

metrO™ B6012
VIBRATIONS SIMPLIFIED...

User Manual



Easiest portable vibration
analyzer and balancer

SIG/VASIS™
TECHNOLOGIES PVT. LTD.

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Disclaimer

Entire discussion in this manual is based on the assumption that user is using metrO™ B6012 within the stated specifications. Vibration measurement and balancing involves measurement on rotating machines. Always keep a safe distance to rotating parts and secure transducers and transducer cables from rotating parts.

Signasis Technologies Pvt. Ltd. and our authorized representatives cannot take responsibility for any accidents on people and machines caused directly or indirectly by the use of metrO™ B6012 and /or any of its accessories. Signasis Technologies Pvt. Ltd. and our authorized representatives assume no liability for damages on machines and plants as a result of the use of metrO™ B6012 measurements.

Even though great efforts are made to make the information in this manual free from errors and to make the information complete for the user, there could be things we have missed, because of the large amount of information. As a result of this, we might change and correct these things in later issues without further information. Also changes in the metrO™ B6012 equipment may take place that affect the accuracy of the information.

Warranty disclaimer

Signasis Technologies Pvt. Ltd. warrants the products to be free from defects in material and workmanship under normal use and service within one year from the date of purchase and which from our examination shall disclose to our reasonable satisfaction to be defective. Warranty claimed products shall be returned prepaid to Signasis Technologies Pvt. Ltd. for service.

We reserve the right to repair or to replace defective products. Always try to explain the nature of any service problem, at best by e-mail or letter. Check first all natural problems like empty batteries, broken cables, etc. When returning the product, be sure to indicate that the purpose is to make repairs and indicate the original invoice number and date of shipment to you, if possible.

Warranty of product is limited only to repair or replacement of faulty components and not replacement of the whole product. Company's decision for repair or replacement against manufacturing defect will be final and binding under all circumstances.

Chapter 1: Instrument conventions

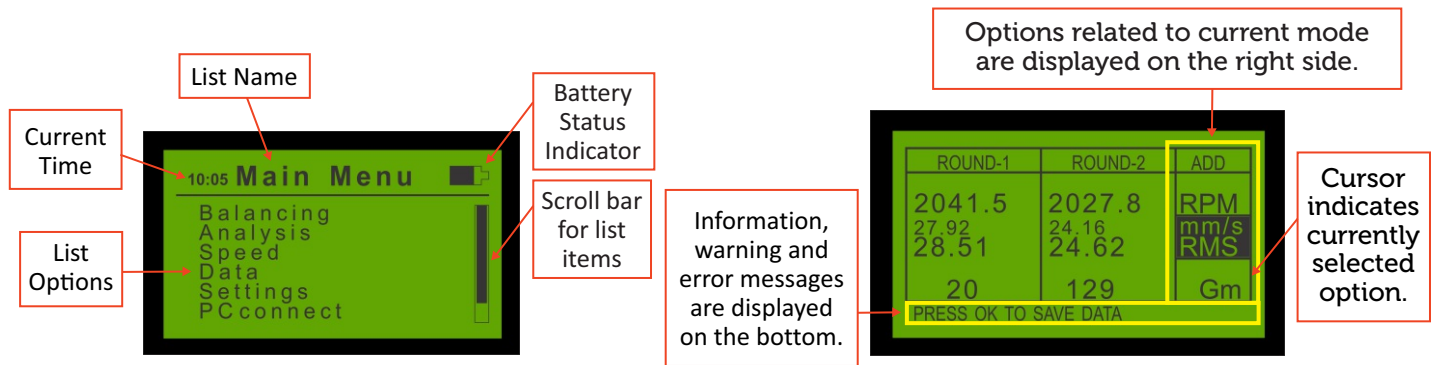


Figure 1-1: General screen layout

User can navigate through any menu screen using UP or DOWN arrow keys. Cursor indicates current location of sub-menu selection. User can select current sub-menu selection by pressing **OK** key.

To return back to the starting point of previous menu, press **ESC** key.

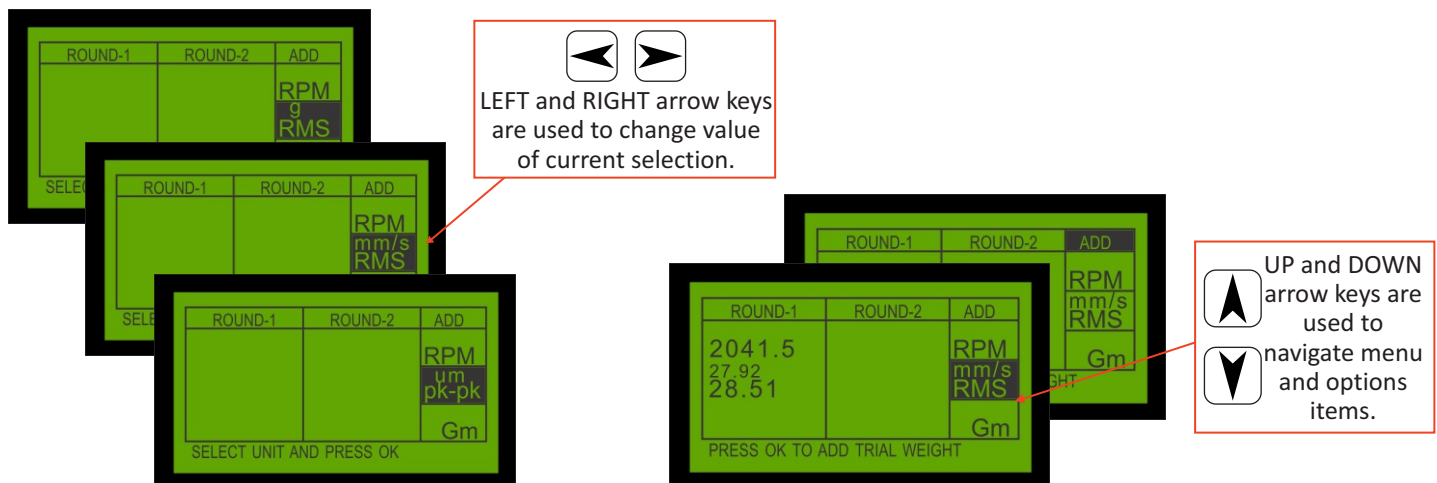


Figure 1-2: Options navigation

Modes of operations during which readings are taken from sensor/s are termed as measurement modes. During any measurement mode, user can select speed or amplitude variable by pressing UP or DOWN arrow keys (cursor indicates current variable selection). To change the unit of measurement for the currently selected variable, press LEFT or RIGHT arrow keys.

Note: All measurement variables and all corresponding units are not available in all the modes. Refer to the specific mode for list of available variables and corresponding units.

For any sub-menu under settings menu, UP or DOWN arrow keys are used for navigation and LEFT or RIGHT arrow keys are used to modify value of currently selected variable (cursor indicates current variable selection), if available as an option. RIGHT arrow key is used to increment value and LEFT arrow key is used to decrement value.

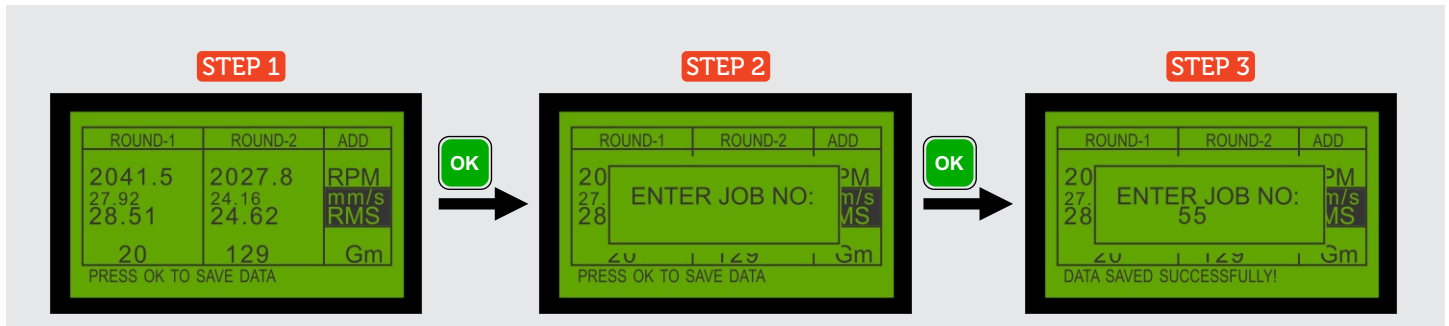


Figure 1-3: Balancing data saving flow diagram

For saving data in any operating mode, an information message of the type shown in Step 1 above will be displayed in either of the following circumstances:

- 1) In any of the balancing modes, Round-2 of balancing data is calculated and is stable symbolizing that balancing operation is completed and data can now be saved.
- 2) In any of the analysis modes, data is paused for detailed analysis and the user can now save paused data. Press OK key in **Step 1** above for saving data.

Step 2 will display a pop-up screen where user can enter job number to store data.

Data is stored as a combination of **job number** and **trial number**. **Job number** is entered by user as shown above and trial number is auto-incremented. This will help user to save multiple data with the same job number and can later be identified easily depending on the **trial number**.

For example, if user wants to store spectrum data for a particular blower along three axis then the user can first save data along x-axis with **job number - 55**, then along y-axis and then along z-axis with the same job number. The instrument will save these data with **trial numbers 01 (for x-axis), 02 (for y-axis) and 03 (for z-axis)**.

Press OK key after entering job number.

In **Step 3** information message regarding data saving process will be displayed.





Notes:

- After reaching maximum number of saved data records, the next data will override the least recently stored data just like a first-in, first-out
- After data is successfully saved, press ESC key to return to the previous state. In any of the balancing mode, ESC key press will exit the

1.1: Abbreviations

ACRONYM	DESCRIPTION
RMS	Root Mean Square
p	peak
p-p	peak to peak
um	micron
mm/s	millimeter per second
m/s ²	meter per second square
RPM	Rotations per Minute
CPM	Cycles per Minute
Hz	Hertz

1.2: Precautionary tips

- Correct indication of speed measurement using optical sensor and laser is blinking LED LASER is only a pointing tool and might not point at the correct position under all circumstances. 
- Point the LASER perpendicular to the reflective tape while measuring speed using optical sensor. Hold the instrument horizontal. Internal optical sensor is designed to provide best results and maximum working distance under these circumstances.
- Use stroboscope in external trigger mode by pressing the EXT button  when connected to the instrument.
- It is NOT recommended to plug-in the charger during taking measurements for best results.
- During stroboscope indication, indicator for optical sensor  will blink because stroboscope emits light in infrared region as well. This will however not affect functionality of the instrument.
- Battery status indication is only voltage representation and not the actual charge representation. Always keep the battery charged before any site visit for un-interrupted working.
- Do not connect another type of charger. This might permanently damage the instrument.
- To power-OFF the instrument, keep the power button  pressed for at least 5 seconds. Release the key after the instrument displays a message to release the key for powering down.

Chapter 2: Concept of automatic 2-round balancing

We are pleased to introduce concept of Automatic 2-round balancing to reduce overall time required for balancing and simplify the unbalance location prediction criteria.

- Point of unbalance is always indicated with respect to the sensor position.
- Rotational speed and diameter of job is assumed to be constant during balancing.
- Addition or removal of trial weights must always be done only at the indicated point of unbalance at radial distance from the center, i.e. along the periphery of the rotating body.
- To locate the point of unbalance in degrees, point the optical sensor at the reflective tape in line on the same side as that of accelerometer. This constraint is imposed because unbalance is always indicated with respect to the accelerometer. Pointing the optical sensor in other directions will give erroneous results.
- When point of unbalance is indicated in degrees, angle is measured from the reflective tape in the direction of rotation.

In round 1 of balancing, stable speed is determined and point of unbalance is indicated along with its amplitude, depending on the mode of balancing. For e.g. stable speed obtained is 2970 RPM with unbalance of A1 = 9 mm/s at 30 degrees and unbalance indication is for removal of weight.

After obtaining these results add/remove some trial weight at the point of unbalance indicated depending on mode of unbalance indication respectively. In our example suppose we remove W1 = 2 grams of trial weight at 30 degrees from the reflective tape in the direction of rotation of shaft.



Enter the value of trial weight and press OK key to proceed to round 2. In round 2, stable speed is determined as previously and current point of unbalance along with its amplitude is indicated depending on the mode of balancing. Make sure that the new stable speed obtained is almost same as previously. metrO™ B6012 also gives the weight to be added/removed further in order to completely remove unbalance. This weight is calculated based on the reduction in unbalance reading in round 2 because of the addition/ removal of trial weight. In our example, unbalance amplitude is A2 = 3 mm/s at 30 degrees in round 2. Then the weight to be further removed is calculated as:

$$W = (A2 \times W1)/(A1-A2) = (3 \times 2)/(9 - 3) = 1 \text{ gram}$$

This means that user has to remove 1 gram at 30 degrees from the reflective tape in the direction of rotation.

2.1: Steps for using 2-round balancing

Following article will give you a step by step guide for using 2-round balancing method -

1. Mount the sensor as per requirement and connect the sensor to metrO™ B6012.
2. Mark numbers/alphabets on the rotating shaft to locate the point of unbalance by stroboscope (or stick a reflective tape on the rotating shaft to locate point of unbalance using optical sensor).
3. Connect stroboscope to the instrument  . Connect power supply to stroboscope & switch it ON. Press EXT button  to use the stroboscope in external trigger input mode.
4. Select balancing sub-menu from Main Menu.
5. Select appropriate sub-menu for performing balancing, e.g. Automatic.
When user enters appropriate balancing sub-menu, it is the start of round-1.

Round-1

1. Select preferred unit for balancing and press OK key to proceed.
2. Firstly metrO™ B6012 has to detect speed of rotating shaft. In case of automatic balancing mode, speed will be detected automatically from the vibration sensor. For Optical balancing mode, it will detect speed using optical sensor and in Manual balancing mode, user has to feed in speed.
3. Once stable speed is acquired and acknowledged by pressing OK key (no need to acknowledge in Automatic balancing mode), amplitude of vibration corresponding to the acknowledged frequency is displayed according to the units selected. (In Manual balancing mode threshold must be adjusted to detect highest amplitude). User can change units for display of frequency at any time from among those available in the current mode.
4. Stroboscope indicates the point of unbalance (add/remove) with respect to the sensor position. Optical balancing mode has the option to view the point of unbalance (add/remove) either in degrees with respect to reflective tape or using stroboscope.
5. Press OK key when vibration amplitude reading is fairly stable. Pressing ESC key without pressing OK key first will not save round-1 data. Always first acknowledge round-1 data by pressing OK key and then user can press ESC key and switch OFF the instrument.
6. Depending on the initial reading of vibration amplitude obtained in round-1, add/remove some trial weight from the rotating shaft at the point indicated by stroboscope depending on whether stroboscope shows the point where weight has to be added or removed respectively. Add/remove trial weight only at the point along the periphery of rotating body indicated by stroboscope or degrees.
7. Enter this trial weight added/removed by using numeric key input. If the current option selected by cursor is Gm, use LEFT/RIGHT arrow keys for decrementing / incrementing the trial weight value. Press OK key. This will start round-2

Round-2

1. Repeat steps 2 & 3 of round-1 here which indirectly gives step 4 of round-1 as output.
2. In addition, the instrument calculates the weight to be added/ removed at the point indicated in step 1 above depending on the settings for indicating point of unbalance: add/remove.
3. Add/remove the weight mentioned above from the point indicated along the periphery of rotating body for precise balancing depending on the unbalance indication setting.
4. Press OK key to save balancing data.
5. Press ESC key after successfully saving data.

Notes:

- If ESC key is pressed during any on-going balancing operation, data will be saved. User will be asked if required to resume previous balancing or start a new balancing process next time the user selects the same balancing mode operation. Press OK key to resume previous balancing process else ESC key to start a new balancing round.
- Flow diagram shown next is a guideline on how to decide the balancing operation process to be selected.



Figure 2-1: Minimum & max amplitude, add/remove weight option navigation

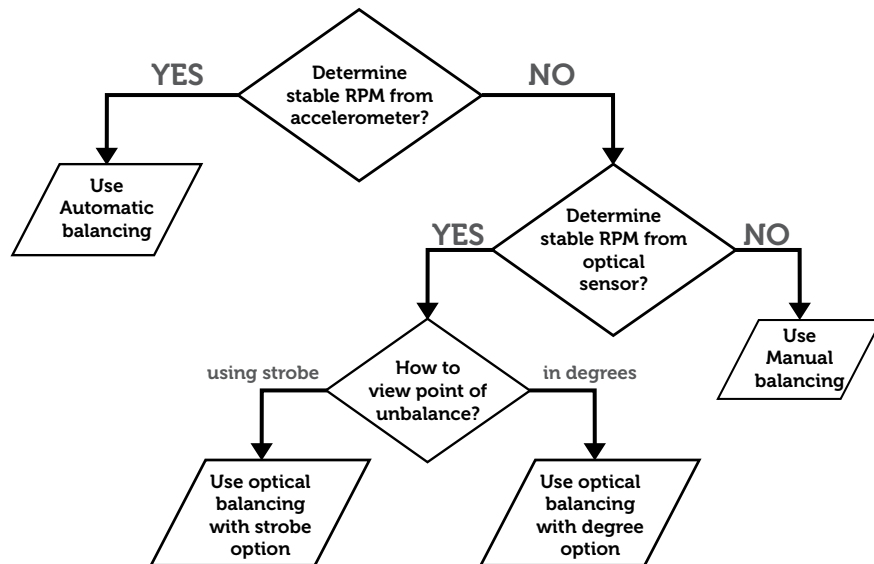


Figure 2-2: Balancing mode selection criteria

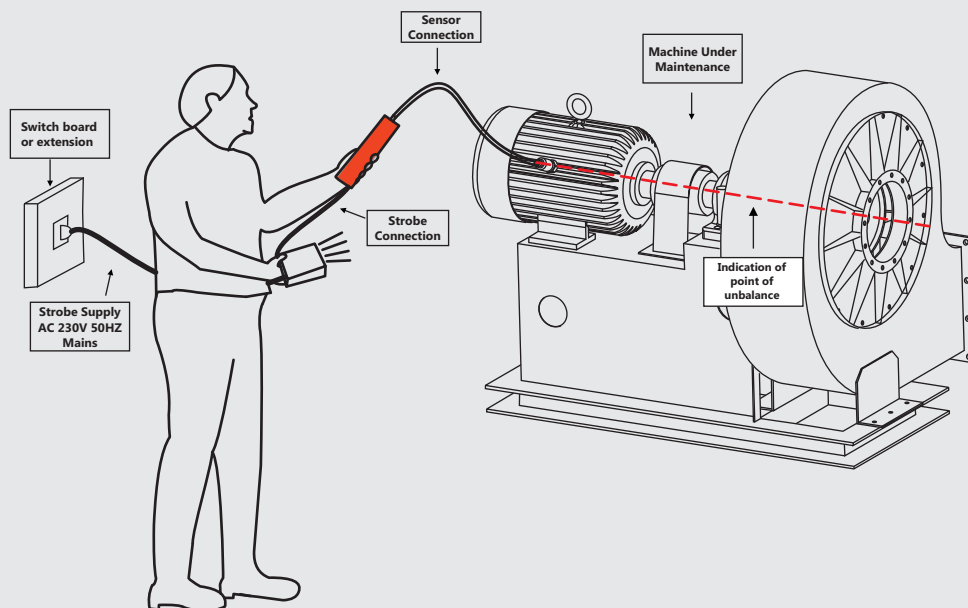


Figure 2-3: Location of point of unbalance

Chapter 3: Balancing

3.1: Automatic balancing

This is a completely automatic mode for balancing intuitively developed & introduced by Signasis Technologies Pvt. Ltd. In this mode, rotational speed will be automatically obtained from the accelerometer signal and point of unbalance is indicated by stroboscope light depending on the setting for mode of unbalance indication. There is no need to acknowledge the speed obtained. If stable speed is not obtained from the accelerometer, its corresponding process message is displayed. Stable speed in this case means speed from accelerometer $\pm 3\%$.

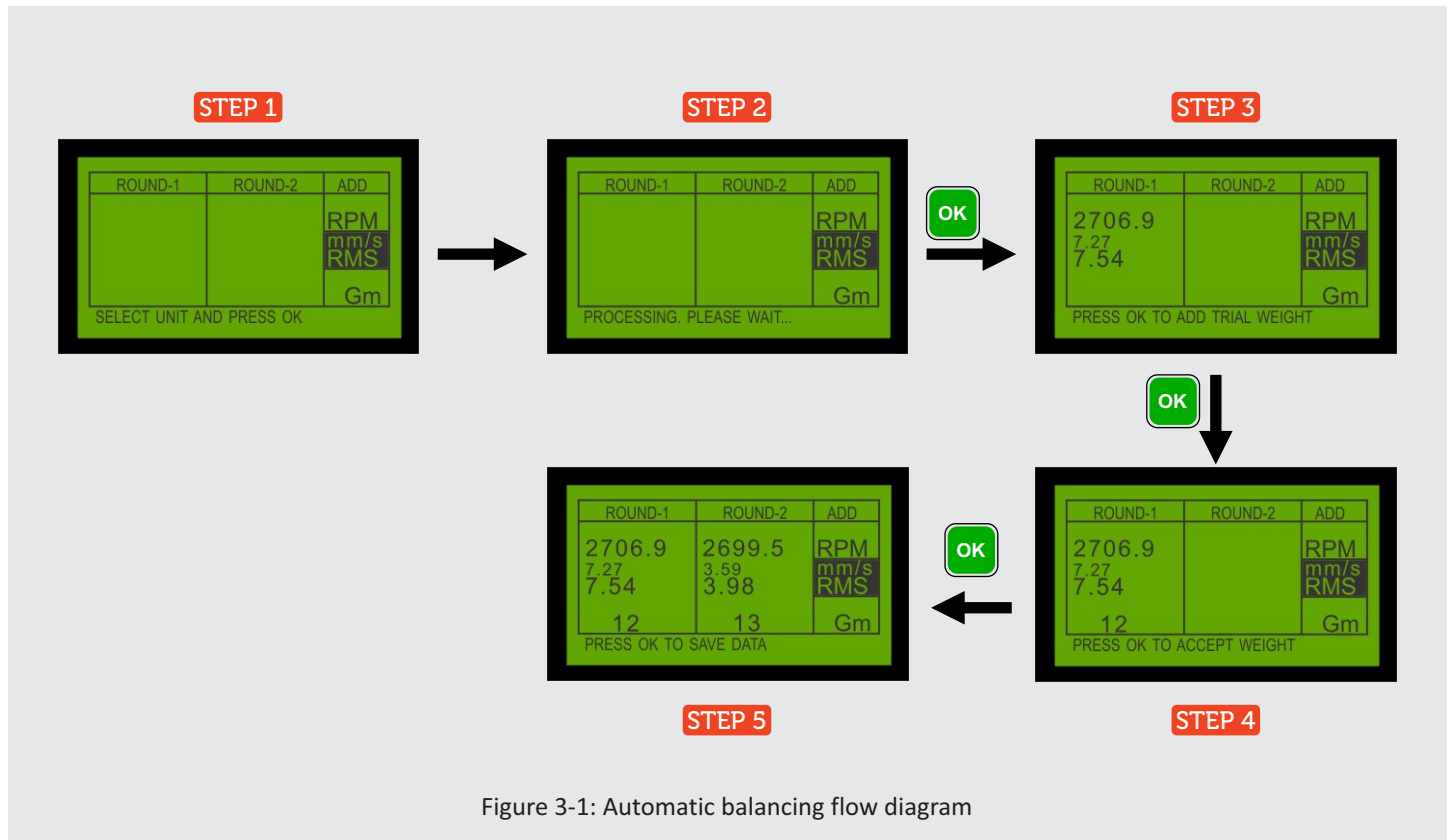


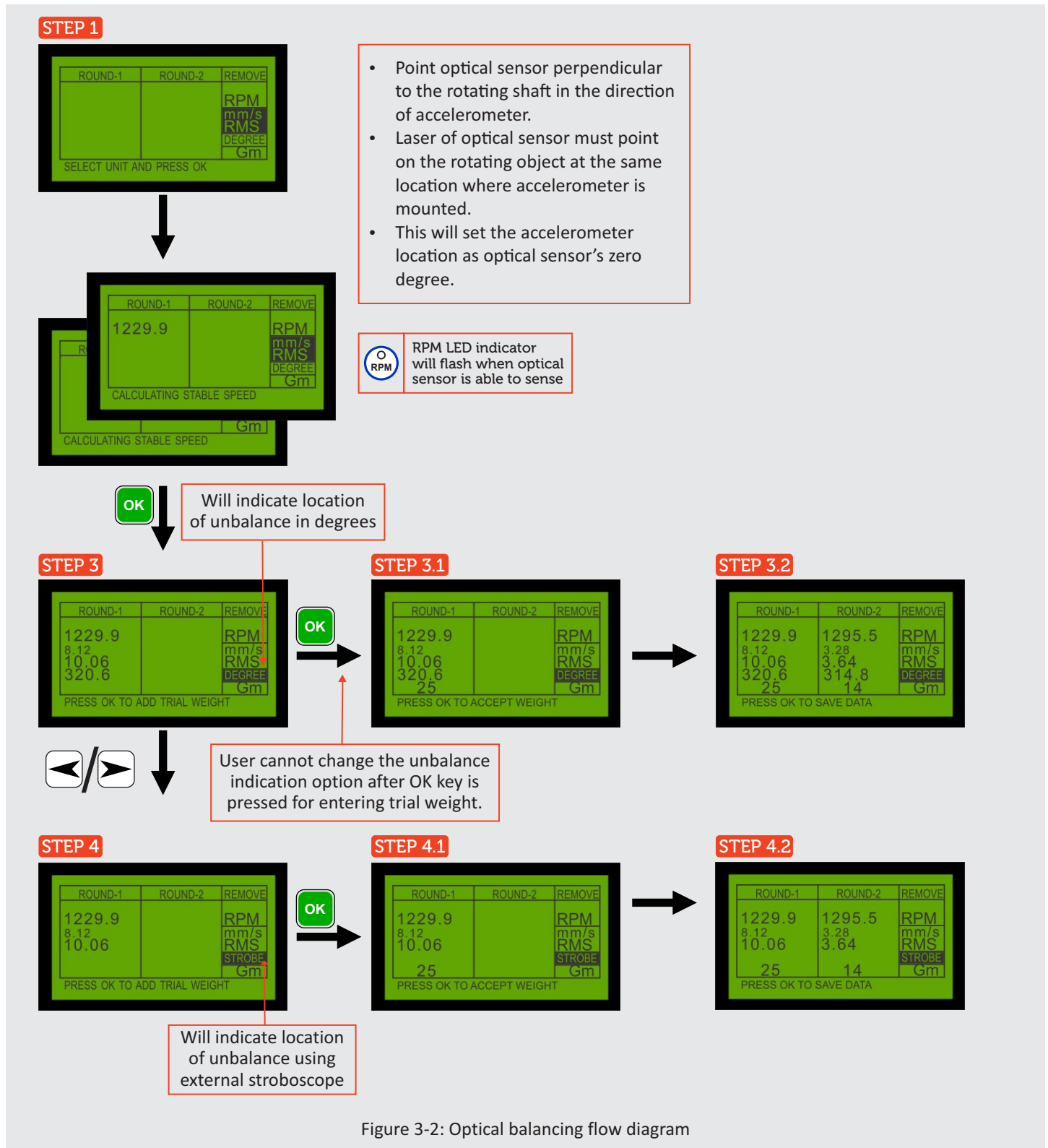
Figure 3-1: Automatic balancing flow diagram

3.2: Optical balancing

In this balancing mode, rotational speed is obtained using built-in optical sensor and point of unbalance is indicated using strobe light OR in angle measured in degrees with respect to reflective tape in the direction of rotation.

Note: User has the option to select preferred method for indication of point of unbalance only in round-1 after stable RPM has been determined.

Stick a small piece of reflective tape on the rotating shaft and measure its speed by pointing the optical sensor towards the shaft. After stable reading is obtained, acknowledge this reading by pressing OK key to proceed further. Stable speed in this case means speed from accelerometer $\pm 2\%$. Acknowledged speed and processing will be indicated by displaying the corresponding process message.



3.3: Manual balancing

In this balancing mode, rotational speed is set manually by adjusting the frequency of stroboscope light to be equal to the speed of rotating shaft and point of unbalance is also determined manually by tuning the threshold.

Use numeric key input to set the approximate frequency and press OK key. Connected stroboscope will flash at this frequency. Use LEFT / RIGHT arrow keys to finely tune by decrementing / incrementing the flashing frequency. Observe the rotating shaft in stroboscope light and when it visualizes of being stable, frequencies of stroboscope & shaft are said to be matched and this is the speed of rotation. Acknowledge this speed by pressing OK key.

Current value of threshold will appear after processing the request. Select the threshold variable option by pressing UP or DOWN arrow keys. Adjust the threshold to such a point where max value of amplitude is obtained by pressing LEFT or RIGHT arrow keys. This point will be indicated by stroboscope light and is said to be the point of unbalance (add/remove).

Tip: The optimal threshold value is when if incremented, then stroboscope stops firing.

Tip: Manual speed can also be determined from stroboscope using internal trigger setting by pressing INT key and setting the strobe light flashing speed using control knobs on the stroboscope. This speed can then be fed in the instrument using numeric keys.

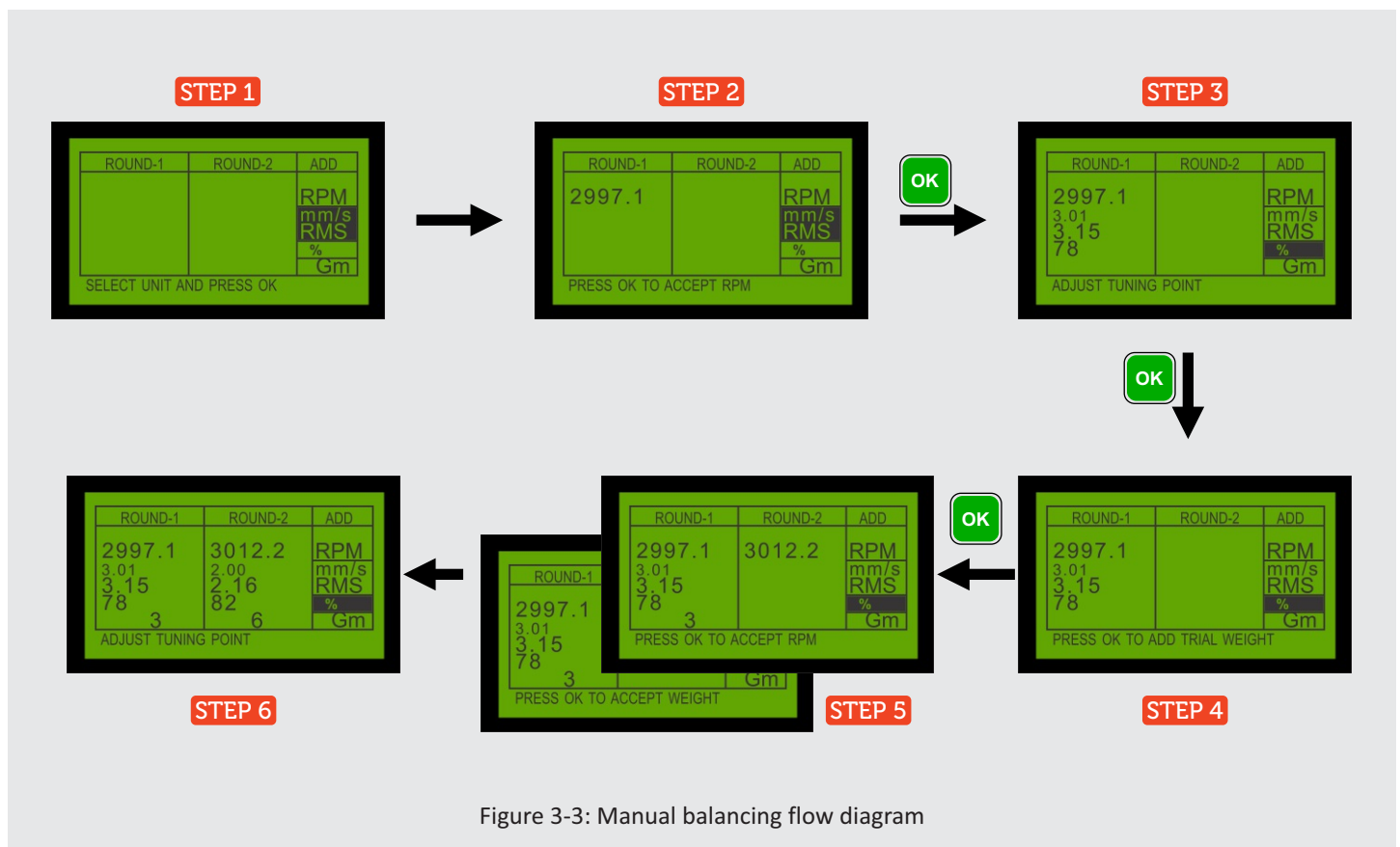


Figure 3-3: Manual balancing flow diagram

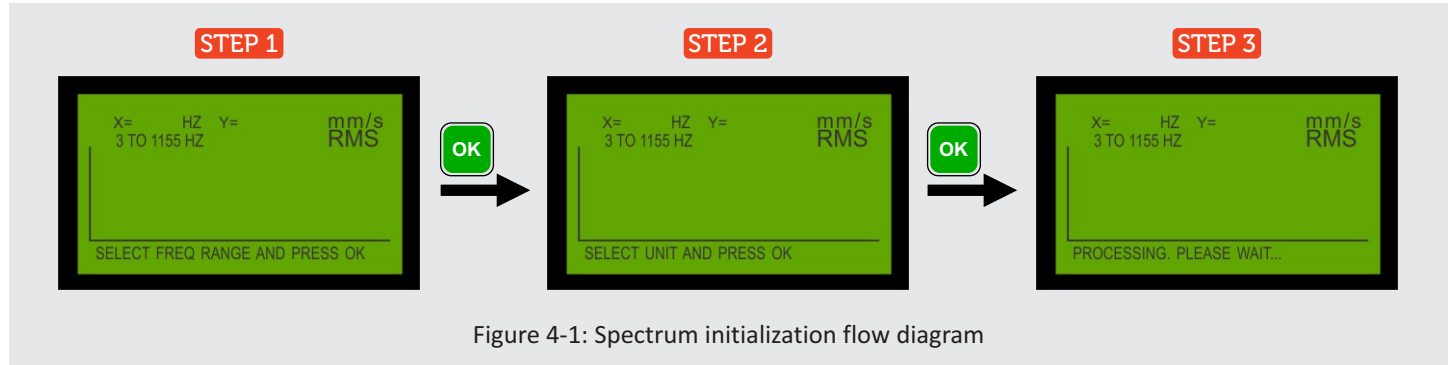
Chapter 4: Analysis

4.1: Spectrum

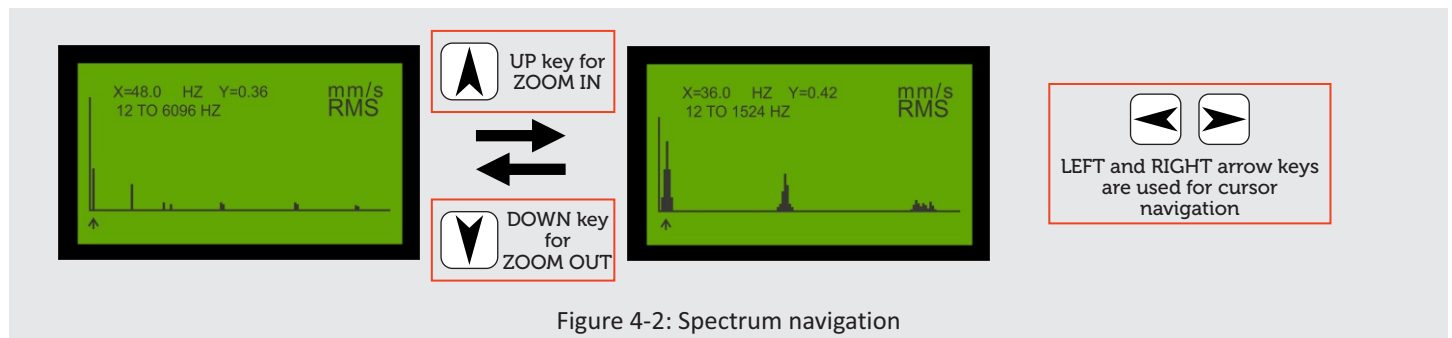
Spectrum analysis mode is used to view real-time vibration spectrum. User can select between two frequency bands:

- Narrow band : 3 Hz to 1 KHz with 3 Hz of spectral resolution
- Wide band : 12 Hz to 5 KHz with 12 Hz of spectral resolution

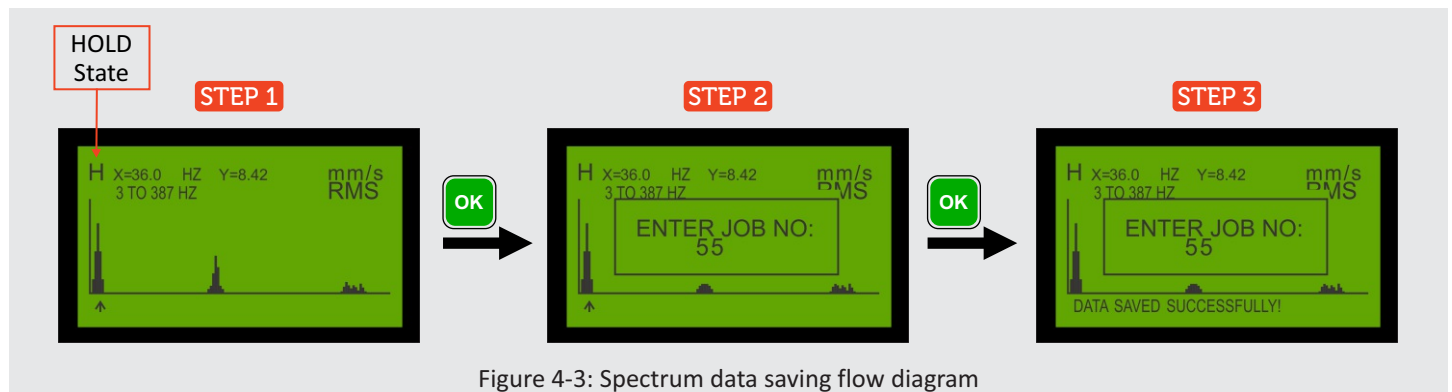
User has to select amplitude unit prior to processing vibration data by using LEFT / RIGHT arrow keys as shown below.



User can Zoom IN / OUT and navigate the vibration spectrum as shown below.



For detailed analysis of frequency components, press OK key to pause real-time update of spectrum data. Then use arrow keys for navigation as shown above. Save this paused data by pressing OK key as shown below. After successfully saving spectrum data, instrument will return to the hold state. Press ESC key to come out of hold state and view real-time vibration spectrum.



4.2: Levels analysis

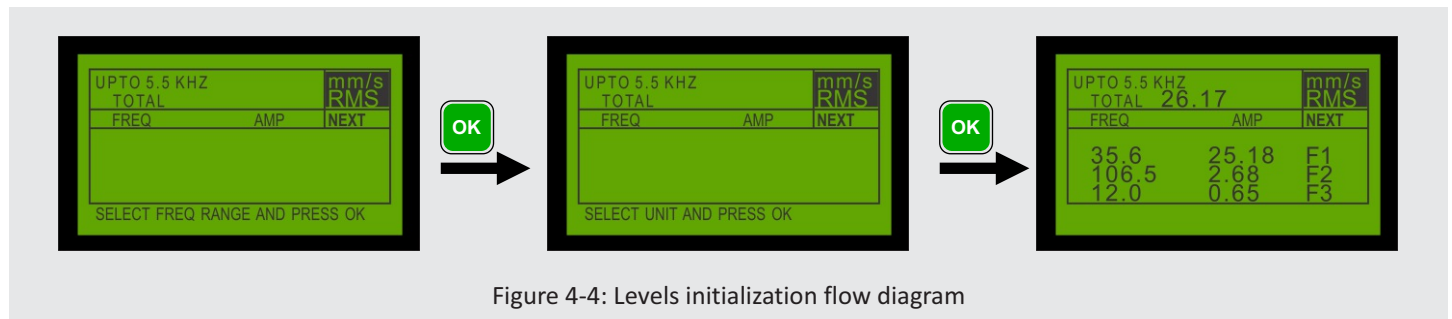
This mode is used for easy to understand analysis of vibration signal from accelerometer. It calculates 2 parameters:

- True RMS amplitude of total vibration signal in terms of selected unit. Peak and peak to peak values are derived from this true RMS value.
- Top 6 contributing frequencies at which vibration exists in descending order of their corresponding amplitude derived from vibration spectrum. For example, frequency contributing highest vibration amplitude to the total vibration signal is denoted by F1 , second highest contributing frequency is denoted by F2 and so on till F6.

This mode has two frequency ranges similar to spectrum analysis:

- Narrow band : 3 Hz to 1 KHz
- Wide band : 12 Hz to 5 KHz

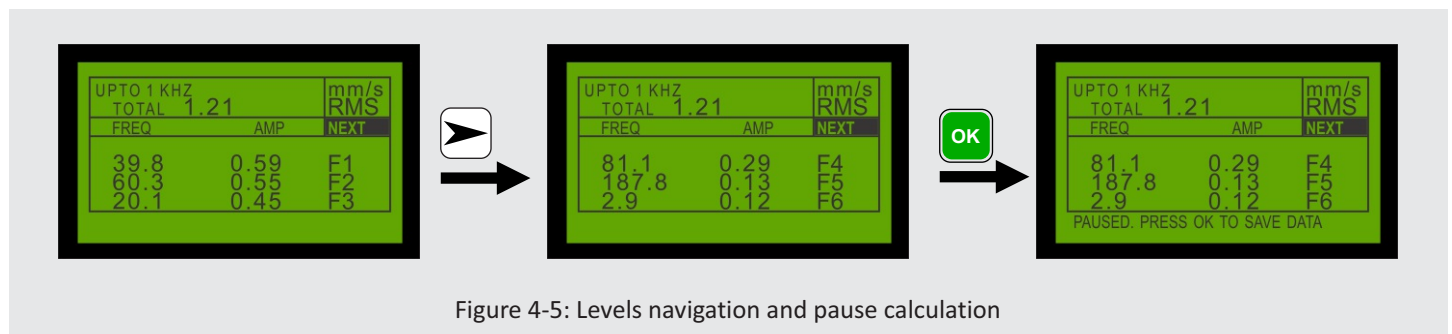
Levels mode uses advanced interpolation techniques for compensating for spectral leakage to derive frequency and corresponding amplitude with better accuracy from vibration spectrum. This provides better resolution as compared to spectral analysis.



LEFT and RIGHT arrow keys are used for frequency and unit selection.

Note: Total vibration amplitude is not a simple summation of amplitudes of individual contributing frequency. Relation between amplitudes of contributing frequencies and total vibration amplitude is given below. E.g. consider the rotational speed to be 50Hz. If A1 = 8 mm/s at 50 Hz, A2 = 4 mm/s at 100 Hz and A3 = 1 mm/s at 200 Hz then the total vibration amplitude is given by:

$$Total = \sqrt{(A1)^2 + (A2)^2 + (A3)^2} = 9 \text{ mm/s}$$



User can pause data for analysis by pressing OK key. User can navigate paused data by selecting NEXT option and then using LEFT / RIGHT arrow keys. User can then save paused data by pressing OK key again.

Chapter 5: Additional modes

5.1: Speed

Modes of operations under this menu are used to determine rotational speed by various methods. Navigate selection of mode by pressing UP or DOWN arrow keys. To enter into currently selected mode (indicated by cursor), press OK key. To return to the previous menu, press ESC key.

After entering into any of the included operational modes, if unstable reading is obtained, its corresponding process message is displayed. User can change the unit of measurement by pressing LEFT or RIGHT arrow keys. Pressing OK key will hold the current reading and display corresponding process message.

Optical

This mode is used to determine rotational speed from optical sensor. Stick a small piece of reflective tape on the rotating shaft and point the optical sensor towards it. Observe the blinking LED to confirm signal reception by optical sensor. Instrument will display calculated stable speed when successful reception by optical sensor else will display corresponding warning message.



Manual

This mode is used to determine rotational speed with the help of stroboscope. The basic concept behind this method is that when the frequency of light from stroboscope matches the rotating frequency, the rotating shaft visualizes being stable. Connect stroboscope to metrO™ B6012 and use external trigger mode on stroboscope by pressing EXT button. Use numeric keys for approximate speed input and press OK key to accept the input so that stroboscope starts flashing light at this frequency. Use the LEFT / RIGHT arrow keys to change the frequency of light from stroboscope by 1 RPM (fine tuning). Observe the rotating shaft in stroboscope light and when it visualizes of being stable, frequencies of stroboscope & shaft are said to be matched and this is the speed of rotation

Note: The same can be accomplished by using the stroboscope in internal trigger mode and setting the strobe light flashing speed using control knobs on the stroboscope.

5.2: Data

This menu is used to view saved balancing and analysis data. It's sub-menus include balancing, spectrum and levels. Data is stored as a job number - trial number pair and it is viewed in a similar way in data sub-menu's. Most recent data stored appears first and least recent appears last.

Navigate through the data records using UP / DOWN arrow keys and select the record whose details need to be viewed using OK key. User can navigate saved data when viewing its details with some limitations, e.g. user cannot change the unit of amplitude measurement.

- Balancing data mode shows all data stored in various balancing modes. The mode of balancing used for a particular record is evident only after viewing the record details.
- Spectrum data mode shows saved spectrum data. Press OK key for amplitude zooming while viewing stored spectrum data.
- Levels data mode shows saved levels data.

5.3: PC Connect

This menu is used for connecting metrO™ B6012 to a computer via RS232 interface. Select the mode by pressing OK key and exit the mode by pressing ESC key. Connection status and all other relevant information will be displayed on the computer. This mode is used for transferring saved data to the computer and for remote analysis of vibration data.

User can use RS232 to USB cable for connecting the instrument to computer via USB.

Computer software might add more features in further releases.

5.4: Info

This menu provides general information about metrO™ B6012.

Chapter 6: Settings

This menu includes all the settings applicable to metrO™ B6012. Press UP or DOWN arrow keys to navigate through the menu. Press OK key to enter currently selected sub menu (cursor indicates the currently selected sub menu) and press ESC key to return to the previous menu. Use UP or DOWN arrow keys to navigate and LEFT/RIGHT arrow keys to change values of currently selected options. Following sub menus are available under this menu:

6.1: Sensor

This setting is used to set accelerometer sensitivity according to its calibration certificate. Accelerometer sensitivity is always measured in mV/g.

6.2: Job type

This setting defines instrument sensitivity. Available sensitivity options are LOW, MEDIUM and HIGH. This sensitivity is concerned with our proprietary automatic balancing algorithm and sets algorithm's sensitivity for balancing different types of jobs, eg. high sensitivity will balance jobs whose unbalance frequency amplitude is closer to other unwanted vibration frequency amplitudes.

Default value is MEDIUM sensitivity.

Tip : Inexperienced users should not modify this setting.

6.3: Units

This setting is used to set default amplitude and frequency measurement units.

6.4: Display

This setting indicates status and level of graphic display backlight. Enter this sub menu by pressing OK key to edit these settings.

graphic display backlight can be made ON or OFF. If graphic display backlight is ON, its brightness level can be set depending on the operating environment's illumination.

6.5: Clock

This menu is used to edit the real time clock settings like date, time, etc. in case of inaccurate values.

Square cursor indicates the current selection that can be modified. Press UP or DOWN arrow keys to modify the current selection. Use numeric key input to modify date and time values. Press LEFT or RIGHT arrow keys to change day value.

Note : Clock time to be edited is always displayed in 24 hour format.

The time format option is used for clock display on menu screen where current time can be shown either in 12 hour or 24 hour format. Default is 24 hour format.

6.6: Power


This setting indicates the status and time duration for auto power-off in order to enhance battery life. Enter this sub menu by pressing OK key to edit these settings.

Auto power-off can be made ON or OFF. When ON, user can set approximate time of inactiveness after which metrO™ B6012 will be turned OFF. Power off delay time is set in seconds. Auto power-off feature will be disabled during any of the measurement mode to ensure sufficient time for the user to take measurements.

6.7: Reset

This setting is used to reset all the settings and data to default value in case of any failure or system crash. Enter this sub menu by pressing OK key. Select the appropriate option to reset using UP / DOWN arrow keys and press OK key. Corresponding reset successful message will be displayed after reset is successful.

Chapter 7: FAQ's

- Q. Highest contributing frequency to total vibration amplitude is multiple of actual RPM. What can be done under such circumstances?
- A. Vibration frequency at multiples of RPM indicates machine faults other than unbalance. Levels mode will display the contributing frequencies in descending order based on their vibration amplitudes. Analyze the contributing frequencies and reduce vibrations due to those before proceeding for balancing. For balancing, vibration frequency at the actual RPM must be the highest contributing frequency to the total vibration amplitude.
- Q. How to check connection between stroboscope and vibration analyzer instrument ?
- A. Connect vibration analyzer and strobe with the connecting cable provided. Connect external AC power supply (mains) to strobe with the power cord provided and switch ON the strobe. The strobe should start flashing. Now press  key on the strobe so that it is set to flash on receiving external signal input from vibration analyzer (it should stop flashing after pressing the button). Switch ON the instrument and navigate to Speed -> Strobe mode. Enter some numeric RPM value, e.g. 1000 and press OK key. Strobe should start flashing at 1000 RPM since instrument will send external flashing signal. Press ESC key and strobe should stop flashing. This confirms that the connection between strobe and vibration analyzer instrument is successful.

Chapter 8: Technical Specifications

INSTRUMENT

Analysis frequency range	1 Hz to 5000 Hz (60 RPM to 300000 RPM).
Measurement Units	mm/s, g, m/s ² , micron (μm)
Type of Average	RMS, peak and peak-to-peak
Measurement range	velocity : 0 to 300 mm/s RMS acceleration : 0 to 15 g RMS displacement : 0 to 2000 microns peak to peak
Total vibration measurement type	True RMS
Unit conversion	Hardware integration
Fast Fourier Transform (FFT)	Vibration signal spectrum with 1024 lines of resolution. Sensitivity up to -26 dB.
Analysis frequency bands	a. 3 Hz to 1024 Hz with 3 Hz of resolution b. 12 Hz to 5000 Hz with 12 Hz of resolution
Balancing frequency range	1Hz to 1000Hz (60 RPM to 60000 RPM)
Methods of Balancing	Introducing the concept of 2-round balancing with implementation in different modes 1. Automatic balancing method 2. Built-in tachometer guided balancing method 3. Manual balancing method
Unbalance Indication	a) Using stroboscope/ strobe light b) Angle (in degrees) with respect to reflective tape when using built-in tachometer.
Input signal level	4mV to 4.8V peak-to-peak Sensitivity: -40dB
Accelerometer type	Constant current accelerometer, magnetic mount, 10-ft polyurethane jacketed cable
Accelerometer sensitivity	100mV/g (standard) +/- 10%
Tachometer type	Built-in infrared tachometer with laser pointing and LED receiver indication
Tachometer measuring RPM	10 to 60000 RPM
Tachometer range	10 cm to 60 cm
Autoscale	Yes
Real Time Clock	Yes
Auto Power-off	Yes
Processor	DSP controller @ 120MHz
Display	128x64 graphic LCD with back-light adjustment
Keypad	Membrane keys
Power Supply	11.1V/2.2AH Li-ion battery with charger
Power Usage	11.1V/106mA (more than 7hrs. of continuous operation)
Overall Dimensions	125 x 225 x 50mm (approx.)
Weight	700 grams (approx.)

STROBOSCOPE

Flash Light	Xenon Flash @320V DC
Power Supply	230VAC/50Hz

Declaration

Due to continuous development, Signasis reserves the right to make changes in specifications without prior notice or liability. While every precaution has been taken to ensure accuracy and completeness in this literature, Signasis assumes no responsibility, and disclaims all liability for damages resulting from use of this information or for any errors or omissions.



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