measure Mode

Onsite analysis using Measure Mode involves watching a machine's vibration on-screen as it occurs and analyzing the measurement on the instrument (rather than recording the vibration then transferring it to Ascent for later analysis using the software). This method of measuring allows you to take a quick look at a machine's vibration patterns without having to save the recording or create a machine and points etc. You can still store the recording once the measurement is complete if you choose to do so.

Warning: Take care of personal safety when taking measurements in industrial environments. Follow all safety regulations at all times. Read also Precautions (page 6), before attempting to take measurements.

- From the Main Menu press RESET 1 Measure.
- Choose a quick setup option or one of the automated menus e.g. Time Synchronous Averaging or Cross Channel Phase.
- Press RESET 1 and use the number keys to enter the machine running speed (RPM).
- Press ENTER to continue.
- Attach the sensor (and tachometer if you are taking rotor speed and phase angle measurements).
- Start the machine and allow it to operate under its normal load and running speed.

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- To start the measurement press START STOP



- Wait for the sensor and vb hardware to settle. When the settling time has elapsed or the hardware has settled measuring begins and the spectrum, waveform or tachometer reading is displayed and continually updated. (You can press START STOP while the instrument is settling to cancel the remaining settling time but this is **not** recommended as the measurement may not be accurate.)

- To stop the measurement from updating press START STOP. To resume measuring and updating the display press START STOP again. Some basic analysis can be carried out straight away including displaying the amplitude of a spectral peak and identifying any harmonics (see Analyzing Measurements on page 55).

- To save the measurement press MENU to display a pop-up menu and select option RESET 1 Record.

- Select or create a machine, point and direction to save the recording to.

OR

- To stop viewing the measurement and exit without saving press MENU twice to return to the Main Menu.

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Using Quick Setup Menus

The instrument's quick setup menus automate most of the measurement set up process for spectra, waveforms and demodulation measurements. These measurements are free run so you can record for as long or short a length of time as you wish.

Most parameters are set for you - you are only required to adjust a few settings. Any of the default parameters can be changed before or during measuring. The default parameters for each quick setup are listed in Default Parameters (page 36).

- Access the Measurement Menu by pressing RESET 1 from the Main Menu.



- To take a spectrum, waveform or demodulation measurement, press the number key that corresponds to that option.

Instructions for using each of these quick setup menus are described next.

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1. Spectrum Quick Setup

- From the Main Menu press RESET 1 Measure, to open the Measurement Menu.
- From the Measurement Menu press RESET 1 Spectrum Quick Setup.



The only parameter you need to set is the Fmax value. This can be done in two ways:

➢ Press RESET 1 to display the Machine Running Speed Menu then use the number keys to enter an RPM value. The Fmax will be set to 40 x the RPM (or rounded up to the closest value).

OR

- Press HELP 2 to display the Set Fmax Menu and use ∧ or ∨ to select a value.

- Once the Fmax is set press ENTER to return to the quick setup menu then press START STOP to take the measurement.

When a measurement has been taken it can be analyzed immediately on the instrument (see Analyzing Measurements on page 55) or stored for later analysis (see Storing Measurements on page 54).

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Setting your own parameters

Option 0 Custom Setup allows you to customize this menu to use your own settings instead of the factory defaults. See Custom Setups (page 57) for more information.

2. Waveform Quick Setup

- From the Main Menu press RESET 1 Measure, to open the Measurement Menu.
- From the Measurement Menu press HELP 2 Waveform Quick Setup.



The only parameter you need to set is the duration value. This can be done in three ways:

- ➢ Press RESET 1 to display the Machine Running Speed Menu then use the number keys to enter an RPM value. The duration will be set to the time it takes the machine to make 20 revolutions.

OR

- ➢ Press HELP 2 to display the Set Duration Menu and use ∧ or ∨ to select a value.

OR

- Press LIGHT 3 to display the Set Fmax Menu and use ∧ or ∨ to select a value. The value you select will determine the equivalent duration value. If the waveform is later transferred to Ascent and displayed as a spectrum, this Fmax value will be used on the chart.

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- Once the duration is set press ENTER to return to the quick setup menu then press START STOP to take the measurement.

When a measurement has been taken it can be analyzed immediately on the instrument (see Analyzing Measurements on page 55) or stored for later analysis (see Storing Measurements on page 54).

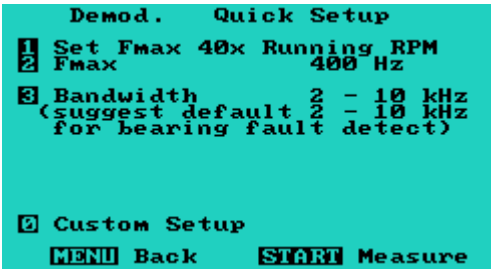
Setting your own parameters

Option 0 Custom Setup allows you to customize this menu to use your own settings instead of the factory defaults. See Custom Setups (page 57) for more information.

3. Demodulation Quick Setup

The following information explains how to use the quick setup menu to perform demodulation measurements. For a full explanation of the demodulation process and its uses see Demodulation (page 101).

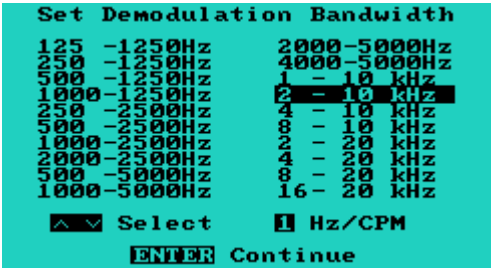
- From the Main Menu press RESET 1 Measure, to open the Measurement Menu.
- From the Measurement Menu press LIGHT 3 Demod Quick Setup.



The only parameters you need to set are the bandwidth and Fmax values. The bandwidth must be selected first as this will determine the range of available Fmax values.

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- Press LIGHT 3 to display the Set Demodulation Bandwidth Menu and use ^ or v to select a value.



- Press ENTER to return to the quick setup menu and set the Fmax. This can be done in two ways:

  - Press RESET 1 to display the Machine Running Speed Menu then use the number keys to enter an RPM value. The Fmax will be set to 40 x the RPM (or rounded up to the closest value).

OR

  - Press HELP 2 to display the Set Fmax Menu and use ^ or v to select a value.

- Once the Fmax is set press ENTER to return to the quick setup menu then press START STOP to take the measurement.

When a measurement has been taken it can be analyzed immediately on the instrument (see Analyzing Measurements on page 55) or stored for later analysis (see Storing Measurements on page 54).

Setting your own parameters

Option > 0 Custom Setup allows you to customize this menu to use your own settings instead of the factory defaults. See Custom Setups (page 57) for more information.

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Default Parameters

When using the quick setup menus the following parameters are automatically applied.

	Spectrum	Waveform	Demodulation
Domain	Frequency	Time	Frequency
Window	Hanning	N/A	Hanning
Quantity	User defined	User defined	Accel
Spectral Lines	400	1024 samples	400
Fmin	1 Hz (60 CPM)	N/A	1 Hz (60 CPM)
Fmax	Automatic	Automatic	Automatic
Average Type	4 x Linear 50% overlap	N/A	4 x Linear 50% overlap
Amplitude Scale	Linear	Linear	Linear
Trigger	Internal Free run	Internal Free run	Internal Free run
Display Orders	OFF	OFF	OFF
Harmonic Cursor	OFF	OFF	OFF
Tach Display	OFF	OFF	OFF

Any of the default parameters can be changed before and during measurement. See Setting Measurement Parameters (page 63) for more information.

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Using Automated Menus

Advanced operations can be carried out using the automated setups available from the Measurement Menu. You need only set one or two parameters yourself and the instrument will automatically apply default parameters that are optimized for the settings you specify. As with the quick setup menus, any of the default parameters can be changed before or during measuring. The default parameters for each automated setup are listed in Default Parameters (page 52).

- Access the Measurement Menu by pressing RESET 1 from the Main Menu.



- To take a measurement, press the number key that corresponds to the option required.

Instructions for using each of these automated setup menus are described next.

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4. Tachometer Display

The Tachometer Display option displays a readout of the machine speed and the amplitude and phase angle of the 1X vibration. This can be used to:

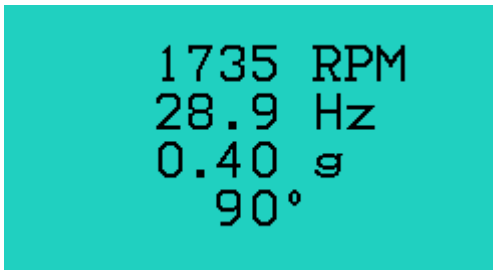
- Verify the machine running speed
- View the phase angle of the vibration relative to the tach signal
- Take a quick preview of the 'out of balance' level

- From the Main Menu press RESET 1 Measure then + 4 to access the Tachometer Display Menu.



- To display the RPM, connect the tachometer. To check the vibration level, attach the sensor also. The vibration level will be displayed in the units selected in the Display Options Menu.

- With the sensor(s) connected, press START STOP to begin measuring. To stop, press ENTER



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This running values screen will display the RPM and the equivalent value in Hz. With the sensor connected, the vibration level will also be displayed along with its phase angle relative to the tachometer signal.

Setting your own parameters

Option 0 Custom Setup allows you to customize this menu to use your own settings instead of the factory defaults. See Custom Setups (page 57) for more information.

5. Time Synchronous Averaging

This is a useful vibration analysis technique for distinguishing between spectral peaks that are very close to, but not exactly, the harmonics of the machine's running speed. After performing a large number of averages, peaks that are whole number multiples of the running speed will be still be visible while those that are non-synchronous will be cancelled out from the spectrum.

- From the Main Menu press RESET 1 Measure then 5 to display the Time Synchronous Averaging Menu.



The parameters you need to set are the duration, number of samples and number of averages.

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The duration value can be set in three ways:

- Press RESET 1 to display the Machine Running Speed Menu then use the number keys to enter an RPM value. The duration will be set to the time it takes the machine to make 20 revolutions.

OR

- Press HELP 2 to display the Set Duration Menu and use ^ or v to select a value.

OR

- Press LIGHT 3 to display the Set Fmax Menu and use ^ or v to select a value. The value you select will determine the equivalent duration value. If the waveform is later transferred to Ascent and displayed as a spectrum, this Fmax value will be used on the chart.

- Select the number of samples by pressing + 4. This controls the number of spectral lines used when the waveform is transferred to Ascent and displayed as a spectrum.

- Set the number of averages by pressing – 5 to change the value displayed. 16 or more averages is recommended in order to remove non-synchronous peaks from the final spectrum.

Note: You **must** use a tachometer as the trigger source.

When measuring is complete the resulting time waveform can be transferred to your PC and viewed as a spectrum within the Ascent software.

To store the measurement see Storing Measurements (page 54).

Setting your own parameters

Option > 0 Custom Setup allows you to customize this menu to use your own settings instead of the factory defaults. See Custom Setups (page 57) for more information.

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6. Bump Test

The bump test is a useful vibration analysis technique to help identify resonance frequencies in a machine's structure. It requires 'bumping' (i.e. hitting) the machine structure when the machine is stopped, while taking a peak hold measurement. Careful selection of the mallet or hammer is required along with the strength and direction of the bump to ensure that suitable frequencies are injected into the structure without causing damage.

- From the Main Menu press RESET 1 Measure then BACK 6 to display the Bump Test Menu.



The only parameter you need to set is the Fmax value. This can be done in two ways:

➢ Press RESET 1 to display the Machine Running Speed Menu then use the number keys to enter an RPM value. The Fmax will be set to 5 x the RPM (or rounded up to the closest value).

OR

- Press HELP 2 to display the Set Fmax Menu and use ∧ or ∨ to select a value.

- Once the Fmax is set press START STOP to begin sampling.
- 'Bump' the machine with the hammer.
- Repeat several times.

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To store the measurement see Storing Measurements (page 54).

Note: In free run mode with peak hold averaging, the instrument will continue sampling and displaying the peak values for each spectral line.

Tips:

With the spectrum displayed press ^ or v to move the cursor and check the frequency of any resonance peaks found.

Press LIGHT 3 then ENTER to clear the spectrum.

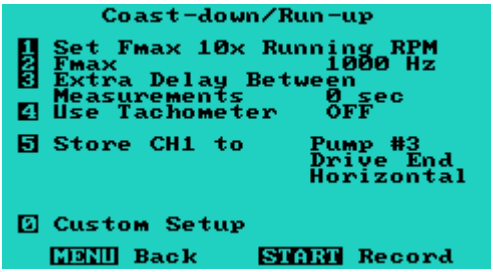
Setting your own parameters

Option > 0 Custom Setup allows you to customize this menu to use your own settings instead of the factory defaults. See Custom Setups (page 57) for more information.

7. Coast-down/Run-up Recordings

Coast-down and run-up recordings involve taking a series of recordings with a short delay between them. This technique can be used to study the resonance behavior of a machine as its speed gradually increases during power-up or decreases during coast-down.

- From the Main Menu press RESET 1 Measure then NEXT 7 to display the Coast-Down/Run-Up Menu.



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The only parameter you need to set is the Fmax value. This can be done in two ways:

- Press RESET 1 to display the Machine Running Speed Menu then use the number keys to enter an RPM value. The Fmax will be set to 10 x the RPM (or rounded up to the closest value).

OR

- Press HELP 2 to display the Set Fmax Menu and use ^ or v to select a value.

- Once the Fmax is set, select the machine, point and direction in which the sequence of measurements will be stored.

Recommendations
A large number of recordings will be created so we recommended you create a new 'point' for each new coast-down or run-up measurement to clearly separate each set of recordings.

For machines with a slow coast down or run up, e.g. more than one minute, we recommend that you add a few seconds extra delay between recordings (press LIGHT 3 then enter the number of seconds required).

The use of a tachometer is also recommended but not essential. It obtains an RPM reading for every measurement, which aids interpretation.

Taking a measurement

- Press START STOP to begin the recording sequence.
- After the first spectrum has been recorded, switch off the machine (or begin ramping its speed up or down).
- Once the machine has stopped rotating (or its speed has been fully adjusted) press START STOP

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The measurement location should now contain a large number of measurements. These can now be transferred to the Ascent software for display as a waterfall chart. Simple bode plots can also be created provided the tachometer was used during recording.

To store the measurements see Storing Measurements (page 54).

Setting your own parameters

Option  Custom Setup allows you to customize this menu to use your own settings instead of the factory defaults. See Custom Setups (page 57) for more information.

8. Cross Channel Phase

Note: This functionality is only available to vb3000 users.

Phase analysis is an effective means of diagnosing machine faults such as misalignment, resonance, soft foot and looseness among others. Phase analysis is also useful in *distinguishing* faults that look like imbalance but are actually caused by something else (such as misalignment, which can show up at 1X RPM similar to imbalance). Knowledge of the phase relationships of various machine faults will help to confirm the existence of a specific machine fault and help to prevent misdiagnosis.

Cross channel phase is a convenient method of taking phase measurements that does not require the use of a tachometer or reflective tape. Instead, phase is measured between two sensors.

Note: When taking measurements, be aware of the direction each sensor is facing. If you are measuring across the coupling in the axial direction you will probably turn the sensors in opposite directions, thereby introducing an additional 180° phase change. Remember to take this into consideration when analyzing the phase measurements.

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Recommendations

1. Determine the exact frequency of interest by using spectra to identify high amplitude peaks at specific frequencies.

2. Position the channel 1 sensor in a location which has high vibration at this frequency. Do **not** move this sensor once testing has started.

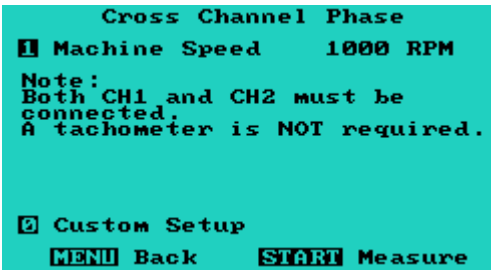
3. Try out different locations with the channel 2 sensor, noting the phase and amplitude relationships compared to the fixed channel 1 position.

4. Repeat steps 2 and 3 at any other locations of interest.

Taking a measurement

- Connect the two sensors to the appropriate machine locations.

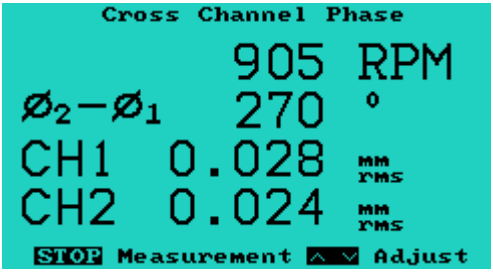
- From the Main Menu press RESET 1 Measure then 8 to display the Cross Channel Phase Menu.



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The only parameter you need to set is the frequency of interest - this is typically the machine running speed.

- Press RESET 1 to enter the RPM then ENTER to continue.
- Press START STOP to begin measuring both channels.



The instrument will perform a spectral peak search at the entered frequency (machine speed or any frequency of interest) on the channel 1 signal. The frequency of the **actual** peak is displayed at the top of the screen, always in RPM. The instrument then looks at exactly the same frequency on channel 2 and displays the phase difference $Ø_2$ - $Ø_1$ (CH2 - CH1). The instrument also displays the amplitudes of both channels at that peak frequency.

- To change the target frequency (the peak of interest) use ^ or v to adjust the value in 50 RPM increments.

Note: This measurement cannot be saved.

Setting your own parameters

Option 0 Custom Setup allows you to customize this menu to use your own settings instead of the factory defaults. See Custom Setups (page 57) for more information.

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Fault Types and their Phase Relationships

Misalignment - high amplitude peaks will appear at 1X, 2X and sometimes 3X the running speed. Look for a 180° (± 30°) phase change across the coupling in the axial direction (for angular misalignment) or radial direction (for parallel (offset) misalignment). Bearing misalignment (cocked bearing) will cause a twisting motion in the axial direction. Look for a 180° (± 30°) phase change from the top to the bottom of the bearing housing or from one side to the other.

Imbalance - a high amplitude peak will appear at 1X the running speed. Confirm that the phase difference from horizontal to vertical on the bearing is close to 90° (± 40°). The phase difference between left and right horizontal locations should be within 30° of the phase difference between left and right vertical locations. If the phase is unstable then there may be another reason for a large running speed vibration e.g. looseness or misalignment.

The degree of couple imbalance versus force imbalance can be investigated by looking at the phase difference between the two sides of the machine - if there is little couple imbalance then only a single plane correction may be required to balance the rotor.

Resonance (flexible structures) - high amplitude peaks will appear where natural resonance frequencies of the structure coincide with excitation frequencies (e.g. 1X, other low orders of running speed, blade pass frequency etc). Look for a 0° phase change when both sensors are positioned in the same direction between two stationary points. The phase change will be 180° when there is a stationary point between the sensors.

Resonance (variable speed machines) - to investigate resonance you can vary the machine speed. A phase shift of 180° will occur as machine speed is increased from below a resonance to above a resonance. A 90° phase shift will be present at the resonant frequency. If a machine is running close to resonance, any small speed variation will cause large phase shifts.

Resonance (at a bearing) - look for a change from the normal 90° phase difference in the horizontal and vertical directions at 1X. When a natural frequency is close to 1X in either direction, that phase angle may be well be on the way towards its 90° phase change so

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the two phases may no longer be 90° apart (assuming that the structure has a different natural frequency in either direction).

Eccentric belt pulley - a high amplitude peak will appear at 1X the running speed of the pulley. Look for a phase change of either 0° or 180° between the horizontal and vertical readings, which indicates straight line motion instead of the usual 90° difference. This symptom is similar to bearing resonance (described above) but in this case the direction of maximum vibration will be in line with the two belts.

Mechanical looseness - high amplitude peaks will show up at many multiples of the running speed and sometimes even multiples of 0.5X running speed e.g. 1.5X, 2.5X etc. Look for fluctuating phase readings at a location from one recording to the next to the next. Also compare the phase readings at 30° increments around a bearing housing - the phase will be significantly different at each angle.

Mechanical foot looseness (soft foot) - a high amplitude peak will show up at 1X the running speed. Look for a 90° to 180° phase change between the machine foot and its concrete base. The soft foot may also have a different phase measurement from the other feet.

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9. Long Time Waveform

Note: This functionality is only available to vb3000 users.

Long time waveforms allow you to take a continuous recording over a very long time period (over 17 hours), making it particularly useful for capturing transients. Recordings are taken continuously without any gap until the memory is full or until you manually stop recording. The amount of time you can record for is dependent on the Fmax (which determines the sample rate) *and* how much available memory is left in the instrument.



When transferred to the Ascent software you can display the waveforms as spectra with up to 160 000 lines. To record enough samples to achieve the full 160 000 line FFT you must record for at least the following amounts of time:

Fmax	Recording Time
10 kHz	16 secs
1 kHz	160 secs (2:40 minutes)
100 Hz	1600 secs (26:40 minutes)

In *most* of these cases the upload time to the Ascent software will be 2 minutes or less.

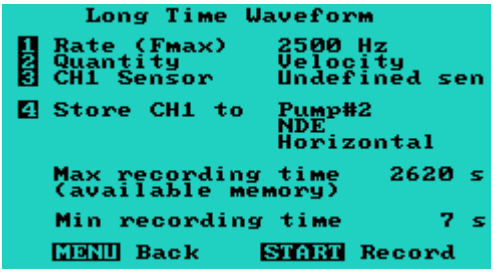
Note: The speed with which a long time waveform can be displayed in the software depends on the processing speed of your computer. We recommend that you first test your computer's ability to handle lengthy waveforms by recording less than the 160 000 line maximum.

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- From the Main Menu press RESET 1 Measure then 9 to display the Long Time Waveform Menu.

- Press HELP 2 to display the Set Fmax Menu and use ^ or v to select a value. If the waveform is later transferred to the software and displayed as a spectrum, this Fmax value will be used on the chart. (The actual sampling rate is 2.56 times higher than this Fmax value.)

- Press ENTER to continue. The maximum recording time (amount of time available for recording) will be displayed in seconds near the bottom-right of the screen. (This amount may be much smaller than expected if the instrument's memory has become 'fragmented'. See the note at the end of this topic for additional information and solution.) The minimum recording time is also displayed. If a recording is stopped before this time has elapsed the recording will not be saved. (If you want to take a recording that is equal to or shorter than this amount of time, record a normal time waveform.)



- Press HELP 2 to toggle the amplitude quantity between acceleration, velocity and displacement.

- Press LIGHT 3 to select a sensor.

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- Press + 4 to select a machine, point and direction to save the recording to. (We recommend saving each long time waveform to a new measurement location as this makes it easier to delete them individually.)

- Press START STOP to begin recording and press START STOP again when you wish to stop recording.

If you do not stop the recording manually the instrument will continue sampling until the displayed time has elapsed, which indicates that this memory chunk is full. When measuring, the instrument will display a running count of the time (in seconds) that the recording has taken rather than displaying the waveform being measured.

When measuring is finished the selected measurement location will contain many individual recordings. Once these are transferred, the Ascent software will connect all the recordings together in the correct order to form one continuous waveform.

We recommend that you erase long time waveforms from the instrument immediately after transferring them to the software, as the very large number of recordings can considerably slow down menu navigation.

Note: The instrument automatically uses the largest available chunk of free memory. This can be considerably less that the total free space if the memory has become 'fragmented' over a long period of use. To de-fragment the memory, transfer all data from the instrument to the software and perform a full memory erase (see Erasing all Recordings on page 168).

Displaying a long time waveform in the software
When recording has finished the selected measurement location will contain many individual 4096 sample recordings. Once these are transferred the Ascent software will connect the recordings together in the correct order to form a continuous waveform.

Note: In order to prevent the software's processing and display speed from slowing down, a maximum of 100 recordings will be joined together to create individual 'chunks' of a long time waveform.

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This means that a lengthy waveform will appear as several 409 600 sample recordings.

- To create a high resolution spectrum of a waveform, from the Ascent navigator select the schedule entry that contains the long time waveform and plot one of the recording 'chunks'.

- If you are using Ascent level 2 or higher use **Analyze>Partial Waveform Analysis** or **Freq. Based Waveform Analysis** to zoom in on selected portions of the waveform. If you are using Ascent level 1 plot the waveform and change the bottom axis to Frequency. You can then use the normal zooming and panning functions to carry out detailed analysis.

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Default Parameters

When using the automated menus, the following parameters are automatically applied.

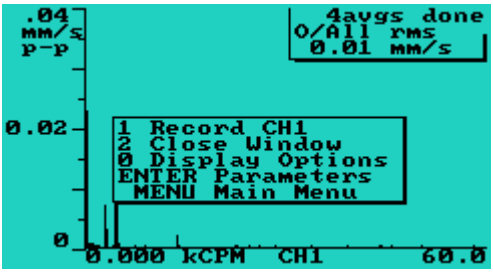
	Tach Display	Time Synchronous Averaging	Bump Test	Coast-down/ Run-up	Cross Channel Phase
Domain	Frequency	Time	Frequency	Frequency	Frequency
Window	Hanning	N/A	Hanning	Hanning	Hanning
Spectral Lines	400	User defined	400	400	400
Fmin	1 Hz	N/A	1 Hz	1 Hz	1 Hz
Average Type	4 X Linear	16 X Linear	Peak hold	1 X Linear	1 X Linear
Amplitude Scale	Linear	N/A	Linear	Linear	Linear
Trigger	Tach Free run	Tach Free run	Internal Free run	Internal Free run	Tach Free run
Display Orders	OFF	OFF	OFF	OFF	OFF
Harmonic Cursor	OFF	OFF	OFF	OFF	OFF
Tach Display	ON	OFF	OFF	OFF	ON
Autorepeat	OFF	OFF	OFF	ON	OFF

As with any measurement, the parameters can be changed before and during measuring as described in Setting Measurement Parameters (page 63).

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Storing Measurements

- After taking a measurement, with the spectrum, waveform or tachometer reading displayed press MENU to open a pop-up window containing the Record option.



- Press RESET 1 to record the measurement. You will then need to either select a machine, point and direction to save the measurement to or create these now.

Selecting an existing machine, point and direction

- Press ^ or v to highlight a machine.
- Press ENTER to select it and display the next menu. Repeat this process for the point and direction.

Creating a machine, point and direction

- Highlight a '-new-' machine and press HELP 2 to display the Edit Name Menu. See Entering Text and Numbers (page 16), for details of how to enter names for your machines, points and directions.
- When you have entered a name, press ENTER twice to save the name and display the next menu. Repeat this process for the point and direction.

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Analyzing Measurements

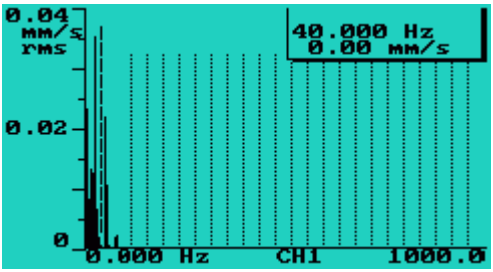
The spectrum/waveform/tachometer reading is displayed on the instrument screen once a measurement has been taken. Spectra and waveforms displayed on the instrument can be analyzed in the following ways:

Displaying the amplitude/frequency of a peak

- To read the vibration amplitude or level corresponding to a particular frequency or time press ^ or v to move the cursor to that frequency or time value. The values indicated by the cursor are displayed at the top-right of the screen.

Note: The overall vibration value is not displayed while cursors are activated.

- To move the cursor rapidly press SHIFT + ^ and SHIFT + v



Using cursors to display frequency and amplitude levels

Displaying harmonics

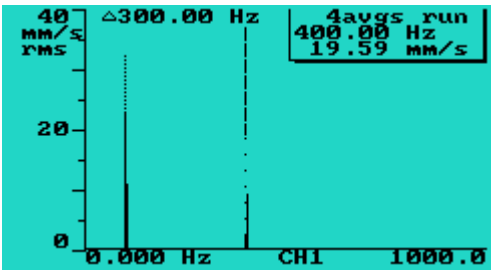
- To identify the harmonics of a peak, move the cursor to the peak of interest. If the harmonic cursors option has been turned on (see below), additional cursors are displayed at frequency or time values that are whole-number multiples of the frequency or time value indicated by the main cursor.

- To turn on harmonic cursors press > 0 to access the Display Options Menu then press < 9 to toggle the cursors on. Press ENTER to return to the chart display.

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Displaying frequency/time difference between peaks

- To display the frequency difference or time difference between two peaks press ^ or v to position the main cursor at one of the peaks.
- Press SHIFT then 8 to anchor a datum cursor at the peak.
- Press ^ or v to position the main cursor at the other peak. The delta symbol △ appears beside a value indicating the frequency or time difference between the two peaks.



- To clear the datum cursor move the main cursor to where the datum cursor is and then press SHIFT then 8 again (or press SHIFT then 8 twice if not on the datum cursor).

Zooming

- To take a close-up view of a spectrum or waveform move the cursor to the position of interest and press SHIFT then + 4 to zoom in by a factor of 2.
- To zoom out (by a factor of 2), press SHIFT then − 5.

The more spectral lines or the more waveform sample points used, the more times you can zoom. Moving the cursor to the edge of the screen within zoomed views will pan the viewing area across the spectrum or waveform by up to 50% of the viewing area.

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Changing display options

- To change the display options of a spectrum or waveform in order to view the spectrum or waveform more clearly, press > 0 to access the Display Options Menu. See Setting the Display Options (page 59) for more information.

Custom Setups

Any of the instrument's quick setup or automated menus can be customized to use your preferred settings. You simply choose your own measurement parameters, save the settings in a custom setup menu then choose that same custom setup whenever you want to measure or record that measurement type.

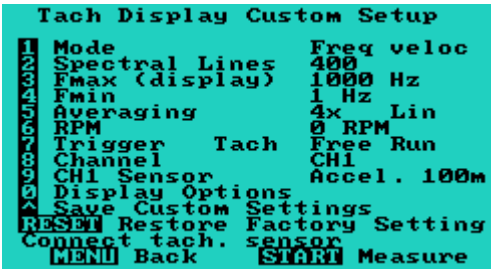
- To create a custom setup, from the Main Menu press RESET 1 then select the Quick Setup or Automated menu you want to customize.



- Press > 0 Custom Setup.

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- Change the parameters as required then press ^ to save your custom settings. If you forget to save the settings the parameters will revert back to their previous settings after you take a measurement.



You cannot save settings that conflict with the type of measurement you are trying to create e.g. if you are creating a Tach Display custom setup you cannot set the trigger to internal. When you try to save the settings or take the measurement, the instrument will force the settings to whichever parameters are appropriate for that type of measurement (in this case the trigger setting would be forced to tachometer).

Note: When you create a custom setup your settings will overwrite the factory default parameters. If you wish to restore the factory defaults to any quick setup or automated menu, open the custom setup you want to restore then press SHIFT + RESET 1

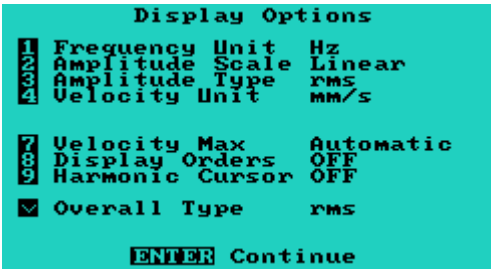
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Setting the Display Options

Display options control the way a measurement is displayed on the instrument such as showing the frequency in Hz or CPM, or setting the amplitude type to rms, Ø-peak or peak-peak.

- To access the Display Options Menu, from the Main Menu press RESET 1 Measure then press > 0 twice.

Note: This screen shot shows the factory default settings (the measurement mode is set to frequency for spectra and the quantity to velocity). Your screen may differ depending on the settings you have chosen.



- To change any of the display options press the corresponding number key to cycle through the available options. When you have finished press ENTER to return to the previous screen.

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RESET 1

Frequency Unit
Available units are Hz and CPM/kCPM. The frequency unit Hz, is equivalent to ‘cycles per second’ and kCPM stands for ‘kilocycles per minute’.

HELP 2

Amplitude Scale
Either linear or log scale can be chosen for the bottom axis. The linear amplitude scale can be used in most cases. The log scale (base 10) is more useful for displaying vibration with both very large and very small amplitudes. If the log scale is selected, the log range (the range of the amplitude axis) will appear as option 6 in this menu.

LIGHT 3

Amplitude Type
Applies to the chart scale for the left axis. For spectra this can be set to rms, Ø-peak or peak-peak. The Ø-peak and peak-peak values are 'derived' from the rms value. Ø-peak is calculated by multiplying the rms value by 1.414. Peak-peak is calculated by multiplying the rms value by 2.828. For time waveforms the amplitude type is always Ø-peak.

\+ 4

Velocity Unit
(Also acceleration unit, displacement unit and current unit - Amps only) Available SI and imperial options are: velocity - mm/s, in/s; acceleration - g, m/s^2; displacement - mm, µm, mil. If the Amplitude Scale is set to Log, the options VdB and AdB are also available. The vibration velocity level (VdB) is defined as 20 times the logarithm of the ratio of the rms velocity level to a reference velocity value, the VdB reference. Acceleration expressed in AdB is defined as 20 times the logarithm of the ratio of the rms acceleration level to 1 µg rms.

– 5

VdB Reference
See above. The value 1e-6 mm/s is an abbreviation for 1x10-6 mm/s and is the SI reference level. The value 1e-5 mm/s is the reference level used by the US Navy and many American industries.

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BACK 6 **Log Range**
Used to specify the left axis range when the amplitude scale is set to log.

NEXT 7 **Velocity Max**
Velocity max, acceleration max, displacement max or current max is the highest amplitude value that will be **displayed** on the amplitude axis. If the linear amplitude scale is selected this value can be set to automatic.

. 8 **Display Orders**
When display orders is turned on, the frequency axis of spectra is labeled in orders of running speed instead of in Hz or CPM. When using cursors to analyze a displayed chart, the frequency readout of the cursors is also displayed in orders. When viewing time waveforms, the time axis is labeled in Revs instead of ms. Note that the running speed (RPM) must be entered (either manually or using the tachometer) to enable this feature.

< 9 **Harmonic Cursor**
If the harmonic cursor option is turned on, additional cursors will be displayed at frequencies that are whole-number multiples of the frequency indicated by the main cursor. See Analyzing Measurements on page 55, for information on using cursors.

Overall Type
The vibration overall level can be scaled as rms, Ø-peak or peak-peak. This setting can be different for each of acceleration, velocity and displacement if required. The overall scale can be set differently to the amplitude type (chart scale) e.g. you can set the amplitude type to Ø-peak and the overall scale to rms.

Changing display options once measuring has begun

- With a chart or tachometer reading displayed, press > 0 to access the Display Options Menu directly. Note that only the options that are applicable to the type of measurement being performed will be displayed.
- Press ENTER to resume measuring.

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Section 4: Manual Setup Measurement Parameters

This section describes the different parameters used to take measurements and how to apply them.

You will learn to:

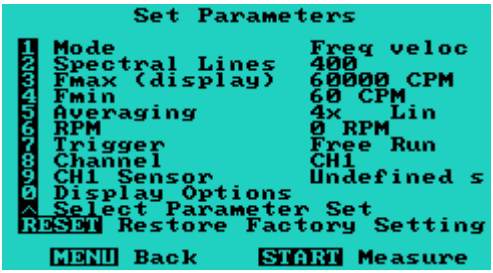
- Set spectrum parameters
- Set waveform parameters

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Setting Measurement Parameters

To take a completely manual measurement (i.e. you set all parameters yourself) use the Manual Setup option.

- From the Main Menu press RESET 1 Measure then press > 0 to select Manual Setup. This opens the Set Parameters Menu.



- Change the parameter settings as required. Alternatively select a pre-existing parameter set by pressing ^. Use the arrow keys to highlight a parameter set then press ENTER to select it.

- To take a measurement press START STOP. See Walk-through: Taking Measurement in Measure Mode (page 29) for full instructions for taking measurements. Ignore the first four steps as these refer to using the quick setup menus to take a measurement.

Some parameter values can be changed directly in this menu e.g. press HELP 2 to change the number of spectral lines or * 8 to toggle the channel(s) used to take the measurements.

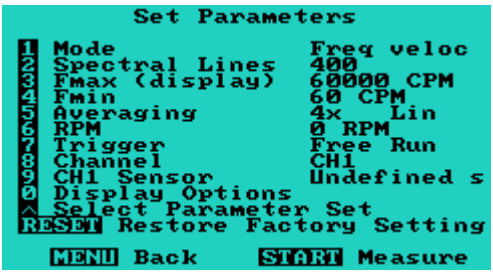
For other parameters, pressing a number key will open another menu where you can change the parameters settings for that menu item e.g. pressing + 4 Fmin opens the Change Fmin Value Menu.

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Note: When you set the parameters for a measurement you cannot choose settings that conflict with the type of measurement you are trying to create e.g. if you are measuring acceleration you cannot select a current sensor. If you try to take the measurement the instrument will display an 'Invalid Combination' message and no measurement will be taken.

Changing parameters once measuring has begun
Measurement parameters are normally chosen before taking a measurement but can also be changed once measuring is underway.

- While the hardware is stabilizing or the instrument is collecting data the hourglass icon will be displayed. During this time, pressing keys 1-9 will access the associated Set Parameters Menu item directly.



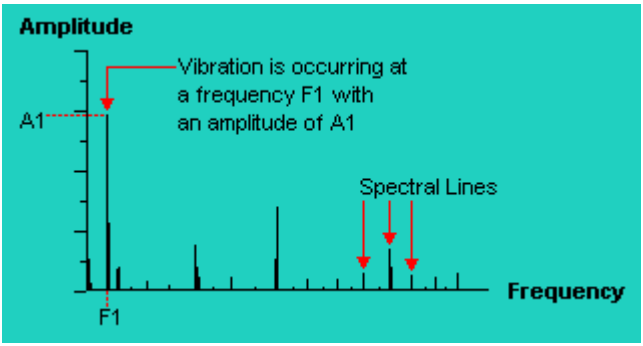
- Make any required changes then press ENTER to resume measuring.

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Setting Spectrum Parameters

A vibration spectrum is a chart of vibration amplitude versus vibration frequency. The vibration spectrum of a machine component shows the frequencies at which the component is vibrating and the amplitude of vibration at each of these frequencies.

vb spectra consist of discrete spectral lines displayed at fixed frequency intervals. The height of each spectral line represents the amplitude of vibration at the frequency the spectral line is positioned. The more spectral lines in a spectrum, the higher the resolution of the spectrum (but more memory is used).



A simplified illustration of a discrete vibration spectrum

The vibration spectrum of a vibrating machine component is the basic tool for understanding the nature of the vibration. To ensure a spectrum is as informative as possible, the measurement parameters that are used to obtain the spectrum must be set appropriately.

- To begin setting measurement parameters, from the Main Menu press RESET 1 then press > 0 to display the Set Parameters Menu.

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Setting the Measurement Mode

- From the Set Parameters Menu press RESET 1



When in the Measurement Mode Menu:

RESET 1 **Domain** toggles the Domain between Frequency (spectra), Time (waveform) and Demod (demodulation).

HELP 2 **Quantity** toggles the amplitude quantity between Displacement, Velocity, Acceleration and Current (Acceleration is the only option available when the Domain is set to Demod).

LIGHT 3 **Window** toggles the type of window between Hanning and Rectangular. This is not available when the Domain is set to Time.

- To change any of the options press the number key that corresponds to that menu item. When you have finished press ENTER to return to the Set Parameters Menu.

Domain
When Domain is set to Frequency the instrument displays spectra rather than waveforms.

Quantity
Measuring velocity is applicable for most situations. However, displacement spectra are usually more informative for low vibration frequencies (below 30 Hz/1800 CPM) and acceleration spectra for high frequencies (above1 kHz/60 kCPM).

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Window
Measured data is usually not directly used to generate a spectrum but is first modified using a 'window' function. Windowing compensates for known limitations of the mathematical process (FFT) that transforms the data into a spectrum. Multiplying data by a window function prevents spectral lines from smearing or leaking into one another, thereby making the data block appear like a complete wave. The Hanning window is normally used for this purpose. If the Rectangular window is used the data will not be modified.

Setting the Number of Spectral Lines

- From the Set Parameters Menu press HELP 2 to toggle the number of spectral lines.

The number of spectral lines ranges from 400 to 3200 (6400 for the vb3000).

The resolution of the spectrum increases with the number of spectral lines used i.e. the more spectral lines the more information the spectrum contains. However, the more spectral lines used, the longer the measurement takes and the more memory is used to store the spectrum. Use 6400 lines only when required e.g. when you need to distinguish between two closely-spaced vibration frequencies or when the Fmax is very large. For coast-down or run-up measurements a setting of 400 lines is recommended.

Note: When taking a dual channel recording the number of spectral lines is reduced to 1600 (3200 for the vb3000).

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Setting the Fmax

The Fmax is the maximum frequency **displayed** on the spectrum i.e. the frequency range, starting from zero, over which vibration amplitudes are displayed. The unit Hz is equivalent to cycles per second (1 Hz = 60 cycles per minute).

- From the Set Parameters Menu press LIGHT 3 to display the Set Fmax Menu.



- Press ^ or v to highlight a frequency maximum and ENTER to select. You can also press < 9 or > 0 to move horizontally across the columns.

In general the higher the operating speed of the machine, the higher the Fmax needs to be to capture all crucial information. For vibration involving fingered elements such as gear teeth, fan blades, pump vanes, and bearing elements, an Fmax equal to 3 times the number of fingers multiplied by the operating speed is usually sufficient. For vibration not involving fingered elements, an Fmax equal to 10 times the operating speed is usually sufficient. You can calculate the Fmax yourself or the instrument can do it for you.

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Using the vb instrument to calculate the Fmax

- From the Set Fmax Menu press RESET 1



- Press LIGHT 3 to display the Enter Orders Menu and use the number keys to enter a value. A value of 10, for example, will display 10 order of the running speed.



- Press ENTER to return to the Set Fmax Menu.

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- Press + 4 to enter a default running speed (RPM) of the machine. The instrument will automatically select the appropriate Fmax value to display at least the specified number of orders.



- Press ENTER to return to the Set Fmax Menu or press the key twice to return to the Set Parameters Menu.

Displaying Hz/CPM instead of orders

- To display the Fmax value as Hz or CPM instead of orders, from the Set Fmax Menu press RESET 1
- The equivalent Hz value will be highlighted. To select this press ENTER
- To display CPM/kCPM press RESET 1 again to display the equivalent value then press ENTER to select the highlighted value.

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Setting the Fmin

The purpose of the Fmin setting is to eliminate the 'ski-slope' effect from the low frequency end of the spectra. All spectral lines **below** the Fmin value will be set to zero and will **not** be included in the overall rms calculation.

Note: the value can only be entered in Hz, but will be displayed in CPM in the Set Parameters Menu (if your Display Options are set to CPM). So, for example, to obtain an Fmin of 60 CPM enter a value of 1 Hz - this is the default value.

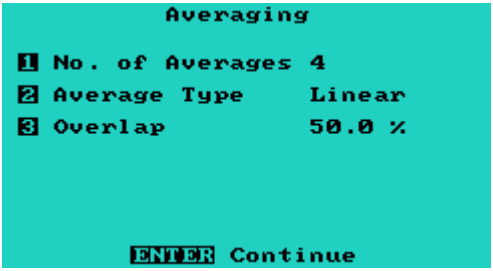
- From the Set Parameters Menu press + 4 and use the number keys to enter a value then press ENTER to continue.



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Averaging

- From the Set Parameters Menu, press 5 to display the Averaging Menu.



Setting the Number of Averages

The larger the number of spectra used for averaging, the more any noise spikes in vibration signals are reduced and the more accurately true spectral peaks are represented. However, the larger the number of averages, the more data needs to be collected and therefore the longer it takes to obtain the average spectrum. Four averages are sufficient for most cases. Set the number of averages to one if spectra averaging is not required, for example, with run-up and coast-down recordings.

- From the Averaging Menu press RESET 1



- Press ^ or v to highlight the number of averages and ENTER to select.

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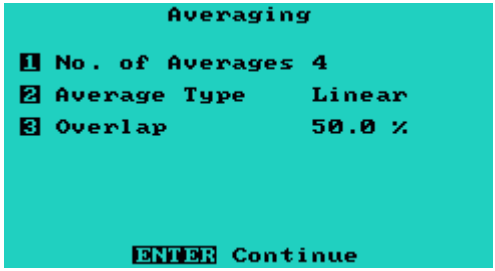
Setting the Average Type

When vibration is measured, several spectra are usually measured and then averaged to produce an average vibration chart. The averaging process minimizes the effect of random variations or noise spikes that are inherent in vibration signals. Averaging is applied to amplitude values, not to the frequency range.

Linear averaging is suitable for most cases. The amplitude value at each frequency of a spectrum is added to the same frequency of the next spectrum. The sum is then divided by the number of averages taken.

Exponential averaging is normally used only if vibration behavior varies significantly during measurement, such as during run-up and coast-down measurements. The most recent spectra have more influence on the final average than earlier measurements. Averaging is continuous until the measurement is stopped.

Peak hold is useful for measuring the maximum amplitude peak that occurs over a period of time and for measuring resonances during a bump test. Peak hold does not actually average the amplitude values but records and displays the maximum amplitude of each spectral line.



- Press HELP 2 to cycle through the Average Types, Linear, Exponential and Peak hold.

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Setting the Overlap Percentage

Overlapping is a means of collecting and displaying data more quickly. As vibration measurements are collected a percentage of the new data is combined (overlapped) with each subsequent measurement. The higher the overlap percentage, the less newly acquired data is needed to generate a spectrum and thus the faster the spectrum can be displayed. An overlap percentage of 50% is ideal for most cases.

- From the Averaging Menu press LIGHT 3



- Press ^ or v to highlight the percentage to overlap and ENTER to select.

Setting the Machine Running Speed

- From the Set Parameters Menu press BACK 6



- Press RESET 1 and type in an RPM value then press ENTER to save this value.

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Ask for RPM

If the machine RPM is available at the time of recording, for example from an installed rev counter or a hand held tachometer, the user can be instructed to enter the RPM via the vb instrument keypad. When Ask for RPM is selected, the user will be prompted to enter the machine RPM before taking the recording. This RPM value is saved with the recording and displayed in the Ascent software. Additional recordings on the same machine that also have Ask for RPM selected, and which have the same default RPM value, will be assigned the same entered value. Ask for RPM can be used in both route and recording mode but not in measure mode.

Setting the Trigger Type

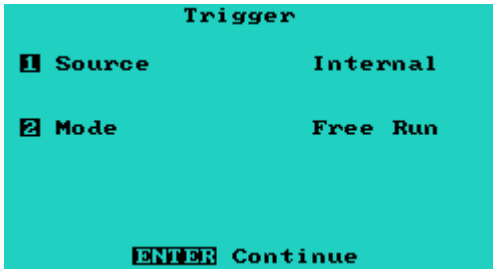
Source

If the internal trigger source is selected the instrument will start measuring the moment it is ready to do so. If the tach trigger source is selected the speed of the rotor will be displayed and measurements will be started only when a tachometer pulse is detected. With tach trigger type the averaging is synchronous since each measurement is started at the same point of shaft rotation. This is sometimes called time synchronous averaging.

Mode

If the free run trigger mode is selected the instrument will take measurements continuously. If the single trigger mode is selected only one measurement will be taken.

- From the Set Parameters Menu press NEXT 7



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- Press RESET 1 to change the Source between Internal and Tach.
- Press HELP 2 to change the trigger Mode between Free Run and Single.
- Press ENTER to close this menu and continue.

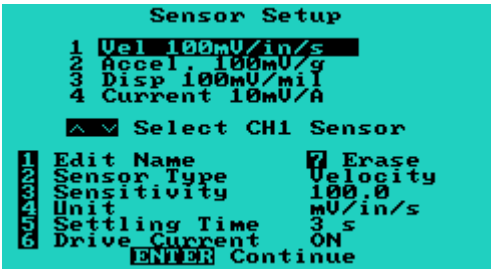
Selecting the Channel(s) for Taking Measurements

- From the Set Parameters Menu press 8 to cycle through the channel(s) to be used, CH1, CH2 or CH1 & CH2.

If both channels are selected (in vb2000/vb3000), channel 1 data will be displayed by default. The display can however be toggled between the channels by pressing 8 once the measurement has started.

Specifying Sensor Settings

- From the Set Parameters Menu press 9



- Press ^ or v to select the sensor to edit.

Once the desired sensor has been selected:

- Press RESET 1 to edit the Name of the sensor.

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- Press HELP 2 to toggle the Sensor Type between acceleration, velocity, displacement and current.
- Press LIGHT 3 to edit the Sensitivity of the sensor. The range of sensitivities will vary depending on the selected sensor unit.
- Press + 4 toggle the Unit measured by the sensor.
- Press – 5 to change the Settling Time for the sensor. The settling times can be anything from 0 seconds to 99 seconds inclusive.
- Press BACK 6 to toggle the Drive Current for the sensor ON or OFF. This is the 2.2 mA supply to power ICP® type accelerometers.
- Press NEXT 7 to reset the name of the sensor (the other settings will remain unchanged).
- Make any changes then press ENTER to continue.

Note: Once a sensor has been defined as a particular sensor *type* e.g. accelerometer, you will not be able to change the sensor to a different type *if* it has been used to take recordings that are stored in the instrument. The instrument will associate the stored measurements with the sensor that was used to record them. If you need to change a sensor's type for any reason, erase all the associated recordings in the instrument first.

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Setting Waveform Parameters

A vibration waveform is a chart of how vibration level changes with time. A vibration waveform shows the vibration level at any particular time during the measurement period.

vb waveforms are discrete charts represented by a series of equally spaced discrete sample points connected by straight lines. The more sample points in a spectrum the higher the resolution of the waveform (but the more memory used).

To ensure a waveform is as informative as possible the measurement parameters used to obtain the waveform must be set appropriately.

- To begin setting measurement parameters, from the Main Menu press RESET 1 then press > 0 to display the Set Parameters Menu.

Setting the Measurement Mode

- From the Set Parameters Menu press RESET 1



- Press RESET 1 to change the Domain to Time.
- Press HELP 2 to toggle the Quantity to be measured between acceleration, displacement, velocity and current.
- When finished, press ENTER to return to the Set Parameters Menu.

Note: Option 3: Window, is not available with waveforms.

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Setting the Number of Samples

- From the Set Parameters Menu, when Time mode is selected press HELP 2 to cycle the number of samples between 1024, 2048, 4096 or 8192 (16 384 for the vb3000).

The resolution of the waveform increases with the number of samples used i.e. the more samples, the more information the waveform contains. However, the more samples in a waveform, the more memory is used up to store the waveform.

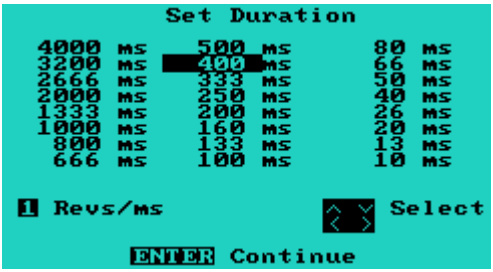
Tip: An easy way to select the number of samples and duration is to let the instrument set them for you. In Frequency mode (option 1 in the Set Parameters Menu), select the Fmax and number of lines then switch to Time mode and the instrument will select the corresponding values.

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Setting the Duration

The duration of a waveform is the total time period over which information may be obtained from the waveform. The unit ms is short for 'millisecond' (i.e. a thousandth of a second). The duration values that you can select are dependent on the number of samples you selected earlier (see previous topic). The larger the number of samples the larger the duration values.

- From the Set Parameters Menu press LIGHT 3



- Press ^ or v to select the required duration and ENTER to select. You can also press < 9 or > 0 to move horizontally across the columns.

- Press RESET 1 to toggle between entering duration in ms or as multiples of the machine's revolution time.

For example, set the duration to 10 Revs to ensure that your recording will cover at least 10 revolutions of the shaft.

Note: You must use a tachometer or set the default RPM for this to function correctly.

Setting Other Parameters

To change the settings for other measurement parameters, please refer to the appropriately titled topics following Setting Spectrum Parameters (page 65).

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Section 5: Recording Data

This section describes the procedures for recording vibration data on the instrument and transferring it to Ascent on a PC.

You will learn to:

- Take recordings
- Review recordings
- Erase recordings
- Transfer recorded data to the PC
- Tag items to be recorded
- Use autorepeat to add a time delay between recordings

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Walk-through: Taking Recordings

The following instructions assume that you have already created the machines you intend to take recordings of.

Warning: Take care of personal safety when taking recordings in industrial environments. Follow all safety regulations at all times. Also read Precautions (page 6) before attempting to take recordings.

- Check the battery capacity of the instrument and if it is less than 30%, charge the battery pack. See Battery Management (page 161) for more information.
- Select the folder containing the machines you wish to monitor. From the Main Menu press 5 Folder Management. The first menu item shows the name of the currently selected folder. If your folder is already selected please skip the next step, otherwise press RESET 1 to display the Select Folder Menu.
- Press ^ or v to highlight a folder then press ENTER to select it. This loads the folder into current memory and returns you to the Folder Management Menu.
- Press MENU to return to the Main Menu.
- From the Main Menu press HELP 2 to access the Select Machine Menu.
- Press ^ or v to highlight the machine for which recordings are to be taken then press ENTER to select the machine.
- In the Select Point Menu select the point for which recordings are to be taken then press ENTER
- In the Select Direction Menu select the direction for which recordings are to be taken then press ENTER

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- In the Select Parameter Set Menu highlight the parameter set for which recordings are to be taken. If **all** is selected a recording will be sequentially taken for each **tagged** parameter set. If none of the parameter sets are tagged and **all** is selected a recording will be taken for all parameter sets.

- To view or edit the parameter values of the highlighted parameter set press HELP 2 then press ENTER to return to the Select Parameter Set Menu.

Note: If you change any of the parameter values other than display options in the Set Parameters Menu, a new parameter set will be created.

- Connect the sensor to the measurement location (see Sensor Setup on page 21). If you are recording tachometer readings, set up the tachometer also (see Tachometer Setup on page 23).

- When you are ready to take the recording(s) press START STOP

- Wait for the sensor and instrument hardware to settle and for the instrument to collect data (if you press START STOP at this stage the recording(s) will be aborted).

When the instrument has finished collecting the data for a particular spectrum or waveform, the spectrum or waveform will be displayed momentarily along with a message confirming that the recording has been completed. You can use the 'Halt after recording' option to keep the chart displayed until you choose to continue (see Halt After Recording on page 172). The recording is stored to your selected location and the Select Parameter Set Menu is then re-displayed. You can then select another parameter set for another recording. Recording tags are automatically cleared as each recording is completed.

- When you have finished taking recordings for a measurement location you can then take recordings at other measurement locations by repeating the above process.

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When you have finished taking recordings at all measurement locations you can review the recordings on the instrument (see next topic, Reviewing Recordings) or transfer them to a PC for detailed analysis using the Ascent software.

Reviewing Recordings

- From the Main Menu press LIGHT 3 to access the Select Machine Menu.
- Highlight the machine to be reviewed by pressing  or  then press ENTER to select the machine. The  symbol indicates that you are in review mode.
- In the Select Point Menu select the point to be reviewed then press ENTER
- In the Select Direction Menu select the direction to be reviewed then press ENTER
- In the Select Parameter Set Menu select the parameter set with the recordings to be reviewed then press ENTER
- In the Select Recording Menu, highlight the recording to be reviewed then press ENTER to display it. Cursors and zooming may be used to better display the data (see Analyzing Measurements on page 55).
- When you have finished reviewing the data in the recording press ENTER to return to the Select Recording Menu from where you may select another recording to be reviewed.
- To select recordings under other parameter sets, directions, points, or machines press SHIFT then BACK 6 to navigate back through the menus.

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Resetting an incorrect RPM
If the RPM was specified incorrectly when a recording was taken this can be corrected either in the vb instrument or in the Ascent software.

- With the spectrum or waveform displayed press BACK 6 to display the Enter Rotor Speed Menu.
- Enter the correct RPM then press ENTER to return to the chart display.

Erasing Recordings

- From the Select Recording Menu press — 5 to erase the highlighted item then SHIFT + RESET 1 to confirm.

Transferring Recordings from the Instrument

- Plug your instrument into the PC using the communications cable (RS232).
- Turn on the instrument and click the Ascent **Receive** button to transfer data from the instrument to your PC.

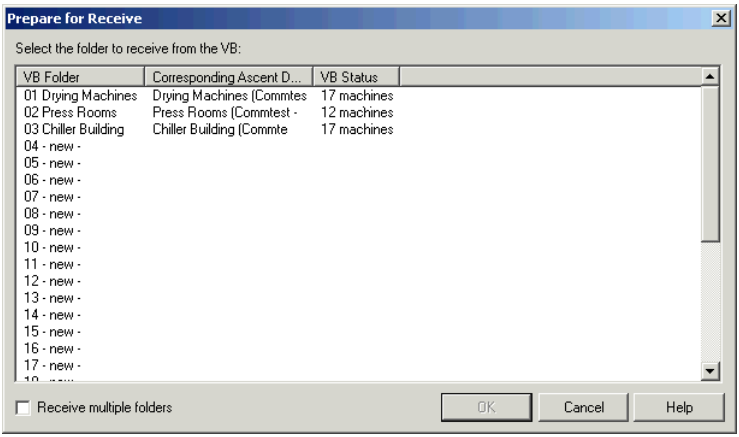


You do not need to make sure that you have the correct folder open; the software stores a hidden key in the instrument for every folder that determines where it belongs.

If you have a single folder defined in the instrument the receive process will proceed automatically. If there are multiple folders in the instrument you will be presented with a screen allowing you to select which folder(s) to transfer.

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- If you are shown this Prepare for Receive window, select the folder you wish to transfer and click **OK**.



- To transfer more than one folder at a time click the 'Receive multiple folders' box then tick the box beside each folder that you want to receive.

Tagging Items

Not all machines or points need to have recordings taken during every recording session. In such cases you can create a sub-list by tagging only the items for which recordings need to be taken. Tags are also helpful in that they remind the person taking recordings which items have not yet been measured.

Tagging an item automatically tags all of its sub-elements e.g. tagging a point automatically tags all of its axes and parameter sets. Such an item is marked with a T. If you selectively tag only some of the elements of an item, the item is marked with a t. When a recording is taken the tag will disappear.

- To tag an item, from the Main Menu press HELP 2 then press ENTER till you have the correct menu displayed.

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- Press ^ or v to highlight the item in the list then press RESET 1 to tag it.

Example:
To tag a machine:

- From the Main Menu press HELP 2 to display the Select Machine Menu.



- Press ^ and v to select the machine and press RESET 1



Note: Only items with at least one parameter set can be tagged.

To untag an item

- Highlight the item in the list and press RESET 1

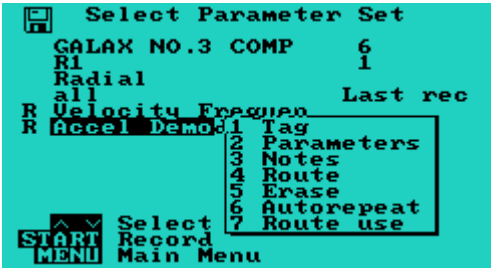
If you wish to tag most elements of an item it might be faster to first tag the item and then untag the elements within it that are not required.

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Autorepeat

Autorepeat is used to take the same recording repeatedly with a short, user-specified delay between recordings. This option is ideal for taking coast-down/run-up recordings. The instrument will take recordings continuously until you choose to stop.

- From the Main Menu press HELP 2 Record then choose a machine, point and direction.
- In the Select Parameter Set Menu press ^ or v to highlight the parameter set you wish to record then press MENU to open a pop-up menu containing the autorepeat option.



- Press BACK 6 Autorepeat then enter the number of seconds the instrument should pause before repeating the recording.



- Press ENTER to return to the Select Parameter Set Menu then press START STOP to begin recording.

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Section 6: Using Routes

This section outlines the procedures for managing routes with your instrument.

You will learn to:

- Use a route to take recordings
- Take off-route recordings
- Name a route
- Erase a route

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What is a Route?

A route is an ordered list of measurement locations that a user follows when taking recordings. When the instrument is operated using an Auto Route, the user is guided through each measurement location according to the sequence.

By using a route, the task of taking recordings becomes much simpler and the potential for mistakes can be minimized. Use the Ascent software to create and manage your route library then send this data into the instrument (see the Ascent *Software Reference Guide*, Creating a Route).

Before creating a route you must first create your measurement locations (machines, points, axes and parameter sets). Each new route is created by selecting, in any order, these machines and locations.

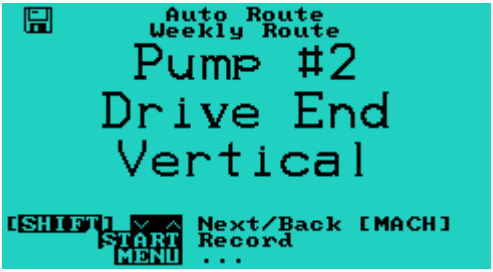
Up to eight routes can be stored in each folder. Each route can only contain machines that are stored within the same folder as the route.

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Walk-through: Taking Recordings Using a Route

Once the first recording has been taken you will automatically be moved to the next location on the route. You can take recordings for all other measurement locations sequentially, or jump to various entries on the route.

- From the Main Menu press 4 to display the Select Route Menu.
- Use the ^ or v keys to highlight a route then press ENTER to select it. The first location on your route will be displayed.



- Attach the sensor to the location indicated on the instrument screen then press START STOP

When the instrument has finished collecting the data, the spectrum or waveform will be displayed momentarily along with a message confirming that the recording has been completed.

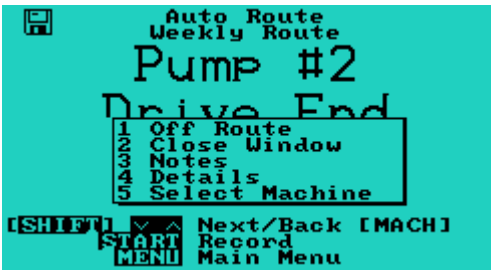
Note: The ON/OFF key can be used as a left-handed START key when on a route. This feature must be turned on using the Options Menu (accessed by pressing 9 from the Main Menu).

- Continue to take recordings using START STOP until all the measurements have been taken and you are returned to the Main Menu. The route is now ready to be transferred to the Ascent software.

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Notes:

- In the Auto Route Menu you can press LIGHT 3 to view or edit notes for the measurement location.
- Press > 0 to view/edit the display options for recorded spectra/waveforms.
- Press + 4 to view the parameter sets at this measurement location.
- Press MENU from the Auto Route Menu to open a pop-up menu that lists these options.



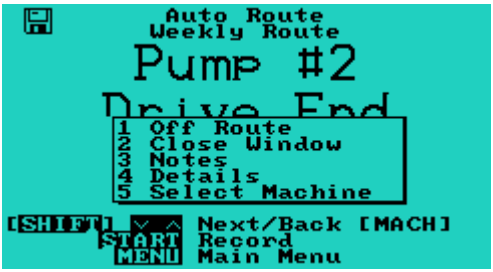
Reviewing Data During a Route

When performing a route you can review any of the recordings you have just taken.

Note: You can only review recordings from the current route using this method (if you wish to review recordings taken on a previous route, see Reviewing Recordings on page 84).

- Press ^ to return to the location you wish to review. You can return to any previous location by pressing this key repeatedly.
- When the route location you wish to review is displayed press + 4 (alternatively press MENU to display a pop-up menu then press + 4 Details).

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This opens the Select Parameter Set Menu. The review option is displayed in the bottom right corner.



- Press ENTER to review the recording.
- When you have finished reviewing press ENTER again to return to the previous menu.
- Press + 4 to return to the Auto Route. You will be returned to the location where you left the route and the next unrecorded location will be displayed.
- You can now press START STOP and continue to record the route as normal or repeat the above procedure if you wish to review more recordings.

Note: If you want to review each recording after you take it, a more efficient method is to use Halt After Recording from the Options Menu. If this option is turned ON then the spectrum or waveform remains on the display after recording (see Halt After Recording on page 172 for more information).

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Skipping Route Entries

- To skip a measurement location press ▽
- To return to the previous measurement location, press △
- To move forwards or backwards by an entire machine, rather than just a measurement location, press SHIFT + ▽ or SHIFT + △

Jumping to a Specific Machine

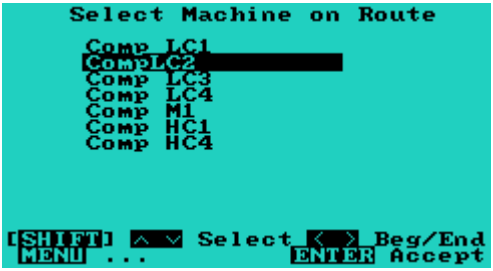
You can 'jump' to a particular machine anywhere within a route. This gives you the flexibility to change the order in which you collect recordings. Each machine is listed only once even though it may appear several times in your actual route. Once you have finished taking measurements on your chosen machine, the machine that immediately follows it in the list becomes the next machine on the route.

- To jump to a particular machine within the route, in the Auto Route menu press 5 (alternatively press MENU to display a pop-up menu then press 5 Select Machine).



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- Use ^ or v to highlight a machine then press ENTER to select it and return to the route. The first location at this machine is displayed.



- To move forwards or backwards by 10 machines press SHIFT + v or SHIFT + ^. Use < 9 or > 0 to move to the beginning or end of the machine list.

Off-route Recordings

When collecting data, you may decide to take additional measurements that are not part of the route sequence. This might be done if a machine's vibration pattern does not look as expected when taking the measurement.

- With the Auto Route screen displayed press RESET 1 to temporarily step out of the route.
- The Select Machine Menu will display. From here you can set up the location and parameters of the extra measurement.
- Take the measurement as normal. Once recording is complete you will be returned to the Select Parameter Set Menu where you can review the recording.
- Press + 4 to return to the route.

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Naming/Renaming a Route

- From the Main Menu press + 4 to display the Select Route Menu.



- Press ^ or v to highlight desired route then press HELP 2 to edit.



- Press SHIFT + RESET 1 to clear the current name then type in a new name for the route.

- Press ENTER to save the name and return to the Select Route Menu.

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Erasing an Entire Route

Warning: The following procedure erases all route entries. Erasing a route does not erase the machines that make up the route entries.

- From the Main Menu press + 4 to display the Select Route Menu.
- Press ^ or v to highlight the route to be erased and press − 5. You will be prompted to confirm.



- Press SHIFT + RESET 1 to erase the route.

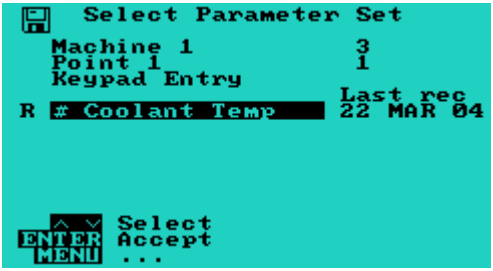
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Keypad Schedule Entries

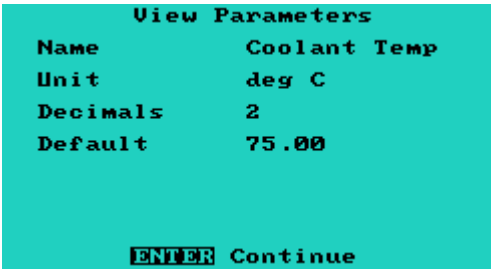
A special type of measurement can be created that requires the person collecting the data to enter a numeric value via the keypad rather than a vibration measurement. These special measurements are called *keypad schedule entries* and can be used to record additional information about your machines such as temperature or motor current. Keypad schedule entries can only be created using the Ascent software - they cannot be created in the instrument. Full details on the practical applications of keypad schedule entries and instructions on how to create them are contained in the Ascent *Software Reference Guide*.

The procedure for recording and reviewing keypad schedule entry data is the same as for vibration data.

- Use the menus to select the machine, point, direction and parameter set. The parameter set of a keypad schedule entry will be preceded by a hash symbol #.

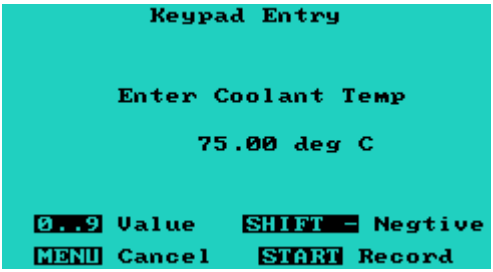


- To view the values of the parameter set, highlight it using ^ v then press HELP 2. To continue press ENTER



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- Either include the parameter set in a route or press START STOP from the Select Parameter Set Menu to take a recording.



- Type in the numeric value and press ENTER. Decimal points will be placed automatically as you enter digits from left to right. Note that the value entered can be either positive (+) or negative (-); press SHIFT to toggle this.

The process for reviewing this data is the same as for reviewing vibration recordings.

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Section 7: Advanced Operation

This section outlines the procedures for performing advanced operations with your instrument.

You will learn to:

- Take demodulated recordings
- Analyze demodulated data
- Take dual channel measurements
- Set and display baseline values

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Demodulation

A useful technique for measuring and analyzing data is demodulation. The demodulation process looks for repetitive patterns created by impact events that lie embedded within the time waveform. The process works by extracting the low amplitude, high frequency impact signals and then tracing an 'envelope' around these signals to identify them as repetitions of the same fault. The resulting spectrum, with the low frequency data removed, will now clearly show the high frequency impact signals and harmonics.

Demodulation is also useful as an early warning device, as it detects bearing tones before they are visible in a normal spectrum.

The high frequency signals that demodulation aims to extract are very localized, therefore extra care must be taken to ensure the accelerometer is setup correctly. Ensure that:

- The accelerometer is mounted close to the fault source.
- The accelerometer is well coupled, using either stud mounting or a very strong magnet on bare metal. A handheld probe or stinger is not recommended.
- The accelerometer mounting is consistent between visits. If not, a trend plot of overall rms values will be meaningless.

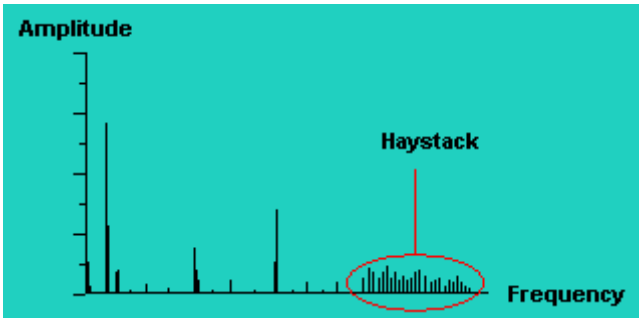
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Setting Demodulation Parameters

The bandwidth determines which range of frequencies the demodulation process will use. It is recommended that the following procedure is followed to determine an appropriate bandwidth.

- Take a 'quick snapshot' measurement using the following parameters:
  Domain: Freq
  Quantity: Accel
  Fmax value: 20 000 Hz (1200 kCPM)

- Examine the graph for a region of broadband high frequency noise or 'haystack'. Such a haystack might look like the one below.



- Select a bandwidth which includes the haystack, but excludes any large individual peaks such as those shown to the left of the haystack in the example diagram.

It is very important that all the large-amplitude/low frequency peaks are rejected. If there are no significant haystacks displayed, a standard bandwidth of (2 to 10) kHz (120 to 600) kCPM is recommended.

When an appropriate bandwidth has been determined, proceed with the demodulation measurement.

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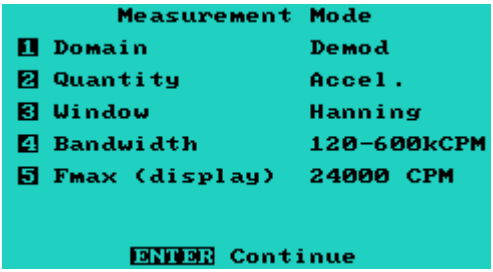
Setting up the demodulation measurement

- From the Main Menu press RESET 1 to display the Measurement Menu.

- Press LIGHT 3 to use the Demodulation Quick Setup Menu (see Demodulation Quick Setup on page 34).

OR

- Press > 0 then RESET 1 to set all parameters manually using the Measurement Mode Menu.



Analyzing Demodulation Data

Measuring, recording and viewing data is exactly the same as for a Frequency/Acceleration spectrum. The demodulation spectra can also be transferred to Ascent and analyzed using the same techniques as for normal spectra e.g. trend plots, alarms, fault frequencies, bearings and gears.

The following are points to keep in mind when analyzing demodulation data:

- The appearance of bearing tones in the demodulated spectrum, but not in the normal spectrum, is a good early warning indicator. It often points to insufficient lubrication.
- As the bearing deteriorates, the baseline noise level increases and bearing tones develop running speed sidebands.
- In the final stages of bearing wear, the bearing tones may become less prominent as cracks and pits become more rounded and distributed over the race.

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Dual Channel Simultaneous Measurements

The vb instrument can measure two channels simultaneously. Dual channel measurements must be taken in measure mode (rather than record mode) and then saved to an appropriate machine location.

Because the instrument has to buffer and manipulate twice the data, some of the more memory intensive operations are not available. The following restrictions apply:

- Number of spectral lines is reduced to 1600 (3200 for vb3000)
- Number of samples (for time waveforms) is reduced to 4096 (8192 for vb3000)

The Ascent software identifies recordings by their location and date/timestamp. If the date/timestamp of two recordings is identical at the same location in the instrument, one is discarded. Therefore, when recording the two channels you must store them at different locations. This can be either a different point or different axes. It is good practice to store the two channels in measurement locations that reflect the position and direction in which the sensors were placed when the measurement was taken.

- To select dual channel measuring, from the Main Menu press RESET 1 then press > 0 to display the Set Parameters Menu.
- Press * 8 twice to change the channel setting to CH1 & CH2.
- Connect sensors to both channels then press START STOP and take the measurement as normal.
- To store the measurements, with the spectrum/waveform/tachometer reading displayed press MENU to open a pop-up window containing the Record option.

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- Press HELP 2 to record both channels then select the machine, point and direction for channel 1.
- Press ENTER to store the channel 1 measurement. The instrument will beep and display the message 'Recorded CH1 - Now record CH2'.
- Select a different location for the channel 2 measurement. Use SHIFT + BACK 6 to navigate back through the machine and point menus if necessary.
- Press ENTER to store the channel 2 measurement. The spectrum/waveform/tachometer reading will be re-displayed with the message 'Recorded CH1 & CH2'.

Viewing both channels
For spectra and waveforms the channel 1 measurement is displayed by default.

- To view channel 2 press 8. The currently displayed channel is indicated at the bottom of the screen.

For tachometer displays, channel 1 is displayed on the left and channel 2 on the right.

Setting Baselines

The instrument can be configured to display the overall rms vibration level from a chosen baseline recording immediately after a new recording is taken. This provides a basic check on the data validity and a useful view of the change in vibration level. As an alternative to displaying baselines, the last recorded measurement's value can displayed instead. The setup and managing of baselines is handled in the Ascent software. Please refer to the Ascent *Software Reference Guide*, for details of how to display baseline recordings on the instrument.

The instrument can also be configured to warn you when a new recording is significantly above or below the baseline overall level. See Halt After Recording (page 172) for more information.

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Section 8: Creating Machines

This section describes the procedures for creating machines within the instrument.

You will learn to:

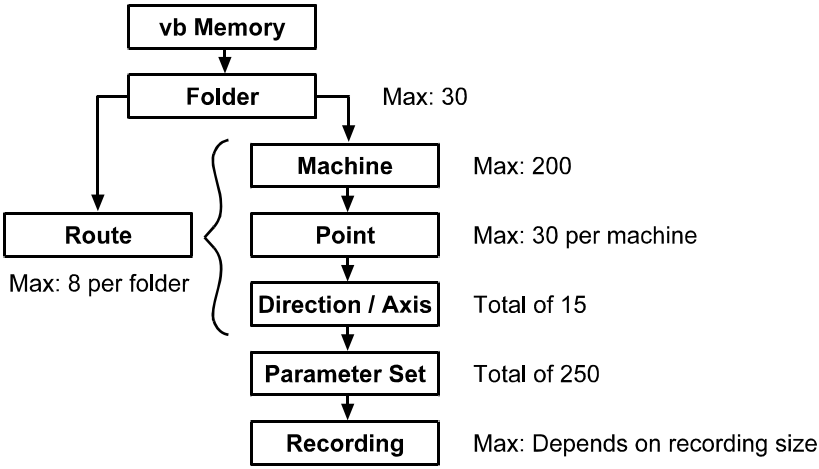
- Create and manage folders
- Create machines, points and locations
- Create parameter sets
- Copy a machine
- Erase machines, points and locations
- Rename machines, points and locations
- Select and attach notes to items
- Remove and erase notes

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vb Data Structure

Instead of analyzing data onsite, you can also record the data on your instrument and analyze the data later. If many machines need to be analyzed recommend that recordings be taken of all machines before any analysis is done. Analysis is best carried out away from machines in safe, quiet environments.

The instrument uses the following hierarchical data storage structure:



Starting at the bottom of the diagram, a **recording** is the vibration data collected at a particular location on a machine.

A **parameter set** defines a set of measurement parameter values that can be used to take a recording. These are useful when you are taking a large number of recordings, each using the same parameter values.

The **direction** refers to the orientation of the sensor - horizontal, vertical etc. Directions are grouped under points as each point can have recordings taken in several axes.

A **point** represents a place on a machine that a measurement will be taken. Points are grouped under the machine that they are located on.

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A **route** is an ordered list of measurement locations that a user follows when taking recordings. It contains a sequential list of the machines to be monitored.

A **folder** is a container that can be used to identify and group machines. For example, if you collect vibration data from several locations, a different folder should be used to hold each separate group of machines.

Routes, folders, machines, points, and directions are identified by the names you give them. Parameter sets are identified by their parameter value summaries e.g. accel 400 ms or veloc 1000 Hz. Recordings are identified by their date and time stamps.

Creating a Machine Data Structure

If recordings are to be taken for a large number of machines on a regular basis, it is useful to first create a data structure containing all the items to be measured. Separate data structures can be created under different folders. Once a folder has been assigned, a list of all machines to be monitored can be created, including their respective points, directions, and measurement parameters.

The fastest and easiest way to create a data structure is to use the Ascent software to first create your folders, machines and points etc, then send these to the instrument. This is the recommended method. Please refer to the Ascent *Software Reference Guide*, Section 2: Basic Operation, for more information.

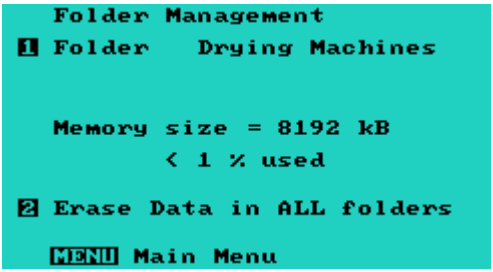
Machines and measurement parameter sets created in the instrument are automatically added to the Ascent database when you use the software Receive function to transfer data from the instrument to your PC.

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Working with Folders

Selecting a folder from the list loads it into current memory. Any new machines you create will automatically be stored in this folder until you select another folder.

- From the Main Menu press 5



- Press RESET 1 to display the Select Folder Menu.



If you have not yet created any folders, the screen will contain the default folder (Unnamed folder) and numbered slots labeled - new -.

- To select an existing folder from the list, press ^ or v to highlight the folder then press ENTER to select it. This loads the folder into current memory and returns you to the Folder Management Menu.

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To create a folder

- Press ^ or v to scroll to one of the slots labeled - new - then press HELP 2 to display the Edit Name Menu.
- Enter a name for the folder by choosing characters from the keyboard (see Entering Text and Numbers on page 16, for details of how to do this).
- Press ENTER to save the name and return to the Select Folder Menu.

To erase a folder

- Press ^ or v to highlight a folder in the list.
- Press MENU to display a pop-up menu containing the Erase option.



- Press – 5 to select the Erase option. A message appears asking you to confirm the erasure.
- Press SHIFT + RESET 1 to erase the folder.

The folder will be removed from the list and the empty slot will be re-labeled - new -.

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Creating a Machine

- From the Main Menu press HELP 2. The Select Machine Menu displays a list of numbered memory locations.



If you have not yet created any machines, the screen will contain numbered slots labeled - new -.

- Press ^ or v to scroll to one of the slots labeled - new - then press HELP 2 to display the Edit Name Menu.
- Enter a name for the machine by choosing characters from the keyboard (see Entering Text and Numbers on page 16, for details of how to do this).
- Press ENTER to save the name.

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Creating a Point

- Select a machine as described in the previous topic: Creating a Machine (page 111).
- From the Select Machine Menu press ENTER

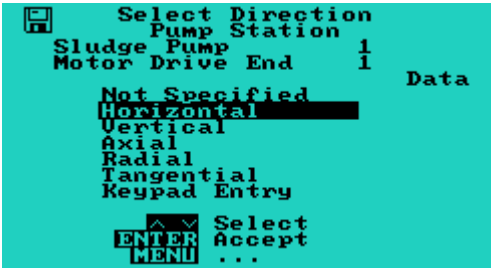


- Press ^ or v to highlight a point.
- Press HELP 2 to display the Edit Name Menu.
- Enter a name for the point by choosing characters from the keyboard (see Entering Text and Numbers on page 16, for details of how to do this).
- Press ENTER to save the name.

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Creating a Direction/Axis

- Create a point as described in the previous topic: Creating a Point (page 111).
- From the Select Point Menu press ENTER



- Press ^ or v to highlight a direction/axis.
- Press ENTER to select the highlighted direction/axis.

All points share the same direction names. The first six default direction names **cannot** be edited.

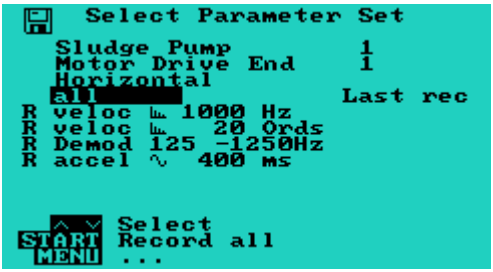
To create a new direction

- Press ^ or v to highlight a question mark in the Select Direction Menu and press HELP 2 to display the Edit Name Menu.
- Enter a name for the direction by choosing characters from the keyboard (see Entering Text and Numbers on page 16, for details of how to do this).
- Press ENTER to save the name.

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Creating a Parameter Set

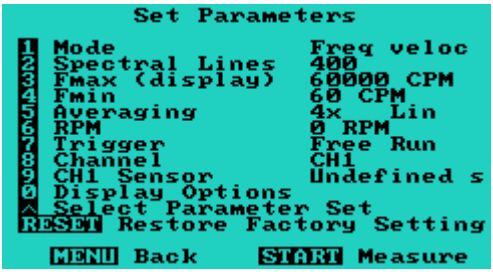
A parameter set is a user-defined group of measurement parameters that are used to take a measurement. Once a parameter set has been created in the instrument it will be added to the list in the Select Parameter Set Menu.



Any parameter set in the list can be selected and used to take measurements. A point can also have more than one parameter set applied to any given axes, giving you the flexibility to take multiple measurements at one location using different parameters.

- Select a direction/axis as described in the previous topic: Creating a Direction/Axis (page 112).
- From the Select Direction Menu press ENTER to select the highlighted direction/axis.

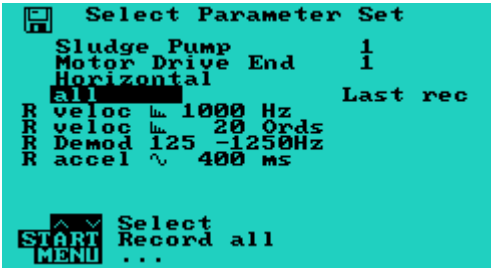
If the direction/axis does not have any parameter sets defined, the Set Parameters Menu will be displayed.



Refer to Setting Spectrum Parameters (page 65) for information on setting the different parameters.

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If the direction/axis already has a parameter set defined the Select Parameter Set Menu will be displayed.



- To review a parameter set, highlight it in the Select Parameter Set Menu and press HELP 2 to review its parameter values.
- To review the parameter set's most recent recording press ENTER

Note: When taking recordings, only the single trigger type can be selected because you are limited by the number of lines specified in your parameter set.

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Copying a Machine

If you have many identical machines you can save a lot of set up time by using the instrument's copy function. Copying a machine creates a new machine with the same named points, directions and parameter sets. Any recordings taken on the original machine are **not** copied to the new machine.

- From the Main Menu press HELP 2 to display the Select Machine Menu.
- Press ^ or v to highlight the machine you wish to copy.



- Press BACK 6 to copy the machine. The copied machine appears in the first unused slot in the list.



The name is the same as that of the original machine except for the last character, which is automatically incremented. The * icon will appear to the right of the new machine to indicate that it has one or more points and directions defined, but no recordings have yet been taken.

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Erasing a Machine

Erasing a machine will remove all its points, directions and recordings permanently from memory.

Note: Any parameter sets used by the machine will **not** be removed but will remain in the Select Parameter Set Menu so they can be applied to other recordings.

- From the Main Menu press HELP 2



- Press ^ or v to highlight the machine to be erased then press – 5
- If the machine has recordings (as indicated by the ✓ icon) you will be prompted to press SHIFT + RESET 1 to erase the data. You must delete any data from the machine before the machine can be erased.
- Once the machine has no data you will be prompted to press SHIFT + RESET 1 to erase the machine.

To cancel the erasure

- To cancel the pop-up window and not erase an item, press ENTER or simply wait to allow the window to disappear by itself.

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Erasing a Point, Direction/Axis or Parameter Set

Erasing points and other items is performed in the same manner as erasing machines.

- From the Main Menu press HELP 2 to display the Select Machine Menu.



- Press ^ or v to highlight the machine containing the item to be erased.
- Press ENTER repeatedly in combination with ^ or v to navigate to the menu containing the item to erase.
- Once you have the correct menu displayed, highlight the item and press MENU to display a pop-up menu containing the erase option.



- Press – 5 to select the erase option. You will be prompted to confirm.
- Press SHIFT + RESET 1 to erase the item.

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Renaming a Machine, Point or Direction/Axis

- Select the machine, point or direction/axis.
- Press HELP 2 to enter the Edit Name Menu.
- Press SHIFT + RESET 1 to clear the current name then type in a new name.
- Press ENTER to save the name and return to the previous screen.

Maintaining Data Integrity

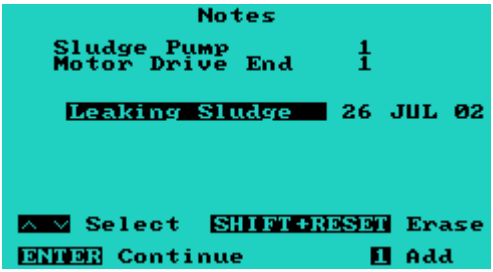
Caution: The Ascent software identifies machines, points, axes and sensors by their names. If you rename such an item in the instrument and then transfer data from the instrument to the Ascent software, the software will treat it as a new item. Furthermore, avoid having duplicate names in the instrument. They will be differentiated solely on the order that they appear in the instrument and the software.

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Attaching Notes to an Item

A 16-character note can be attached to each item on the recording list: machines, points, directions/axes and recordings. To view or edit the note for an item:

- From the Main Menu press HELP 2 then press ENTER till you have the correct menu displayed.
- Press ^ or v to highlight the item in the list.
- Press LIGHT 3 to enter the Notes Menu. This menu lists all the notes that are attached to the currently selected item.



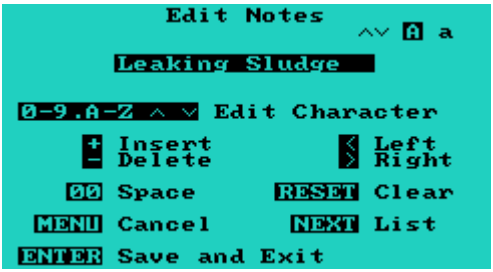
- Press RESET 1 to add a note. See Entering Text and Numbers (page 16), for details on how to add text.
- Press ENTER twice to save the note and return to the previous screen. The icon will appear beside the item to indicate that a note has been attached.

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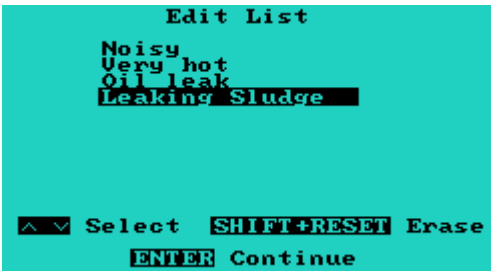
Selecting a Note from a List

When you are in the Notes Menu, pre-defined notes can be added to a machine, point, direction/axis or recording.

- From the Notes Menu (see previous topic: Attaching Notes to an Item on page 120) press RESET 1 to display the Edit Notes Menu.



- Press SHIFT + NEXT 7 to display the Edit List Menu.



- Press ^ or v to highlight the note to be used.
- Press ENTER to select the note and return to the Edit Notes Menu. The note can then be edited if required or press ENTER again to add this note to your item.

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Removing a Note from an Item

- Highlight the item with the note attached then press LIGHT 3 to enter the Notes Menu.
- If there is more than one note attached to the item press  or  to highlight the note you wish to remove.
- Press SHIFT + RESET 1 to remove the note.

Note: This procedure only removes the note from the selected item. The note remains in the Edit List Menu where it can be selected and attached to other items. To permanently erase a note see the next topic.

Erasing a Note Permanently

- Access the Edit List Menu (see Selecting a Note from a List on page 121).
- Press  or  to highlight the note to be erased.
- Press SHIFT + RESET 1 to erase the note.
- Press ENTER then MENU then ENTER again to return to whichever menu you started from.

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Section 9: Balancing Rotors

This section describes the procedure for performing balancing operations on your instrument.

You will learn to:

- Understand the balancing process
- Set balancing parameters
- Perform trial readings
- Perform balancing
- Review balance readings
- Use balance weight calculations
- Load, save, edit and delete data in the vb memory
- Produce balance reports

Note: Balancing is not available in the vb1000v

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Introduction

The instrument can be used to balance rotors that are rigid but **not** rotors that flex significantly at their operating speeds.

An imbalanced rotor is one that has an uneven mass distribution that causes the rotor to vibrate when it is rotated. Balancing a rotor means correcting the uneven mass distribution by adding or removing weight to/from precisely calculated positions on the rotor.

A rigid rotor can be balanced in one plane or two planes i.e. any uneven mass distribution in the rotor can be corrected by adding/removing weights to/from one or two selected cross-sectional planes on the rotor.

For single plane balancing, the mid plane of the rotor is usually used as the balancing plane. For dual plane balancing, usually the planes at the extreme ends of the rotor are used, however, other planes on the rotor can be used also.

Since the effect of a rotating weight (i.e. the centrifugal force) increases with the radial distance of the weight, it is common to add weight to, or remove weight from, the rim of the rotor rather than a position close to the centre of rotation. By making weight adjustments at the largest possible radial distance, the amount of weight that needs to be added to, or removed from, the rotor can be minimized.

The centrifugal force of a heavy spot on the rotor that causes the rotor to vibrate increases with the square of the rotational speed. The vibration level of the rotor may be acceptable at one speed but not at another. It is thus important to always allow the rotor to settle to its normal operating speed before taking balancing analysis measurements.

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Whether a rotor should be balanced in one plane or two planes depends on the dimensions and operating speed of the rotor. The following guideline is commonly used:

Rotor Length to Diameter Ratio	Operating Speed	Balancing Technique
0.5 or less	1000 RPM or less	Single plane balancing
	More than 1000 RPM	Dual plane balancing
More than 0.5	150 RPM or less	Single plane balancing
	More than 150 RPM	Dual plane balancing

Note: Before attempting to balance a rotor, confirm that the cause of vibration is uneven mass distribution in the rotor. Good balancing results can be obtained only if vibration is caused by uneven rotor mass distribution. Attempting to balance a rotor with other problems will not, in general, reduce the vibration level.

The Balancing Process

A rigid rotor can be balanced in one or two planes. The following steps are involved:

Setting Balancing Parameters - Select units and balancing method.

Initial Reading - A measurement of the imbalance is taken.

Trial Weight Reading - A trial weight is attached to the balancing plane and another measurement is taken. For dual plane balancing, the same is also done for the second plane.

Balancing - Correction weights are attached to the balancing plane(s) as recommended by the instrument.

Trim Balance - A measurement is taken in each plane to confirm that the rotor is balanced. Any residual imbalance can be removed via additional trim balance cycles.

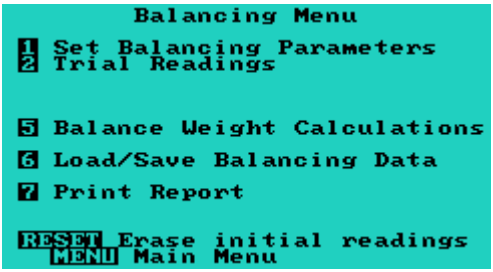
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The Tachometer

The tachometer provides the instrument with information regarding the rotational speed of a rotor and the angle at which the rotor is vibrating. The angle is measured from a fixed reference mark on the rotor and is called the ‘phase angle’. To balance a rotor it is necessary to consider not just the amplitude of vibration but also the phase angle. The amplitude shows the severity of the imbalance and the phase angle indicates the geometry of the imbalance (i.e. the location of the heavy spot). Tachometer Setup (page 23) contains information on how to set up the tachometer to measure phase angles.

The Balancing Menu

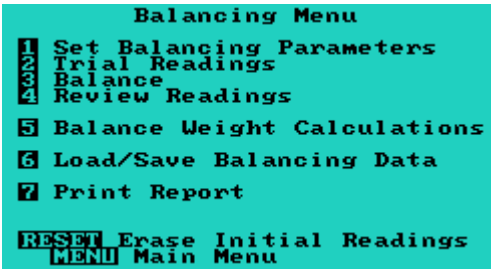
- From the Main Menu press 8 to display the Balancing Menu.



Example of Balancing Menu with no recordings taken

After initial and trial readings have been taken the Balancing Menu will update to give you options to balance and review readings (menu items 3 and 4).

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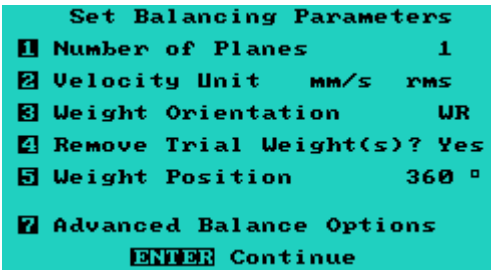
Example of Balancing Menu with recordings

Pressing SHIFT + RESET 1 from this menu erases the current measurement data in a two stage process. The first press erases the trim balance readings. The second press erases both initial and trial weight readings.

The rest of this section describes the Balancing Menu options. Balancing Walk-through (page 145) will explain how to use these options when performing a balance job.

1. Set Balancing Parameters

The Set Balancing Parameters Menu allows you to select the appropriate parameters to be used for balance jobs.



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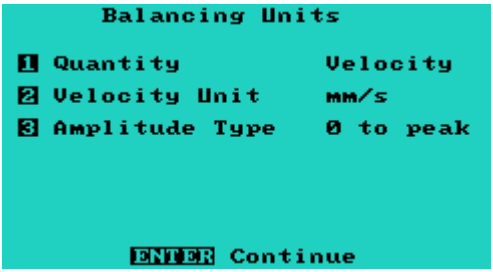
Number of Planes

(vb3000 and vb2000 only)

- Press RESET 1 to toggle the number of balance planes to use.

Balancing Units

The Balancing Units Menu allows you to select different balancing units.



Available units are: (press the appropriate number key to toggle the setting)

RESET 1 **Quantity**	Displacement	Velocity	Acceleration
HELP 2 **Units**	µm, mm, mil	mm/s, in/s	g, m/s2
LIGHT 3 **Amplitude Type**	peak-peak, rms, Ø-peak		

Weight Orientation

This option allows you to choose where to place balance weights on a rotor relative to the rotor's direction of rotation.

With rotation **(WR)** means you choose a reference point then place your weights forward of that point in the direction of rotation (i.e. in the same direction as the rotor turns).

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Against rotation **(AR)** means that if the rotor is turning forward then you place your weights backwards from the reference point (i.e. in the opposite direction of the rotor's rotation).

Ensure that with the rotor stationary, you *measure angles in the direction specified*. Do **not** rotate the rotor in the direction specified.

The selected option is also stored when the balancing data is saved, and reloaded if the data is reloaded from memory.

Note: AR and WR now only describe the placement of balance weights. AR and WR no longer apply to tachometer or cross channel phase measurements.

Remove Trial Weight(s)?

Used to specify whether the trial weight is left on or taken off after the trial reading.

Note: For dual plane balances, if Remove Trial Weights = Yes then the trial weight must be removed after **each** trial run.

Weight Position

Performing balancing operations on a rotor requires establishing a positioning system for balance weights. To do this you must first establish a reference mark anywhere on the rotor circumference then choose the technique that is most appropriate for your balance job.

Degrees
Measure the angle in degrees (0° to 359°) from the reference mark. The radius must stay constant.

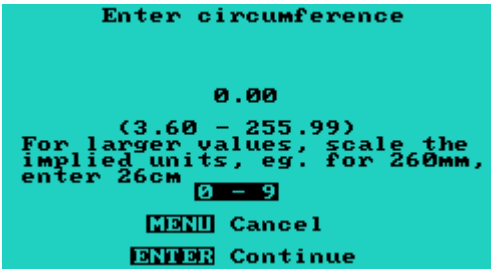
Circumference Arc
Measure the linear distance around the outside of the rotor from the reference mark to the weight.

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 # Fixed Positions
Establish a fixed number of attachment points (e.g. drilled and tapped holes) that are equally spaced on a fixed radius from the center of the rotation.



- Press ^ or v to highlight your selection then press ENTER to continue. If choosing Circumference Arc or # Fixed Positions this will open a sub-menu where you can specify the total circumference or numbers of points.

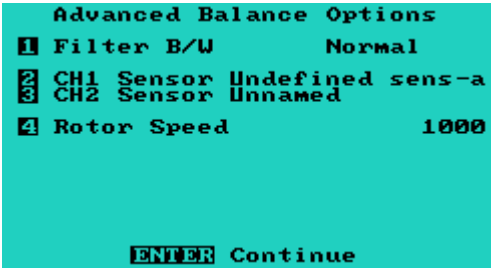


Right Weight Position
Same as for Left Weight Position but only appears if a dual plane balance is selected.

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Advanced Balance Options

- Press NEXT 7 to open the Advanced Balance Options Menu.



RESET 1 **Filter B/W**
Selects Normal or Narrow filter bandwidth for vibration measurement. The Normal option takes faster measurements, allows better stability, and should be used except where background sources of vibration noise exist very close to the frequency (within 150 RPM) of the rotating equipment being balanced. The Narrow option is more useful if noise is present close to the 1X as it takes slower measurements.

HELP 2 **CH1 Sensor**
Used to select/set up the Channel 1 sensor. See Specifying Sensor Settings (page 76), for details.

LIGHT 3 **CH2 Sensor**
Same as for the CH1 Sensor, but only available in dual plane balancing.

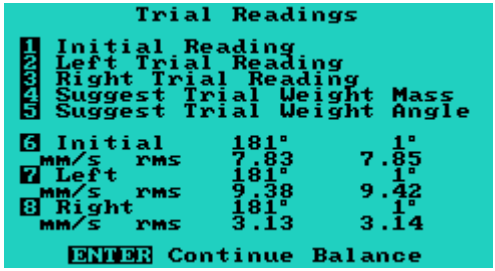
+ 4 **Rotor Speed**
Used to enter the rotor speed. This option is only required for calculations if balance readings are being entered manually. The instrument obtains this value from the tachometer if measurements are being performed.

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2. Trial Readings (Single/Dual Plane)

The Trial Readings Menu allows for the initial measurements to be performed before beginning the balancing of the machine.

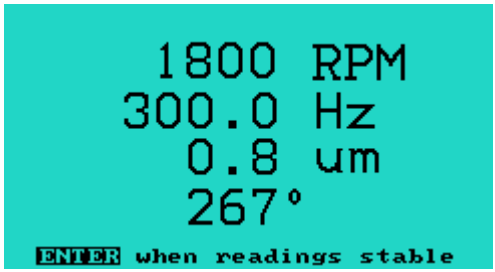
- The Trial Readings Menu is accessed by pressing HELP 2 from the Balancing Menu.



The diagram shows a dual plane balance job after initial and trial readings have been taken.

Initial Reading

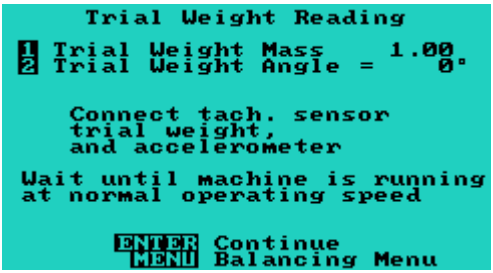
Used to take an initial reading to determine the 'out of balance' level before performing any balancing procedures. When measuring has started, the instrument will display the initial measurement in Hz, RPM, your chosen display units and degrees (the phase angle of the imbalance).



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Trial Weight Reading (Left Trial Reading)

Used to take a trial weight reading in single plane balancing and the left trial weight reading in dual plane balancing.



The diagram shows the factory default values for trial weight mass (1.00) and angle (0°).

Note: Your trial weight must be of a sufficient mass to change the rotor imbalance so that the instrument can perform its calculations accurately (the industry norm is approximately 30% change in amplitude or 30° in phase). If in doubt use the Suggest Trial Weight Mass Calculator (described shortly).

Right Trial Reading

Used to take a trial weight reading in dual plane balancing.

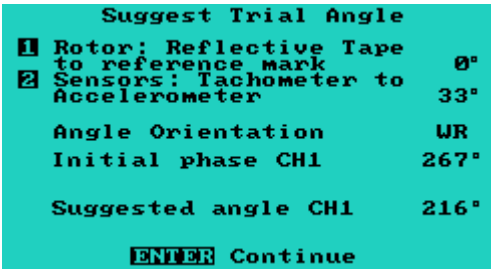
Suggest Trial Weight Mass

Opens the Suggest Trial Weight Calculator. This calculates a suitable trial weight to cause a significant change from the initial reading.

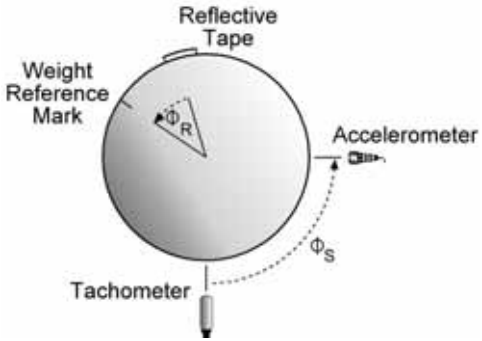
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Suggest Trial Weight Angle

This tool aids you in determining where on the rotor to place the trial weight after an initial reading has been taken. The aim is to reduce the initial vibration in order to maximize the accuracy of the trial weight readings.



This function suggests a trial weight angle based on the phase of the initial reading, the angle between the tachometer and accelerometer sensors (Φ_S) and the angle between the tachometer reflective tape and your weight reference mark on the rotor (Φ_R). The suggested angle is measured from the weight reference mark in the direction of the Angle Orientation.



- From the Balancing Menu press HELP 2 Trial Readings.
- Press RESET 1 to take your initial reading.

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- After the initial reading has been taken press — 5 Suggest Trial Weight Angle.
- Press RESET 1 to enter the tachometer-to-reference-mark angle. On the rotor, measure the angle between the tachometer reflective tape and your weight reference mark. If these marks are aligned with each other enter zero.
- Press ENTER then press HELP 2 and enter the angle between the tachometer and accelerometer.
- Press ENTER and the instrument will calculate a suggested trial weight angle.

Notes:
This calculator can only be used with accelerometers.

Angles are measured using the same orientation as is used for the placement of balance weights i.e. with rotation or against rotation. The angle orientation defaults to that chosen in the Set Balancing Parameters Menu. If this orientation is changed, your entered angles and result will be automatically translated to the new orientation for you.

Dual plane balance jobs are also supported, with suggested angles calculated for both planes. However the calculator should only be applied in cases where each balance plane is physically close to its accelerometer sensor, and the two planes are well separated from each other (e.g. by more that the rotor diameter). In particular for overhung rotors the calculator should only be used in single plane mode on the closest bearing and balance plane, to help with reducing the static imbalance only. The CH2 accelerometer and weight reference mark positions must be in line with those of CH1.

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Initial

Allows the initial reading to be manually input without having to use the instrument to record the measurement directly from the machine.

Left

Left (or Trial for single plane balancing) allows the trial or left trial readings to be manually input.

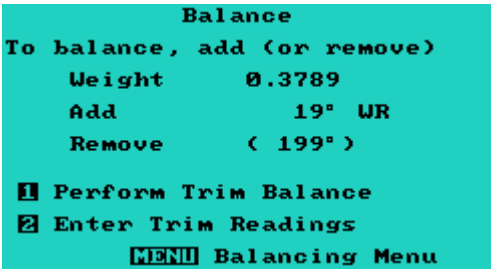
Right

This option is only available for dual plane balancing and allows the right trial readings to be manually input.

3. Balance

This menu displays the weight to be added or removed to balance the rotor, and the angle, fixed position(s) or circumference arc at which to do so.

- The Balance Menu is accessed by pressing LIGHT 3 from the Balancing Menu.



Note: The weight units are not displayed but are implied to be the same as those used for the trial weights.

The direction of angle measurement is specified by the two letters following the angle. ‘WR’ indicates With Rotation and ‘AR’ indicates Against Rotation.

If the weight is to be removed then the angle to do so is displayed in parentheses ‘()’. This is the point of attachment + 180°.

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Perform Trim Balance

Used to take a measurement of the machine after the weight has been added or removed from the rotor.

Perform Trim Balance confirms the balance level achieved after the weights were positioned. After another measurement is taken, the Balance Menu will display the new balancing requirements.

The balance process can end at this point or continue with another reposition of balance weights, as indicated, to improve on the balance level. Repeat until you are satisfied with the results or no further reduction of imbalance can be achieved.

The ISO 1940 limits option, available from the Balance Weight Calculations Menu, is provided with the instrument to help you determine the acceptable level of residual imbalance for your rotor. See Balance Weight Calculations (page 138), for more information.

Enter Trim Readings

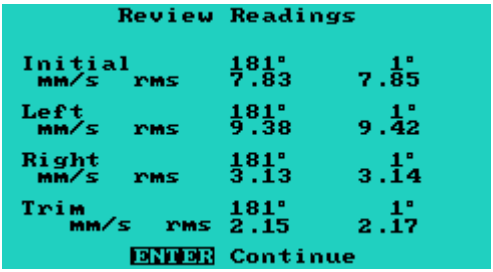
Allows for trim reading to be manually input without having to use the instrument to record the measurement directly from the machine.

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4. Review Readings

Review Readings reviews the results of the Initial Reading, Trial Reading, and latest Trim Balance Reading. These values can be saved to, or loaded from data storage as described in Load/Save Balancing Data (page 141).

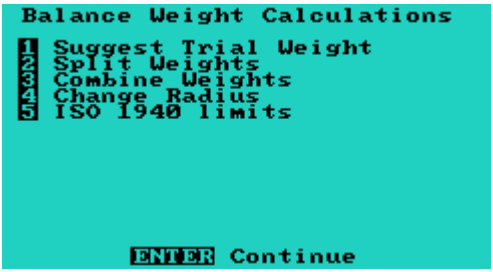
- The Review Readings Menu is accessed by pressing + 4 from the Balancing Menu.



5. Balance Weight Calculations

This menu provides a number of useful calculation tools that support you in performing balance jobs.

- The Balance Weight Calculations Menu is accessed by pressing − 5 from the Balancing Menu.

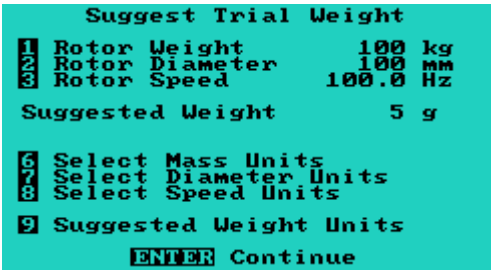


The results of any balance weight calculation will be displayed using the same units as the input weight.

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Suggest Trial Weight

This tool aids you in determining the appropriate amount of suggested balance weight to use based on the weight, diameter and rotor speed of the machine being balanced. The calculator works out a suitable trial weight to cause a significant change from the initial reading.



You also have the option of using different units of measure for the mass of the Rotor (lb, oz, kg), the Rotor Diameter (in, mm), the Rotor Speed (Hz, RPM), and the Balance Weight units (oz, g).

Notes:
Changing from one unit to another does not directly translate the associated value. You will need to reset the value as needed, to match the application.

The Suggest Trial Weight option is also available directly from the Trial Readings Menu (note that the option is called Suggest Trial Weight Mass in that menu).

Split Weights

This tool allows you to take a calculated single point balance solution (correction weight and angle), and translate it into a two weight (split weight) solution. You will need to define the two new correction angles so that the resulting balance weights at each angle can then be calculated.

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Combine Weights

This tool allows the user to combine two weights into a single weight at one angle. This calculation can be performed many times to combine all trim weights into one weight and angle. The user must define the weight and angle of the two beginning balance masses.

Change Radius

This tool takes a single point balance solution and allows you to find a new balance weight based on a change in radius for the existing balance weight. The calculation assumes the angle of weight placement will remain constant and only the distance from center of rotation is changed.

ISO 1940 Limits

This calculation computes the maximum allowable residual imbalance to achieve a desired standard of balance. Please refer to the ISO 1940 standard to find which G levels are appropriate for a particular machine.

This calculator uses the rotor weight, the diameter at which correction weights are added, the speed and the required balance level to determine a maximum residual weight. Units can be toggled in a similar manner to the trial weight correction screen. If the reported correction weight to add or remove is less than this residual, the chosen ISO balance standard has been reached.

When balancing in two planes it is normally sufficient to simply allow half of this residual imbalance on each plane. For asymmetric or overhung rotors, please refer to the ISO 1940 balancing standard.

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6. Load/Save Balancing Data

The instrument is capable of saving up to 10 balancing jobs to machines in its memory. Initial readings, trial readings, trim readings and completed balances can be stored.

- The Load/Save Balancing Data Menu is accessed by pressing BACK 6 from the Balancing Menu.



- Select the desired machine using the arrow keys to scroll from one location to the next on the screen.
- Press SHIFT with the arrow keys to scroll by units of 10.
- Press and hold the arrow keys to accelerate the scroll speed.

Once a machine is selected (indicated by the black, highlighting bar), the possible operations include:

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RESET 1 **Load** balancing data from this machine into the instrument's current memory. The stored data includes the parameter settings, the initial and trial readings, and trim readings.

Caution: This operation will overwrite any data already in current memory.

HELP 2 **Edit** the name of the machine. The screen prompts indicate what options are available for data entry (see Entering Text and Numbers on page 16).

LIGHT 3 **Save** the balancing data currently in memory to the selected machine.

Caution: This operation will overwrite any balance data already stored in this memory location. The symbol ✓ is displayed to the right of any memory location that has vibration data stored in it. The symbol ⚖ is displayed to the right of any memory location that has balancing data stored in it.

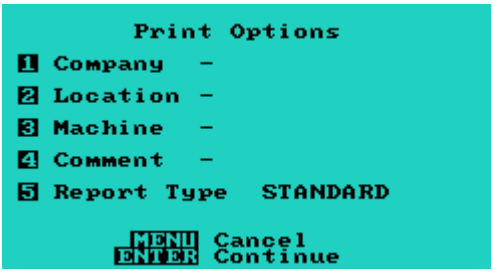
\+ 4 **Delete** erases the balancing data from the selected machine, leaving all other data belonging to the machine intact.

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7. Print Report

Detailed balancing reports are normally produced from Ascent using the Report menu. However, you also have the option of using a thermal printer to print directly from the instrument. Within the instrument, two report types are available: STANDARD and EXTENDED. STANDARD prints the initial imbalance and the residual imbalance left in the machine. EXTENDED prints the initial imbalance, trial balance recordings and the associated trial weight(s) used, and the residual imbalance left in the machine.

The print options you set will determine which information is included in the report.



To include the company name, location, machine name or any comments, press the number key that corresponds to that option. The Edit Name Menu will open allowing you to type up to 16 characters. If any of the four user-defined fields are left blank, then they are not printed on the report.

Refer to Printing from the Instrument (page 157), for details on setting up the printer.

- The Print Report Menu is accessed by pressing NEXT 7 from the Balancing Menu.
- Enter any optional information to be included in the report, e.g. machine name, by pressing the appropriate number key and typing in the characters, then press ENTER to close the Edit Name Menu.

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- Press 5 to select the report type.
- Press ENTER to print the report.

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Section 10: Balancing Walk-through

This walk-through guides you through the process of balancing a rotor using single and dual plane balancing. Dual plane balancing requires all the steps relating to single plane balancing and includes extra instructions marked with 

You will learn to:

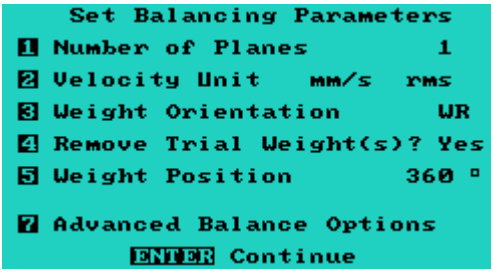
- Set balancing parameters
- Take initial imbalance measurements
- Set up and apply trial weights
- Perform balancing and trim balances

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Step 1. Set Balancing Parameters

- Check the battery capacity of the instrument and if it is less than 30%, charge the battery pack (see Battery Management on page 161).
- From the Main Menu press 8 to access the Balancing Menu.
- Press SHIFT + RESET 1 twice to reset any previous readings.

The following screen shows the parameters that were set for this walk-through.



- Press RESET 1 to access the Set Balancing Parameters Menu. See Set Balancing Parameters (page 127), for details of how to set your parameters.

Step 2. Initial Reading

- **Stop the machine**.
- Attach the sensor to the bearing housing closest to the rotor. For best results attach it in the radial direction in which the machine is most flexible (and vibrates the most).

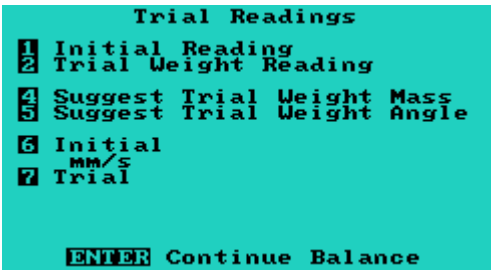
Attach the sensor to each of the bearings supporting the rotor. It does not matter how the sensors are paired or which sensor is attached to which end.

- Set up the tachometer (see Tachometer Setup on page 23).

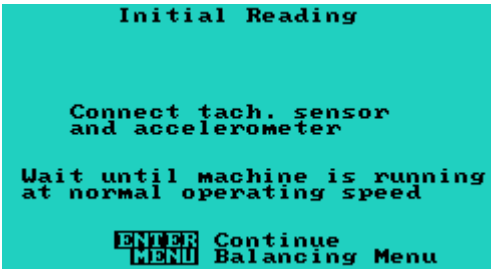
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- **Start the machine** and let the rotor settle to its normal operating speed. Since the vibration level is dependent on the speed of the rotor it is important to take all readings while the rotor is operating at its normal speed.

- Press HELP 2 from the Balancing Menu to access the Trial Readings Menu.



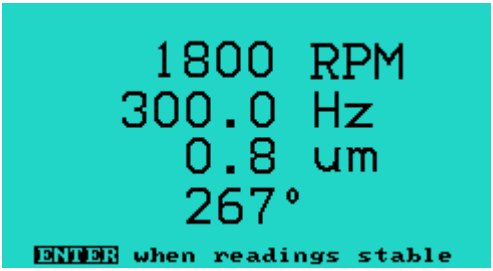
- Press RESET 1 to access the Initial Reading Menu.



- Press ENTER to perform an initial measurement of imbalance.

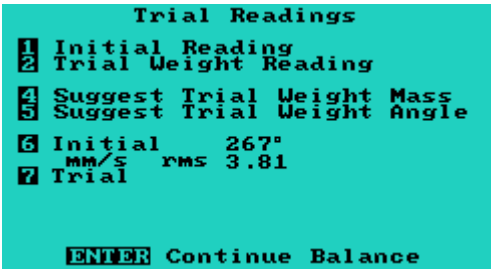
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After a few seconds, the instrument displays the speed of the rotor in RPM and Hz, the vibration level due to the imbalance (i.e. amplitude at 1X the rotor speed), and the phase angle of the vibration. Note that our recording shows an amplitude of 3.8 mm/s. The aim is to reduce this to an acceptable level.



- Wait for the readings to stabilize then press ENTER to store the recording.

The Trial Readings Menu will again be displayed. The Initial Reading measurement is shown using the amplitude and units you selected from the Set Balancing Parameters Menu, and includes the phase angle of the imbalance.



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Step 3. Trial Weight Reading

- **Stop the machine**.

- Establish a reference mark on the balancing plane. This will be used to measure the angular position of the trial weight and the final balance weights. The reference mark can be at **any** position around the balancing plane. It does not need to be referenced to the tachometer reflective tape position.



In dual plane balancing, establish a reference mark on the Right plane also. It does not need to correspond with the Left plane reference mark.

- Attach a trial weight to the balancing plane. It is important that the trial weight is not too large as it may damage machine bearings, and not too small as its effect will be imperceptible. If you are unsure how much weight to use press 

from the Trial Readings Menu to access the Suggest Trial Weight Menu. From here you can calculate an appropriate weight to use. When you have finished press 

to return to the Trial Readings Menu.

Note: You can use any weight unit (gram, kg, oz, lb), without informing the instrument. The instrument will express the final balance weights in the same (implied) units.

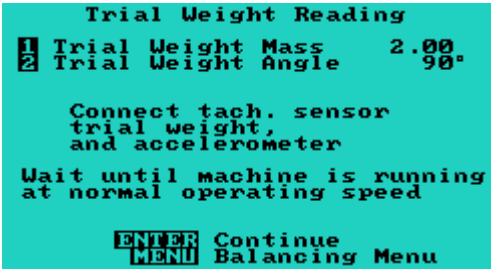


In dual plane balancing, attach the first trial weight to the designated Left plane.

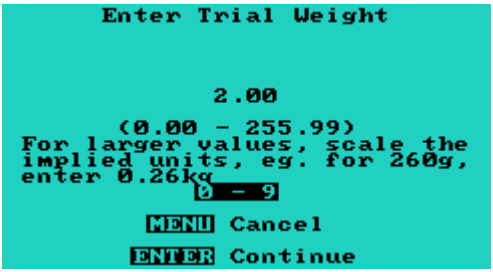
- The trial weight position should be near the rim of the rotor but can be at any angular position. Starting at the reference mark, measure the angular position in the direction specified for the Angle Measurements parameter in the Set Balancing Parameters Menu. This will be either WR (with rotation), or AR (against rotation).

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- Press HELP 2 to access the Trial Weight Reading Menu.



- Press RESET 1 to enter your own Trial weight mass. Use the number keys to enter a value then press ENTER to continue.



The Left Trial Reading Menu replaces the Trial Weight Reading Menu for dual plane balancing.

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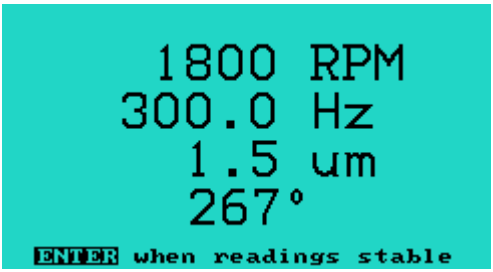
- Press HELP 2 to enter the angular position of the trial weight with respect to the reference mark. (If using circumference arc or fixed positions for your weight position reference system, enter the trial weight point or trial arc.) Use the number keys to enter a value then press ENTER to continue.



- Replace safety covers, **start the machine again**, and let the rotor settle to its normal operating speed.

- Press ENTER to take a reading of the imbalance with the trial weight added.

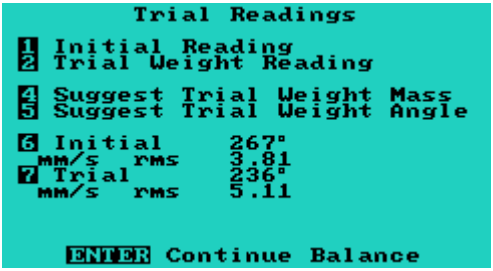
After a few seconds, the instrument displays the speed of the rotor in RPM and Hz, the vibration level with the trial weight added (i.e. amplitude at 1X the rotor speed), and the phase angle of the vibration.



- Wait for the readings to stabilize and then press ENTER to accept the recording. Note that our recording now has an amplitude of 5.1 mm/s. The trial weight has actually increased the imbalance.

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The Trial Readings Menu is now updated to display both the Initial and Trial reading measurements.



Perform the same procedure for the Right plane by attaching a trial weight to the designated right plane. If the option 'Remove Trial Weight' is set to YES then the Left Trial weight must be removed before performing the Right Trial reading.

Perform the reading using option LIGHT 3 Right Trial Reading from the Trial Readings Menu.

- Press ENTER to return to the Balancing Menu.

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Step 4. Balancing

With Initial and Trial Readings completed the main Balancing Menu will display the Balance option.

- Press LIGHT 3 to access the Balance Menu.

The instrument displays the weight required to correct the initial imbalance and the angular position at which it must be attached. As an alternative to attaching a correction weight, you could also remove the same amount of weight half a revolution (180º) away from where you would attach the correction weight. The angular position for weight removal is shown in parentheses.



- **Stop the machine**. If the option Remove Trial Weight is set to YES remove the trial weight.

- Attach or remove the recommended correction weight as indicated by the instrument and then proceed to Trim Balance.

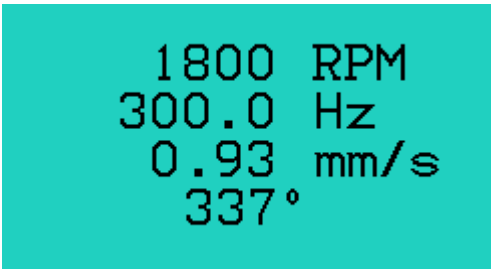
In dual plane balancing there will be two columns of weights and positions to add or remove the associated weights. The column on the left-hand side of the screen refers to the designated Left plane and the column on the right hand side of the screen refers to the designated Right plane.

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Step 5. Trim Balance

- Replace safety covers, **start the machine again** and let the rotor settle to its normal operating speed.
- Press RESET 1 to perform a Trim Balance.

After a few seconds the instrument displays the vibration level with the imbalance corrected.



- Press ENTER to return to the Balance Menu.

The instrument will now display the details of additional weight adjustments required to trim-balance the rotor (i.e. to further reduce the level of vibration/imbalance). You can end balancing at this point or continue with another reposition of trim balance weights, as indicated, to improve on the balance level. The trim balance process can be repeated until you are satisfied with the results. When you have finished, press MENU to return to the Balancing Menu.

- You may wish to check that the residual imbalance meets machine-balancing standards such as ISO 1940 and ISO 2372. The instrument includes an ISO 1940 calculator should you wish to check the residual imbalance. To access this, from the Balancing Menu press – 5 Balance Weight Calculations.
- To review measurement and weight adjustment details at various stages of the balancing process, press + 4 Review Readings from the Balancing Menu.

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- At any point in the process it is possible to save the balancing data to a machine in the current data folder. To save the recordings, return to the Balancing Menu and press 

Load/Save Balancing Data. Select a machine and press 

Save, to save the balancing data. You will then be returned to the Balancing Menu.

Note: Only one balance job at a time can be saved to a machine - any existing balance data will be overwritten. To create a 'history' of balance jobs carried out on one machine, create a new machine each time you need to save the balancing data. Give the machines similar names to remind you that they all refer to the same machine.

Tips for Balancing

- Before performing a balance job, clean the rotor removing any dirt or loose-hanging material such as rust, flaking paint etc, which may affect balancing results if they fall off later.

- Ensure that any weight(s) you add will not come loose at the normal rotor speed and that it will not obstruct machine motion. If possible, manually rotate the rotor to ensure that the weight does not clash with any part of the machine, keeping in mind that the rotor's center line may shift when operated at its normal speed.

- Ensure the weight of any mechanism used to hold the correction weights in place is included as part of the correction weight. If you are welding on the weight, make sure that the weight of the flux is not included (scrape the flux off before weighing the electrode).

- Ensure that the shape of the correction weight does not cause it to become a dirt trap since dirt accumulated on the weight may cause rotor imbalance.

- It is important to attach the correction weight(s) at the same radial distance that the trial weight was i.e. if the trial weight was attached 'n' mm/inches from the center of the rotor, the correction weight must also be attached 'n' mm/inches from the center of the rotor.

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Section 11: Utilities

This section describes how to use the utility functions of your instrument.

You will learn to:

- Print from the instrument
- Adjust the LCD display
- Set the date and time
- Manage the instrument battery pack
- Erase all recordings and machines
- Upgrade the instrument firmware using PROFLASH
- Set other instrument options

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Printing from the Instrument

The optional Seiko DPU-414-30B printer is not included with the standard vb kit.

Connecting and setting up the printer to the instrument is outlined as follows:

- Plug the printer cable D connector into the printer serial input and the 5 pin connector plug into the instrument's RS232 port.
- Switch the printer on and ensure the ON LINE indicator (green) is on, as it does not come on automatically on some printers, and will need the ON LINE button pressed.

Caution: When using the DPU-414-30B printer, use only the Seiko power adapter provided (6.5 Volt output). Printer damage may occur if any other power adapter is used.

Notes:
Earlier models of Seiko DPU printer are not supported. In particular the DPU-411 printer is not supported.

When using the DPU-414 printer ensure that its internal battery is charged prior to operation. If the printer battery is flat the printer will switch itself Off Line and printing will cease.

Printing Balancing Reports from the Instrument

Although the most flexible way to print balancing reports is to upload the data to Ascent, it is also possible to print directly from the instrument. (see Print Report on page 143 for full details).

DPU-414-30B Printer Setup

The DPU-414-30B has a virtual DIP SW which should be set up the first time the printer is used. You may need to reset operational settings if the supply voltage is interrupted.

Caution: Never turn the printer off while it is writing the new setting to memory. Always wait until DIP SW setting complete !! is printed before turning the power off.

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To set the virtual DIP SW, begin with the DPU-414-30B switched off and complete the following procedures:

- Slide the power switch to ON while pressing the ON LINE button.
- Release the ON LINE button after a list of the current settings starts printing out.

The printout of the current settings is followed by the prompt:

Continue ? :Press On-line SW
Write ? :Press Paper feed SW

- To change the DIP SW settings press the ON LINE button.
- To leave the DIP SW settings unchanged press the FEED button.

After pressing the ON LINE button, DIP SW1 is printed, prompting the input of new settings for switch numbers 1 through 8 of DIP SW1. Refer to the following table for the required settings to print from the instrument. Always input either ON or OFF for every setting for switch numbers 1 through 8 because DIP SW Set mode cannot be cancelled once it is initiated.

- ON can be set by pressing the ON LINE button once and OFF by pressing the FEED button once

The setting is printed out after the ON LINE or FEED button is pressed to confirm the new setting.

As soon as switch number 8 is set the printer once again prompts Continue ? or Write ?. Continue ? (ON LINE) allows DIP SW2 and DIP SW3 to be set in turn, and Write ? (FEED) exits DIP SW setting mode.

After the FEED button is pressed, the ON LINE and OFF LINE lamps alternately blink and the new settings are written to memory. When the printer finishes writing everything to memory, 'DIP SW setting complete !!' is printed out and the printer returns to the ON LINE mode.

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As soon as switch number 8 of DIP SW3 is set, the printer writes the settings to memory regardless of which button is pressed.

DPU-414-30B 'Virtual' DIP Switch Settings

DIP SW	Switch No.	Function	Switch Settings	Status
DIP SW1	1	Input = Serial	OFF	Essential
	2	Printing Speed = High	ON	Optional
	3	Auto Loading = ON	ON	Essential
	4	Auto Line Feed = OFF	OFF	Essential
	5	Setting Command = Enable	ON	Essential
	6	Printing	ON	Optional
	7	Density	OFF	Optional
	8	= 93%	OFF	Optional
DIP SW2	1	Print Columns = 40	ON	Essential
	2	User Font Backup = ON	ON	Optional
	3	Character Select = Ordinary	ON	Essential
	4	Zero = Normal	ON	Optional
	5	International	ON	Essential
	6	Character	ON	Essential
	7	Set	OFF	Optional
	8	= England	OFF	Essential
DIP SW3	1	Data Length = 8 bits	ON	Essential
	2	Parity Setting = No	ON	Essential
	3	Parity Condition = Odd	ON	Essential
	4	Busy Control = H/W Busy	ON	Essential
	5	Baud	OFF	Essential
	6	Rate	ON	Essential
	7	Select	ON	Essential
	8	9600 bps	ON	Essential

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Adjusting the LCD Screen

Adjusting the Contrast

- From the Main Menu press and hold ^ to darken the LCD.
- Press and hold v to lighten the LCD.

If the screen flickers when the cursors or highlight bar are moved rapidly, make the LCD darker.

Restoring the Default Contrast

- From the Main Menu press SHIFT + RESET 1 to restore the default contrast.

Turning the Backlight On/Off

The backlight provides better LCD visibility in dark environments.

- In any screen, press SHIFT + LIGHT 3 to turn the backlight on/off.

Note: The backlight consumes a relatively high level of power and will automatically turn off if the battery voltage falls below 6.1 V.

Setting the Date and Time

- From the Main Menu, press BACK 6 Date & Time.



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- To cycle to a particular item, press ENTER. The item will flash to show that it is selected.
- Use ^ and v to change the value of the currently selected item.
- Press MENU to save changes and exit.

All recordings are date and time stamped according to the clock shown in the Date & Time Menu.

Battery Management

The instrument is powered by a rechargeable Nickel-Cadmium (Ni-Cad) battery pack. The normal operating range is 6.0 V to 8.5 V. The Battery Management Menu displays the current percentage of full battery charge available.

Some automatic features have been built into the instrument to help ensure that the battery pack is always sufficiently charged.

Below 6.6 Volts, the instrument displays a flashing icon at the top left corner of the screen and beeps once every minute as a reminder that the battery pack needs to be charged. In the Battery Management Menu a flashing 'Low Battery' message is also displayed.

Below 6.1 Volts, the instrument automatically turns off the backlight to prevent further power draining.

Below 80% battery capacity, the instrument automatically begins to charge the battery pack if external power is supplied.

At 5.5 Volts, the instrument automatically powers down. The power saver is another feature that helps conserve power.

The instrument is equipped with an internal backup component that protects data and settings in case the battery pack is momentarily removed from the instrument. The backup component is kept charged by the battery pack if the battery pack is functioning normally.

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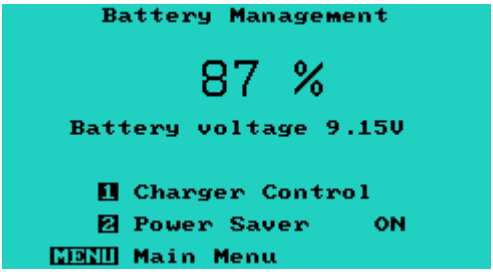
Warning: Do not detach the battery pack from the instrument for more than 2 hours as this will drain the backup component, thereby causing data and setting to be lost.

Warning: Before charging the battery pack, ensure that the power transformer used is an approved instrument power transformer 13.5 V ± 1.5 V DC, 1 A output, center positive, and that the voltage and frequency of your mains AC power matches that of the power transformer.

The battery pack can be charged by supplying 13.5 V ± 1.5 V DC, 1 A power to the instrument charger socket. The power transformer supplied in the kit provides this DC voltage. The optional car adapter charging lead may also be used to charge the battery pack in a vehicle with a 12 V negative-chassis power system.

Checking the Battery Charge and Voltage

- From the Main Menu press NEXT 7 to display the Battery Management Menu.

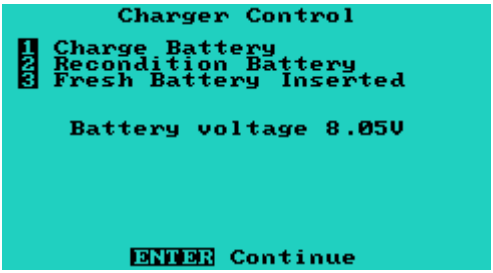


The remaining battery charge and voltage are displayed.

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Charger Control

This menu allows manual control of the battery charge function. The current battery voltage and charging state are displayed.



RESET 1 **Charge Battery**
Manually begins battery charging cycle.

HELP 2 **Recondition Battery**
Fully discharges and then automatically recharges the battery.

LIGHT 3 **Fresh Battery Inserted**
Resets the battery capacity scale percentage to 100% at the current battery voltage.

These options are explained in detail in the following pages.

Recharging the Instrument

Warning: Read the warnings in Battery Management (page 161) before charging the battery.

- Plug the power transformer into a standard power outlet and the connector to the instrument's charger socket.

If the battery charge level is less than 80% the battery will begin charging automatically. You can continue to use the instrument while the battery pack is being charged.

If the battery does not begin charging automatically follow the instructions below to begin charging.

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- From the Main Menu press NEXT 7 Battery Management.
- Press RESET 1 Charger Control.
- Press RESET 1 to begin charging. A flashing 'CHARGING' message will be displayed.

If there is no power coming from the power transformer a flashing 'NO CHARGER' message will be displayed. If this happens, check that the mains power is turned on and the battery adapter is connected properly.

Charging stops automatically when complete or you can press START STOP in the Charger Control Menu to stop the charging. A full charging cycle takes approximately 2 1/2 hours.

Reconditioning the Battery Pack

Warning: Read the warnings in Battery Management (page 161) before performing this operation.

Battery reconditioning is the process of first discharging and then recharging batteries. It reduces the undesirable memory effect in the Ni-Cad battery. The battery pack should be reconditioned the first time it is used and at least once a month thereafter to prevent battery degradation. The recondition process will take up to two hours, depending on initial battery charge.

Caution: If the battery pack is not reconditioned the first time it is used, the battery charge displayed may be incorrect.

- Plug the instrument power transformer to a standard power outlet and its connector to the instrument charger socket.
- From the Main Menu press NEXT 7 Battery Management.
- Press RESET 1 Charger Control.

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- Press HELP 2 to recondition the battery. Discharging is indicated by the flashing 'DISCHARGING' message on the screen.

The instrument automatically proceeds to charge the battery once the battery pack is fully discharged.

Fresh Battery Inserted

This resets the battery capacity scale percentage to 100% at the current battery voltage. This option should be used when a new, fully recharged battery is exchanged for a discharged battery.

Caution: If this selection is made when the attached battery is not fully charged the battery capacity scale will no longer be set accurately. Performing a Recondition Battery will recharge the battery and reset the scale.

Power Saver

Power saver is a feature that helps conserve power in the instrument. Power saver will turn the LCD display off after 8 minutes of inactivity (no key presses). The instrument will continue to function and any key press will turn the LCD on to the previously displayed screen. After 15 minutes of inactivity, power saver will power down the instrument. If the battery is being recharged, only the LCD screen will be turned off and the instrument will remain on until charging is complete.

The power saver is automatically turned on every time the instrument is powered up. You may turn it off temporarily by toggling power saver OFF from the Battery Management Menu.

- To turn off Power Saver, from the Main Menu press NEXT 7 Battery Management.

- Press HELP 2 to toggle Power Saver ON and OFF.

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Replacing the Battery Pack

- Lift the boot stand.
- Unscrew the battery pack using a suitable screwdriver and screw in the new one.

Warning: Ensure that the battery pack is securely fastened but not over-tightened.

Memory Management

Instrument Memory

The vb3000 has a standard memory size 32 MB that can store up to 11 000 recordings depending on recording type as shown below.

Recording Type	Resolution	Maximum Number of Recordings	
		NO Phase Data	WITH Phase Data
Frequency	400 lines	11 000	11 000
	800 lines	11 000	8192
	1600 lines	8192	4096
	3200 lines	4096	2048
	6400 lines	2048	1024
Time	1024 samples	11 000	-
	2048 samples	8192	-
	4096 samples	4096	-
	8192 samples	2048	-
	16 384 samples	1024	-

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All other vb instruments have a standard memory size of 8.5 MB that can store up to 8192 recordings depending on recording type as shown below:

Recording Type	Resolution	Maximum Number of Recordings	
		NO Phase Data	WITH Phase Data
Frequency	400 - line	8192	4096
	800 - line	4096	2048
	1600 - line	2048	1024
	3200 - line	1024	512
Time	1024 - sample	4096	-
	2048 - sample	2048	-
	4096 - sample	1024	-
	8192 - sample	512	-

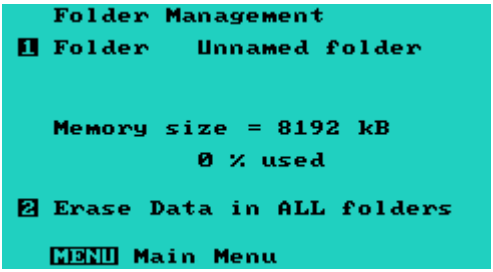
We recommend you transfer recordings to a PC (see the Ascent *Software Reference Guide*) and erase recordings not required on the instrument at the earliest convenience. This frees up memory on the instrument for later use.

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Checking the Memory Used

- From the Main Menu, press 5 to access the Folder Management Menu.

The percentage of memory used is displayed in the middle of the screen.



Note: If more than 98% of the memory is used, you will need to erase some recordings before further recordings can be taken.

Erasing all Recordings

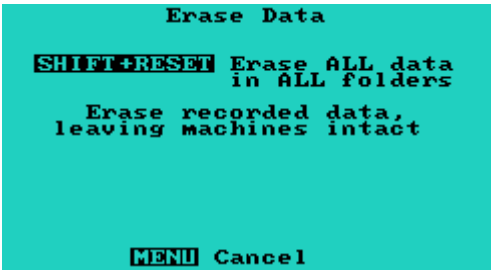
Warning: This procedure permanently erases all the recordings in **all** folders. This cannot be undone.

To erase individual recordings see Erasing Recordings (page 85).

Erasing all recordings removes each machine's recordings permanently from memory but retain the machines, points, directions and parameter sets.

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- From the Main Menu, press 5 Folder Management.
- Press HELP 2 Erase Data in ALL Folders.



- Press SHIFT + RESET 1 to erase all data (recordings). You will be prompted to confirm the erasure.
- Press SHIFT + RESET 1 again to confirm or MENU to cancel. The Erase all Folders Menu displays with a message confirming there are no recordings in memory.



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Erasing all Machines

Warning: The following procedure erases **all** machines (including all the points, directions, and parameter sets in the machines). The procedures for erasing individual machines, points, directions or parameter sets are covered in section 4.

Erasing all machines is a two-stage process. Before erasing all machines, all recordings must first be erased. See the previous topic, Erasing all Recordings, for instructions on how to do this.

After erasing all recordings you will be prompted to erase all folders, machine and points.



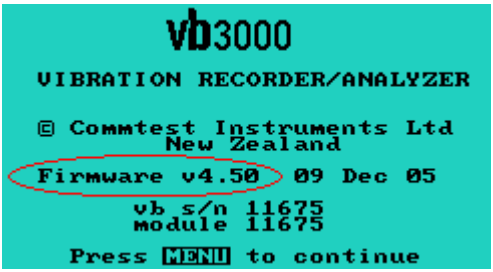
- Press SHIFT + RESET 1 to erase all machines. You will be prompted to confirm.
- Press SHIFT + RESET 1 again to confirm the erasure. The displayed menu will now show 0% memory usage.

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Upgrading Firmware Using Proflash

To upgrade the instrument to the latest version of firmware you PROFLASH the instrument with a new firmware file.

- To view your instrument's firmware version, turn the instrument off then on again. The current firmware version is displayed at power up.



Warnings

PROFLASHING to any version will erase **all** recordings in the instrument memory.

PROFLASHING to firmware version 3.00 will restore your instrument to the factory default state. All data will be erased. This includes folders, routes, machines, parameter sets, recordings and balance jobs. If you wish to save any of this information, please transfer all data folders to the software before PROFLASHING your instrument.

PROFLASHING the instrument takes approximately one minute and the instrument will re-start several times during the process. Do **not** interrupt the process as this will damage the instrument. The instrument's LCD screen will advise when the PROFLASH is complete.

- With the instrument powered on, connect and turn on the battery charger.
- Connect the instrument via the communication cable to a PC with the Ascent software.
- From the software main menu, select **File>Proflash VB** and follow the on-screen instructions.

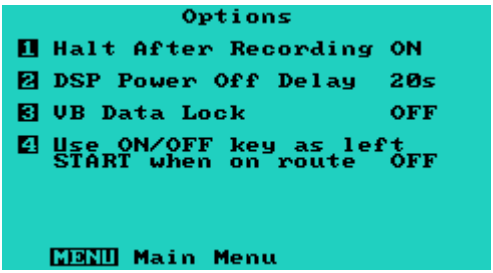
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Most of the tasks involved with PROFLASHING are carried out from within the Ascent software. Refer to the Ascent on-line help for detailed instructions on how to PROFLASH your instrument. (From the Ascent menu select **Help>Index**, then type 'Proflash' to display the help file).

Other Options

The Options Menu provides you with a number of choices to customize the way your instrument works. To access the Options Menu:

- From the Main Menu press 

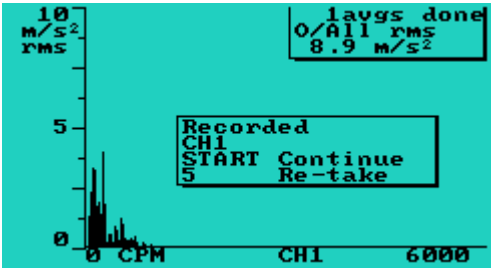


Halt After Recording

Halt After Recording is used to hold the last recorded spectrum or waveform on the instrument screen so that it can be analyzed before the next recording is taken. You can also use this option to display a warning prompt if the new recording is significantly above or below the baseline overall rms for this location (see Baseline warnings later in this topic).

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When Halt After Recording is turned ON the spectrum or waveform remains on the display until you choose to take the next recording.



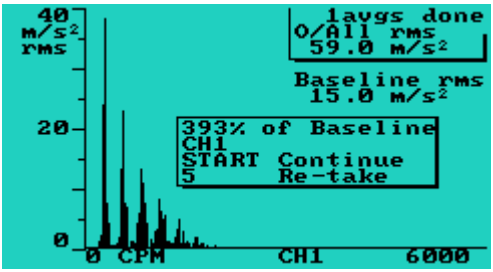
If Halt After Recording is OFF recordings will only be displayed for two seconds before the instrument returns automatically to the Select Parameter Set Menu (or the Auto Route Menu if you are recording a route).

- To turn on Halt After Recording, from the Main Menu press < 9 Options.
- Press RESET 1 to change this option from OFF to ON. To turn off Halt After Recording press RESET 1 repeatedly to cycle through the options until OFF is displayed.
- Halt After Recording can be enabled temporarily for just the newest reading by pressing ENTER at any time while the measurement is being taken.

With the display halted you can use the cursor and zooming features to review the chart before deciding to accept (record) it or reject it and re-take the recording. This option also applies during Auto Route.

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Baseline warnings (Applies to vb3000 only)
You can set Halt After Recording to prompt you when a new recording is significantly above or below the baseline overall level. This can be used to provide a basic check of data validity e.g. if the overall level of the new recording is very different from the baseline you may not have taken the measurement correctly. When the warning option is turned on it will halt the display *only* if the recording deviates a certain percentage from the baseline. This gives you a chance to analyze the new recording and decide whether to re-take the measurement or not.



Note: Baselines must be set within Ascent then sent to the instrument. Please refer to the Ascent *Software Reference Guide*, for details of how to set and display baseline recordings on the instrument.

There are two levels of warning you can set:

The 'relaxed' warning will halt the display and activate the prompt only if the new recording's overall level is lower than 25% or higher than 200% of the baseline overall. If the overall level is *within* the 25% to 200% range the measurement will not halt. For example, if your baseline overall level was 2 g and the measured rms level was 3 g the percentage is 150%. This is within the 'relaxed' range so the recording will not halt.

The 'tight' warning will activate if the new recording's overall level is lower than 50% or higher than 150% of the baseline overall level.

Note: The percentage displayed on the screen is limited to 999%. If a measurement's overall level is higher than this number the percentage will be rounded down to 999%.

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- To turn on the Halt After Recording warning, from the Main Menu press 9 to access the Options Menu.
- Press RESET 1 to toggle the option between ON / OFF and 'tight' / 'relaxed' warnings.



Halt After Recording 'relaxed'



Halt After Recording 'tight'

Backlight Off Delay

Backlight Off Delay allows you to reduce the battery's power consumption by turning the backlight off after a specified number of seconds. This can significantly increase the time between battery recharging.

- From the Main Menu press 9 Options.
- Press HELP 2 and enter a number between 0 seconds and 99 seconds for the delay time. The default is 20 seconds.

Note: To keep the backlight permanently on while the instrument is in use switch Power Saver OFF.

- To turn off Power saver, from the Main Menu press NEXT 7 Battery Management.
- Press HELP 2 to toggle Power Saver OFF.

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vb Structure Lock

This feature prevents machine or point names, routes or folders from being edited or accidentally deleted by unauthorized persons. Notes, machine, points and directions can still be added, but cannot be deleted when the instrument has the Structure Lock turned ON.

To lock the instrument

- From the Main Menu press < 9 Options.
- Press ENTER and enter a code (remember this code or write it in this manual).
- Press ENTER and the instrument will then be locked.

To unlock the instrument

- From the Main Menu press < 9 Options.
- Press LIGHT 3 and enter the code that was used to lock the instrument.
- Press ENTER and the instrument will then be unlocked.

Note: If you ever forget the unlock code use the Ascent software to unlock it. With the instrument connected to the PC via the supplied communication cable, go to the Ascent menu and select File>Lock / Unlock VB.

Left-handed Start Key for Auto Routes

The ON/OFF key can be used as a left-handed START key when on a route.

- From the Main Menu press < 9 Options.
- Press + 4 to toggle this option ON / OFF.

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Section 12: Troubleshooting

Contacting Technical Support

If you have any problems please contact Commtest support staff directly for assistance. Our e-mail address is help@commtest.com.

We also provide a searchable knowledge base of frequently asked questions (FAQ) on our website.

- The knowledge base can be found at www.commtest.com. Click the FAQ link to access the knowledge base.

Resetting the Instrument

Warning: If the instrument does not respond to any key press while it is operating it will continuously draw power until it is reset and turned off. You must reset a non-responding instrument as soon as possible.

- In any screen hold down RESET 1 and press ON OFF then release to reset the instrument.

Resetting the instrument does not erase data or settings stored in the instrument.

Power Problems

Symptom	Cause	Remedy
Instrument cannot power up	Low battery level Electrostatic discharge (ESD exceeding 8 kV)	Charge battery pack Reset instrument
Instrument powers down when backlight is turned on	Low battery level	Charge battery pack
Instrument powers down shortly after powering up	Low battery level	Charge battery pack

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Data Transfer Problems

Symptom	Cause	Remedy
Ascent unable to transfer data and 'Transfer failed' or Ascent Error dialog is displayed on the computer	Data transfer cable not properly connected	Check cable connections
	Data transfer cable connected to wrong computer COM port	Test COM port availability with instrument and use an available COM port

Data Problems

Symptom	Cause	Remedy
'Insufficient Memory' is displayed	No memory space left for new recordings	Erase obsolete recordings (transfer data to a computer first if necessary)
Spectrum/waveform displayed seems incorrect	Displayed units (amplitude scale, log range, velocity max) set incorrectly	Adjust display units, especially increase log range and/or reduce velocity max
	Sensor mounted to wrong location	Mount sensor on substantial structures near bearings and in the appropriate location and orientation
	Sensor not mounted properly	Ensure sensor is mounted firmly
	Sensor connected to wrong channel	Connect sensor to an enabled channel
	Sensor damaged	Replace sensor
Measured data is inconsistent	Sensor not mounted correctly	Ensure sensor is consistently and firmly mounted in the same location and orientation
A machine, point or direction cannot be tagged for taking recordings	No parameter sets in the machine, point or direction	Create parameter sets for the machine, point or direction
'No Route' is displayed	No route present in the instrument	Transfer a route from a computer

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Other Problems

Symptom	Cause	Remedy
Instrument does not respond to any key press	Electrostatic discharge exceeds 8 kV	Reset the instrument
'DSP cmd' 'DSP no ack' 'DSP not rdy' 'DSp no cmd' or 'Stack overflow' displayed	Memory conflict	Turn the instrument off and on again. If the problem persists, send the instrument to an authorized dealer for servicing
'Switch off then connect module' is displayed	Module has worked itself loose (n.b. the module is where sensors are plugged in).	Switch off the instrument and press firmly on the module or use an allen key to tighten it Reset instrument
	Module is damaged	Test for module damage - switch off the instrument and plug in the battery charger. From the battery management menu press the 'menu' key. The main menu should appear without the model number (instrumentvb3000/2000/1000/vb1). This will confirm that the main instrument is OK and that the module is faulty. Send instrument to an authorized dealer for servicing.
Instrument does not seems to measure	Accelerometer drive current not turned on for ICP® type accelerometer	Toggle ON the drive current in the Sensor Setup Menu
	Sensor sensitivity set too low or high	Match sensor sensitivity to sensor specifications (usually 100 mV/g) in the Sensor Setup Menu
	Sensor not connected	Connect Sensor
	Sensor damaged	Replace Sensor
	Sensor cable damaged	Replace Sensor cable

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Appendix 1: List of Abbreviations

AC	Alternating Current
A/D	Analog-to-Digital
CH	Channel
COM port	Computer Serial Port (1 to 4)
CPM	Cycles per minute
DC	Direct Current
DSP	Digital Signal Processor
ESD	Electro-Static Discharge
FFT	Fast Fourier Transform
Fmax	Maximum Frequency
Fmin	Minimum Frequency
Hz	Hertz
In or "	Inches
ISO	International Organization for Standardization
KB	Kilobytes
kCPM	Kilocycles per minute
kV	Kilovolts
LCD	Liquid Crystal Display
MB	Megabyte
MHz	Megahertz
MIMOSA	Machinery Information Management Open Systems Alliance
µm	Micrometer
mm	Millimeter
ms	Millisecond
Ni-Cad	Nickel-Cadmium
PC	Personal Computer
QA	Quality Assurance
RAM	Random Access Memory
rms	Root-mean-squared
ROM	Read-Only Memory
V	Volts
V DC, 1 A	Volts DC, 1 amp

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Appendix 2: Specifications

Specifications	Model vb3000	Remarks
Sensor Input		
Number of channels	2	
Accelerometers	2-wire, low impedance piezoelectric, 100 mV/g nominal	Commonly termed 'ICP® type'. Sensitivity (8.5 to 2300) mV/g
Velocity sensors	100 mV/in/s (4 mV/mm/s) nominal	Sensitivity (8.5 to 2300) mV/in/s = (0.34 to 90.55) mV/mm/s
Displacement sensors	100 mV/mil (4 mV/µm) nominal	Sensitivity (8.5 to 2300) mV/mil = (0.34 to 90.55) mV/µm
Current sensors	100 mV/amp nominal	Sensitivity (0.1 to 2300) mV/amp
Connector	BNC	Safety feature: Break-free inline connector
Input impedance	>100 kΩ	
Voltage swing	16 V peak-peak	AC coupled input, allows for ± 8 V sensor output swing (± 80 g)
Sensor excitation current	0 mA or 2.2 mA (configurable)	2.2 mA required for ICP® type accelerometer
Sensor excitation voltage	24 V maximum	At sensor terminals with sensor attached
Sensor detection	Warns if short circuit or not connected	Channel 1 only
Tachometer Input		
Sensor	Laser sensor with reflective tape included in kit	Sensor triggers when the tape reflects its beam
Laser sensor range	10 cm to 2 m nominal	Dependent on size of reflective tape
Sensor supply	7.2 V nominal 6.0 V to 9.5 V instrument battery	Available to power sensor. Protected by 0.1 A PTC
Input type	Optically isolated, accepts TTL pulse	
Pulse rating	2.5 V (4 mA) min, 10 V (27 mA) max, off-state < 0.8 V	Triggers on negative edge
Speed range	30 RPM to 65 000 RPM (0.5 Hz to 1.08 kHz)	
Display	RPM, Hz, 1X amplitude and phase angle	For selected amplitude type, phase angle in degrees
Parameter Indication		
Displays	Acceleration, velocity, displacement, demodulation and current	User selectable
Maximum levels	± 80 g (800 m/s^2), ± 4 in/sec (100 mm/s), ± 800 amps ± 400 mil (10 mm)	∅-peak. Typical, dependent on individual calibration
Dynamic signal range	≥ 95 dB (typical at 400 line resolution)	Acceleration and velocity. Greater with higher resolution and averaging
Harmonic distortion	Less than -70 dB typical	Dependent on input level and type. Other distortions and noise are lower
Units	g or m/s^2, in/s or mm/s, mil or mm or µm, amps AdB, VdB	∅-peak, peak-peak or rms AdB ref. 1 µg rms, VdB ref. configurable 1.0e-5 mm/s rms or 1.0e-6 mm/s rms
Graph types	Spectrum (freq domain), waveform (time domain)	Solid histogram for spectrum, line graph for waveform
Magnitude display	Overall rms value, cursor-position value	Digital readout on chart
Warnings	% change in overall since baseline	Tolerances: Tight 50% to 150%, relaxed 25% to 200%
Cursors	Standard cursor Dual cursors Harmonic cursor	Vary x position to display x and y values Lock standard cursor as reference and display difference Up to 32 whole-number multiples of standard-cursor frequency
Accuracy	± 1% (0.1 dB)	Measured at 100 Hz, 23 ± 5 °C, 400 lines, 400 Hz range
Frequency response	± 0.1 dB from 10 Hz to 15 kHz; ± 3 dB from 1 Hz to 40 kHz	Acceleration and velocity. From value measured at 100 Hz
Spectrum Display		
Fmax possible ranges	0 to (100, 125, 150, 200, 300, 400, 500, 600, 800) Hz 0 to (1, 1.2, 1.6, 2, 2.5, 3, 4, 5, 6, 8, 10, 15, 20, 30, 40) kHz	Or equivalent CPM values Or orders-based from 1X to 30 000X
Fmin possible range	0 to Fmax	vb instrument zeroes all spectral lines below Fmin
Resolution	400, 800, 1600, 3200, 6400 lines (configurable)	3200 lines maximum for dual channel measurements
Frequency scale	Hz, CPM, orders	Linear scale. Can zoom in to display individual spectral lines
Amplitude scale	Acceleration, velocity, displacement or current	Linear or log scales
Window shapes	Hanning, rectangular	
Overlap	(0, 12.5, 25, 37.5, 50, 62.5, 75, 87.5) %	Dependent on Fmax and number of lines
Number of averages	1, 2, 4, 8, 16, 32, 64, 128	Increases sampling time proportionally
Averaging types	Linear, exponential, peak hold, synchronous	
Demod bandwidths	20 bandwidth options	From 125 Hz to 1250 Hz up to 16 kHz to 20 kHz
Waveform Display		
Number of samples	1024, 2078, 4096, 8192, 16 384	
Long time waveform	Up to 15 kHz Fmax. Over 17 hours duration or until memory full	
Time scale	10 ms to 32 seconds/ 1 rev to 30 000 revs	
Time synchronous averages	1, 2, 4, 8, 16, 32, 64, 128	Only available when tachometer triggered
Keypad Entry		
Prompt and unit strings	16 characters each	
Input value range	± 59 999	
Time Intervals		
	Lines	
	Range **400** **800** **1600** **3200** **6400**	Dependent on number of lines and number of averages (values shown in table for no overlap, no averaging, maximum display update rate of 4 per second)
Measuring time in seconds (example ranges)	0 Hz to100 Hz 4 8 16 32 64 0 Hz to 800 Hz 0.5 1 2 4 8 0 Hz to 4 kHz 0.1 0.2 0.4 0.8 1.6 0 Hz to 40 kHz 0.01 0.02 0.04 0.08 0.16	
Typical recording time	5 s for 1600 lines, 1600 Hz, 8 averages, 50% overlap	Not including initial startup and settling time

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Specifications	Model vb3000	Remarks
Trigger Modes	Single (key press), free run	Trigger status displayed (busy, done, run, stop)
Logging Features		
Output formats	vb screen, transfer to Ascent PC-based software	
Data storage	32 MB non-volatile	Total of 11 000 spectra at 800 line resolution or 4000 spectra at 3200 line resolution
Data storage format	Up to 30 folders Up to 200 named machines per folder Up to 780 named machines for all folders Up to 30 multi-axial points per machine Up to 8 routes per folder	User-specified machine, point, and axis names (16 characters) entered from PC or keypad. Each recording has a unique time/date stamp
Balancing		
Planes	1, 2	
Speed range	30 RPM to 60 000 RPM	
Measurement type	Acceleration, velocity, displacement	
Min and Max values	(0.0004 to 4) in/s = (0.01 to 100) mm/s	∅-peak. Typical, dependent on calibration
Weight modes	Angle 0° to 360°, fixed position, circumference arc	e.g. attach weights on fan blades, linear distance around circumference
Remove trial weights	Yes, No	
Filter bandwidths	15 CPM, 150 CPM	
Manual data entry	Yes	Allows re-entry of previous balance jobs
Storage	10 balance jobs total	

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Specifications	Model vb2000	Remarks
Accelerometer Input		
Number of channels	2	
Type	2-wire, low impedance piezoelectric	Commonly termed 'ICP® type'
Sensitivity	100 mV/g nominal	Sensitivity 8.5 mV/g to 2300 mV/g
Connector	BNC	Safety feature: Break-free inline connector
Input impedance	>100 kΩ	
Voltage swing	16 V peak-peak	AC coupled input, allows for ± 8 V sensor output swing (± 80 g)
Sensor excitation current	0 mA or 2.2 mA (configurable)	2.2 mA required for ICP® type accelerometer
Sensor excitation voltage	24 V maximum	At sensor terminals with sensor attached
Sensor detection	Warns if short circuit or not connected	Channel 1 only
Tachometer		
Sensor	Laser sensor with reflective tape included in kit	Sensor triggers when the tape reflects its beam
Laser sensor range	10 cm to 2 m nominal	Dependent on size of reflective tape
Sensor supply	7.2 V nominal 6.0 V to 9.5 V instrument battery	Available to power sensor. Protected by 0.1 A PTC
Input type	Optically isolated, accepts TTL pulse	
Pulse rating	2.5 V (4 mA) min, 10 V (27 mA) max, off-state < 0.8 V	Triggers on negative edge
Speed range	30 RPM to 65 000 RPM (0.5 Hz to 1.08 kHz)	
Display	RPM, Hz, 1X amplitude and phase angle	For selected amplitude type, phase angle in degrees
Parameter Indication		
Displays	Acceleration, velocity, displacement, demodulation	User selectable
Maximum levels	± 80 g (800 m/s^2), ± 4 in/sec (100 mm/s) ± 400 mil (10 mm)	∅-peak. Typical, dependent on individual calibration
Dynamic signal range	≥ 95 dB (typical at 400 line resolution)	Acceleration and velocity. Greater with higher resolution and averaging
Harmonic distortion	Less than -70 dB typical	Dependent on input level and type. Other distortions and noise are lower
Units	g or m/s^2, in/s or mm/s, mil or mm or µm AdB, VdB	∅-peak, peak-peak or rms AdB ref. 1 µg rms, VdB ref. configurable 1.0e-5 mm/s rms or 1.0e-6 mm/s rms
Graph types	Spectrum (freq domain), waveform (time domain)	Solid histogram for spectrum, line graph for waveform
Magnitude display	Overall rms value, cursor-position value	Digital readout on chart
Cursors	Standard cursor	Vary x position to display x and y values
	Dual cursors	Lock standard cursor as reference and display difference
	Harmonic cursor	Up to 32 whole-number multiples of standard-cursor frequency
Accuracy	± 1% (0.1 dB)	Measured at 100 Hz, 23 ± 5 °C, 400 lines, 400 Hz range
Frequency response	± 0.1 dB from 10 Hz to 5 kHz; ± 3 dB from 1 Hz to 20 kHz	Acceleration and velocity. From value measured at 100 Hz
Spectrum Display		
Fmax possible ranges	0 to (100, 125, 150, 200, 300, 400, 500, 600, 800) Hz 0 to (1, 1.2, 1.6, 2, 2.5, 3, 4, 5, 6, 8, 10, 15, 20) kHz	Or equivalent CPM values Or orders-based from 1X to 30 000X
Fmin possible range	0 to Fmax	vb instrument zeroes all spectral lines below Fmin
Resolution	400, 800, 1600, 3200 lines (configurable)	1600 lines maximum for dual channel measurements
Frequency scale	Hz, CPM, orders	Linear scale. Can zoom in to display individual spectral lines
Amplitude scale	Acceleration, velocity, displacement	Linear or log scales
Window shapes	Hanning, rectangular	
Overlap	(0, 12.5, 25, 37.5, 50, 62.5, 75, 87.5) %	Dependent on Fmax and number of lines
Number of averages	1, 2, 4, 8, 16, 32, 64, 128	Increases sampling time proportionally
Averaging types	Linear, exponential, peak hold, synchronous	
Demod bandwidths	20 bandwidth options	From 125 Hz to 1250 Hz up to 16 kHz to 20 kHz
Waveform Display		
Number of samples	1024, 2078, 4096, 8192	
Time scale	10 ms to 32 seconds/1 rev to 30 000 revs	
Time synchronous averages	1, 2, 4, 8, 16, 32, 64, 128	Only available when tachometer triggered
Keypad Entry		
Prompt and unit strings	16 characters each	
Input value range	± 59 999	
Time Intervals		
	Lines	
Range	**400 800 1600 3200**	
Measuring time in seconds (example ranges)	0 Hz to 100 Hz 4 8 16 32 0 Hz to 800 Hz 0.5 1 2 4 0 Hz to 4 kHz 0.1 0.2 0.4 0.8 0 Hz to 20 kHz 0.02 0.04 0.08 0.16	Dependent on number of lines and number of averages (values shown in table for no overlap, no averaging, maximum display update rate of 4 per second)
Typical recording time	5 s for 1600 lines, 1600 Hz, 8 averages, 50% overlap	Not including initial startup and settling time
Trigger Modes	Single (key press), free run	Trigger status displayed (busy, done, run, stop)
Logging Features		
Output formats	vb screen, transfer to Ascent PC-based software	
Data storage	8 MB non-volatile	Total of 8 000 spectra at 400 line resolution or 1000 spectra at 3200 line resolution
Data storage format	Up to 30 folders Up to 200 named machines per folder Up to 780 named machines for all folders Up to 30 multi-axial points per machine Up to 8 routes per folder	User-specified machine, point, and axis names (16 characters) entered from PC or keypad. Each recording has a unique time/date stamp

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Specifications	Model vb2000	Remarks
Balancing		
Planes	1, 2	
Speed range	30 RPM to 60 000 RPM	
Measurement type	Acceleration, velocity, displacement	
Min and Max values	(0.0004 to 4) in/s = (0.01 to 100) mm/s	∅-peak. Typical, dependent on calibration
Weight modes	Angle 0° to 360°, fixed position, circumference arc	e.g. attach weights on fan blades, linear distance around circumference
Remove trial weights	Yes, No	
Filter bandwidths	15 CPM, 150 CPM	
Manual data entry	Yes	Allows re-entry of previous balance jobs
Storage	10 balance jobs total	

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Specifications	Model vb1000	Remarks
Accelerometer Input		
Number of channels	1	
Type	2-wire, low impedance piezoelectric	Commonly termed 'ICP® type'
Sensitivity	100 mV/g nominal	Sensitivity 8.5 mV/g to 2300 mV/g
Connector	BNC	Safety feature: Break-free inline connector
Input impedance	>100 kΩ	
Voltage swing	16 V peak-peak	AC coupled input, allows for ± 8 V sensor output swing (± 80 g)
Sensor excitation current	0 mA or 2.2 mA (configurable)	2.2 mA required for ICP® type accelerometer
Sensor excitation voltage	24 V maximum	At sensor terminals with sensor attached
Sensor detection	Warns if short circuit or not connected	
Tachometer		
Sensor	Laser sensor with reflective tape included in kit	Sensor triggers when the tape reflects its beam
Laser sensor range	10 cm to 2 m nominal	Dependent on size of reflective tape
Sensor supply	7.2 V nominal 6.0 V to 9.5 V instrument battery	Available to power sensor. Protected by 0.1 A PTC
Input type	Optically isolated, accepts TTL pulse	
Pulse rating	2.5 V (4 mA) min, 10 V (27 mA) max, off-state < 0.8 V	Triggers on negative edge
Speed range	30 RPM to 65 000 RPM (0.5 Hz to 1.08 kHz)	
Display	RPM, Hz, 1X amplitude and phase angle	For selected amplitude type, phase angle in degrees
Parameter Indication		
Displays	Acceleration, velocity, displacement, demodulation	User selectable
Maximum levels	± 80 g (800 m/s^2), ± 4 in/sec (100 mm/s) ± 400 mil (10 mm)	Ø-peak. Typical, dependent on individual calibration
Dynamic signal range	≥ 95 dB (typical at 400 line resolution)	Acceleration and velocity. Greater with higher resolution and averaging
Harmonic distortion	Less than -70 dB typical	Dependent on input level and type. Other distortions and noise are lower
Units	g or m/s^2, in/s or mm/s, mil or mm or µm AdB, VdB	Ø-peak, peak-peak or rms AdB ref. 1 µg rms, VdB ref. configurable 1.0e-5 mm/s rms or 1.0e-6 mm/s rms
Graph types	Spectrum (freq domain), waveform (time domain)	Solid histogram for spectrum, line graph for waveform
Magnitude display	Overall rms value, cursor-position value	Digital readout on chart
Cursors	Standard cursor Dual cursors Harmonic cursor	Vary x position to display x and y values Lock standard cursor as reference and display difference Up to 32 whole-number multiples of standard-cursor frequency
Accuracy	± 1% (0.1 dB)	Measured at 100 Hz, 23 ± 5 °C, 400 lines, 400 Hz range
Frequency response	± 0.1 dB from 10 Hz to 5 kHz; ± 3 dB from 1 Hz to 20 kHz	Acceleration and velocity. From value measured at 100 Hz
Spectrum Display		
Fmax possible ranges	0 to (100, 125, 150, 200, 300, 400, 500, 600, 800) Hz 0 to (1, 1.2, 1.6, 2, 2.5, 3, 4, 5, 6, 8, 10, 15, 20) kHz	Or equivalent CPM values Or orders-based from 1X to 30 000X
Fmin possible range	0 to Fmax	vb instrument zeroes all spectral lines below Fmin
Resolution	400, 800, 1600, 3200 lines (configurable)	
Frequency scale	Hz, CPM, orders	Linear scale. Can zoom in to display individual spectral lines
Amplitude scale	Acceleration, velocity, displacement	Linear or log scales
Window shapes	Hanning, rectangular	
Overlap	(0, 12.5, 25, 37.5, 50, 62.5, 75, 87.5) %	Dependent on Fmax and number of lines
Number of averages	1, 2, 4, 8, 16, 32, 64, 128	Increases sampling time proportionally
Averaging types	Linear, exponential, peak hold, synchronous	
Demod bandwidths	20 bandwidth options	From 125 Hz to 1250 Hz up to 16 kHz to 20 kHz
Waveform Display		
Number of samples	1024, 2078, 4096, 8192	
Time scale	10 ms to 32 seconds/1 rev to 30 000 revs	
Time synchronous averages	1, 2, 4, 8, 16, 32, 64, 128	Only available when tachometer triggered
Keypad Entry		
Prompt and unit strings	16 characters each	
Input value range	± 59 999	
Time Intervals		
	Lines	
Range	**400 800 1600 3200**	
Measuring time in seconds (example ranges)	0 Hz to 100 Hz 4 8 16 32 0 Hz to 800 Hz 0.5 1 2 4 0 Hz to 4 kHz 0.1 0.2 0.4 0.8 0 Hz to 20 kHz 0.02 0.04 0.08 0.16	Dependent on number of lines and number of averages (values shown in table for no overlap, no averaging, maximum display update rate of 4 per second)
Typical recording time	5 s for 1600 lines, 1600 Hz, 8 averages, 50% overlap	Not including initial startup and settling time
Trigger Modes	Single (key press), free run	Trigger status displayed (busy, done, run, stop)
Logging Features		
Output formats	vb screen, transfer to Ascent PC-based software	
Data storage	8 MB non-volatile	Total of 8 000 spectra at 400 line resolution or 1000 spectra at 3200 line resolution
Data storage format	Up to 30 folders Up to 200 named machines per folder Up to 780 named machines for all folders Up to 30 multi-axial points per machine Up to 8 routes per folder	User-specified machine, point, and axis names (16 characters) entered from PC or keypad. Each recording has a unique time/date stamp

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Specifications	Model vb1000	Remarks
Balancing		
Planes	1	
Speed range	30 RPM to 60 000 RPM	
Measurement type	Acceleration, velocity, displacement	
Min and Max values	(0.0004 to 4) in/s = (0.01 to 100) mm/s	∅-peak. Typical, dependent on calibration
Weight modes	Angle 0° to 360°, fixed position, circumference arc	e.g. attach weights on fan blades, linear distance around circumference
Remove trial weights	Yes, No	
Filter bandwidths	15 CPM, 150 CPM	
Manual data entry	Yes	Allows re-entry of previous balance jobs
Storage	10 balance jobs total	

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Specifications	Model vb1000v	Remarks
Accelerometer Input		
Number of channels	1	
Type	2-wire, low impedance piezoelectric	Commonly termed 'ICP® type'
Sensitivity	100 mV/g nominal	Sensitivity 8.5 mV/g to 2300 mV/g
Connector	BNC	Safety feature: Break-free inline connector
Input impedance	>100 kΩ	
Voltage swing	16 V peak-peak	AC coupled input, allows for ± 8 V sensor output swing (± 80 g)
Sensor excitation current	0 mA or 2.2 mA (configurable)	2.2 mA required for ICP® type accelerometer
Sensor excitation voltage	24 V maximum	At sensor terminals with sensor attached
Sensor detection	Warns if short circuit or not connected	
Tachometer		
Sensor	Laser sensor with reflective tape included in kit	Sensor triggers when the tape reflects its beam
Laser sensor range	10 cm to 2 m nominal	Dependent on size of reflective tape
Sensor supply	7.2 V nominal 6.0 V to 9.5 V instrument battery	Available to power sensor. Protected by 0.1 A PTC
Input type	Optically isolated, accepts TTL pulse	
Pulse rating	2.5 V (4 mA) min, 10 V (27 mA) max, off-state < 0.8 V	Triggers on negative edge
Speed range	30 RPM to 65 000 RPM (0.5 Hz to 1.08 kHz)	
Display	RPM, Hz, 1X amplitude and phase angle	For selected amplitude type, phase angle in degrees
Parameter Indication		
Displays	Acceleration, velocity, displacement, demodulation	User selectable
Maximum levels	± 80 g (800 m/s^2), ± 4 in/sec (100 mm/s) ± 400 mil (10 mm)	∅-peak. Typical, dependent on individual calibration
Dynamic signal range	≥ 95 dB (typical at 400 line resolution)	Acceleration and velocity. Greater with higher resolution and averaging
Harmonic distortion	Less than -70 dB typical	Dependent on input level and type. Other distortions and noise are lower
Units	g or m/s^2, in/s or mm/s, mil or mm or µm AdB, VdB	∅-peak, peak-peak or rms AdB ref. 1 µg rms, VdB ref. configurable 1.0e-5 mm/s rms or 1.0e-6 mm/s rms
Graph types	Spectrum (freq domain), waveform (time domain)	Solid histogram for spectrum, line graph for waveform
Magnitude display	Overall rms value, cursor-position value	Digital readout on chart
Cursors	Standard cursor	Vary x position to display x and y values
	Dual cursors	Lock standard cursor as reference and display difference
	Harmonic cursor	Up to 32 whole-number multiples of standard-cursor frequency
Accuracy	± 1% (0.1 dB)	Measured at 100 Hz, 23 ± 5 °C, 400 lines, 400 Hz range
Frequency response	± 0.1 dB from 10 Hz to 5 kHz; ± 3 dB from 1 Hz to 20 kHz	Acceleration and velocity. From value measured at 100 Hz
Spectrum Display		
Fmax possible ranges	0 to (100, 125, 150, 200, 300, 400, 500, 600, 800) Hz	Or equivalent CPM values
	0 to (1, 1.2, 1.6, 2, 2.5, 3, 4, 5, 6, 8, 10, 15, 20) kHz	Or orders-based from 1X to 30 000X
Fmin possible range	0 to Fmax	vb instrument zeroes all spectral lines below Fmin
Resolution	400, 800, 1600, 3200 lines (configurable)	
Frequency scale	Hz, CPM, orders	Linear scale. Can zoom in to display individual spectral lines
Amplitude scale	Acceleration, velocity, displacement	Linear or log scales
Window shapes	Hanning, rectangular	
Overlap	(0, 12.5, 25, 37.5, 50, 62.5, 75, 87.5) %	Dependent on Fmax and number of lines
Number of averages	1, 2, 4, 8, 16, 32, 64, 128	Increases sampling time proportionally
Averaging types	Linear, exponential, peak hold, synchronous	
Demod bandwidths	20 bandwidth options	From 125 Hz to 1250 Hz up to 16 kHz to 20 kHz
Waveform Display		
Number of samples	1024, 2078, 4096, 8192	
Time scale	10 ms to 32 seconds/1 rev to 30 000 revs	
Time synchronous averages	1, 2, 4, 8, 16, 32, 64, 128	Only available when tachometer triggered
Keypad Entry		
Prompt and unit strings	16 characters each	
Input value range	± 59 999	
Time Intervals		
	Lines	
	Range **400** **800** **1600** **3200**	
Measuring time in seconds (example ranges)	0 Hz to 100 Hz 4 8 16 32 0 Hz to 800 Hz 0.5 1 2 4 0 Hz to 4 kHz 0.1 0.2 0.4 0.8 0 Hz to 20 kHz 0.02 0.04 0.08 0.16	Dependent on number of lines and number of averages (values shown in table for no overlap, no averaging, maximum display update rate of 4 per second)
Typical recording time	5 s for 1600 lines, 1600 Hz, 8 averages, 50% overlap	Not including initial startup and settling time
Trigger Modes	Single (key press), free run	Trigger status displayed (busy, done, run, stop)
Logging Features		
Output formats	vb screen, transfer to Ascent PC-based software	
Data storage	8 MB non-volatile	Total of 8 000 spectra at 400 line resolution or 1000 spectra at 3200 line resolution
Data storage format	Up to 30 folders Up to 200 named machines per folder Up to 780 named machines for all folders Up to 30 multi-axial points per machine Up to 8 routes per folder	User-specified machine, point, and axis names (16 characters) entered from PC or keypad. Each recording has a unique time/date stamp

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Specifications	Common to all vb models	Remarks
Display	Graphic LCD	
Resolution	240 pixels x 128 pixels	
Viewing area	4.3" x 2.3" (110 x 60) mm	
Backlight	Electro-luminescent	
PROFLASH	Allows vb firmware to be upgraded via serial comms	Download firmware service packs via the Internet
Communications	RS232	15 kV ESD protected. Cable with DB9 connector
Baud rate	57 600 bits per second	USB adapter provided
Battery		
Type	Custom Nickel-Cadmium pack	
Voltage	7.2 V nominal	
Capacity	1500 mAh nominal	
Operating time (typical)	12 hours with backlight off, 7 hours with backlight on	Depends on mode and setup
Charger and conditioner	Integral charger - automatic and manual control	Power transformer with 13.5 V ± 1.5 V DC, 1 A output included in kit
Charge rate	0.7 A nominal	2.5 hours for complete charge nominal
Discharge rate	0.5 A nominal	Combats NiCad battery memory effect
Mechanical		
Size	9.7" W x 6.1" L x 3.0" H (247 x 154 x 75) mm	Including protective boot
Weight	4.4 lb (2 kg)	Including protective boot and strap
Environmental		
Temperature/Humidity		
Operating	32 °F to 122 °F (0 to 50) °C	
	80% RH 32 °F to 86 °F	Non-condensing
	70% RH 86 °F to 122 °F	Non-condensing
Storage	14 °F to 140 °F (-10 to 60) °C	
	95% RH	
EMC	EN55022, CISPR22	Radiated and conducted emissions
	EN55024, CISPR24	RF field, ESD and fast transient immunity

Revised 22 November 2005. While every effort has been made to provide the most accurate information we advise that information in this document may contain technical inaccuracies or typographical errors. Commtest Instruments Ltd may at any time and without notice make improvements and/or changes in the products described in this information.

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