SmartBalancer4

Contents

Foreword

Congratulations, and thank you for deciding to purchase the SmartBalancer 4 field balancing unit and signal analyzer. With this newly developed measuring unit, you have a reliable aid on the spot when it comes to recording and analyzing complex machine signals.

The SmartBalancer 4 detects all forms of machine vibrations, roller bearing conditions (optional), and process and visual inspection data, and saves this information for evaluation, archiving, and documentation.

Despite its extensive functional features, the SmartBalancer is easy to operate and effective in use:

- High measurement accuracy and fast data recording
- SmartBalancing Mode
  - 'Balancing' for detection and correction of rotor unbalances in one or two planes (option).
  - Analysis of overall and spectrum (FFT) for machine diagnosis
- Connection of almost any sensor type
- Optional advanced analysis for individual measurements for machine diagnosis

Hardware

- Six synchronous analog measurement channels
- Two speed measurement channels
- Muti-touchscreen (glove compatible), ON/OFF button, and two ENTER buttons.
- Adequate storage space (MicroSD card, 256 GB, permanently installed).
- One RGB LED to display battery and charge status
- Energy saving mode
- Dust-proof and protected against spray water (IP65) - ideal for the rough industrial environment.
- Military standard connector technology

Data recording and analysis

- Characteristic values
  - Vibration in acceleration, speed, and deflection
  - Current and voltage (process figures)
  - Envelope (roller bearing condition) (optional)
  - Speed
- Signals
  - Frequency and order-based data recording
  - Amplitude, envelope, and order spectrum
  - Time signal
  - Phase measurement (synchronous)
  - Field balancing (1-/2-plane balancing of rigid rotors)
  - Coast-down curve (natural vibrations, complete machine set) (coming soon)
  - Impact test (natural vibrations, individual components) (coming soon)

Ergonomics

- Large capacitive touchscreen with color display ensures clear presentation and optimum legibility (1280 x 800 pixels, 220 x 137 mm, 16.7 million colors)
- Graphic user interface
- Backlit with ambient light sensor
- Multi-touch – gesture control and glove compatible
- Screen is optically bonded for high contrast and increased shock resistance

Power supply

- Li-ion rechargeable battery of the latest generation for 8 operating hours per charge
- Intelligent charging function in the unit
- Energy saving mode

Communication

- PC connection via USB-C

Documentation

- Printout of measurement data and reports, direct onto paper or as PDF file.

About these instructions

These instructions describe the basic functions, and the operation of the measuring unit in the operating modes of balancing, analysis, and roller bearing analysis.

1. Safety and operating instructions

Familiarize yourself with the safety and operating instructions given in this section before commissioning the measuring unit. SmartBalancer4 and the related sensors are precision instruments and must not be dropped or subjected to physical shock.

Symbols used

Symbol	Description
	WARNING. RISK OF DANGER.
	WARNING. HAZARDOUS VOLTAGE. Risk of electric shock.
	Consult user documentation.
	Conforms to European Union directives.
	Conforms to UK legislation.
	This product complies with the WEEE Directive and its marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste. Do not dispose of this product as unsorted municipal waste. .
	Denotes that the product is made of parts that are recyclable.

General safety

A ***Warning*** identifies conditions and procedures that are dangerous to the user.

A ***Caution*** identifies conditions and procedures that can cause damage to the Product or the equipment under test.

Warning

To prevent possible electrical shock, fire, or personal injury:

- Read all safety information before you use the product.
- Carefully read all instructions
- Do not alter the product and use only as specified, or the protection supplied by the product can be compromised.
- Do not use the product around explosive gas, vapor, or in damp or wet environments.
- Use only approved power adapters to charge the battery.
- Do not use the product if it operates incorrectly.
- Use only specified replacement parts.
- Use the product only as specified.

- Do not open the product. Have the product repaired only through an approved technical site.
  - Repairs to the measuring unit must be carried out only by authorized specialist personnel.
  - Only original replacement parts and original accessories must be used.
  - The electrical equipment may only be used when in a properly functioning condition. Faults such as defective plugs or loose connections must be rectified immediately. Damaged cables must be replaced by a specialist.
  - Design changes or technical safety modifications to the measuring unit or accessories are not allowed.

Caution

- As with any software that processes data, data may be lost or altered under certain circumstances. Schenck strongly recommends that you keep a backup or printed record of all important data.
- Schenck assumes no liability for data lost or altered as a result of improper use, repairs, defects, battery replacement/failures or any other cause.
- Schenck assumes no responsibility, directly or indirectly, for financial losses or claims from third parties as a result of use of this product and any of its functions, such as loss or alteration of stored data.

Proper use

- SmartBalancer is used only to measure electrical signals in industrial environments with the technical specifications taken into account. Care must be taken to ensure that the device is not dropped or knocked about. Sensors and cables are used only in specified areas. No liability will be assumed when components or operation procedures as described in this manual are altered without permission of the manufacturer. Use SmartBalancer as intended or the device protection can be compromised.
- SmartBalancer is designed for use as a portable balancing unit for the balancing of stationary machines with only rotating components (rotors), such as turbine rotors, inductors, circulating pumps, circulating compressors, blowers and similar. This does not include machines with oscillating components, such as all piston engines.
- SmartBalancer may be used without restriction for the balancing of rigid rotors. Flexible (soft) rotors may be balanced with SmartBalancer in the area of the resonance frequency (±25%), but only by an experienced user. The measuring unit and the accessories may only be operated by trained personnel.
- The measuring unit may only be used for the measurement of machine signals in the industrial area, taking into account the technical specification (see “Appendix - Technical data”).
- Pick-ups and cables may only be used in the specified area defined in the technical data sheets.
- Transport of devices that use lithium batteries – When you return lithium-ion battery-operated devices to an approved technical site for inspection, service, calibration check, or repair, make sure that the batteries are not defective. If you suspect a defect in the battery, DO NOT ship the unit with the faulty battery back to Schenck USA Corp. You may contact your local representative for further information.

- Transport of magnetic components – To make sure that stray magnetic fields do not affect the avionics in aircraft, the aviation industry has put forward stringent regulations for air transportation of magnetic material. The magnetic field strength of such components must not exceed specified limits. To comply with this regulation, a cover plate for all Schenck magnetic component is available. The plate lowers the magnetic field strength significantly and keeps the magnetic field strength well below the required limits, and therefore cause no restrictions for air transportation.

Any further form of use constitutes improper use and is not allowed. Schenck accepts no liability for damage caused by improper use. Faulty or impermissible use, or failure to observe these operating instructions, invalidates any guarantee on the part of SCHENCK.

Operation

- Portable radio devices and variable frequency drives in the immediate vicinity of the measuring unit can cause interference. Check if necessary whether the plug connections between the pick-up and measuring unit are firmly connected.
- Expose the SmartBalancer, pick-up and cables only to the permissible environmental influences.
- Protect the connections on the measuring unit against soiling with the aid of the rubber flaps provided.

CE conformity

SmartBalancer conforms to the EU directives for electromagnetic compatibility (EMC) (2014/30/EU) and electrical operating equipment applicable for charger (2014/35/EU), 2011/65/EU (RoHS-Directive) und 2014/53/EU (Radio Equipment Directive).

The measuring device is CE-marked in accordance with the EMC Directive 2014/30/EU.

2. Unit and Interfaces

The images below show the interfaces and operating elements of the measuring unit:

Label	Part	Function
1	Enter button (left)	Start a measurement and/or cancel the action
2	Battery charge LED	Shows battery charge capacity when the device is in sleep mode
3	Ambient light sensor	Adjust display brightness automatically
4	Multi-touchscreen	Graphical display and touch-sensitive user interface
5	Enter button (right)	Start a measurement and/or confirm the action
6	Stand	Removable stand to hold device in different positions

Note: The two grey ENTER buttons (1 & 5) are by default connected to the action buttons in the applications. The ENTER buttons can be used to activate actions buttons such as NEXT / MEASURE.

The connections for the sensor and data cables are located on the front side of the measuring unit.

For designation and identification of the six multi-pin connections, numbers are embossed on the inside of the rubber protection flaps. The corresponding cables are fitted with different size connectors to correlate to the sockets on the unit. With the aid of the marking point on the connector and on the socket, the cable can be connected correctly. To disconnect, first unlock it by pushing the plug sleeve to the rear. Only then can you disconnect the plug from the unit. Never pull direct on the cable itself!

Label	Part	Function
1	On/Off Button	Switch the device ON and OFF; activate/deactivate sleep mode
2	Channel 6	Analog input – connection for sensor
3	Channel 5	Analog input – connection for sensor
4	Channel 4	Analog input – connection for 5/6th sensor
5	Trigger Point 2	Connection for sensor to measure rotational speed or trigger signal
6	Trigger Point 1	Connection for sensor to measure rotational speed or trigger signal
7	Channel 3	Analog input – connection for sensor
8	Channel 2	Analog input – connection for sensor
9	Channel 1	Analog input – connection for 5/6th sensor
10	USB-C	Communication interface to PC
11	Charging socket	Connection for charger
12	Stand	Removable stand to hold device in different positions

Analog

Input channels 1, 2, 3, 4, 5, & 6 are provided for the measurement of analog signals. The SmartBalancer will auto-connect to the active and connected sensors. The setting in the balance will assign which of the two planes (A or B) the sensors are connected to.

Digital

Digital signals are recorded by the channel marked with the TP 1 or TP 2 (Trigger point) these are used for connection of a reference pick-up or speed sensor.

2.1 System Packages

At this time, the following SmartBalancer 4 packages are available:

- VIB 5.011-SR — SmartBalancer 4 standard balancing package
- VIB 5.014-SR — SmartBalancer 4 multi-channel balancing package

Description	VIB 5.011-SR	VIB 5.014-SR
SmartBalancer 4 device	✓	✓
Ruggedized Trolley case	✓	✓
Shoulder strap	✓	✓
Hand strap (2 no.)	✓	✓
Power supply	✓	✓
USB-C data cable	✓	✓
Mobile Industrial accelerometer	✓ (2 no.)	✓ (4 no.)
Straight cable for line drive transducer	✓ (2 no.)	✓ (4 no.)
Magnetic holder for curved surfaces	✓ (2 no.)	✓ (4 no.)
Laser trigger / RPM sensor	✓	✓
Bracket (stand) for Laser Trigger	✓	✓
Cable for laser trigger / RPM sensor	✓	✓
Reflective tape	✓	✓
SmartBalancer 4 multi-channel firmware certificate	×	✓

Note: Check and ensure that the delivered package items conform to the purchase order and the packing list. Contact Schenck or your local sales representative if any package items are damaged or missed.

2.2 Designation Plates

The position and contents of the two designation plates on the measuring unit and the battery are shown in the following illustration.

2.3 Concept

In the SmartBalancer, the focus is on the full machine train and not the individual measurement locations. Machine templates are used to create the full asset to be measured, and includes all machines on the train, all measurement locations, and measurement tasks for the locations.

Note: The term measure locations are used to refer to the locations where the sensors are mounted when an asset is measured.

To quickly determine the machine speed the SmartBalancer uses ***Speed measurement***. This function can also be accessed via the measurement screen hamburger menu (☰).

2.4 Home Screen

The home screen shows when the device is turned on and contains shortcut icons required to operate the SmartBalancer. The displayed icons depend on the registered applications.

If required, use the back arrow (<) to trace the path back to the home screen.

Note: Icons shown on the home screen are different and depend on the registered application.

Tap the respective icon to access the respective function. The dots on the bottom of the screen show the number of pages available for the home screen.

Label	Name	Function
1	Analysis	Use to start the vibration analysis application. Tap the icon to start the application from a machine template or the necessary asset. (Asset will open the file manager).
2	Balancing	Use to start the balancing application. Tap the icon to start the application from a machine template or the necessary asset. (Asset will open the file manager).
3	Coast down / Run Up	Use to start a run-up or coast-down test. Tap the icon to start the application from a machine template or the necessary asset. (Asset will open the file manager).
4	Speed measurement	Use to determine machine speed
5	Machine templates	Use to create machine hierarchy or when measuring a similar machine
6	File manager	Use to administrate saved machine templates
7	Task templates	Use for predefined measurement data set. This includes measurement quantity, upper & lower frequencies, number of lines, measurement time, sample rate, etc.….

8	Settings	Use to apply desired device and measurement settings
9	Help	Use to access the device on-board help
10	Machine Template shortcut	Use the machine template shortcut to open the template of your choice. The symbols at the top right corner show the application that will start.

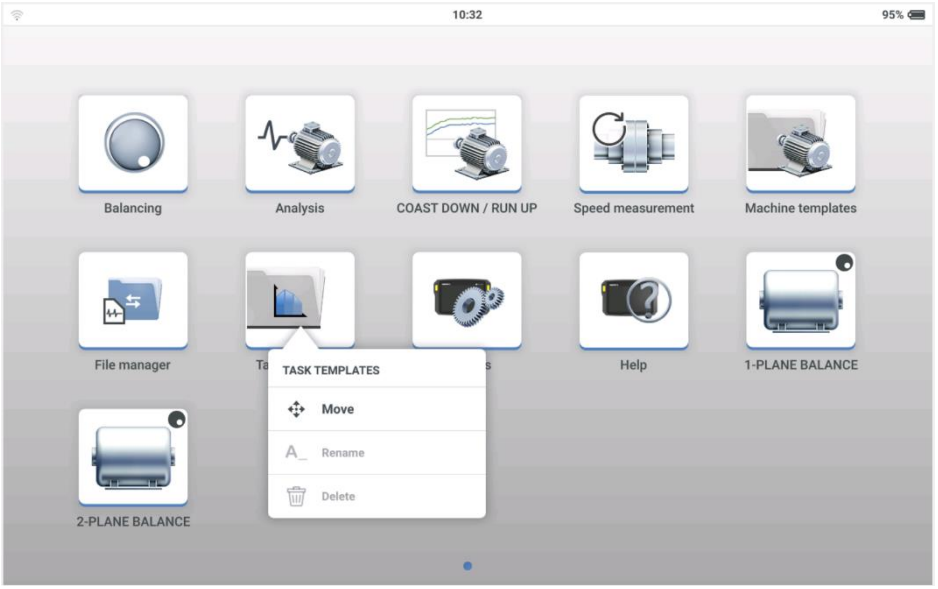
Machine Template shortcut legend:

 - Opens in vibration analysis application

 - Opens in balancing application

 - Opens in the coast-down / run-up application

Move applications icons on the home screen.



- Touch and hold down any application icon on the home screen. A context menu will appear.
- Tap the menu item ***Move***. The icon will begin to jiggle.
- Drag the icon to the necessary location. This can be on the same home screen or another home screen page.
- When finished, tap the screen to stop the jiggle and lock the icon in position.

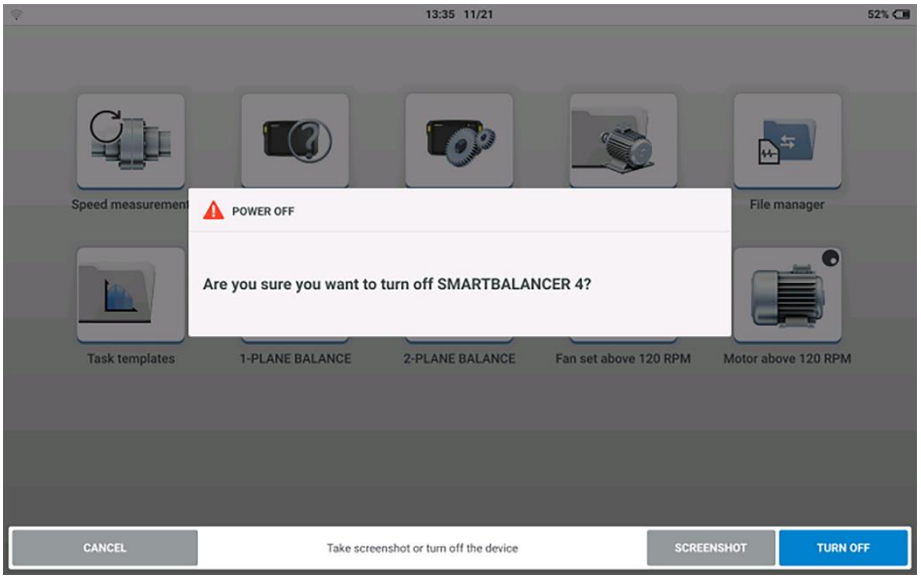
Note: For factory default application on the menu item ***Move*** is active. User created shortcut icons can be renamed and deleted.

2.5 Notes on Operation

Switching on / off

To switch on the unit, press and hold down the ON/OFF button until the device peeps. The battery status LED lights up green. After a short period, the home screen shows in the display, and the battery status LED switches off.

To switch off the unit, press and hold down the ON/OFF button briefly. Tap ***TURN OFF*** to confirm.



Sleep Mode

The device can be made to either sleep or be switched off. When the device is in sleep mode, it uses very little power and starts instantly when the ON/OFF button is pressed. When in sleep mode, the battery status LED lights green. The duration required before the device enters sleep mode is set under ***Power Manager*** in device settings.

Touchscreen

Raindrops, water droplets, and wet fingers will affect the touchscreen's functionality. If the touch screen becomes wet, please use a soft lint-free dry cloth to dry the touchscreen completely before you switch on the SmartBalancer 4 again.

Power supply

The device has an internal, rechargeable battery. To charge, connect the device to a main supply via the provided charger/adapter. The charger/adapter is connected to the charging socket. The battery status LED lights are green when charging. The battery capacity is shown in the top right corner of the display.

- Charge the non-removable battery only with the supplied charger/adapter. Follow the safety instructions supplied with the charger.
- Maximum charge temperature is 40°C (104°F).
- Do not deep discharge the battery (<15%).
- Observe the storage and transport conditions given in Handling precautions.

Connect the SmartBalancer to the power supply regularly, if you are not going to use the measuring unit for any length of time. This will prevent the battery from becoming fully discharged and the date and time settings being deleted.

Do not continue to use damaged batteries! Do not open the battery using force or throw it into the fire! Do not short-circuit the connection contacts! Maximum charging temperature: 40ºC. Dispose of the battery properly at the end of its useful life.

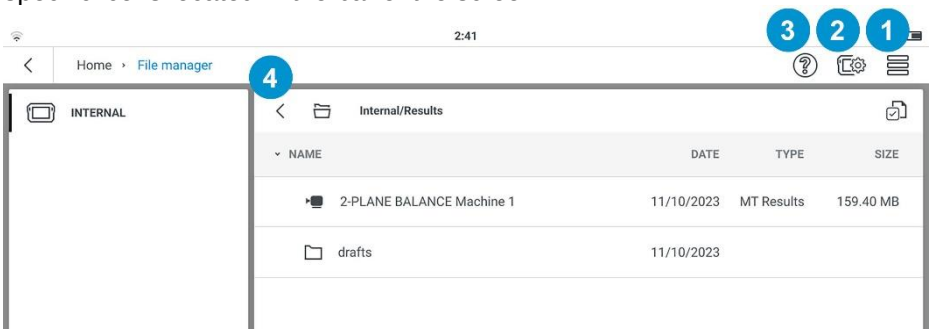
The SmartBalancer can be switched on or off during the charging process.

Toggle on or off settings

To change an option from on to off or vice versa tap the slider bar. ( ) indicates function is off to turn on the desired function ( ) indicates the function is on.

Helpful Icons

To help the user navigate through the SmartBalancer, all applications have specific icons located in the bar of the screen.



Label	Name	Function
1	Hamburger menu	Tap to view menu items related to the current context. In this example, as no item has been highlighted, the context menu item shown will be ***New***. This is used to create a new measurement template.
2	Device/measurement settings	Tap to open context-specific device and measurement settings.
3	Help	Tap to see context-sensitive help.
4	Previous	Tap to return to the previous screen in the given path.

2.6 Shoulder and Hand Straps

The unit and the measurement equipment can be transported safely and conveniently using a shoulder strap and a hand loop to ensure convenient transport and a secure grip.

A shoulder strap and two hand straps are provided with the SmartBalancer 4 to give more comfort when the device is used for an extended period of time.

NOTE: When the device is carried with either the hand straps and/or the shoulder straps, the display must face the operator. This makes sure that the device cools as required. Also, the display is protected.

Shoulder strap

Attach the strap to two diagonally opposing eyes. Adjust the length of the strap so that the measuring units can be hung over the shoulders and operated conveniently.

Use the buckles and the two Velcro fasteners to adjust the length of the shoulder strap to the required size.

Use the snap hooks and attach the shoulder strap to the hand strap eyelets. Use any two diagonally positioned eyelets. This makes left or right-handed operation possible.

Hand loop

The hand loop can be fitted to the right or left side. For a firm and stable grip, insert the hand through the loop.

Use the buckles to adjust the length of the hand straps. When the size of the hand straps is correct, use the Velcro fasteners to wrap the straps. This gives you a reliable and comfortable grip.

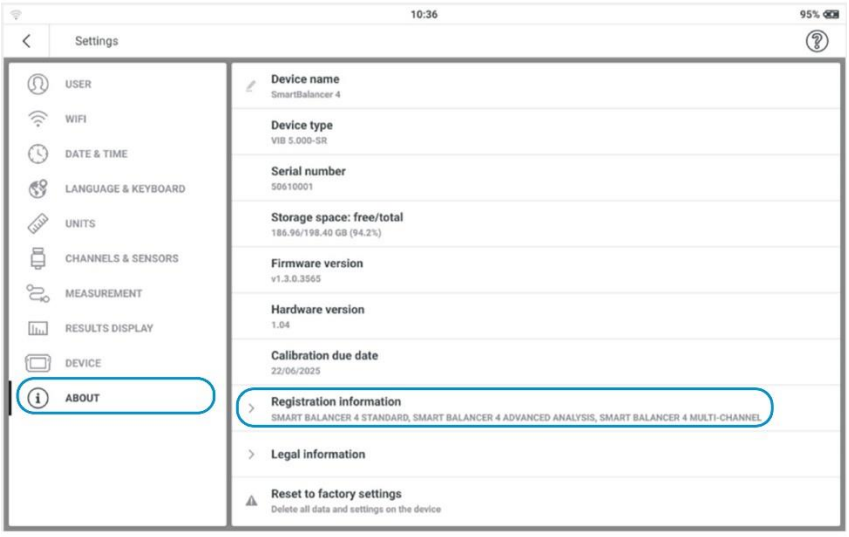
2.7 License Additional Applications

If additional SmartBalancer 4 applications are purchased, these must be registered on the device. The registration details are available in the supplied firmware registration certificate.

Register applications

- Make sure you have the firmware registration information at hand. The following information will be provided by Schenck:
  - Device Serial number Example: 50000xxx
  - Feature key Example: 000100234
  - License code Example: ABCDEFGH

- From the home screen, tap the settings icon.
- With the settings screen open select ***About>Registration information.***



- With the Registration information window open, tap ***ENTER KEY AND CODE***

- Use the alphanumeric keypad and enter the given feature. Tap ***APPLY CHANGES*** to confirm entry.
- The license code field is then shown. Use the alphanumeric keypad and enter the given license code.
- Tap ***APPLY CHANGES*** to confirm entry. If registration is successful, the hint ***Feature successfully registered*** is shown. All registered applications are then shown in ***Settings*** > ***About*** > ***Registration information***.

2.8 Data transfer

Data transfer takes place via the USB-C connection. The following data can be transferred:

- Balance Reports
- Screenshots
- Software update to the unit

The data is retrievable when connected to the PC via the standard file manager.

The USB-C to USB-A cable is used to connect the SmartBalancer to a USB port on the PC.

2.8.1 Update

The update is in a .rom file. The updated file is then loaded into the unit via the USB-C to USB-A cable provided.

- Download the updated file to the desired directory on a PC
- Turn the SmartBalancer on
- Connect the SmartBalancer to the PC via USB cable
- Open the SmartBalancer from the file explorer
- Double click on the ***Data Folder*** – then ***System Data Folder*** to access the ***Update Folder***
- Transfer the update file [SB4_vx.x.x.xxxx.rom] to the ***Update Folder***
- Disconnect the SmartBalancer from the PC

Make sure the SmartBalancer remains connected to the PC during the entire firmware update process.

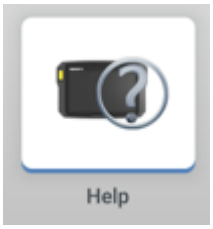
Upon the completion of the data transfer, **TAP UPDATE NOW** on the device to proceed with the firmware update.

During the update a progress bar is shown on the screen and a note is shown: ***Update in progress. Do not turn off the device.*** This process usually takes a few minutes. Wait until the SmartBalancer screen indicates that ***Firmware update successful.*** Tap **OK** to close the process.

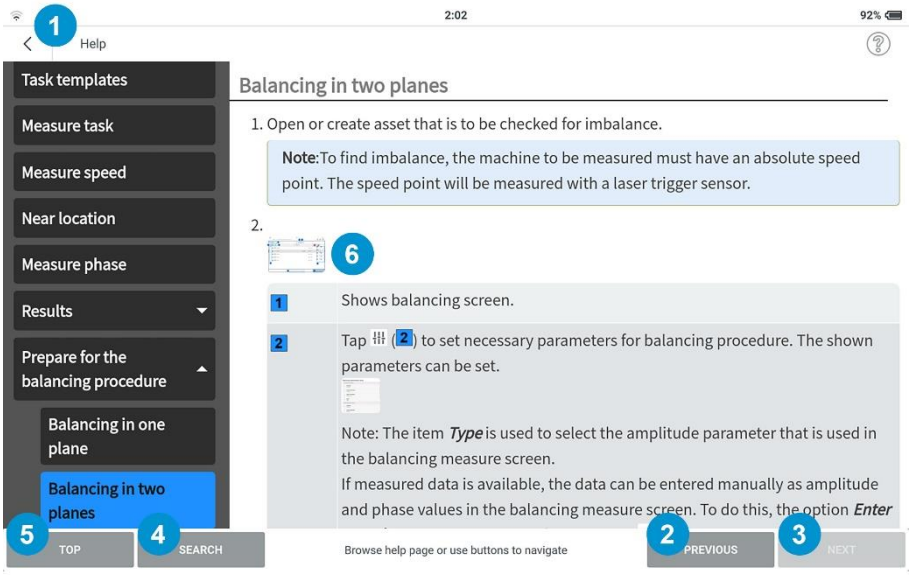
The current version can be found in the about section of the settings.

NOTE: An option to update the firmware at a later stage is available. If this option is selected, update hint will be shown when the SmartBalancer is switched on.

2.9 On-board Help



Tap the Help icon on the home screen to access the on-board help. Tap the "?" on any screen to access context-sensitive help for the specific screen.

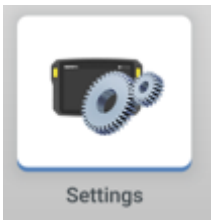


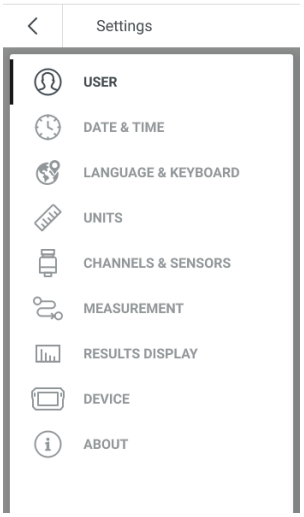
Label	Function
1	Tap **<** to return to the previous screen in a given path.
2	Tap **PREVIOUS** to go back to the last help page visited.
3	Tap **NEXT** to go forward with visited help pages.
4	Tap **SEARCH** for a full-text search. A search field together with an onscreen keyboard will appear.
5	Tap **TOP** to return to the beginning of the help page.
6	Image thumbnails will be used throughout this on-board help. Tap the image thumbnail to enlarge the image for better viewing. To zoom out and proceed, tap the enlarged image.

NOTE: Scroll to the bottom of the page to access other related topics wherever used.

3. Settings

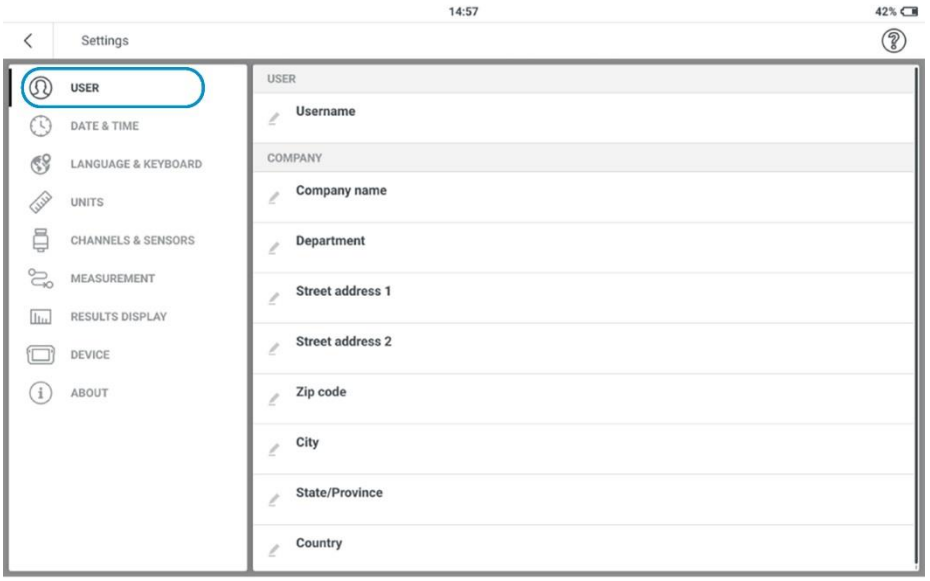
These settings can be checked and edited if necessary:





3.1 User

Used to set the user and company details.



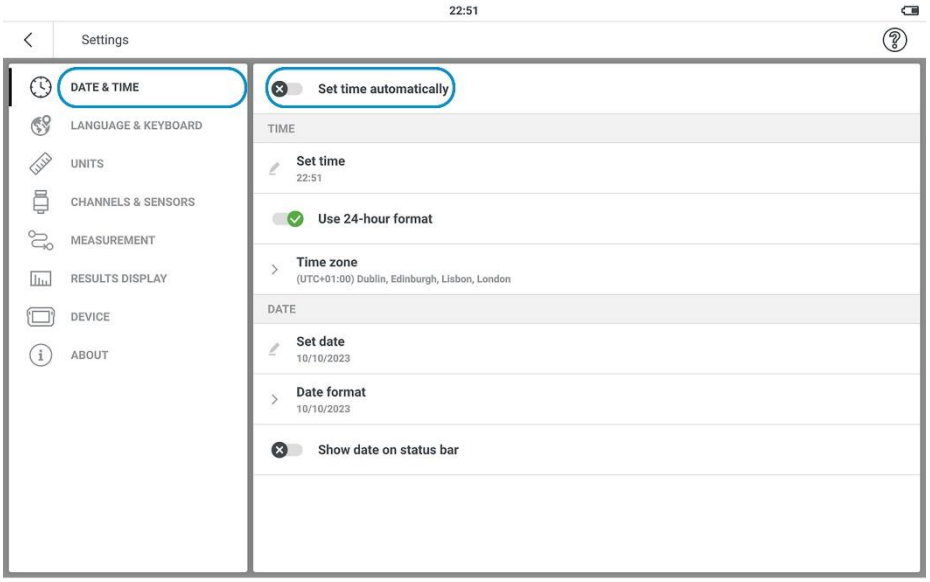
Tap on the field you would like to edit, use the alphanumeric keyboard, and edit the user item as necessary. The name entered can be seen in the field if ***Show*** is toggled on. Tap **APPLY CHANGES** to confirm changes.

NOTE: Due to the General Data Protection Regulation (GDPR) the user name must be anonymized. The entered name will be shown in asterisks (each asterisk representing a character). This entered user name will be shown in the report if turned on in the ***Report setup***.

The entered company name, address, and zip code are shown on the report.

3.2 Date & Time

Used to set the time and date automatically or manually. The date and time can be set in a 12- or 24-hour format.



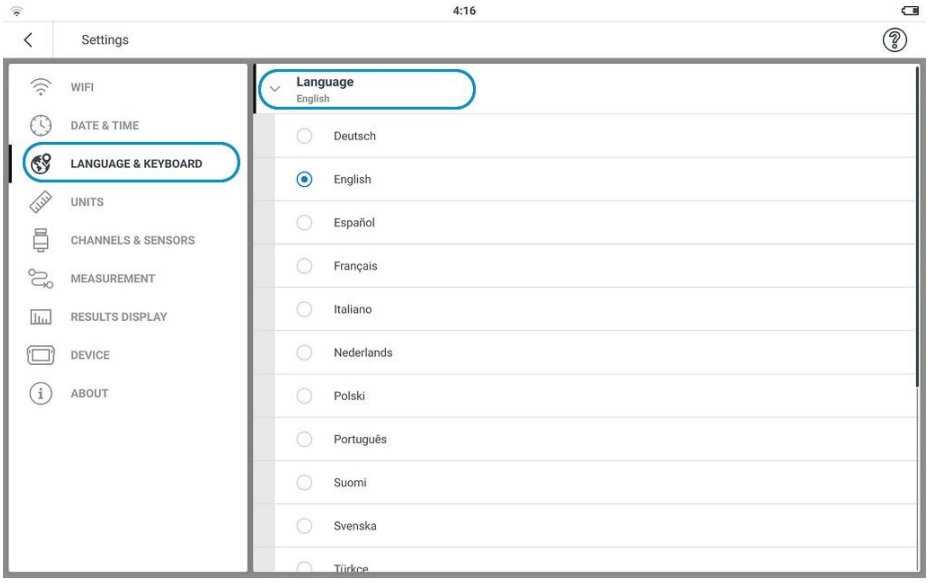
When ***Set Automatically*** is on then the manual edit function is turned off.

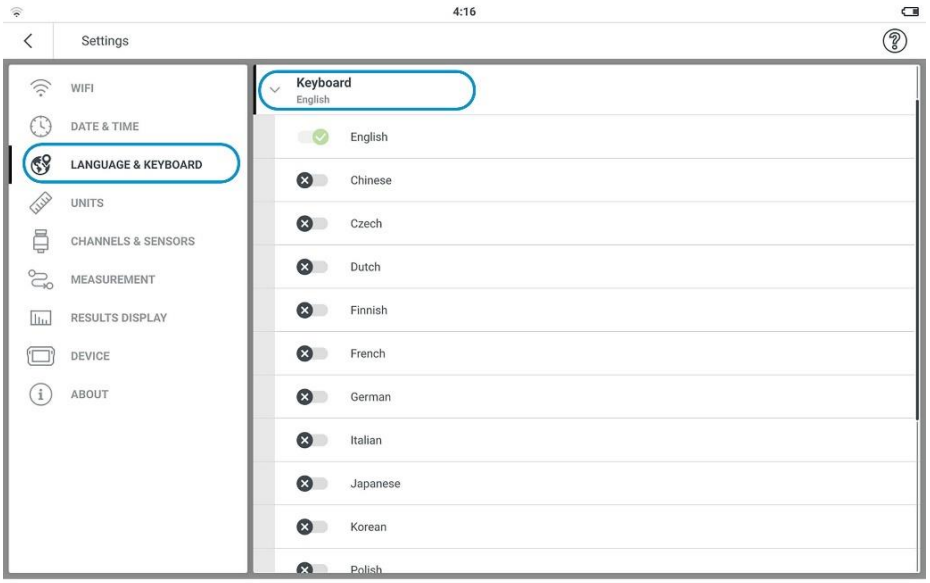
When ***Set Automatically*** is off then tap to manually set the time and date. Use the pop-up calendar and then the pop-up clock to set the time and date respectively. Tap **SET TIME** or **SET DATE** to confirm changes.

3.3 Language & Keyboard

Used to change the user interface (UI) language and UI keyboard layout. Only one UI language can be set at a time, but the selection of serval UI keyboards layouts is possible. If several UI keyboard layouts have been selected, the keyboard icon is active. Tap the icon to cycle through the available keyboard layouts.

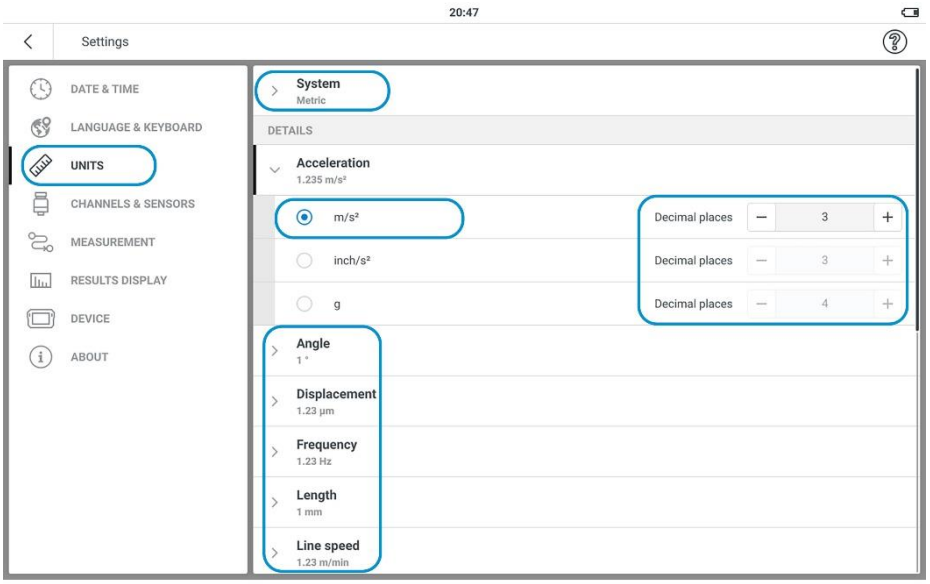
Tap ***Language*** or ***Keyboard*** and then use the related drop-down list to select UI language or IO keyboard layout(s).





3.4 Units

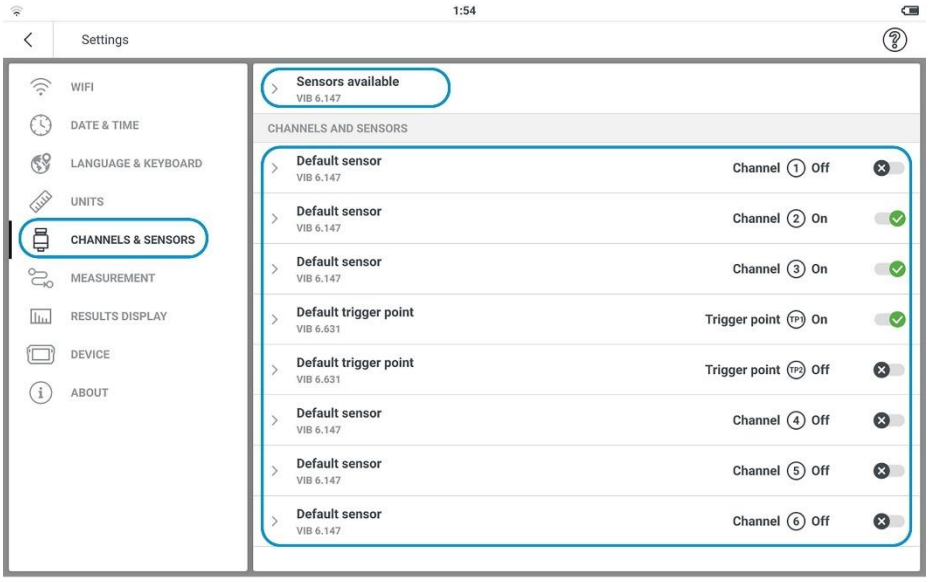
Used to set the measurement system to either metric or imperial. The accuracy in decimal places can also be set. If the units of any quantity are set to a different value from the selected measurement system, then the system name ***custom*** will be shown.



If the user changes to a default measurement system, a hit to override any customized settings is shown.

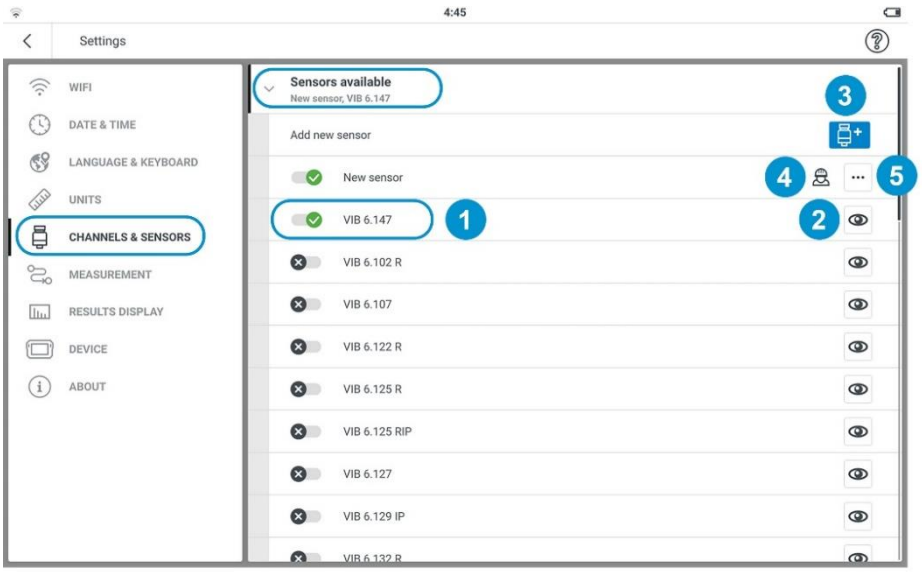
3.5 Channels & Sensors

Used to show all the factory–configured and user-defined sensors, set default sensors for related channels, and set up additional sensors.



Sensor Available – used to show all available sensors and the channel default sensors. Tap ***Sensors Available*** to see all listed sensors. The listed sensors are factory-configured and user defined sensors in the device.

For standard sensors, no settings need to be made / changed. This is only used if there is interest of the user to choose other sensors to be used.



Label	Name	Function
1	Selected sensors	Shows preselected sensors; tap sliders to preselect necessary sensors. Preselected sensors are usually available to the user and appear listed first when the sensors are assigned to the measurement channels.

2	Sensor Parameter	Tap (eye) to review the parameters of the selected sensor. The icon is available for only factory configured sensors. Factory configured sensors cannot be deleted from the list of available sensors.
3	Add additional sensor	Tap the icon to add a new single axis sensor to the list of available sensors. A window to edit the sensor parameters will show. Edit the parameters as required.
4	User defined sensor	Shows the user defined sensors. User defined sensors can be deleted from the list of available sensors.
5	Edit user defined sensors	Tap the meatball menu to edit the name and the parameters of the added user defined sensors, or to delete the sensor.

3.6 Measurement - Sensor Live Values

Vibration location default – used to set the default parameter that is shown at a vibration location when live sensor data is on. The set parameter is valid for all measurement locations on the asset. Only two parameters can be selected.

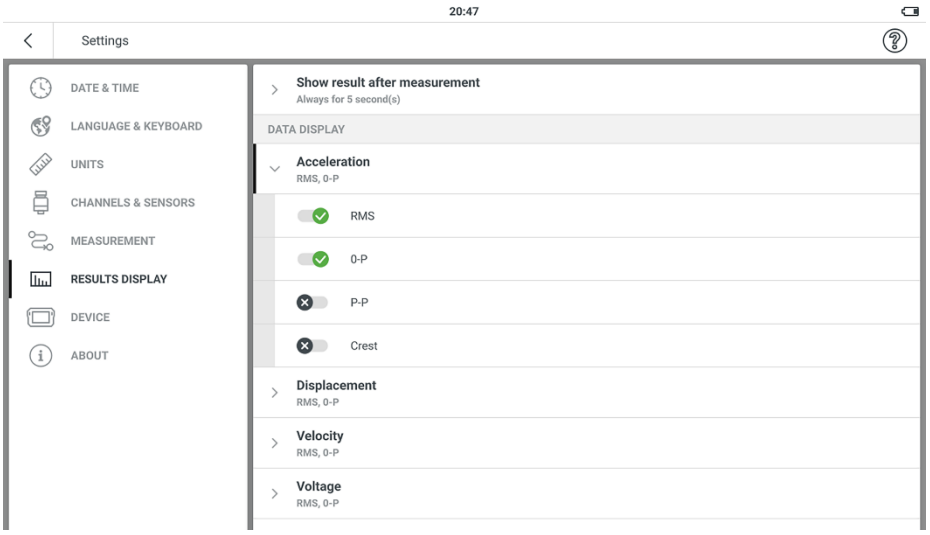
Displacement location default – used to set the default parameter that is shown at a displacement location when live sensor data is on. The set parameter is valid for all measurement locations on the asset. Only two parameters can be selected.

3.7 Results Display

Used to configure the results screen using characteristic overall values.

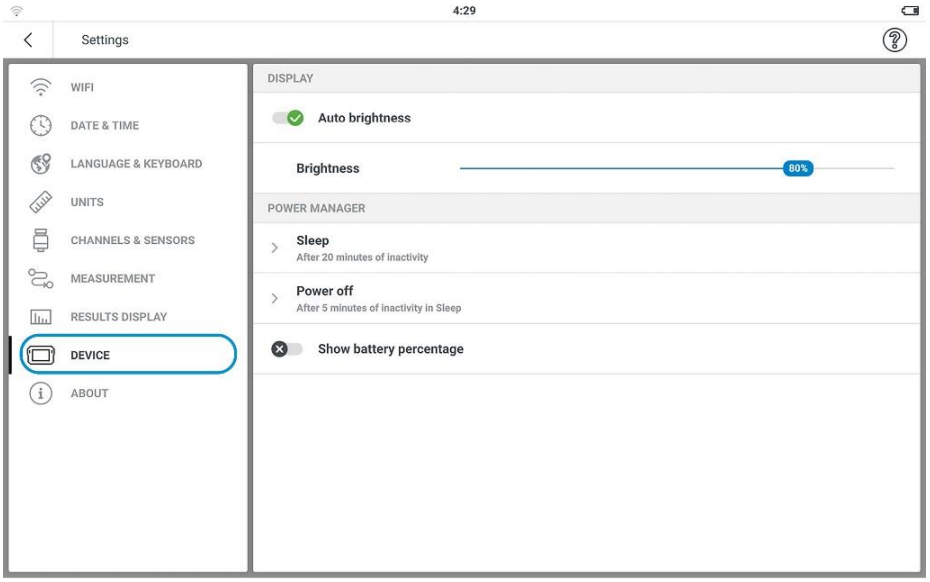
Display results after measurement – used to set the time to show live results. This includes time waveform, spectra, and overall values. Use the drop-down menu to select desired time option. If time is based on status, make sure that the correct status is selected.

Data display – used to set the overall values for the measurement quantities. These values are shown on the right frame in the results screen under the overall values page. Use the quantity drop-down menu to select the desired overall value.



3.8 Device

Used to change the appearance of the display, control the brightness of the display, and set the power options.



Auto brightness – When on ( ), the display brightness is controlled to match the current light conditions using the built-in ambient light sensors. When off ( ), display brightness is controlled using the ***Brightness*** slider.

Brightness – drag the slider to the right or left to control the display brightness. This can be done even if ***Auto brightness*** is on.

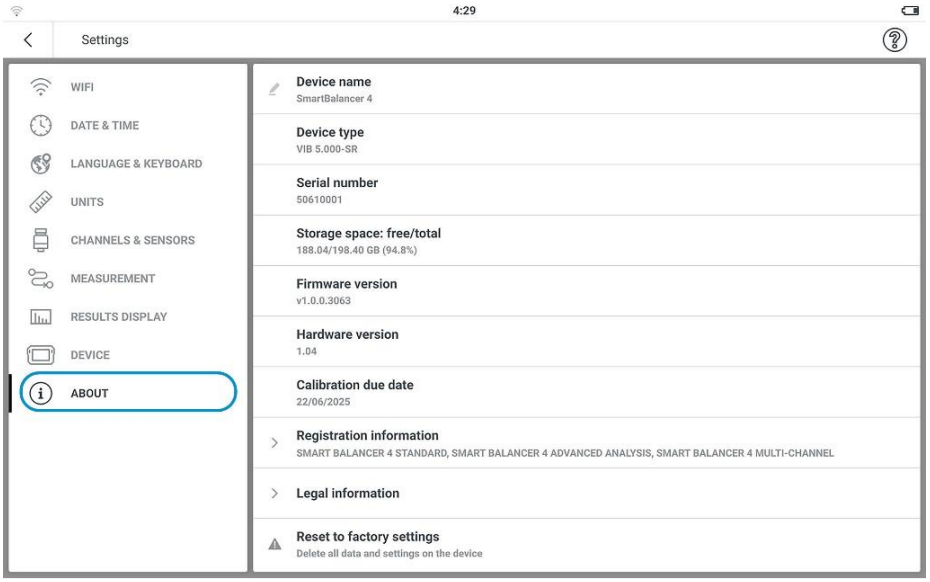
Sleep – use the drop-down menu and select the time interval for the device to be inactive before the device automatically enters sleep mode. If **NEVER** is selected, the device will not go into sleep mode.

Power off – use the drop-down menu and select the time interval for the device to be inactive before the device switches off automatically. If **NEVER** is selected, the device will not switch off.

Show battery percentage – when on ( ), the battery capacity percentage will be shown on the top-right corner of the display. When off ( ) only the battery icon will be displayed.

3.9 About

Used to edit the name of the device, show the device serial number, storage capacity, firmware, and hardware versions, calibration due date, registered applications, legal information, licenses, and to reset the device to factory settings.



Device name – tap to use the alphanumeric keyboard and edit the name of the device. Tap **APPLY CHANGES** to confirm the changes. The device name is shown when the device is connected to a PC.

Registration information – shows licensed applications. Select ***Registration information*** > **ENTER KEY AND CODE**, then use the numeric keypad and enter the provided registration code. Tap **APPLY CHNAGES** to complete the registration and activate the licensed applications.

Legal information – shows the necessary legal and open-source software information. Tap ***Legal information*** to see the information. Tap **NEXT** to go through the pages. Tap **BACK** to leave the pages.

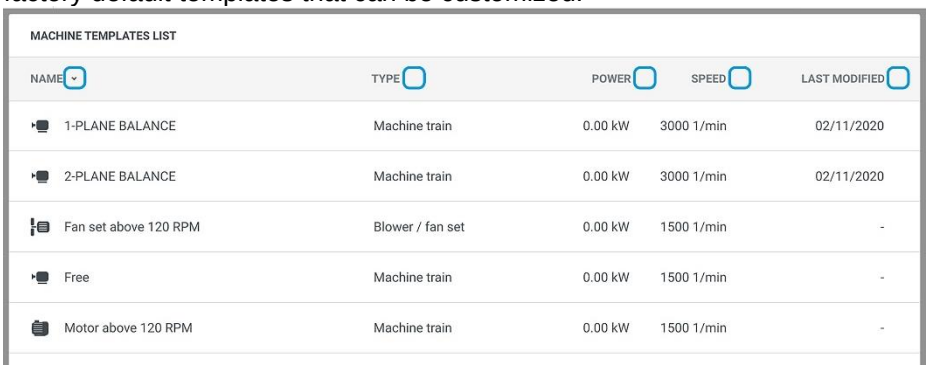
Reset to factory settings – used to go back to default settings. Tap ***Reset to factory settings.*** A hint is shown that warns that all data will be deleted. Tap **ENTER CODE** and enter the code shown in the on-screen keyboard window.

If ***Reset to factory settings*** is done, all data and settings on the SmartBalancer will be deleted.

4. Templates

4.1 Machine Templates

A machine template is used to take measurements of machines of the same type. The locations to be measured are at the same position and the measurement tasks are the same for each machine. Typical applications and service measurements or acceptance measurements (production tests). Available templates are shown in the ***Machine Templates List***. These include factory default templates that can be customized.



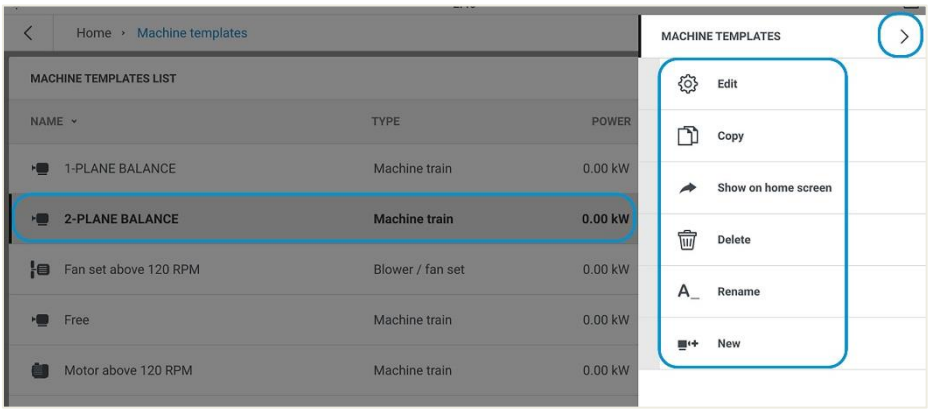
The arrowhead is shown when the column title is tapped. The arrowhead is then used to sort the templates by asset name, type of aggregate, power of aggregate, rotational speed, and date of last modification.

To help the user navigate through the SmartBalancer 4, all applications have three icons (context-sensitive help, device and measurement settings, and hamburger menu) in the top right corner of the screen.

4.1.1 list menu items

If no machine template is highlighted, then the hamburger menu is tapped, the context menu shows only the menu item ***New***.

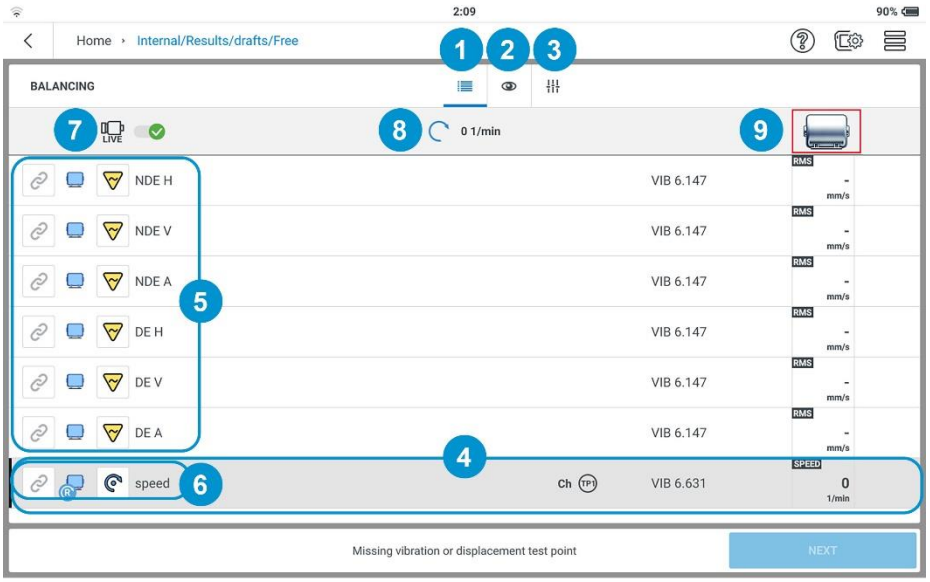
Highlight a machine template on the list, then tap the hamburger menu to see the menu items available for the highlighted template. As an alternative, tap and hold the machine template to show the menu items available for the highlighted template.



The context menu items are used to configure, create a copy, delete, or rename the highlighted machine template. A shortcut for the highlighted machine template can also be created on the home screen. If a shortcut from the home screen already exists, then the menu item ***Shown on Home*** will not be shown. Tap > to close the context menu.

4.1.2 Overview

Tap on the desired template and the measurement screen for the template will be shown.



Label	Function
1	The list view is the default view. The measure locations for the selected machine (9) are shown on the list.
2	Tap (eye) to show the vibration and displacement parameters that can be selected to be shown as live on display. The parameters shown initially come from the settings item ***Sensor Live Values***. The parameters can be changed here, but only for the selected machine train. A maximum of two parameters for vibration and/or displacement can be shown on the screen at one time.
3	Balancing measure setup – allows for settings to be changed for overall settings, spectrum setting, phase settings, and to turn on enter user data function.
4	Shows the current selected measurement location, device measure channel, and the type of sensors to be used to measure the selected location. The measure channel and sensor are selected I the device settings menu item **C*hannels & Sensors***. The live sensor vales for the location are shown if the automatic sensor detection (6) is on.
5	Other measurement locations on the machine.
6	Shows the relative speed point merged with a measurement location.
7	Sensor live data – toggle on or off. When on live values are shown.
8	Absolute speed measured by the reference pick-up or speed sensor
9	Shows the currently selected machine. This is identified by the red rectangle on the outside of the machine picture.

4.1.3 Exit a Machine template without saving

If a machine template is selected for use but is not to be saved use the return arrow < to return to the home screen. A window to save the template as an asset will be shown.

- Tap ***LEAVE*** to exit the screen and return to the machine template lists.
- Tap < to return to the home screen.

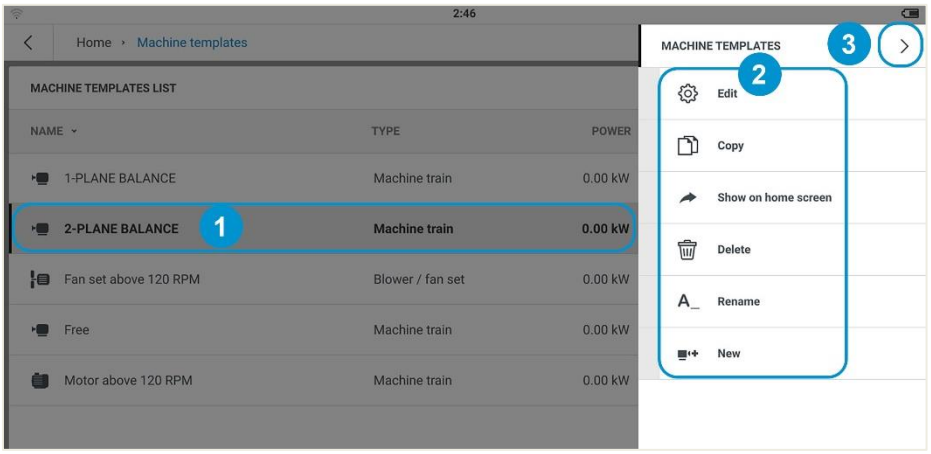
4.1.4 Configuration

Use the configuration screen to:

- Create asset / New template – this can be a single machine or a machine train
- Duplicate machine with all measurement locations (if already edited)
- Add and/or duplicate measurement locations
- Edit measurement locations
- Add measurement task and band values for measurement locations
- Create measurement location groups

To access the configuration screen:

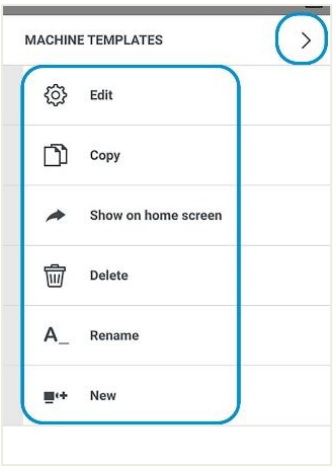
- From the **Machine Templates list** tap and hold the desired machine template or highlight the machine template and open the context menu.



Label	Function
1	Desired machine template
2	Machine templates menu items
3	Tap to open the machine template configuration screen

- On the measurement screen tap the hamburger menu.
- Tap edit to open the configuration screen.

4.1.4.1 Menu items



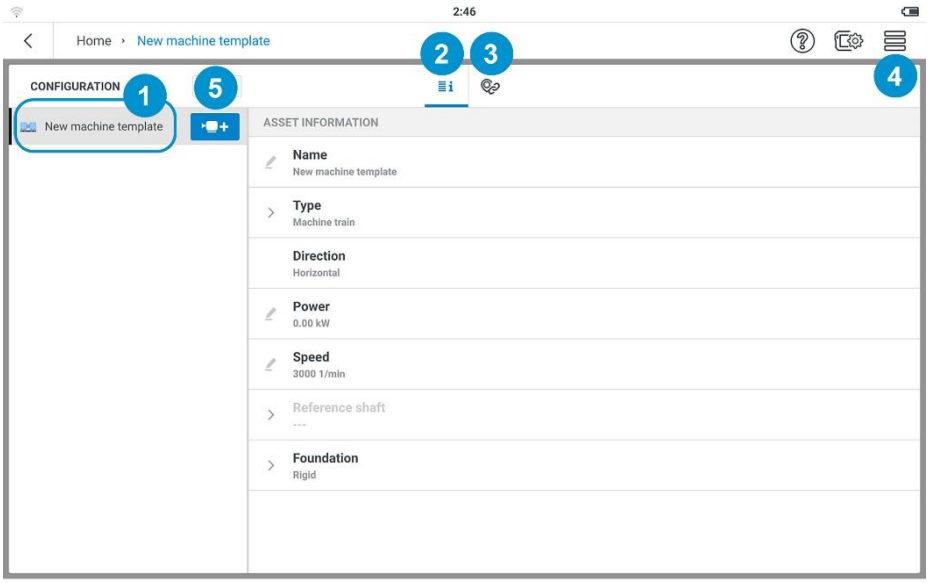
Name	Function
Edit	Tap to open the configuration screen where the assets can be edited.
Copy	Tap to duplicate the highlighted machine template.
Show on Home	Tape to create a home screen shortcut for the highlighted machine template.
Delete	Tap to delete the highlighted machine template. You will be required to confirm the deletion.
Rename	Tap to rename the highlighted machine template.
New	Tap to create a new machine template.

Note: If you tap the hamburger menu icon in the machine templates screen with no templated highlighted, only the menu item new will be shown.

4.1.4.2 Create Asset / New Template

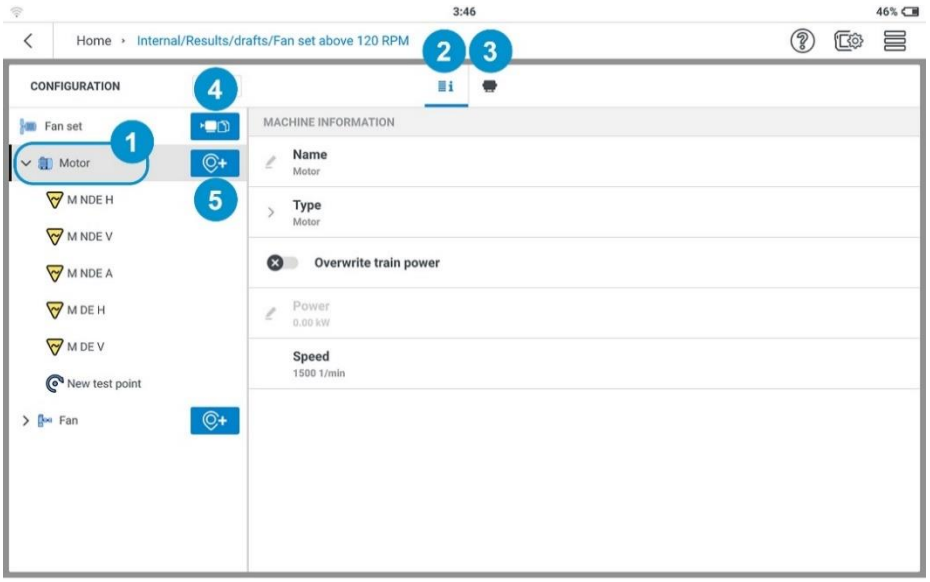
- From the machine templates context menu tap new.
- Edit the new template name as necessary.
- In the configuration screen edit the asset as necessary.

Start at the machine train which is the highest level of the hierarchy. Lower levels include the machine and the measurement location. The different levels show different information.



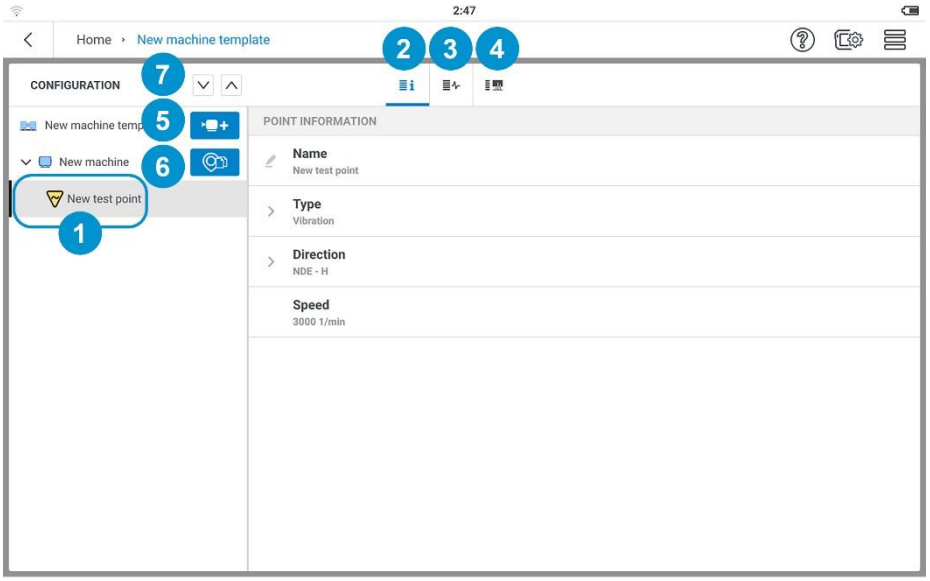
Label	Function
1	Tap machine train level to edit the asset.
2	Tap to edit the asset name (***Name)***, type of asset (***Type***), orientation of asset (***Direction***), asset power (***Power***), asset RPM (***Speed***), ***Reference Shaft*** and the type of foundation (***Foundation***).
3	Tap to create a measurement location group. This function helps compare results for the selected locations.
4	Tap to delete highlighted machine template. You will be required to confirm the deletion.
5	Tap to add a machine to the hierarchy.

In the machine level the user can perform the following actions:



Label	Function
1	Tap desired machine to edit machine information and the machine model.
2	Tap to edit the machine name (***Name)***, type of machine (***Type***), and machine power (***Power***). To edit the machine power the ***Overwrite train power*** function must be on.
3	Tap to see the machine model. A machine model simplifies the correlation between the various and complex vibrations within a machine. The model defines the machine components and include the type of bearing, line frequency, speed ration calculation and information need to calculate fault frequency and speed at each measurement location.
4	Tap to duplicate the selected machine and the related measurement locations.
5	If no measurement location is selected the new measurement location icon is shown. Tap to add a measurement location to the selected machine.

In the measurement location level, the user can perform the following actions:



Label	Function
1	Tap the desired measurement location to edit the measurement location information, add measurement tasks, and add alarm bands.
2	Tap to edit the selected measurement location name (***Name)***, type of parameter to be measured (***Type***), position of the measurement location on the machine (***Direction***), and the machine RPM (***Speed***). The icon at the selected measurement location shows the type of parameter to be measured (refer to ***Parameter icons*** below).
3	Tap to see the measurement task related to the selected location and/or add tasks for the selected location.
4	Tap to see bands related to the selected location and/or add bands for the selected location.
5	Tap to add a machine to the tree. This option is available only when a measurement location is selected. If a machine is selected, then the duplicate machine icon is shown. Tap to duplicate the selected machine and the related measurement locations.
6	Tap to duplicate the selected measurement location. If no measurement location is selected, then the new measurement icon is shown. Tap to add a new measurement location to the selected machine.
7	Tap to reorder the highlighted object by moving the object one position lower or higher respectively. Both measurement locations and machines can be rearranged.

Note: Use the configuration screen hamburger menu to delete the machine and measurement locations if required.

4.1.4.3 Parameter icons

Vibration:

If a vibration parameter is selected to be measured, items to be edited are the measurement location name (***Name***) and the position of the measurement location on the machine (***Direction***).

Speed:

If the speed parameter is selected to be measured, items to be edited are the measurement location name (***Name***) the position of the measurement location on the machine (***Direction***), and how the speed is to be measured (***Measure mode***).

To create a speed point in a machine template:

- Create or open an applicable machine template.

- From the measurement screen tap the hamburger icon to open the measurement screen context menu.
- Tap ***Edit*** to open the configuration screen.
- Create a speed measurement location (see section 4.1.4.2).
- Select ***Type*** to ***Speed*** and the mode to either ***Absolute*** or ***Relative***. Edit the name and the plane where the sensor will be placed.

Note: Usually, the speed point is located on the motor side.

- Tap on the tasks screen icon. Tap on + to open the speed tasks screen.
- Select the speed task and tap ***ADD*** to assign the task to the speed point.

If a relative speed point was selected the speed point is merged with a vibration point on the same machine and shaft. The speed is measured using the vibration signal at this location and the speed finder calculates the machine speed.

Speed finder is a method used to calculate the machine RPM. This method is based on complex algorithms, field tests, and vast experience in vibration analysis.

If an absolute speed point was selected the speed point is independent and must be measured using the laser trigger RPM sensor (key phasor method).

Temperature:

If temperature is selected to be measured, then only the measurement location name (***Name***) can be edited.

Manual Input:

If the parameter measured at the selected measurement location is to be entered manually, then only the measurement location name can be edited.

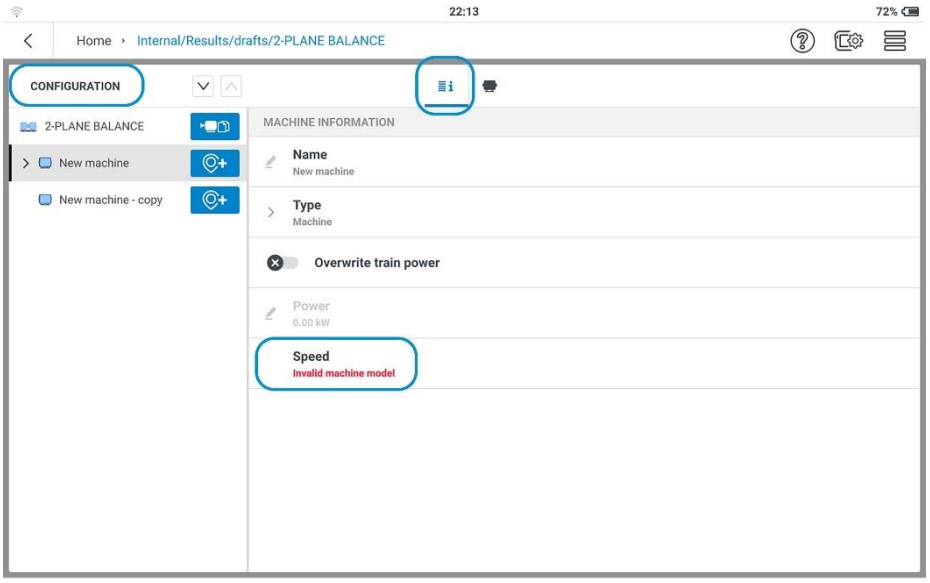
Displacement:

If displacement is selected to be measured, items to be edited are the measurement location name (***Name***) and the position of the measurement location on the machine (***Direction***).

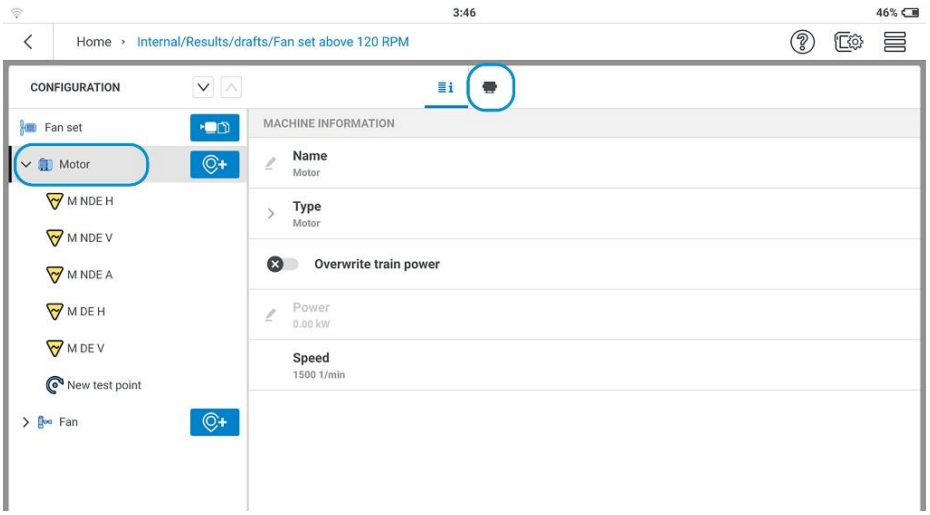
4.1.4.4 Kinematic Model

Machines that rotate also vibrate. The vibrations can be aligned with the components of the machine in a spectral analysis. For a reliable frequency analysis, the sources of the vibration frequencies to be expected and the interdependency must be known. Even in a simple motor-pump machine train, complex vibration causes can exist. A kinematic model helps simplify the correlations. A kinematic model maps the kinematic conditions in a machine train. Based on a referenced speed at a measurement location on a machine train. The reference speed is calculated or measured at the reference measurement location.

The kinematic model has predefined models for many common machine types. Assets can be modeled in the SmartBalancer. If the machine trains are not mapped correctly, it is not possible to measure the machines. A hint will appear is the machine model is invalid.



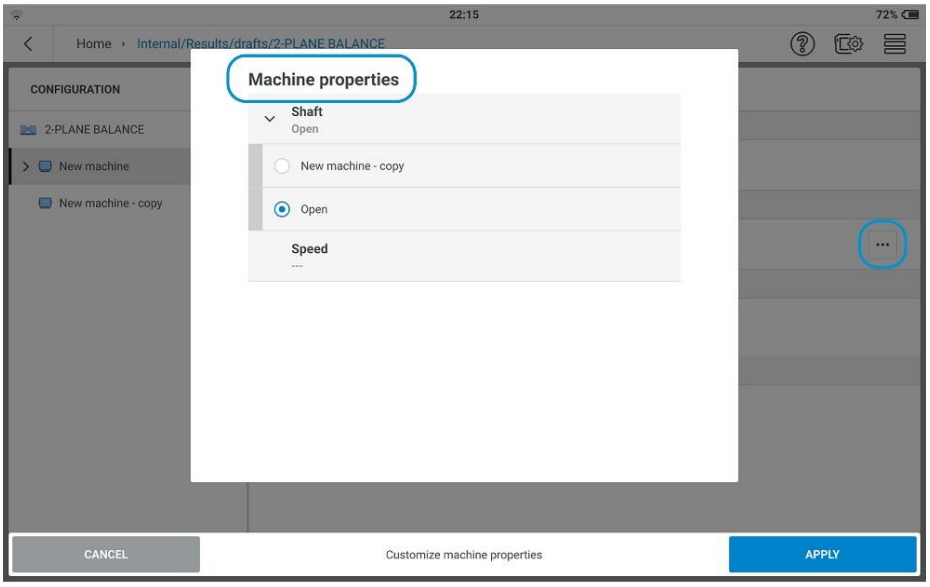
- In the configuration screen, define the machine train and all the measurement locations. Assign all the measurement locations to the necessary measurement tasks.



- To complete the kinematic model for the machine train, tap on a machine at the machine level.

- Tap the machine icon.

- Tap the meatball menu to complete the scheme for the selected machine.

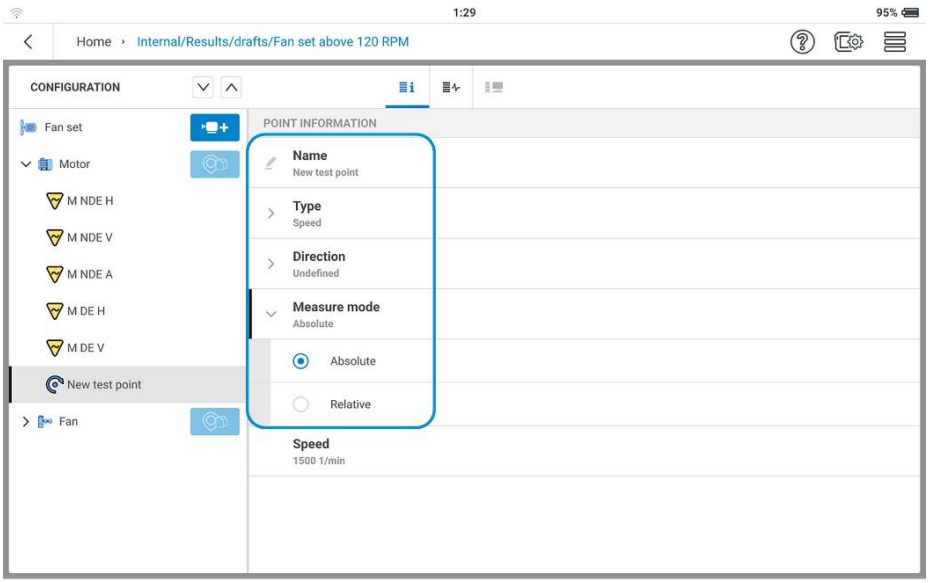


- Set the properties as needed. The shaft that connects two machines must be identified. If the shaft does not connect to a machine, it is left as Open. Select the correct line frequency.

Note: Different machine types will have different properties.

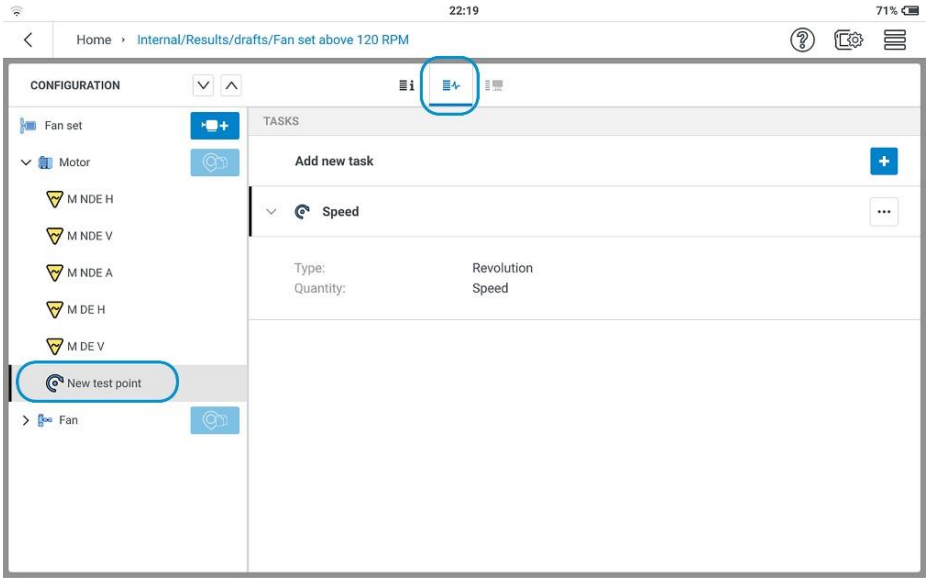
4.1.4.5 Create a speed point

- Create or open the applicable machine template.
- From the measurement screen tap on the hamburger icon to open the measurement screen context menu.
- Tap ***Edit*** to open the configuration screen.
- Create a speed measurement location (refer to ***Create asset*** section).



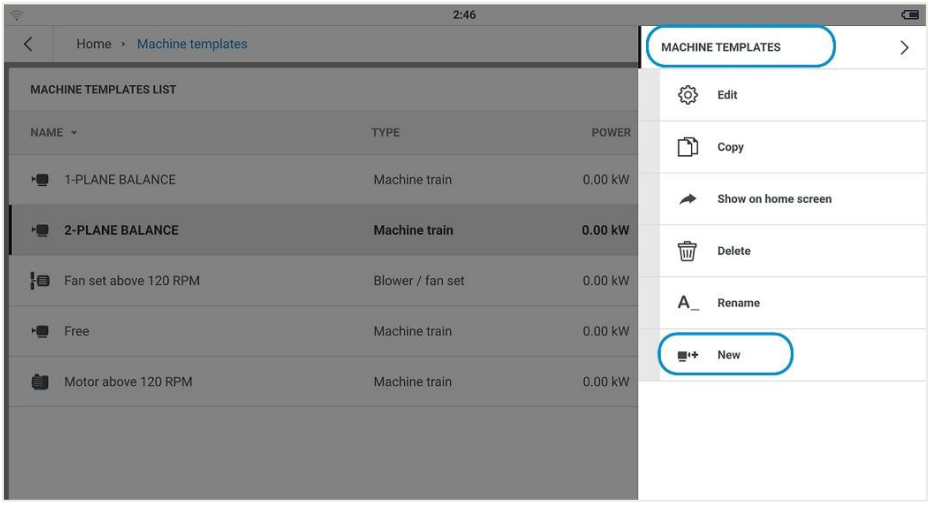
- Select ***Type*** to ***Speed***
- Set the ***Measurement mode*** to **Absolute** for use with a speed reference sensor or ***Relative*** if using the ***Machine speed finder*** mode.
  - If the ***Relative*** mode is selected, the speed point is merged with a vibration point on the same machine and shaft. The speed is then measured using the vibration signal at this location. Speed finder is a method used to calculate the machine RPM. This method is based on complex algorithms, field tests, and vast experience in vibration analysis.
  - If the ***Absolute*** mode is selected, the speed point is independent and must be measured using the laser trigger RPM sensor (Speed Reference).

- Tap on the measurement tasks icon to open the speed tasks screen.
- Select speed task and tap ***ADD*** to assign the task to the speed point.



4.1.5 Create a machine template

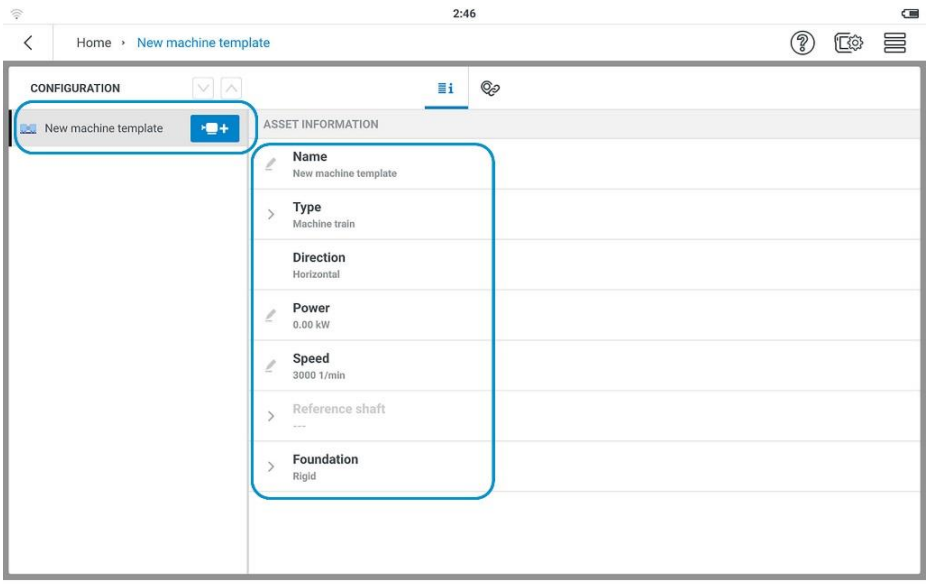
- From the Machine Templates context menu tap on new.
- Enter the new template name - tap Apply Changes.
- In the configuration screen, edit the asset as necessary.



- Tap on the machine + icon to add a new machine type or press and hold machine + icon to skip the machine level and just add a point.

- Tap on the point icon to add a new test point.
- In the point screen, edit the point information as necessary.
- Add additional test points as needed for the machine type.

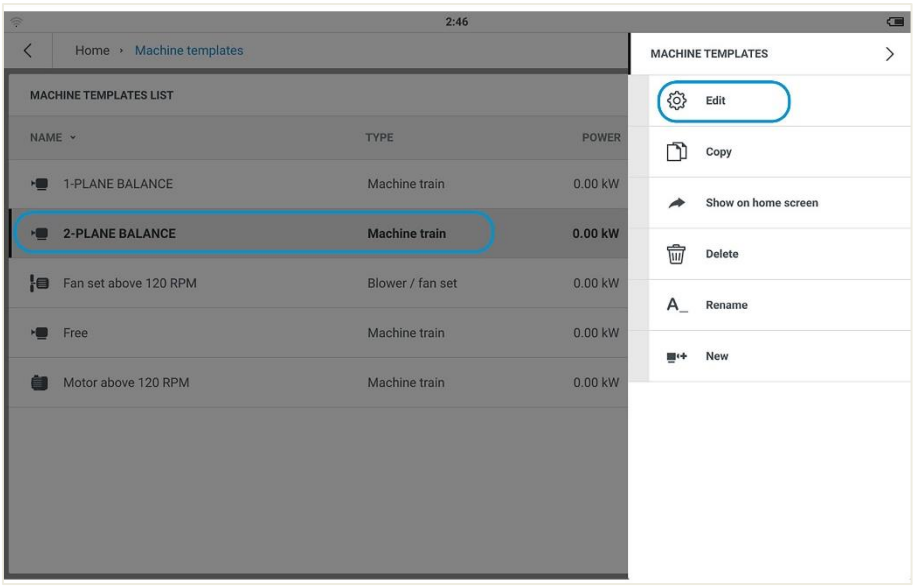
Note: if the advanced analysis option has been purchased – analysis tasks can be added to the point at this level.



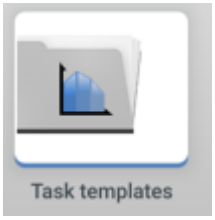
Note: Related measurement tasks must be added for each measurement location.

4.1.6 Edit / Copy a machine template

- Highlight the machine template to be edited or copied.
- From the Machine Templates context menu tap on edit or copy.
- In the configuration screen, edit the asset as necessary (start at the machine train level).



4.2 Task Templates



If the optional Advanced analysis module is purchased, then the ***Task templates*** icon is available on the home screen.

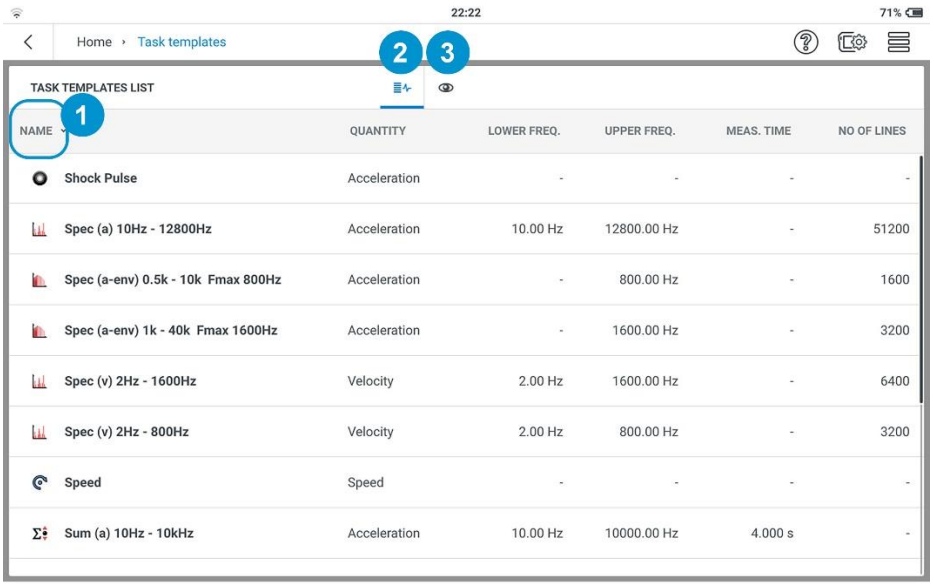
Task templates are used to:

- Show all available measurement tasks and band templates.
- Create user deigned measurement tasks and band templates.
- Delete user deigned measurement tasks and band templates.
- Set the number for columns and column items to be shown.

In order to simplify the preparations for a measurement, and to save you from having to enter the required data, the SmartBalancer provide a range of pre-defined, knowledge-based system measurement task templates. With these task templates you can simply assign them to a measurement location. If changes to the measuring parameters are required a new task template can be created.

Note: System measurement tasks and templates cannot be deleted

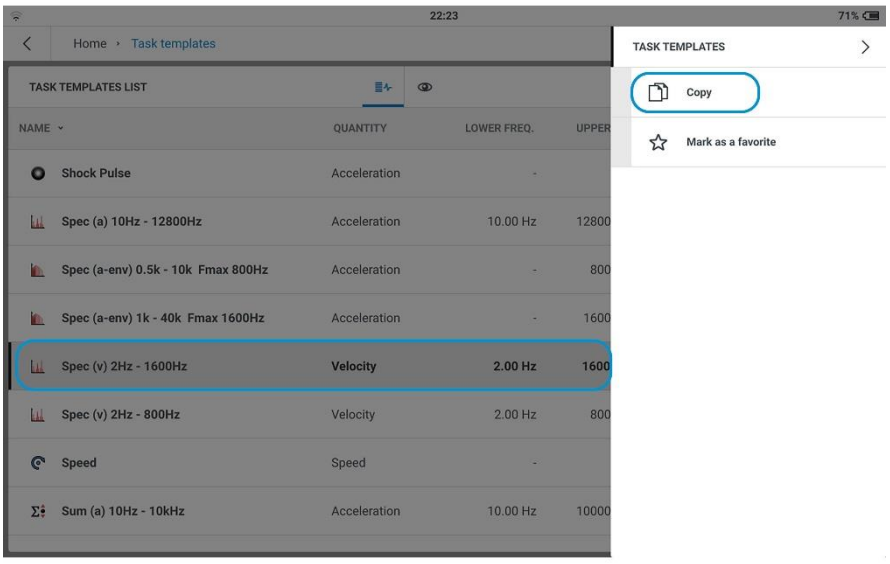
4.2.1 Overview



Label	Function
1	Tap any item in the heading bar to sort the templates in ascending or descending order.
2	Tap to see all available measurement task templates
3	Tap to select up to five column items to be shown. Tap **APPLY** to confirm selection.

4.2.2 Create a measurement task template

- From the ***Home Screen*** tap on the task template icon and the existing template list opens.
- Choose an existing task template. Tap and hold the task template to open the context menu.
- Tap ***Copy*** to create a copy of the selected task template.



- Edit the task details as necessary.
  - Edit name- use alphanumeric keyboard.
  - Quantity – use drop down and select necessary task.
  - Choose the lower frequency from the drop-down menu.
  - Measurement time can be edited with the alphanumeric keyboard.

- After necessary changes have been applied, tape SAVE to add the task to the template list.

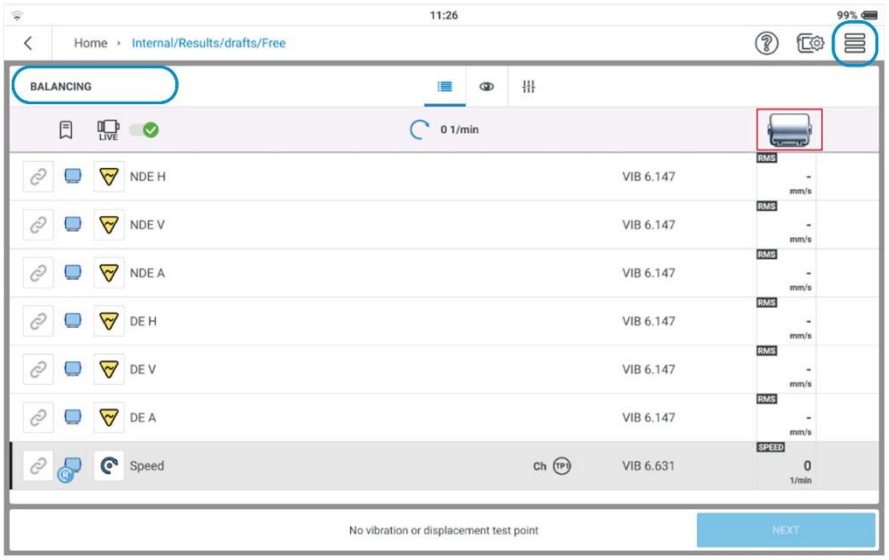
Note: If creating a task with no factory template such as displacement, use an overall value template to start.

5. Functions

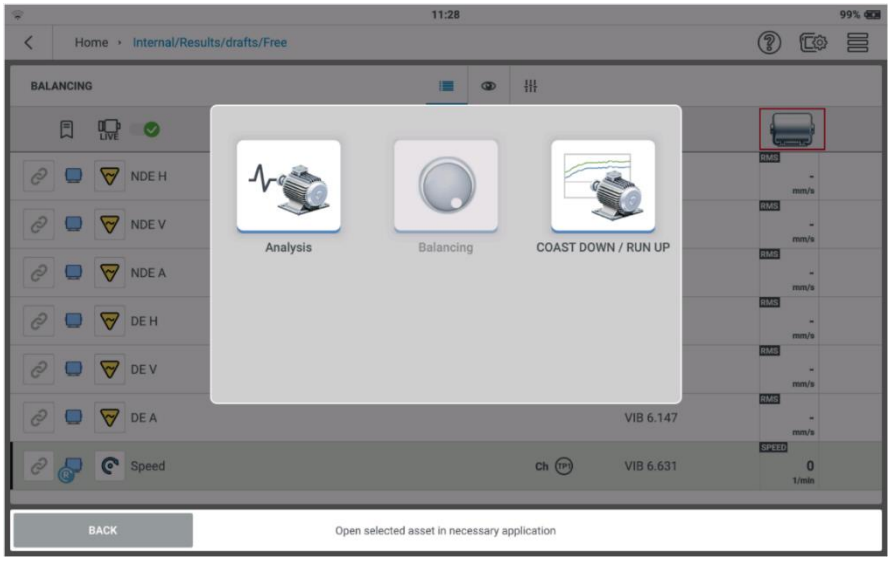
5.1 Change Applications

To change from one application to another in any asset, use the switchover function. The capability to switch over from one application to another is shown when an asset or a machine template is opened.

- Open either a machine template or a saved asset. The top left corner of the screen will show the application from which the asset or the machine template has been opened.



- Tap on the hamburger icon to see the context menu items.
- Tap the menu item ***Switch application*** to change to the necessary application.



In this example, the available applications are ***ANALYSIS*** and ***COAST DOWN/RUN UP***. This is because the application change started from the balancing application. Thus, the icon is shown grayed out. Note: if advanced analysis is not installed in the unit this icon will not appear.

- Tap the necessary application icon to start the application.

5.2 Events

An event in the SmartBalancer 4 can be created in all applications. The events icon is shown in all applications, but the correct events are listed after the specified steps are made in either balancing or coast down / run up test.

5.2.1 Creating an event in balancing

- Open or create an asset that is to be checked for unbalance.
- Follow the balancing steps until the selection of the measurement locations (see section 6.2.8).
- Tap ***NEXT***. This event is then created and listed in the events list. If the measurement is stopped for any reason such as a low battery, not enough time to complete the job, etc.…all current steps are saved to that event.
- When the asset is opened again. Tap on the events list. Tap the necessary balancing event and then proceed with the measurement.

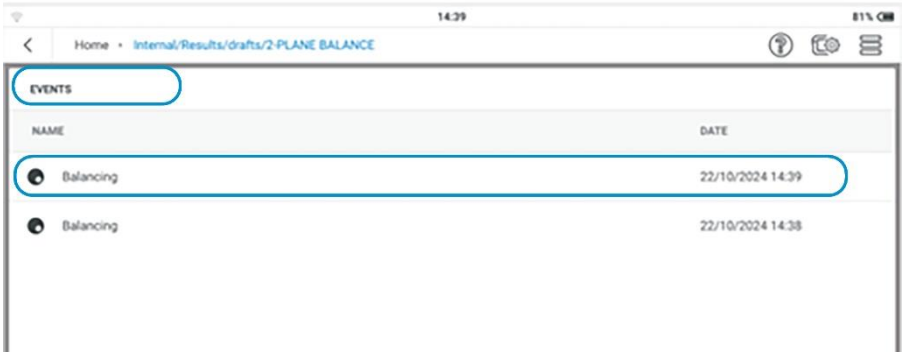
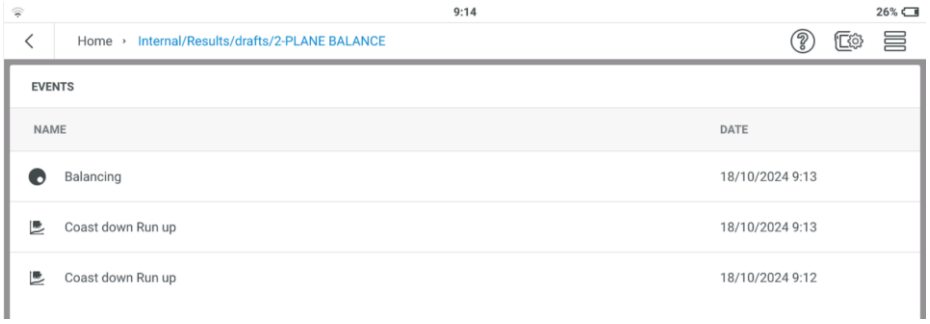


Image with multiple balancing events see page 130

5.2.2 Creating an event in coast down / run up

- Open or create an asset that will be used for the coast down and/or run up to be taken.
- Follow the coast down /run up steps until ***MEASURE*** is shown on the bottom right of the screen (see section 6.3.1).
- Tap ***MEASURE*** and turn on or off the machine, depending on the type of reading. This event is created when the progress bar progresses with the collection of data. If the measurement is stopped for any reason such as a low battery, not enough time to complete the job, etc.…all current steps are saved to that event. If the run up / coast down is canceled the event will not be created.
- When the asset is opened again. Tap on the events list. Tap the necessary coast down and/or run up event to see the results.



- Analysis of the results and temporary post-processing can be made. The new results are not saved.

5.2.3 Events List

The events list shows all corrective and diagnostic measurements that have been created on the selected asset. These events can be renamed or deleted if necessary.

To rename or delete an event:

- Tap and hold the necessary event
- Open the context menu
- Choose **rename** or **delete** for the event.

5.3 Live Data

In balancing and coast down / run up measurements the live sensor values shown are not dependent on the measurement tasks given to the measurement locations.

- Tap on the (eye) to show the vibration and displacement parameters that can be selected to be shown live on the display. Scroll to the bottom of the ***Sensor live values*** screen to see all parameters.

  The following parameters can be selected to be shown live:
  - **Acceleration**: RMS, 0-P, P-P, Crest
  - **Velocity**: RMS, 0-P, P-P, Crest, phase angle, phase-amplitude
  - **Displacement**: RMS, 0-P, P-P, Crest, Phase, Phase-amplitude

  One (1) acceleration or velocity value can be selected, additionally, choose one (1) displacement value for live display.

- Tap on the ***Measurement Setup*** for either balancing or coast don / run up.
- Scroll to the bottom to see all of the parameter options.

  Options to show live values can be chosen from the overall settings or the phase settings.
  - ***Overall***: Acceleration, Velocity, or Displacement with **Type** in RMS, 0-P, or P-P
  - ***Phase***: Acceleration, Velocity, or Displacement

  The combinations must align between the ***Visual*** and the ***Measurement Setups*** for live values to be displayed. Here are examples of combination in the setup, where some will show live results and others will not.

Visual Setting	Measurement Setup	Displayed Live Value
Acceleration RMS Displacement RMS	Acceleration RMS	Acceleration RMS
Acceleration RMS Displacement RMS	Velocity RMS	None
Acceleration RMS Displacement RMS	Displacement RMS	Displacement RMS
Acceleration RMS Displacement RMS	Acceleration 0-P	None
Velocity P-P Displacement P-P	Velocity P-P	Velocity P-P
Velocity P-P Displacement P-P	Displacement P-P	Displacement P-P
Velocity Phase Angle Velocity Phase Amplitude	Velocity RMS Phase Acceleration	None
Velocity Phase Angle Velocity Phase Amplitude	Velocity RMS Phase Velocity	Velocity Phase Angle Velocity Phase Amplitude
Acceleration Crest Velocity Crest Displacement crest	No crest in balancing or coast down / run up	None

6. Measurement

The SmartBalancer can be used in the following operating modes for the measurement of signals and the recording of machine condition data.

- Balancing
- Run up or Coast down
- Analysis (optional)

Preparation

Before starting a measurement, ensure that:

– the battery is charged.
– the device settings are correct (date, etc.).
– the required sensors and cables are ready and in proper operating condition; in the case of speed measurements, you may need a stand for the speed sensor!
– the fixed installed measurement points are in order; carry out a visual inspection; if necessary, clean and rectify any damage.
– a countersink is fitted at the measurement points for manual probes.
– the required measuring templates are set up in the unit.

6.1 Speed

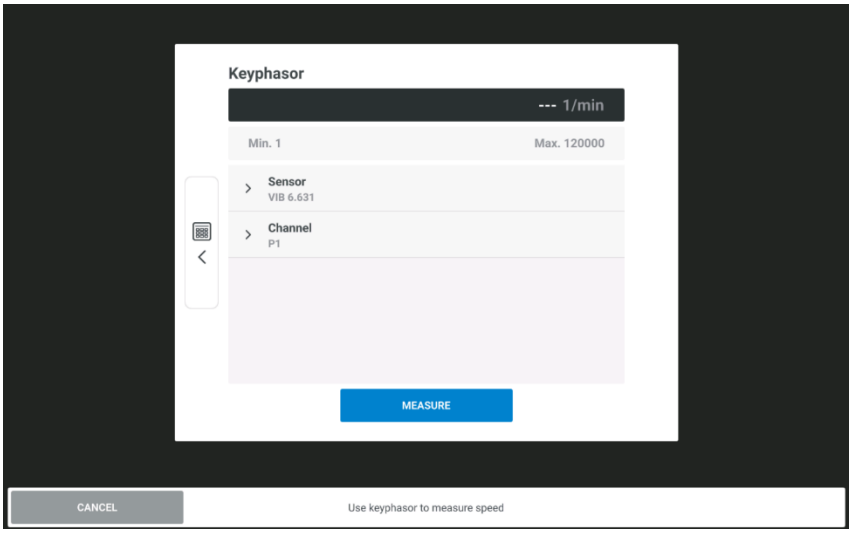
The machine speed can be checked or measured at any time. This can be either an absolute or a relative measurement.

6.1.1 Measurement from Home Screen

From this screen, the machine speed can be measured with the laser trigger sensor.

■ Tap on the ***Speed measurement*** icon from the home screen.

■ Tap ***MEASURE*** to start the speed measurement with the laser sensor connected.

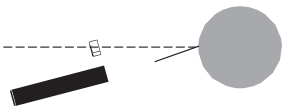


6.1.2 Speed Reference Sensor

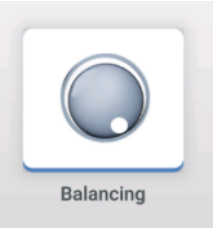
The laser-trigger sensor is used to measure the RPM. The optical laser reference pick-up (VIB 6.631) measures the speed without any physical contact (optically). A laser beam in the sensor head is emitted from the sensor and strikes a measuring mark on the rotating shaft. The mark can amplify the light (e.g. reflective tape) or attenuate the light (e.g. a black, high-contrast line on a light-colored surface). The laser light is scattered back by a reflection mark on the rotating shaft. If the sensor detects the reflection, it emits an electrical impulse. The SmartBalancer calculates the speed from the repetition rate of the voltage pulses.

To prepare the measurement, apply a suitable reflection mark to the stationary shaft (e.g. reflective tape). During the measurement, hold the sensor so that the sensor head with the laser points at a 15-to-20-degree angle to the shaft surface (note the arrow direction on the sensor head!). Optimum measuring distance: 2 - 100cm. If using a white or black mark hold the sensor so that the sensor head with the laser points perpendicularly to the shaft surface.

When balancing or performing measurements with a reference pick-up signal, mount the sensor on the machine using the reference pick-up stand.



6.2 Balancing



The balancing module is based on the well-known ‘influence coefficient method’ and is characterized by its efficiency and great operating convenience. The measurement process used has been optimized using the raw time waveform for each measurement. The perfectly matched measurement settings save you time-consuming preparations and automate recurring process steps. Easy operation is ensured by intuitive, graphic user guidance, which leads you step-by-step through the balancing procedure. Various methods for correction of a rotor unbalance are available for selection: free correction, fixed locations, or fixed mass. If you cannot fit any balancing weight to the rotor, the Smartbalancer can calculate for you the weight that must be removed from the rotor.

6.2.1 Safety During Balancing

The safety instructions in the operating instructions and the following safety instructions on balancing must be read carefully and understood before starting to use the measuring unit.

- Check the rotor for damage before balancing and repair or replace any damaged components.
- Remove any material adhesions and loose parts. The applicable safety regulations must be observed when carrying out measurements on machines.
- When arranging the measurement components, ensure that there are no holders, cables etc. projecting into the vicinity of rotating machine parts.
- When fitting the balancing weights, the corresponding instructions of the manufacturer must be observed.

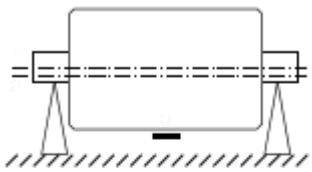
- In the case of welded-on balancing weights, care must be taken to ensure that the attachment points are clean; the earth electrode of the welding machine must be connected to the rotor, and not to the machine.
- In the case of screw-fitted balancing weights, the maximum permissible speed of the rotor must be observed.
- When working on the rotor, the machine must be switched off and secured against switching on again in accordance with the applicable regulations.
- Before the first measurement (initial unbalance), it must be ensured that the preparations have been carried out properly and completely. In addition to the arrangement of the measurement components, care must be taken to ensure that the parameters have been entered correctly in the machine setup. An incorrectly entered rotor mass will result in the calculation of too large a trial weight. The consequences for the operator and the machine may be serious!
- During the trial and correction runs, no persons must remain in the radial area of the rotor. This area must be properly secured against unauthorized entry. If the trial weight becomes detached from the rotor when the machine is running, this can result in fatal danger in this area!
- If the rotor is accommodated in a protective housing, any hatches or openings in the housing must be closed before starting the machine.
- The permissible starting frequency of the machine must not be exceeded otherwise the motor may be damaged.

6.2.2 Balancing Process

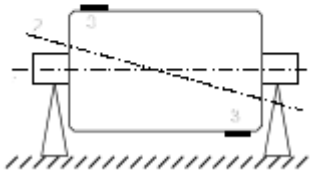
Increased vibrations to machines are undesirable occurrences. They impair the quality of the products, place additional stress on the components and ultimately reduce operating safety. The most frequent cause of these vibrations is the unbalance. The resulting high centrifugal forces lead to premature wear of machine components such as bearings and seals. The objective of balancing rotors is therefore to restrict bearing forces and shaft deformations to acceptable levels.

With the Smartbalancer you can reliably detect an unbalance and quickly correct it.

6.2.3 Unbalance



Static unbalance
1 Rotation axis
2 Mass inertia axis
3 Unbalance



Couple unbalance

If a rotor is correctly balanced, and if the rotor is placed in roller mountings, the rotor will not turn. If an additional mass is applied, this will immediately turn the rotor until it rests at the bottom. This procedure is referred to as ‘rolling’. If the additional mass is applied in the plane of the center of gravity, this will result in a purely static unbalance.

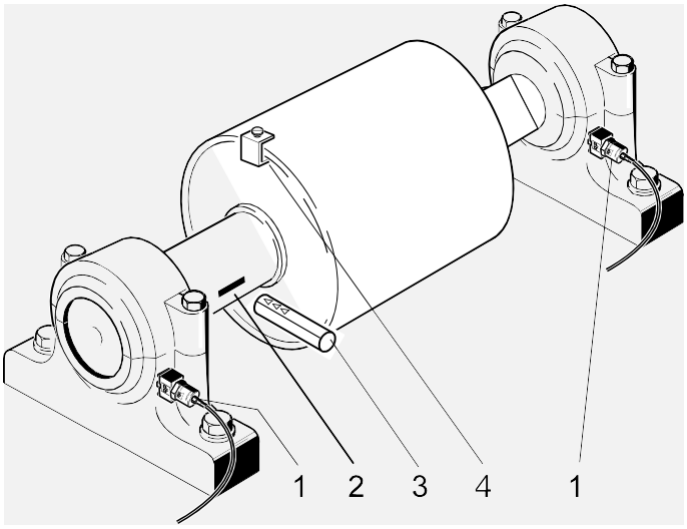
If this rotor is now rotated at the balancing speed, this creates a centrifugal force perpendicular to the axis of rotation.

If two equal unbalances are applied to a fully balanced rotor so that they are directly opposite each other in two separate radial planes, this is referred to as a couple unbalance (or dynamic unbalance). This unbalance cannot be established with the aid of roller mountings since the center of gravity remains on the rotational axis. When the rotor turns, the unbalances cause a moment due to centrifugal force, which generates equal but opposing forces in the bearings. Such unbalances can only be detected and corrected ‘dynamically’ by means of two-plane balancing.

If a single unbalance is applied to a fully balanced rotor in one plane, which does not contain the center of gravity, this is referred to as quasi-static unbalance. This corresponds to a combination of a static unbalance and a couple unbalance and is usually corrected by means of a correction in two planes.

The decision as to whether a rotor should be balanced in one or two planes depends essentially on how many correction planes there are available and the separating distance between them.

Two-plane balancing under operating conditions with an optical reference pick-up and two vibration pick-ups.



1	Vibration pick-up	3	Reference pick-up
2	Reference mark	4	Correction weight

6.2.4 Balancing on machines with rotating masses

The balancing module is based on the well-known ‘influence coefficient method’:

The Smartbalancer first measures the vibration amplitude and phase angle of the vibration caused by the unbalance. A defined test weight is then attached, and the amplitude and phase measured once again. The Smartbalancer then calculates the influence coefficient from the difference of both vibrations and the exact location and amount of the test weight. The unbalance of the rotor is then calculated with the aid of this influence coefficient.

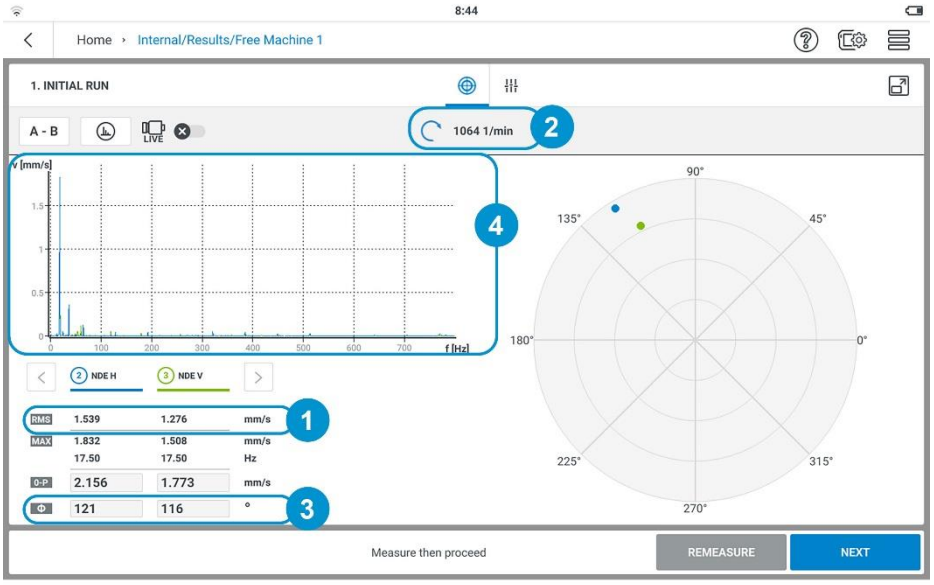
In two-plane balancing, the influence of the mass in the other plane is taken into account in the calculation. All so-called ‘rigid’ rotors can be balanced using this balancing method.

Rotors which are operated outside the speed range in which they behave rigidly are not the subject of these operating instructions. For the balancing of these rotors, further skills and knowledge are necessary, which can be acquired in a seminar by Schenck.

6.2.5 Analysis of the rotor before balancing

Before beginning the balancing, you should first ensure that the cause of the reduced running smoothness of the rotor is actually an unbalance. A vibration diagnosis will also show which balancing method is the most suitable.

The new SmartBalancing Mode now provides all data need for vibration diagnosis on the main balance screen. No longer do you need to navigate through multiple applications to identify the sources of vibrations and unbalances on-site.



Label	Function
1	Overall vibration
2	Speed
3	Phase
4	Spectrum

Vibration data that is included is:

- **Overall Vibration value**
  Detection of the wideband vibration of the machine for documentation of the actual condition before and after balancing. This also identifies the measurement point with the highest vibration level, which is where the sensors should be fitted.

- **Speed**
  Measurement of the rotor speed.

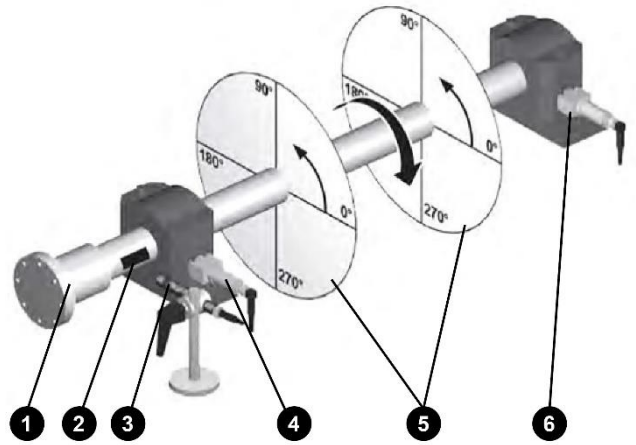
- **Phase measurement - one / two planes**
  Registration of the amplitude and phase angle of the speed-synchronous vibration signal. This can be used for example to determine the type of the unbalance (static / dynamic).

- **Spectrum & time signal**
  Measurement of the FFT spectrum and time signal. If the spectrum is dominated by the 1st harmonic, the most probable cause for the poor running smoothness is an unbalance.

6.2.6 Preparation for balancing

Before starting any work on the machine, it must be switched off and secured against unintentional switching on! The preparations include the arrangement of the measuring components.

Arrangement:



1	Drive side	4	Measurement plane 1
2	Reference mark	5	Correction planes A and B
3	Reference pick-up	6	Measurement plane 2

- First try to establish the cause of the vibrations by visual inspection and rectify this if possible. Example: remove any material adhering to the rotor or tighten any loose bolts in the foundation.

Note: If the machine is not to be balanced on-site in the installed condition, it must be firmly attached to a rigid foundation (direct to the frame or to vibration insulators).

- Determine the measurement and correction plane. Mount the vibration pick-up on the bearing housing at the measurement point with the highest vibration levels. Note the following:
  - The measurement plane should be in the center of the bearing or close to the correction plane (e.g. rotor side, rotor).
  - Vibrations are transmitted via the outer race of a bearing in the radial direction. The pick-up should therefore be attached at the side (horizontal) or at the top of the bearing (vertical). Suitable measurement points can be found by using the test probe to identify the point with the highest vibration levels.

- The sensors should be attached as close as possible to the bearing. Avoid attenuation of the signal due to excessively long transmission paths, bearing covers etc. The measurement direction must correspond to the main vibration direction (usually horizontal). In the case of a horizontal measurement direction, attach the pick-up on the lower half of the bearing housing.
- Wherever possible, use pick-ups which can be screwed to the machine, or attach the pick-up using a magnetic adapter. The pick-up must not be attached to components with natural vibrations, such as covers.
- Test probes are not suitable for balancing!
- For dynamic balancing in two planes: Determine the second plane (B) in the same way.
- Assess the running smoothness of the machine.
- Review the overall vibration and the FFT spectrum (see DIN ISO 10816-3). For example, if the speed is 1,500 rpm and high vibration amplitudes occur in the spectrum at 25 Hz (1st harmonic), these are referred to as rotational frequency vibrations, which indicate an unbalance.

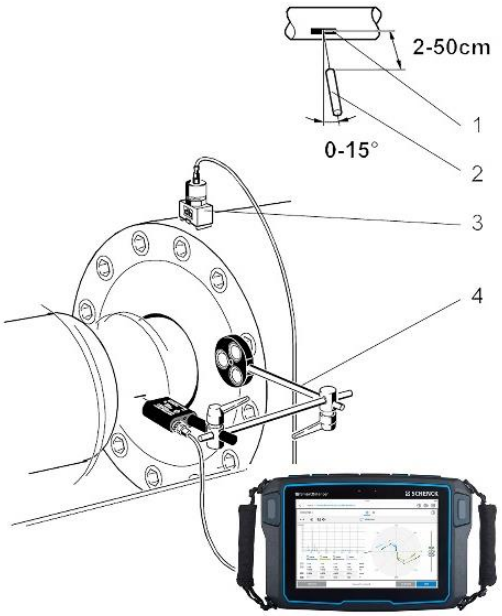
■ Apply an angle reference mark to the shaft while the machine is at a standstill. Use reflective tape as the reference mark.

- Angle convention: The angle reference mark defines the position 0o; the fitting angle for the correction weights is counted opposite to the direction of rotation of the shaft.
- Tip: In the case of fans, number the blades in accordance with the counting direction of the fitting angle. Blade No. 1 is at the 0° position.

■ Fit the reference sensor with the reference stand. Note the following:

- Fit the reference pick-up at a distance of 2 to 50 cm from the shaft surface.
- In order not to interfere with the reference pick-up signal, avoid reflections or other interference with the reference pick-up optic. In case of bright, glossy shafts, fit the reference pick-up at a slight angle (approx. 15°) to the shaft surface.

■ Connect the vibration pick-up and the reference pick-up to the measuring unit.

Reference Sensor Setup			
			
1	Reference mark	3	Vibration pick-up on magnetic adapter
2	Reference pick-up	4	Reference pick-up stand

On completion of the preparations:

- The balancing speed should be as low as possible. The higher the balancing speed, the higher the danger posed by test weights flying off etc.
- Look out for any possible resonance points, and in case of doubt examine the coast-down curve!
- The speed must remain constant during the measurement! Otherwise, the balancing run must be started again.
- The rotor must be at operating temperature during the measurement (e.g. if the rotor normally operates in a hot air flow).
- Before starting the first balancing run, check the correct installation of all measurement components once again.

Note:

1. The balancing RPM and the operation RPM must lie as close as possible. If this is not possible due to high vibration values, start at a lower RPM and approach the operation ROM step-by-step in several balancing runs. The minimum balancing RPM is 120 (2 Hz).
2. Monitor potential resonance points. If not sure, perform a coast down.
3. The RPM must remain constant during a balancing run. If not, the balancing run must be started again.
4. During measurement, the rotor must get to operational temperature.
5. Frequently, static unbalance is dominant at vibration values above 10 mm/s. First, use 1-plane balancing to compensate for this, then continue with 2-plan balancing.
6. Make sure all necessary measurement components are correctly installed before the initial balancing run is started.

6.2.7 Operation

If you are not yet familiar with the operation of the balancing mode, note the following instructions:

6.2.7.1 Settings

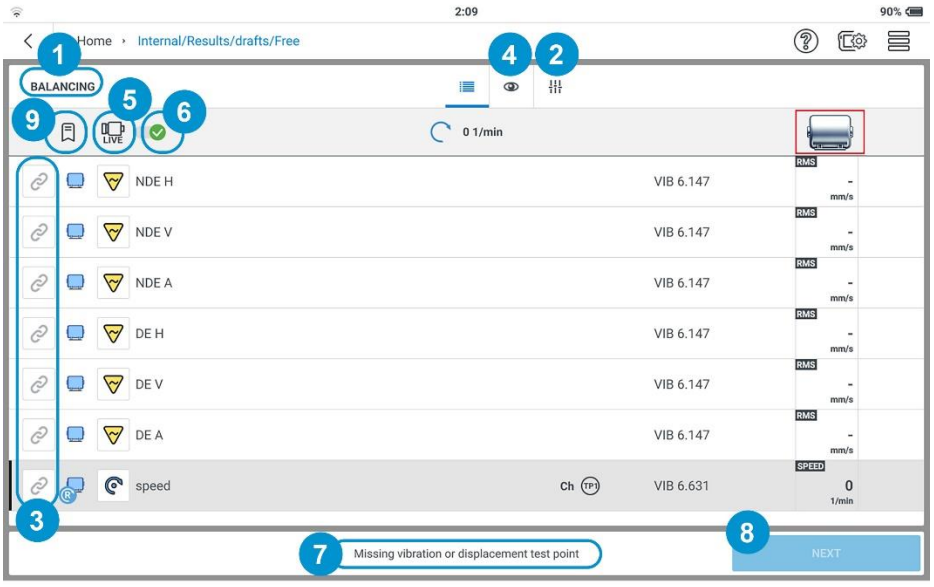
All settings necessary for the measurement and assessment of a balancing run are made in the main settings and machine.

Parameters that you can change during balancing are available in the **B*alancing measurement setup***.

- Overall settings: Quantity / Lower Frequency / Upper Frequency / Type
- Spectrum settings: Quantity / Lower Frequency / Upper Frequency / Number of lines / Window type
- Phase Settings: Quantity / Amplitude
- Enter User Data
- Correction mode: free correction / fixed locations
- Add balancing weights, i.e. weld or screw weights to the rotor.
- Remove balancing weights, i.e. mill weight from the rotor

6.2.7.2 Display

Main balancing screen from an asset.

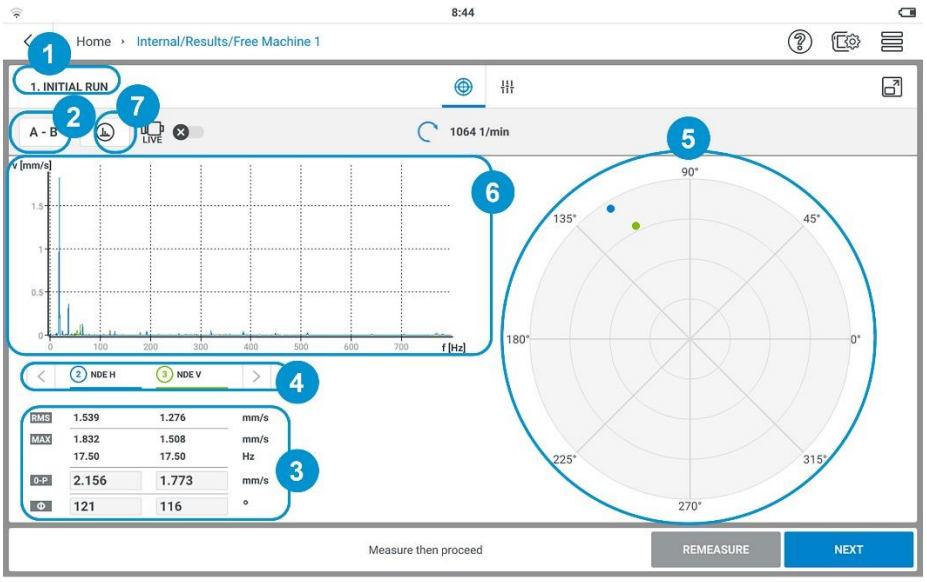


Label	Function
1	Shows Balancing Mode
2	Tap to open the **B*alancing measurement setup*** and set the necessary parameters for the balancing procedure. The parameters that can be set are the overall settings, spectrum settings and Phase settings. **Note**: The item type is used to select the amplitude parameter that is used in the balancing measure screen.
3	Chain Icon shows the available measurement locations. When the location is selected to measure balancing, the icon becomes darker.

4	Tap the (eye) to show the vibration and displacement parameters that can be selected to be shown live on the display (5). The default parameters are set in the setting ***Sensor Live Values*** and can be changed here. A maximum of two parameters can be shown on the screen.
5	Shows the live data from the connected sensors. The values are only shown when sensor live data (6) is toggled on.
6	Turns live sensors data on. When toggled off there are no values displayed in (5).
7	Shows screen hint. This hint is related to the present action.
8	The **NEXT** button is active only when all necessary conditions are correct. In this example, the hint (7) shows an incorrect condition and as a result, the button is inactive.
9	Tap ribbon to show the machines measurement history.

In every balancing run, two main screens are displayed: Measurement and Data

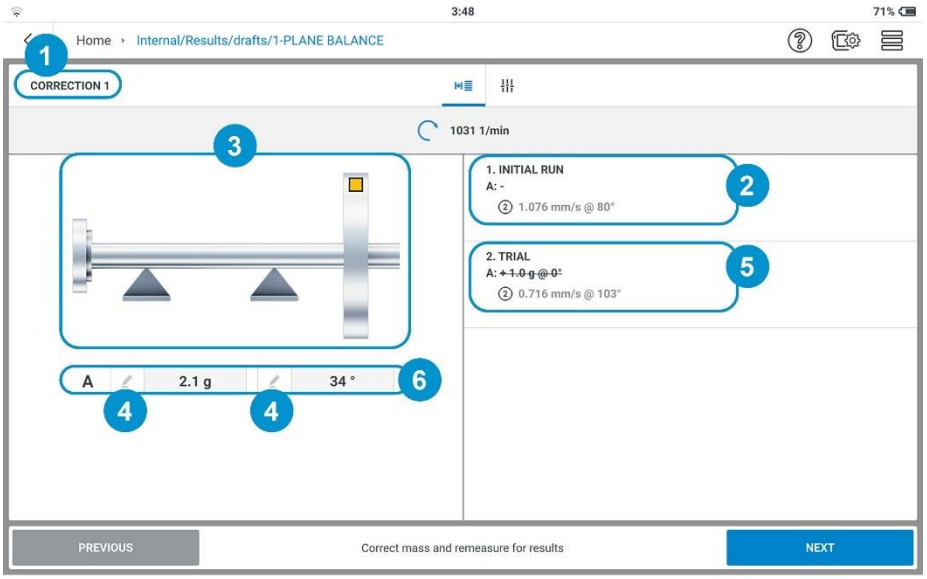
The measurement screen shows the measurement values (spectrum, overall vibration, peak vibration & frequency, amplitude & phase angle) and a graphical polar diagram of the amplitude & phase angle.



Label	Function
1	Shows the current balancing step.
2	Tap to open the ***influence setup*** window. This window is used to select the balancing procedure. This could be either balancing in one plane (for static unbalance) or two planes (for dynamic unbalance). The locations are used to calculate the balancing weights and can also be selected in this window.
3	Shows the phase vector (amplitude and angle) of the measured signal and the velocity RMS value. The amplitude is the highest peak value, and the angle is the phase difference between the trigger signal and the highest peak.

4	Shows the measure locations used in the polar diagram.
5	The Polar diagram is used to show the balancing steps.
6	Spectrum for all sensors connected for the current measured reading
7	Detailed spectrum and vibration results from measurement

The data screen shows the balancing weights and their position on the rotor. The screen also shows the measurement data and balancing weights of all completed runs.



Label	Function
1	Shows the current balancing step.
2	Shows the velocity and phase angle of the synchronous signal measured in the initial run at the different measurement locations.
3	Shows the currently selected rotor type – in this case it is a 1 plane overhung.
4	Enter the actual the trial mass and angle. To edit tap the edit area and use the on-screen keyboard to enter the trial run mass and angle. Then tap **SAVE.**
5	If the trial weight is crossed out, then the trial weight has been removed from the machine. If the trial weight is not crossed out, then it was left on the machine.
6	Shows the recommended mass and angle of the correction weight after the initial run and the trial weight.

In both screens, the relevant balancing step is shown at the top left.

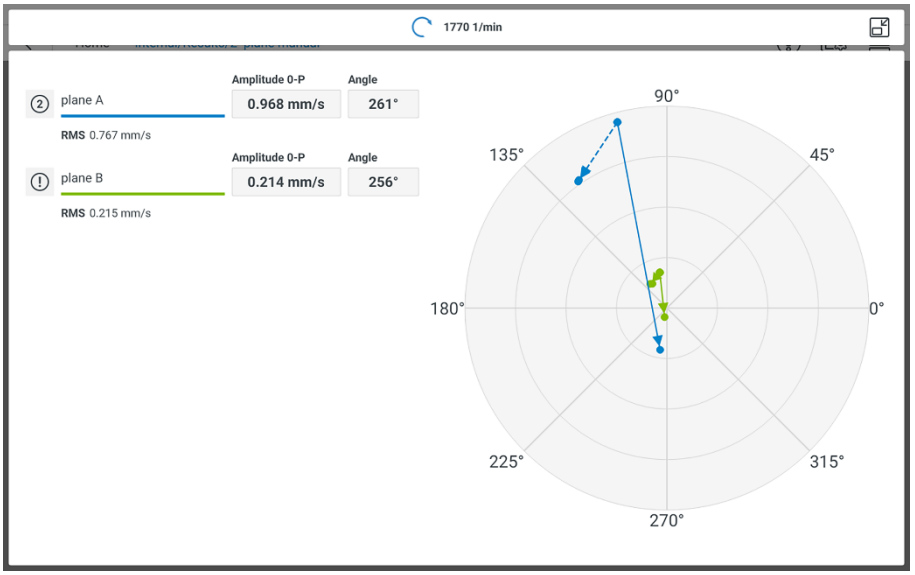
1. **INITIAL RUN**:
   - measurement of the initial unbalance; if the vibration values are within the tolerance range, the rotor is balanced. Otherwise, balancing weights must be fitted to the rotor in accordance with the following balancing steps.
2. **TRIAL:**
   - the fitted test weight added to the rotor and the mass and angle are entered into the plane location.
   - The influence of the fitted test weight is measured, and the required correction weight is calculated.

CORRECTION 1 to ..n :

- Correction runs to reduce the unbalance of the rotor.

Zoom

The initial unbalance is designated by ‘A’ or ‘B’ as the starting point of the balancing procedure. All following measurements are connected to each other by a line. In order to enlarge the view, tap the full screen icon on the top left corner. The Smartbalancer automatically scales the display area with regard to the last two balancing runs.



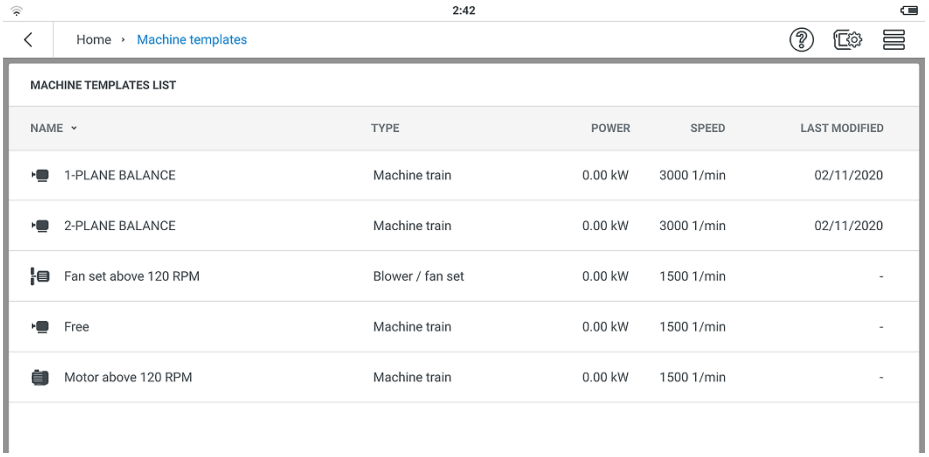
6.2.8 Balancing in one plane

The next section describes the procedure for balancing in one plane. This is done using the machine template **1-PLANE BALANCE**; the standard setting is:

- Correction mode: free
- Balancing weights: add
- Overalls: Velocity RMS, 10 to 1000 Hz
- Spectrum: Velocity, 10 to 800 Hz, 1600 lines
- Phase: Velocity, 0-P

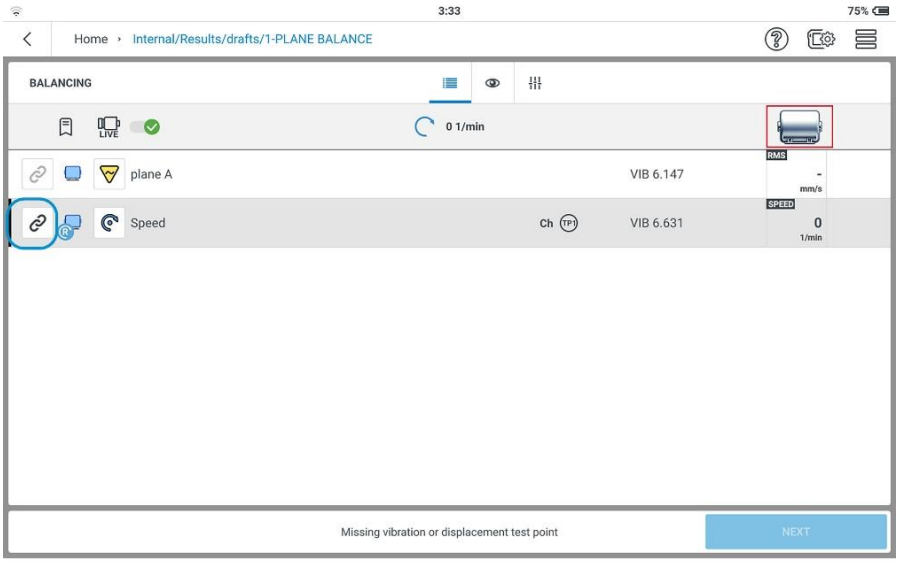
6.2.8.1 Activating the balancing mode

- Turn the SmartBalancer on and wait until the start screen appears (20-30) seconds.
- Tap on the screen symbol ***Machine templates.***
- Choose an existing template or create a new asset that is to be checked for unbalance. In this example, we use the **1-PLANE BALANCE** template**.**
- Check the ***Balancing measurement setup*** after the necessary parameters have been set, tap **APPLY** to confirm balance parameters.



Note: If measured data is available, the data can be entered manually as amplitude and phase values in the balancing measure screen. To do this, the option **E*nter user data*** must be turned on showing a green toggle. To enter speed tap on the ***Hamburger menu***, tap **SPEED**, and enter the running speed.

- Select the locations to measure for the balancing procedure by taping the chain links. When the location is selected to measure balancing then the icon will become darker.



- Mount the sensors as necessary and then connect them to the applicable SmartBalancer inputs.

Note. Before the speed reference sensor and the vibration sensors are mounted and connected to the SmartBalancer make sure that all preparations for the procedure have been done correctly.

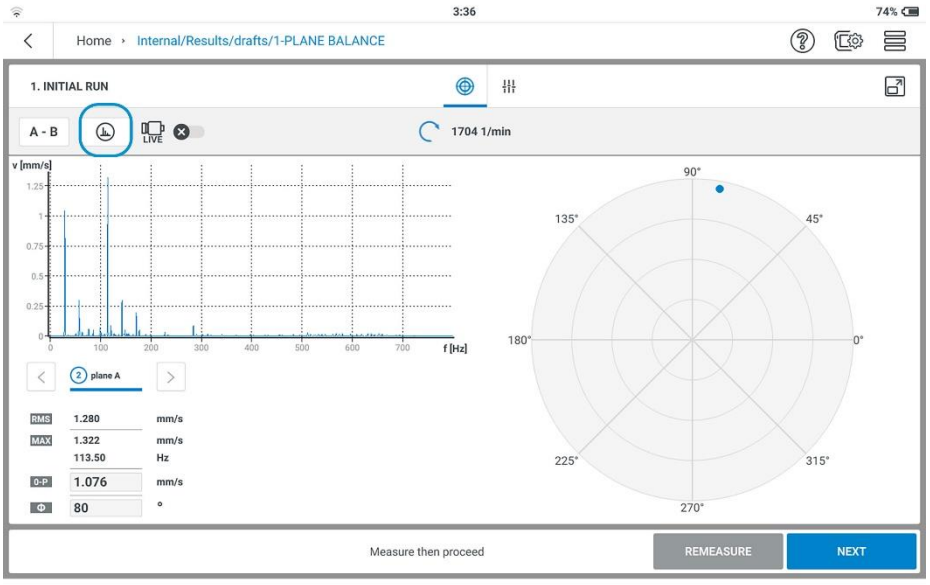
6.2.8.2 Measuring the initial unbalance

- Switch the machine on. Wait until the machine has reached the balancing speed and if applicable the operating temperature.
- Toggle on the live data from the connected sensors. Ensure all connected sensors are reading the vibration and speed is accurately.
- Tap **NEXT** to proceed to measurement screen - ***Initial run***.
- Tap **MEASURE** to take the initial run, initial overall values, and initial spectrum.

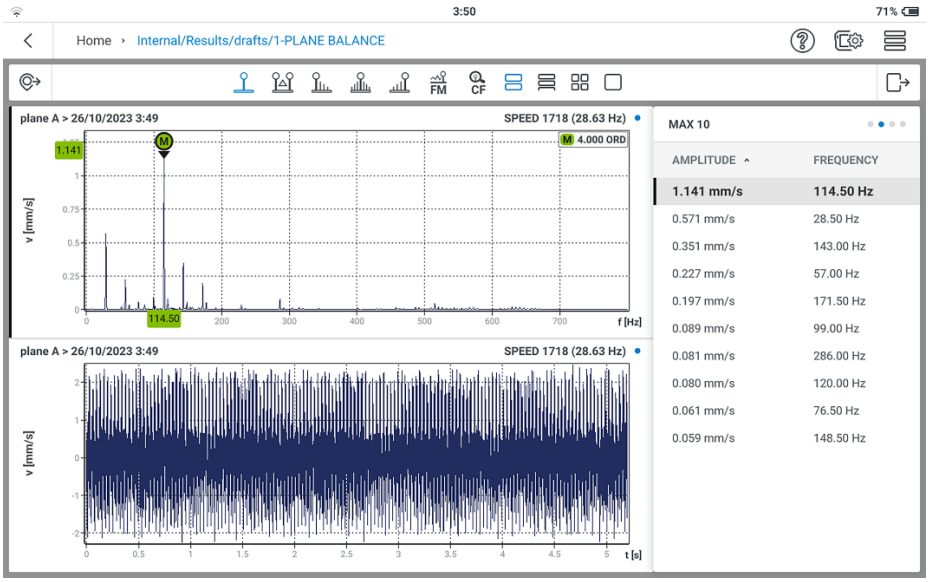
Note. The unit measures the raw time waveform from the sensors and outputs the overall vibration, spectrum, and the amplitude and phase of the speed-harmonic vibration. The longer the measurement is taken the more data is available for the analysis.

- When the values are stable the **STOP** button is shown. Tap **STOP** to lock in the measurement. Tap **REMEASURE** repeat the measurement if need.
- Switch off the machine.

Do not start the reading unless at running speed or erroneous readings will be calculated into the measurement.



Review the overall vibration and spectrum to ensure that the cause if the reduced running smoothness of the rotor is actually and unbalance. Tap the detail icon to expand the spectrum graph and see more detailed vibration results.



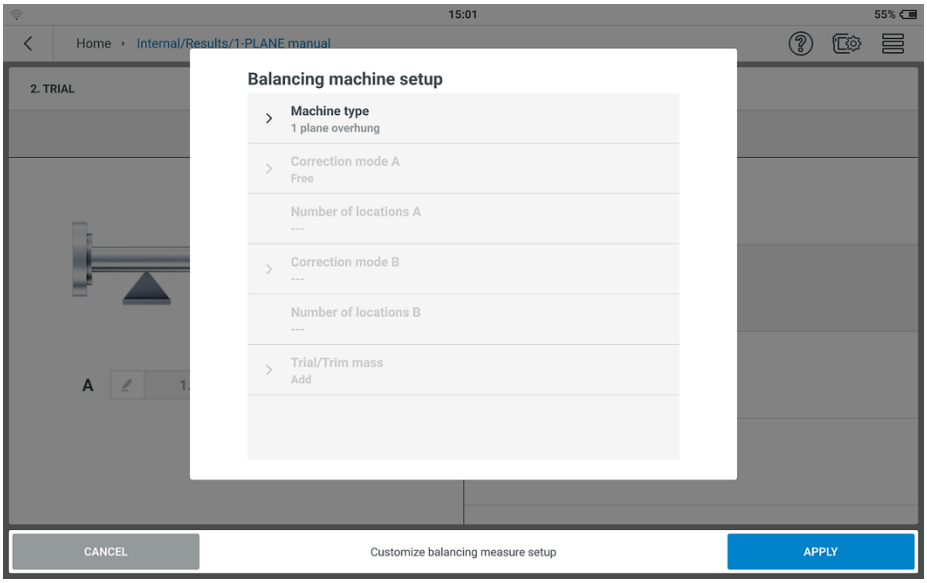
6.2.8.3 Trial Run

- Tap **NEXT** to open the data screen for the trial run.
- Open the ***balancing measurement setup*** to select the applicable rotor information***.***

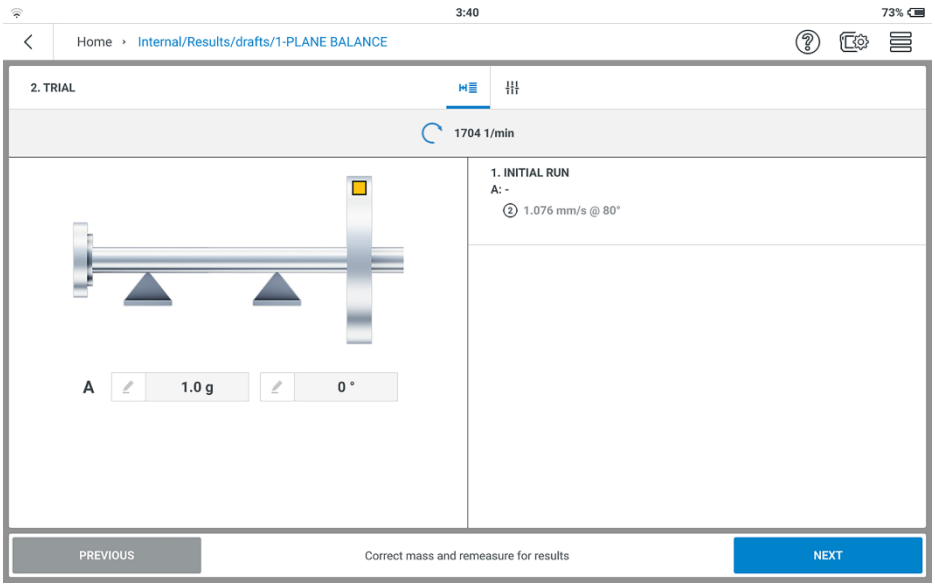
  - Tap > under ***Machine type*** to choose the correct type of machine. Available options are:
    - 1 plane overhung.
    - 1 plane intermediate***.***

  - Tap > under ***Correction mode A*** to select correction mode. Available options are:
    - Free – for planes where the mass cane be added or removed at any regular position.
    - Fixed – for machines that masses can be added or removed at specified positions i.e. – a blade of a ventilator.

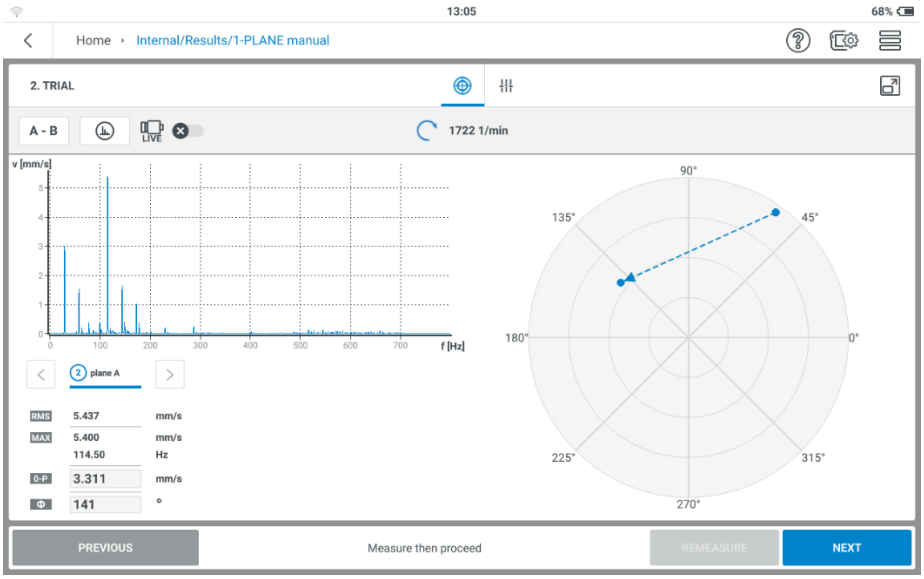
  - Tap > under ***Trial/Trim*** mass to select whether to add or remove mass.



- Enter the mass and angle for the test weight.
  - Tap the edit area on the weight or angle field under the rotor graphic.
  - Enter the relevant value using the on-screen keyboard.
  - Tap **SAVE**



- Tap **NEXT** to proceed to the ***Trial*** screen.
- Switch on the machine.
- Tap **MEASURE** to take the trial run with the attached trial mass.
- When the values are stable the **STOP** button is shown. Tap **STOP** to lock in the measurement. Tap **REMEASURE** repeat the measurement if need.
- Switch off the machine.



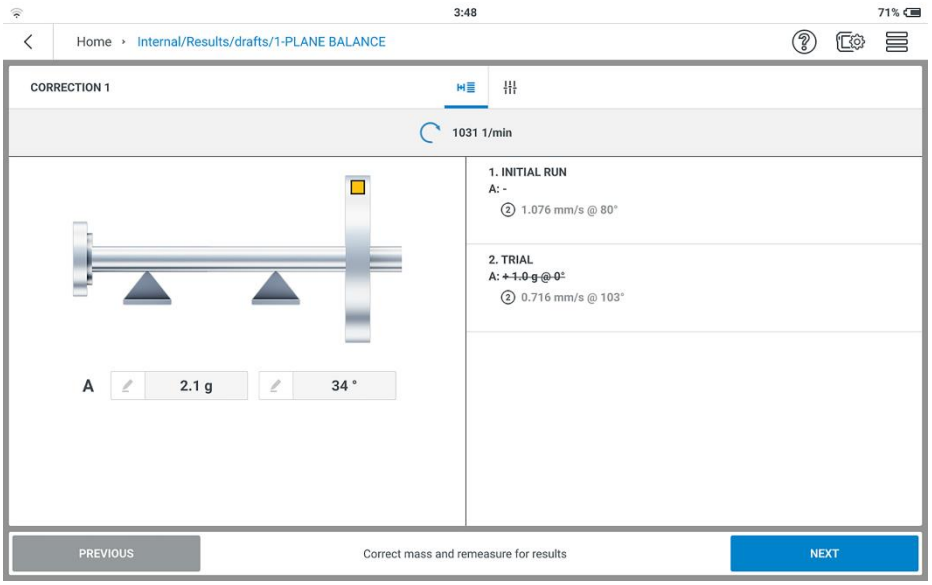
The screen shows the trial run results in digits and as a vector in the polar diagram. The arrow direction shows the path of the balancing run. In the trial run, the unbalance should change sufficiently. If the unbalance only changes slightly, you must increase the test weight. If the unbalance has more than double, you must use a smaller test weight (see check unfavorable influence). If necessary, tap **PREVIOUS** to the data screen of the trial run, change the weight accordingly, and repeat the trial run.

6.2.8.4 Correction run

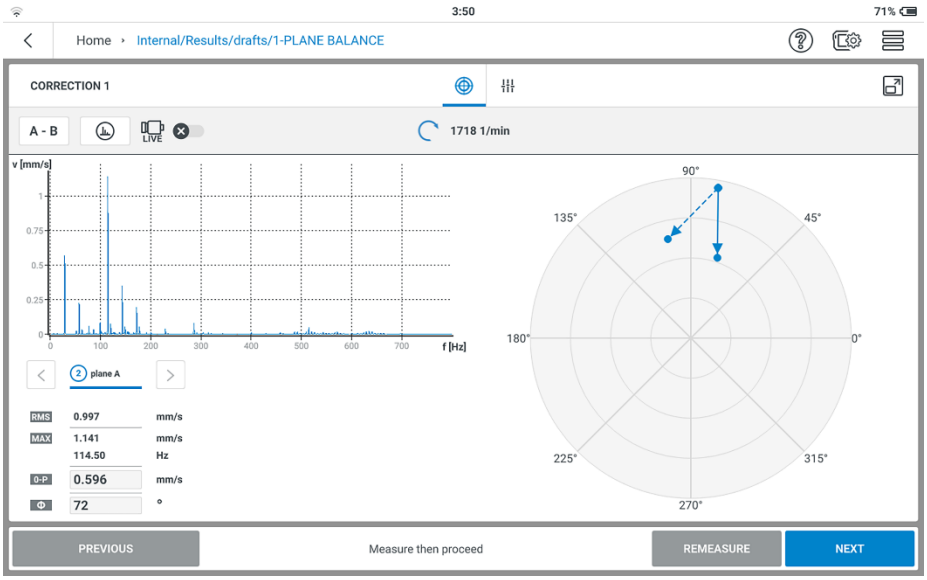
- Tap **NEXT** in order to close the measurement screen of the test run and open the data screen of the first correction run.

Depending on whether the test weight has resulted in and improvement or not, you can leave the test weight on the rotor or remove it. Answer the following enquiry displayed on the screen accordingly.

- Fit the suggested weight at the specified position on the rotor, The values can also be changed if required.



- Tap **NEXT** to proceed to the ***Correction 1*** measurement screen.
- Switch on the machine.
- Tap **MEASURE** to take the correction run with the attached correction mass.
- When the values are stable the **STOP** button is shown. Tap **STOP** to lock in the measurement. Tap **REMEASURE** repeat the measurement if need.
- Switch off the machine.



In the correction runs, the Smartbalancer checks whether the unbalance has been reduced sufficiently from one run to the next.

> **Note**: A restart is recommended if the vibration values deteriorate, and at the same time the correction weights are not reduced significantly.

- Tap **NEXT** in order to close the measurement screen of the ***Correction run 1*** and continue the balancing with the next correction run.

Before every further correction run, it must be specified whether to leave the balancing weight used on the rotor or remove it.

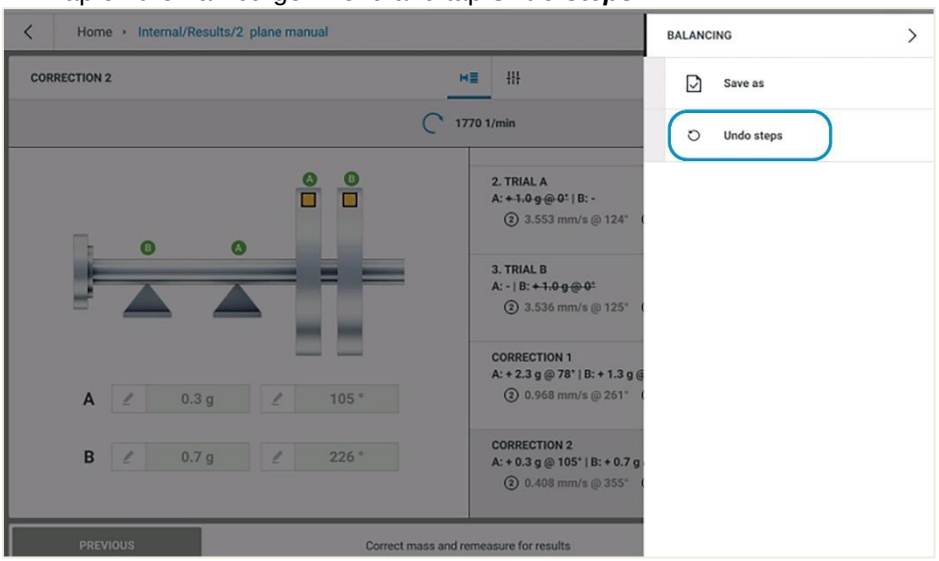
The balancing is completed as soon as the vibration values have reached an acceptable level.

6.2.8.5 Undoing balancing runs

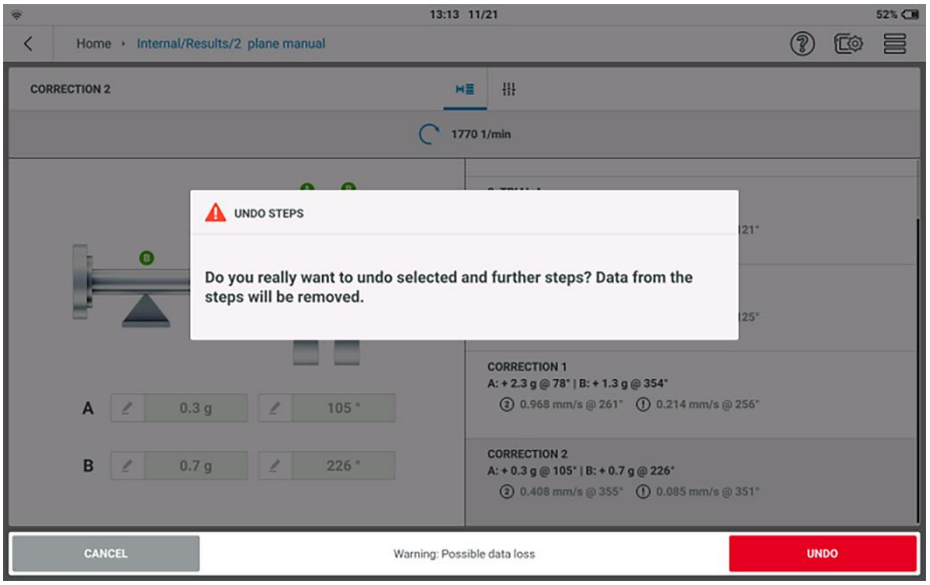
If the measurement results worsen after a trim run, you can return to a run that was acceptable and continue balancing with different weights from there.

- Navigate to the data screen of the trim run at which you wish to continue the procedure.

- Tap on the hamburger Menu and tap ***Undo steps***



- Confirm the next query with ***UNDO.*** All subsequent data from the following steps are deleted.



- Remove the balancing weights that you attached during the deleted trim runs.

6.2.9 Balancing in two planes

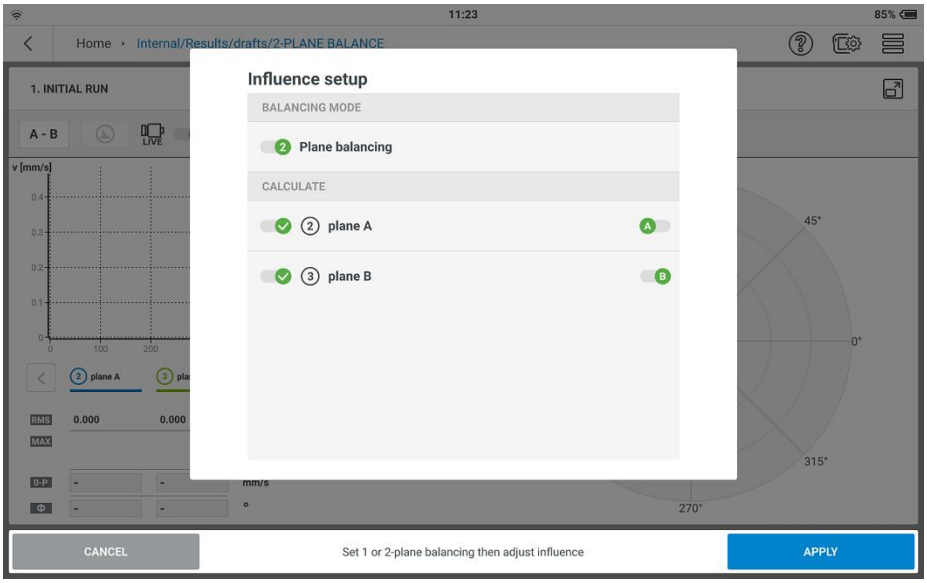
The procedure in this case corresponds in principle to the previous section. Only the special features of balancing in two planes are therefore described below:

6.2.9.1 Measurement procedure overview

Plane A-B:	Definition of the measurement and correction plane.
1. INITIAL UNBALANCE:	Measurement in Plane A and Plane B
2. TRIAL A:	Suggestion for test weight in plane A Measurement in plane A and plane B with test weight in plane A
3. TRIAL B:	Suggestion for test weight in plane B; Measurement in plane A and plane B with test weight in plane B
CORRECTION 1 to N:	Suggestion for balancing weight in planes A & B; Measurement in plane A and plane B

6.2.9.2 Definition of measurement and correction plane A-B

- Activate the balancing mode.
- Check the ***Balancing measurement setup.***
- Proceed to measurement screen - ***Initial run***.
- Tap ***A-B*** to show the ***influence setup*** window. This window is used to select the balancing procedure.
- Under ***Balancing mode*** toggle to turn on **2 plane balancing**. When two plane balancing is selected, the measure locations can be position on the necessary plane.
- Toggle the measuring points to match the corresponding measuring plane A or B.
- Click **APPLY**.
- Connect the sensors as specified in the ***influence setup window*** to measurement plane A to measurement channel A.



6.2.9.3 Trial run

The Trial run is divided into two sections, which are designated **TRIAL A** and **TRIAL B** in the main screens:

TRIAL A: The test weight is fitted in plane A and its influence measured in both planes.

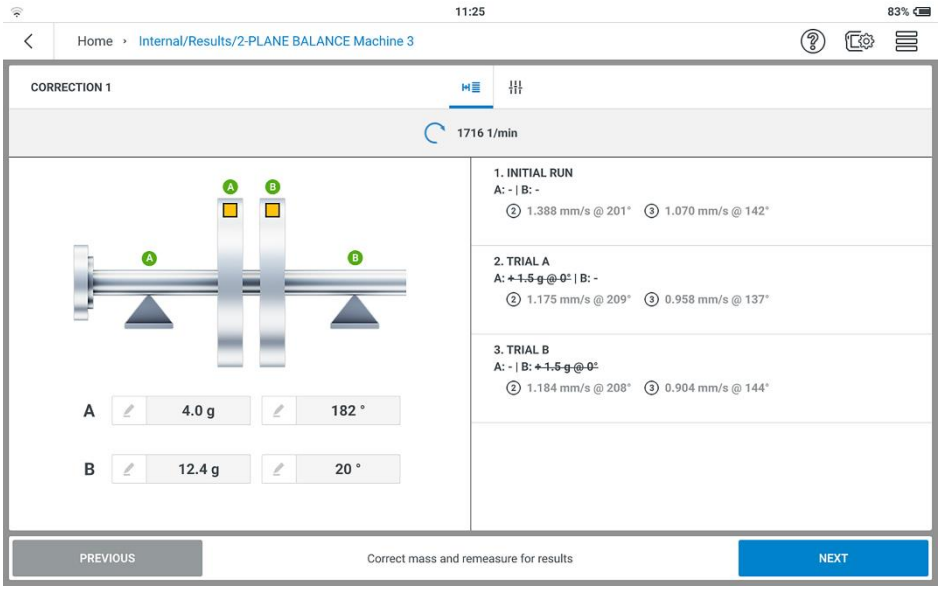
TRIAL B: The test weight is fitted in plane B and its influence measured in both planes.

6.2.9.4 Correction Run

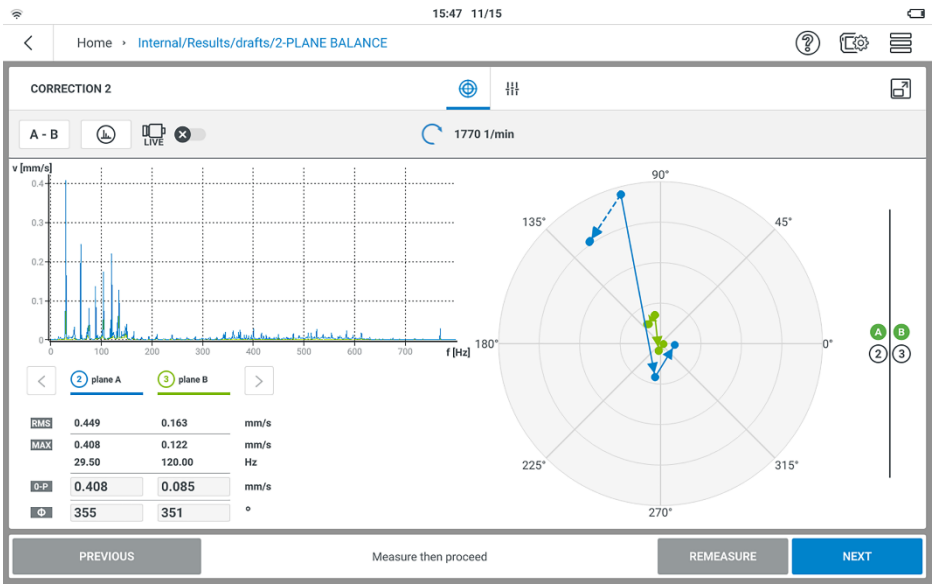
In the data screen of the correction run, enter the balancing weights for both planes. Press the **NEXT**, in order to mark the entry fields in sequence.

The following data is listed for every completed balancing run:

- Weight of the balancing weight
- Fitting angle
- Effective value of the vibration level
- Phase angle



Continue the correction runs until the residual unbalance is within the tolerance range.



6.2.10 Options When balancing

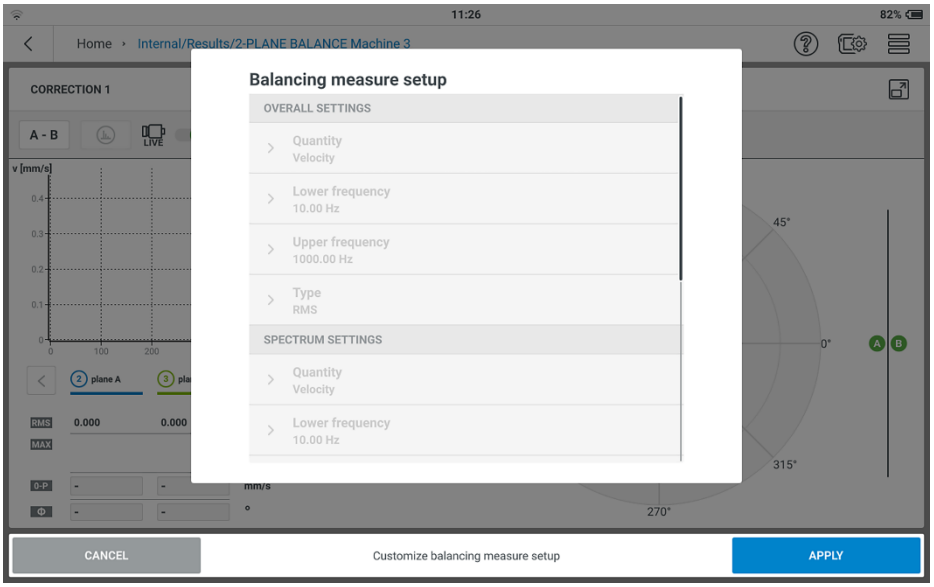
During the trial run and the correction runs, the following options are available:

6.2.10.1 Check measurement settings

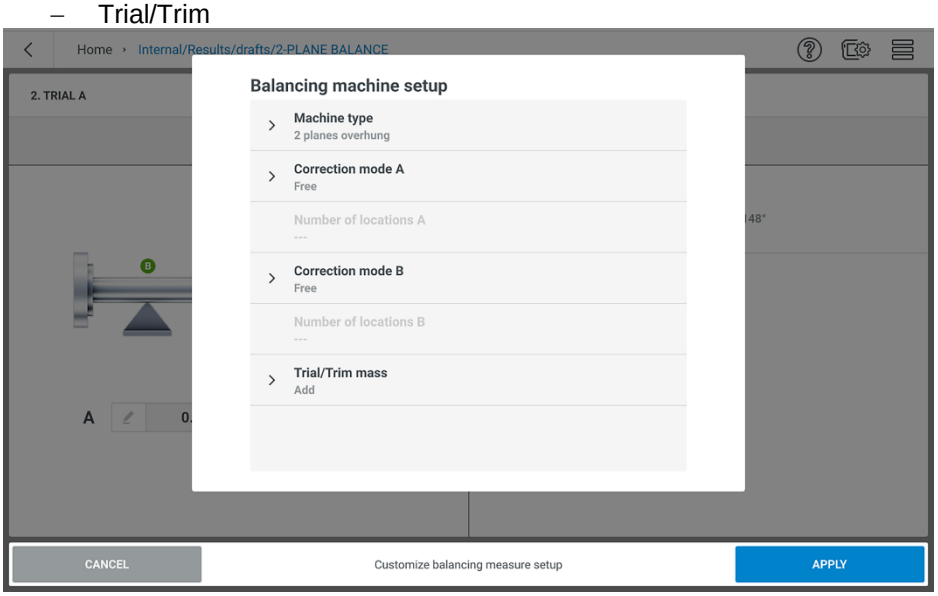
- Tap the ***Balancing measurement setup***

The following settings can be checked (displayed) when in the run screen:

- Overall settings
- Spectrum settings
- Phase settings



- The following settings can be checked / changed when in the data screen.
  - Machine type
  - Correction mode A /B
- The following settings can be checked (displayed) when in the data screen.
  - Trial/Trim



6.2.10.2 Changing the correction mode

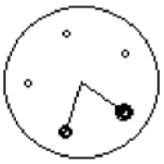
The correction mode refers to the method by which the balancing weight is fitted to the rotor. The standard setting for the correction mode is “Free.”

- When in the trial or correction screen open the ***Balancing machine setup*** to select the applicable rotor information*.*
  - Tap > under ***Correction mode A/B*** to select correction mode. Available options are:
    - Free
    - Fixed

Free

The weight can be any mass and can be fitted at any angular position.

Fixed location



If you can only fit the balancing weight to the rotor at certain positions (e.g. on the blades of a fan), select the correction mode ‘Fixed location’. Then enter the ‘Number of locations’ on the rotor. The Smartbalancer calculates two weights in the balancing runs which must be fitted at two of the specified positions. Position or blade #1 corresponds to the 0^{o} position and should be set up as the reference mark for the reference pick-up.

6.2.10.3 Remove balancing weight

If you do not attach the balancing weights to the rotor by clamping, welding, screwing etc., you can also correct the unbalance by grinding off some of the rotor material.

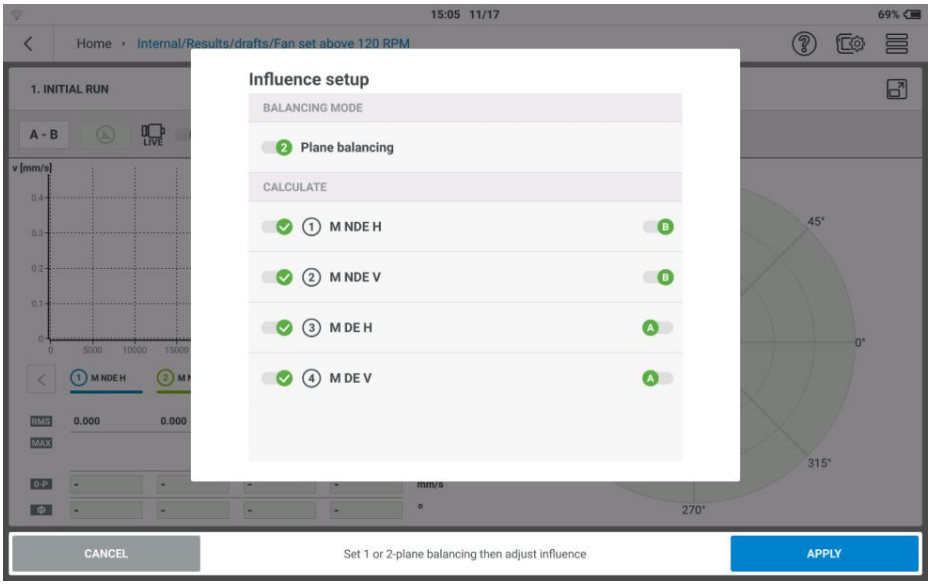
- When in the trial screen open the ***Balancing machine setup*** to select the applicable rotor information*.*
  - Tap > under ***Trial/Trim*** mass to select whether to add or remove mass.

The Smartbalancer then re-calculates the ‘balancing weights’ as negative masses.

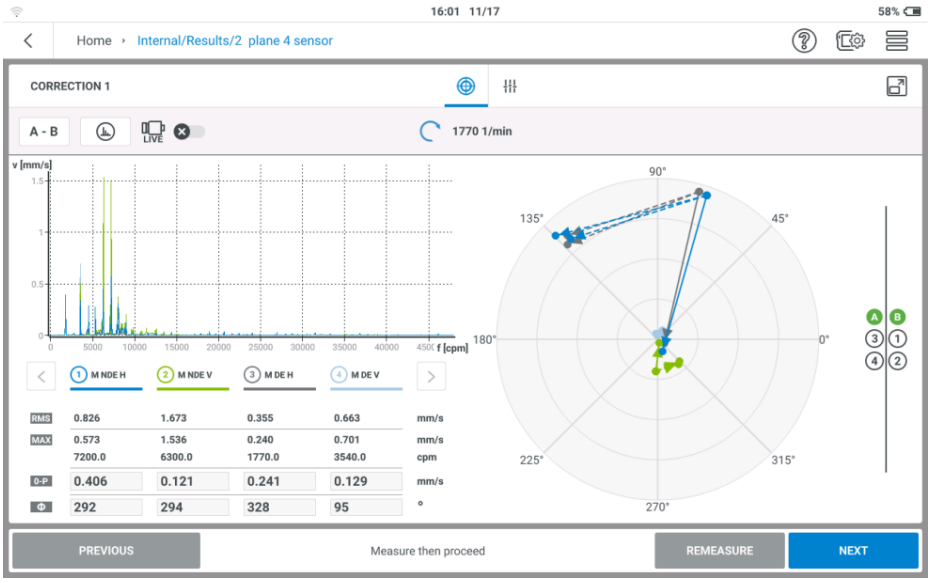
6.2.10.4 Optimize balance with additional sensors

The SmartBalancer can optimize the 1 or 2 plane balance process with more sensors than planes. (optional upgrade required for the addition of more than 2 sensors)

- Activate the balancing mode.
- Check the ***Balancing measurement setup.***
- Choose additional measurement points that should be monitored during the balancing process.
- Proceed to measurement screen - ***Initial run***.
- Tap ***A-B*** to show the ***influence setup*** window. This window is used to select the balancing procedure.
- Under ***Balancing mode*** toggle the measure locations to be associated with the position on the necessary measuring plane A or B.



The SmartBalancer will use the data received from all sensors connected to calculate the recommended correction weights in order to optimize the balance for locations monitored.



6.3 Run up and Coast down

Due to the natural frequency machines must not operate near frequencies that would cause a resonance. The resonance occurs when the excitation frequency matches the resonance frequency or the natural frequency of the machine. To prevent machinery damage due to the resonance the machinery must no operate or be balanced near or at the natural frequency. The natural resonance of a machine can be determined with the aid of an order tracking analysis. In this type of diagnosis measurement, the rotational frequency vibrations are recorded in relation to the machine speed while the machine is “running up” to operating speed or “coasting down” from the operating speed to a standstill.

Run up and coast down curves record the changes in the vibration behavior of the asset when the machine starts up or shuts down.

6.3.1 Taking a Run up or Coast down

Run Up

When taking a run up measurement we want to start to measure before the machine is switched on. The SmartBalancer 4 records the current machine speed and when the set start speed is shown the SmartBalancer 4 will automatically start recording the data. When the set stop speed is shown the SmartBalancer 4 will automatically stop measuring.

Coast down

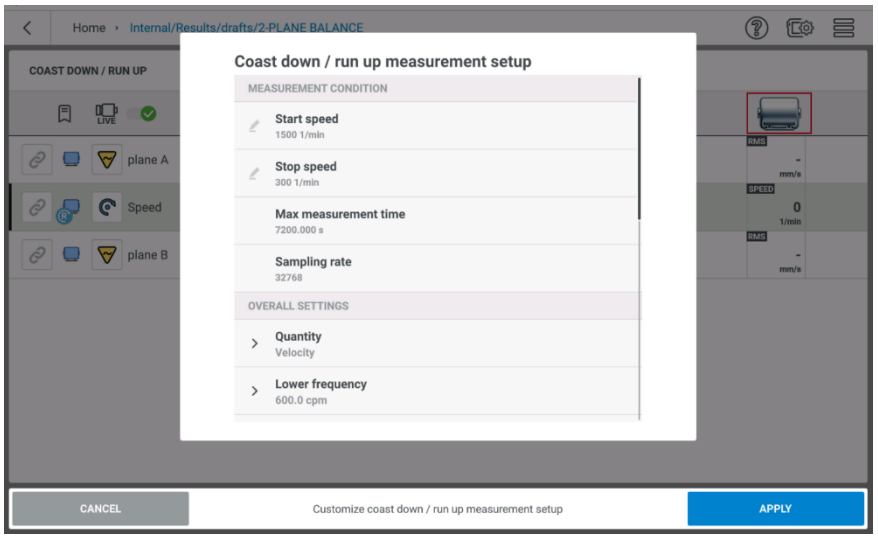
When taking a coast down measurement we want to ensure the machine is running at operating speed before we start the measurement. The SmartBalancer 4 will begin to measure the speed and when the machine is switched off and the speed drops below the set start speed the SmartBalancer 4 will automatically start recording the data. The SmartBalancer 4 will automatically stop the measurement when the set stop speed is shown.

Note: The sensor placement for a Run up or Coast down is similar to balancing. Please refer to 5.3.6 **Preparation for Balancing** for instructions.

- From the Home screen tap on the coast down / run up icon to open. Choose an existing template or asset to start the reading from. (Alternatively, it can be started from either analysis or balancing by switching the application see section 5.2).

- Tap the measurement setup icon to set the necessary parameters for the coast down and run up tests. The minimum and maximum speeds that can be entered are 6 RPM and 30,000 RPM. The following parameters can be set:

  - Spectrum settings: Quantity (acceleration, velocity, or displacement) lower frequency, upper frequency, number of lines, and window type.
  - Phase settings: Quantity (acceleration, velocity, or displacement) and Amplitude
  - Measurement conditions: start speed, stop speed, measurement time, and sampling rate.
  - Overall settings: Quantity (acceleration, velocity, or displacement), lower frequency, Upper frequency, and type



- Tap the arrow > or the pencil to use the alphanumeric keyboard to edit the related item.

- Tap ***SAVE*** to confirm the entry.

Note: The sampling rate is given by the maximum frequency, the maximum measure time, the number of locations measured, and the available disk space on the device.

- Select the locations to measure for the coast down or run up test.

Note: For coast down and run up tests, a speed point, which can be either absolute or relative, is necessary for the measurement procedure. When using the supplied speed sensor ensure that it is mounted correctly. If the signal is too week or missing, this can lead to premature discontinuation of the measurement.

- Mount the sensors as necessary and then connect them to the applicable SmartBalancer 4 inputs.

- For a run up measurement tap ***MEASURE*** then switch the machine on. For coast down measurement ensure the machine is on and then tap ***MEASURE*** and then switch the machine off.

- When the start speed is reached, the collection of data starts, as shown by the progress bar.

- Once completed the progress bar is full and the results are shown automatically. If necessary, the data collection can be manually stopped by tapping ***STOP*** to end the collection.

Label	Function
1	Shows the actual machine speed
2	The progress bar shows the data collection. In this coast down example, the start speed has been reached.
3	Shows the data collection status, and the maximum measurement time. In this coast down example, some data has already been recorded. If the maximum measurement time is reached before the stop speed is reached, the collection of the data will stop.
4	Manual stop of the data collection after it has stated

6.3.2 Run up or Coast down results

In a run up or coast down test, the raw time eave form is recorded and the signal processed is based on the used coast down/run up measurement setup. When post-processing is finished the results are shown. The default result screen shows a Bode plot.

6.3.2.1 Bode Plot

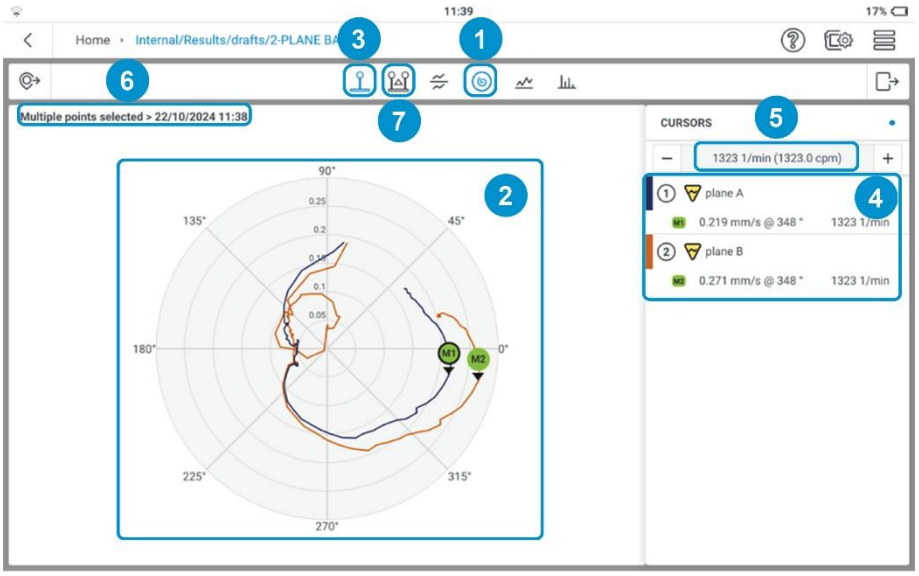
The Bode plot shows the frequency response of the measured asset. The plot has two graphs: one shows the amplitude in relation to the instant machine speed and the other shows the phase angle in relation to the instant machine speed.

Label	Function
1	The upper graph shows the amplitude progression.
2	The lower graph shows the phase angle.
3	Shows the screen title. The title shows the measurement timestamp and the locations selected to be shown. If a single location is selected, then the title shows the name of the selected location. If more than one location is selected, the title shows the multiple points selected.
4	Icon for Bode plot. In this example, it is highlighted and thus the icon is turned on.
5	The main cursor icon is labeled as M when used on the graphs. In this example, the cursor is turned on (for details on cursors please refer to section 5.5.4.4). The cursors on both graphs are synchronized (#7).
6	Shows the amplitude, phase angle, and instant machine speed of the color-coded measurement locations. This information is in the cursor's frame and shows the values of the activated cursors. In this example only the main cursor is active.
7	Similar cursors in the upper (amplitude) and the lower (phase) graph are synchronized.

8	Shows the frequency at the selected cursor. If the delta cursor icon is on, and the delta cursor on the graph is selected, its frequency value will be shown. Use the + or – icons to move the selected cursor to the necessary frequency. Note: the position of the + and – are interchanged for coast down and run up. The + icon will be on the left side for coast down and on the right side for run up.
9	When the parameter or units is tapped the simplified post-processing is started. The parameter is cycled through acceleration, velocity, and displacement.
10	Tap the frequency label to cycle through the machine speed units.
11	The delta cursor icon which is labeled as **D** when used on the graphs. In this example, the icon is not turned on. Cursors for both graphs are synchronized (for details on cursors please refer to section 5.5.4.4)
12	The icon to show the progression of the characteristic overall values relative to the machine speed. See section 5.4.2.3.
13	Icon to show the Nyquist diagram. See section 5.4.2.2
14	Used to open and close the ***Measurement Locations*** frame. The frame shows all the measurement locations on the machine train. To show the results of locations already measured for comparison, check the related boxes.
15	Used to close and open the ***Cursors*** frame. This enlarges the main screen

6.3.2.2 Nyquist Diagram

The Nyquist diagram shows the amplitude and phase of the graph in polar coordinates.

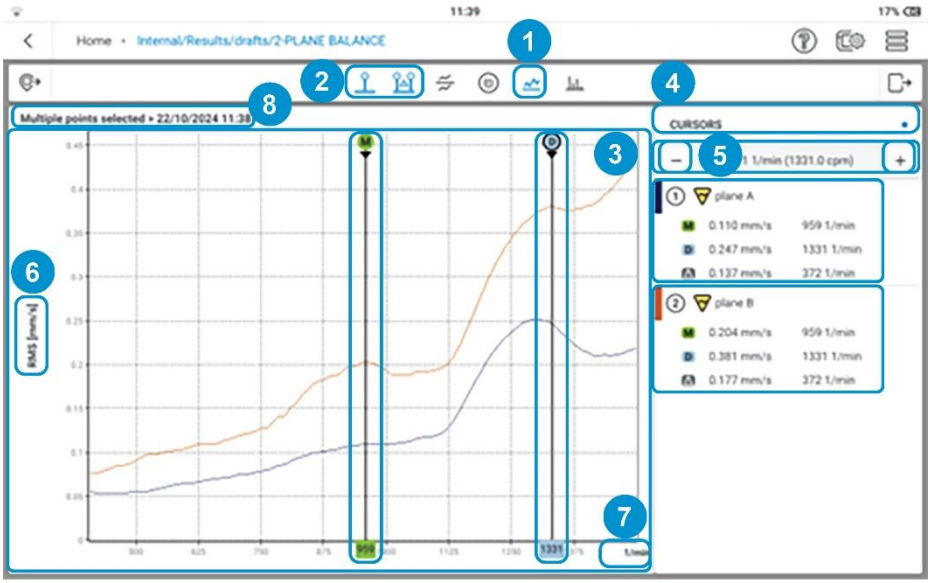


Label	Function
1	Icon to show Nyquist diagram. In this example, it is highlighted and thus the icon is turned on
2	Shows the polar plot of the run up or coast down. In this example, the plots are shown for multiple points as shown on the graph title #7 and the main cursor is active.

3	The main cursor icon which is labeled as M1 when used on the graphs. The main cursor positions on the plots are labeled in incremental order and start with M1. In this example, the cursor is turned on (for details on cursors please refer to section 5.5.4.4). The cursors are synchronized and can be moved to the necessary frequency positions with the + or -. Alternatively, tap the polar plots at the necessary frequency position to move the cursors to these positions.
4	Shows the amplitude, phase angle, and instant machine speed of the color-coded measurement locations. This information is in the cursor's frame and shows the values of all activated cursors. In this example only the main cursor is active.
5	Shows the frequency at the selected cursor. All identical cursors are at the same frequency. A black circle on a cursor label states the cursor is active. In this example, it is the main cursor. If the screen is in a dark mode, the circle is white. Use the + or – to move the selected cursor to the necessary frequency.
6	Shows the screen title. The title shows the measurement timestamp and the locations selected to be shown. If a single location is selected, then the title shows the name of the selected location. If more than one location is selected, then the title shows multiple points selected. In this example, multiple points have been selected.
7	The delta cursor icon which is labeled as **D1** when used on the graphs. In this example, the icon is not turned on. Cursors for both graphs are synchronized (for details on cursors please refer to section 5.5.4.4). The delta cursor position on the plots is labeled in incremental order and starts with D1. The delta cursors are synchronized and can be moved to the necessary frequency position with + or -. Alternatively, tap the polar plots at the necessary frequency position to move the cursors to these positions.

6.3.2.3 Overall Value

The overall value graph shows the progression of the characteristic overall vibration values relative to the frequency. The vibration values are set in the measurement setup and can be in RMS, 0-P, or P-P.

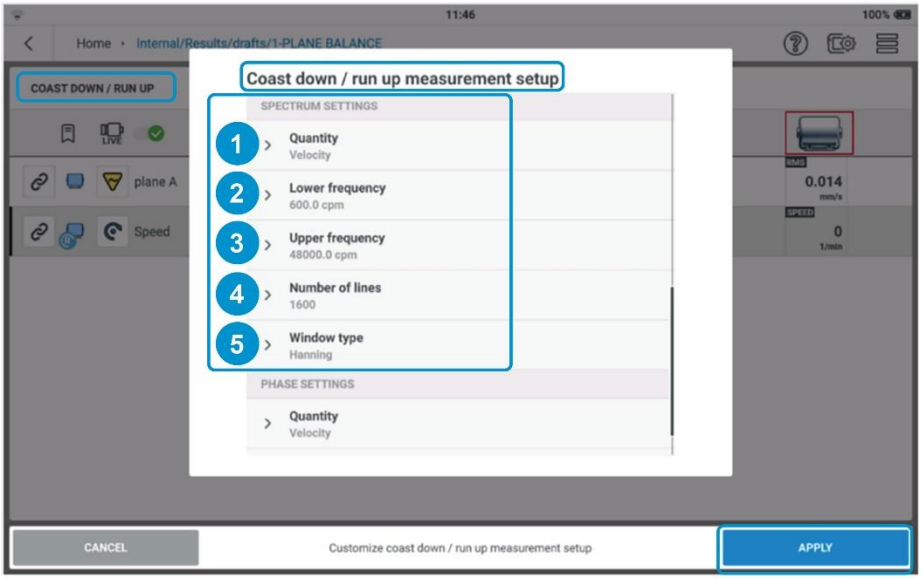


Label	Function
1	Icon to show the overall RMS values. The diagram shows characteristic overall values relative to the machine speed.
2	In the example, both the main and delta cursor icons are turned on.
3	Shows the RMS values for the selected measurement locations relative to the machine speed. In this example multiple measurement locations have been selected. Both the main Cursor M and the delta cursor D are shown because their related icons are turned on. The main cursor is the active cursor hence the black circle on the label.
4	The cursor frame shows the values of the cursors that are turned on. If the delta cursors is also on the calculated Δ values are shown.
5	Shows the frequency at the selected cursor which is identified by a black circle on the cursor label. In this example, it is the main cursor. If the screen is in a dark mode, the circle is white. Use the + or – to move the selected cursor to the necessary frequency.
6	Post-processing is done when the parameters and units are tapped. The parameter is cycled through acceleration, velocity, and displacement. The timestamp for results from post-processing is shown with an asterisk *.
7	Tap the frequency label to cycle through the machine speed units.
8	Shows the screen title. The title shows the measurement timestamp and the locations selected. If a single location is selected then the title shows the name of the selected location. If more than one location is selected then the title shows multiple points selected. In this example, multiple points have been selected. Results from post-processing are shown with an asterisk.

6.3.3 Run up or Coast down Spectrum

In coast down and/or in run up the vibration analysis can also be done by the comparison of the spectra. The settings for the spectrum are done in the coast down/run up measurement setup. Refer to section 5.4.1.

Tap the measurement setup icon when in the ***coast down/ run up*** application screen. The C***oast down/ run up measurement setup*** window will show. Scroll to see the spectrum settings. Use the drop-down menus and select the necessary spectrum settings.



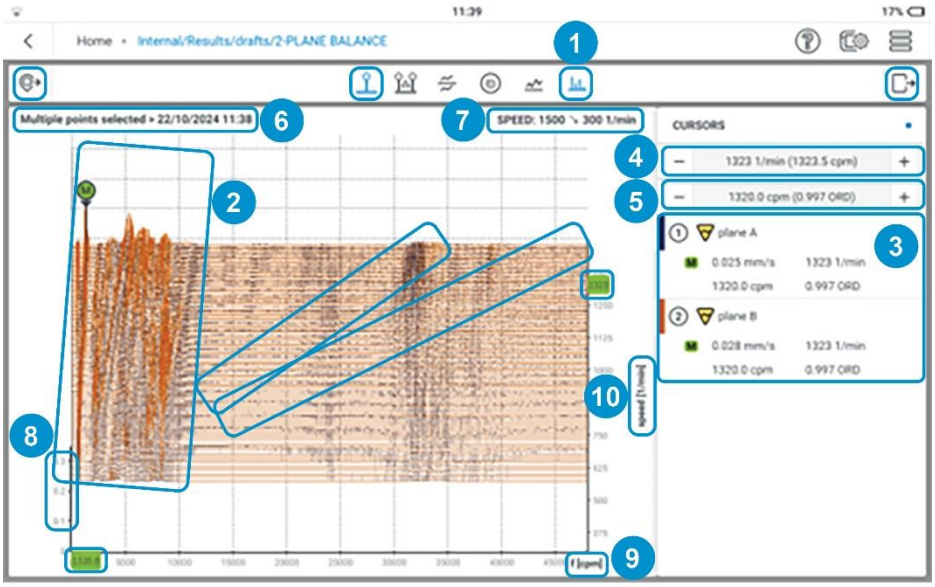
Label	Function
1	The quantity drop-down menu has the following options: acceleration, velocity, and displacement. The default selection is velocity. Make sure that the type of measurement location is related to the selected quantity. For example, if the quantity is displacement the n a displacement measurement location is necessary.
2	Lower frequency drop-down menu is used to select one of the following frequencies: 0.1 Hz; 0.5 Hz; 1 Hz; 2 Hz; and 10 Hz. The default lower frequency is 10 Hz. The selected lower frequency value must be less than the selected upper frequency value.
3	Upper frequency drop-down menu is used to select one of the following frequencies: 100 Hz; 200 Hz; 400 Hz; 800 Hz; 1600 Hz; 3200 Hz; 6400 Hz; 12800 Hz; 25600 Hz; and 51200 Hz. The default upper frequency is 800 Hz. The selected upper frequency value has an effect on the maximum measurement time and the sampling rate.
4	The number of lines drop-down menu is used to select the number of lines to be displayed in a spectrum. The selected number of lines and the selected upper frequency provide the resolution of the spectrum. These number of lines can be selected from the following: 400; 800; 1600; 3200; 6400; 12800; 25600; 51200; and 102400.
5	The window type drop-down menu is used to select one of the following window functions: Rectangular; Hanning; Hamming; Flat top; and Kaiser.

Window Type descriptions are as follows:

- Rectangular – for the analysis of individual pulses, particularly if the pulse is at the start of the time window.
- Hanning – for the analysis of a continuous process with high frequency resolution and the lowest possible leakage effect
- Hamming – same as Hanning but higher amplitude errors
- Flat top – for precision amplitude analysis of a continuous process
- Kaiser – same as Hanning but lower amplitude errors

6.3.4 Run up or Coast down Spectrum Results

After a coast down or run up test the spectrum can be used to analyze the condition of the machine at different speeds. The spectra for a single or multiple location can be shown.



Label	Function
1	The spectra icon which in this example is turned on.
2	Shows the spectra of the selected multiple measurement locations. The main cursor is the 1st order frequency. The other highlighted sections on the graph are the 2nd and 3rd order.
3	Show the spectrum amplitude at the main cursor position for all selected measurement locations. The instant machine speed at the 1st order frequency is also shown. This information is in the cursor's frame and shows the values of all activated cursors. In this example only the main cursor is active.
4	Shows the machine's speed at the active cursor. Use the + or – to move the cursor to the necessary machine speed.
5	Shows the spectra frequency at the selected cursor. If the delta cursor icon is on, then the delta cursors frequency value is shown. Use the + or – to move the selected cursor to the necessary frequency.
6	Shows the screen title. The title shows the measurement timestamp and the locations selected to be shown. If a single location is selected, then the title shows the name of the selected location. If more than one location is selected the title shows multiple points selected. In this example, multiple points have been selected
7	Shows whether the test is a coast down or a run up. In this example, it is a cost down.
8	Spectra amplitude axis.
9	Tap the frequency label to cycle through the spectra frequency units (default selected in settings).
10	Tap the speed label to cycle through the machine speed units (default selected in settings).

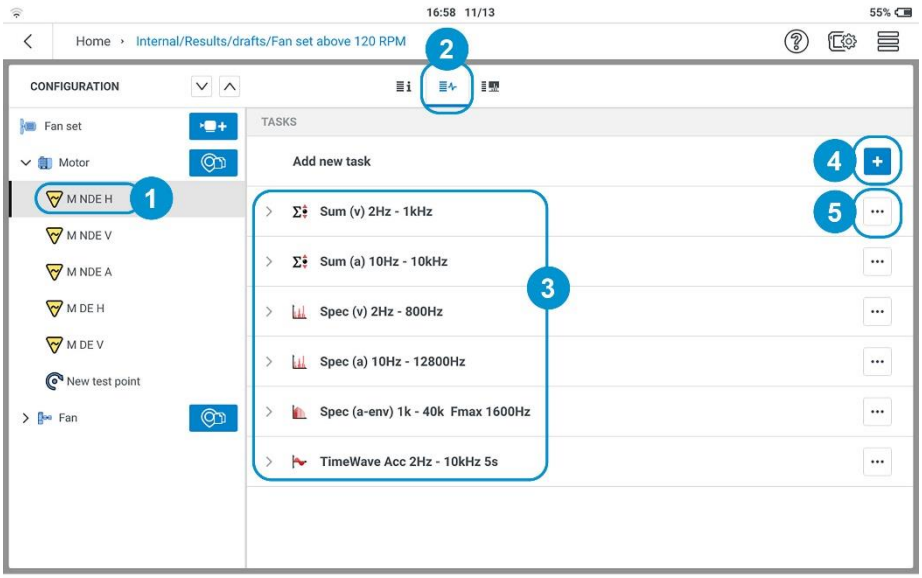
6.4 Analysis

The Advanced Analysis package provides a detailed analysis of the machine, including custom FFT frequency analysis, bearing envelope spectrums, time waveform, and cross-phase measurements. These supplementary functions can be added at any time, enabling even more comprehensive field analysis.

6.4.1 Measurement Task

What is a measurement task? To take a measurement at a location, the device requires information on the type of parameter to be measured, the type of sensor used, and if necessary, the data for the evaluation of the result. If the RPM must be recorded, then this information is also required. This data set is a measurement task. The device contains a full collection of measurement tasks generated based on the ***Task templates***. It is also possible to create user-defined measurement tasks.

Measurement tasks can be assigned to any measurement location.



Label	Function
1	Selected measurement location with the name defined (M DE a = Motor Drive End Axial) measures the parameter vibration.
2	Tap to see the measurement tasks assigned to the selected location.
3	Measurement tasks assigned to the selected location.
4	Tap to assign new measurement tasks to the selected location
5	Tap to view the selected task details; edit the task name and time to measure; delete selected measurement task; save any changes made to the selected measurement task. (Different task will have different task details).

6.4.1.1 Characteristic overall vibration values

These values are used to evaluate the machine, bearing, and gear conditions. A good indicator of the vibration forces acting on a machine is the effective value, Root Mean Square (RMS), of the vibration velocity in the frequency range of 10-1000 Hz or 2-1000 Hz. Evaluation criteria of the permissible vibration levels are specified in the ISO 10816-3 norm.

The highest signal amplitudes as peak values (0-Peak, Peak-Peak) are recorded and used to calculate the crest factor.

The Crest factor is the ratio of the highest amplitude to the effective RMS value of a vibration and is a measure of the intensity of the impacts in the form of a vibration. Crest factor is used to identify ear in roller bearings and gearing mechanisms, and cavitation. A harmonic vibration of amplitude 1 has 0.707 as its effective value and the crest factor of 1.41. If the crest factor is higher than 1.41, impacts with higher amplitudes occur.

6.4.1.2 ISO 10816-3 assessment of machine vibrations

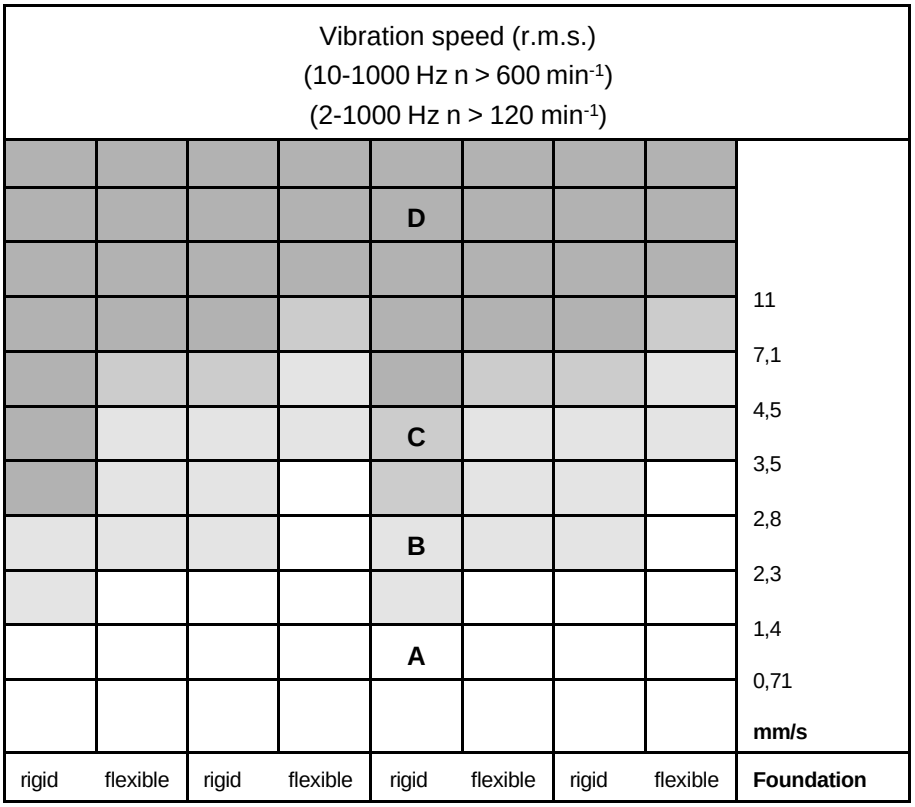
In order to assess the machine condition, first allocate your machine to a machine class with the aid of the lower axis. Read off from the lateral axis in which range the measured effective value falls.

Proceed as follows:

Range A: Continue to measure at regular intervals.

Ranges B and C: Find the cause of the increased vibration levels. Observe the machine closely. Plan for a switch-off procedure.

Range D: Take immediate measures: Localize the cause, switch the machine off, and rectify the problem.



Pumps, radial, axial, diagonal P>15kW		Medium-sized machines 15kW<P ≤300kW	Large machines 300kW<P <50MW	**Machine type**
direct drive	Intermediate shaft belt drive	Motors 160≤H<315mm	Motors 315mm≤H	
Group 4	Group 3	Group 2	Group 1	**Group**

6.4.1.3 Envelope spectrum acceleration

The envelope analysis is used to detect periodic impacts in the vibration signal of machines. Its primary use is in the diagnosis of roller bearing damage and gearing damage, and it is based on the demodulation of amplitude modulated vibration signals.

Periodic impact sequences in a component excited high frequency machine resonances that serve as a carrier signal of the low frequency impact signal. To separate the low frequency modulation from the high frequency resonance, the signal is filtered with a high pass filter, rectified, and then filtered using a low pass filter. The remaining signal consists of only the modulation signal, which is referred to as an envelope.

6.4.1.4 Spectrum acceleration

The amplitude spectrum of the vibration acceleration (broadband spectrum) is used to find the excitation regions of machines. For example, in roller bearings the noise is excited at higher frequencies.

6.4.1.5 Spectrum velocity

The amplitude spectrum of the vibration velocity (machine spectrum) is used to machine problems such as unbalance and misalignment.

6.4.1.6 Timewave form

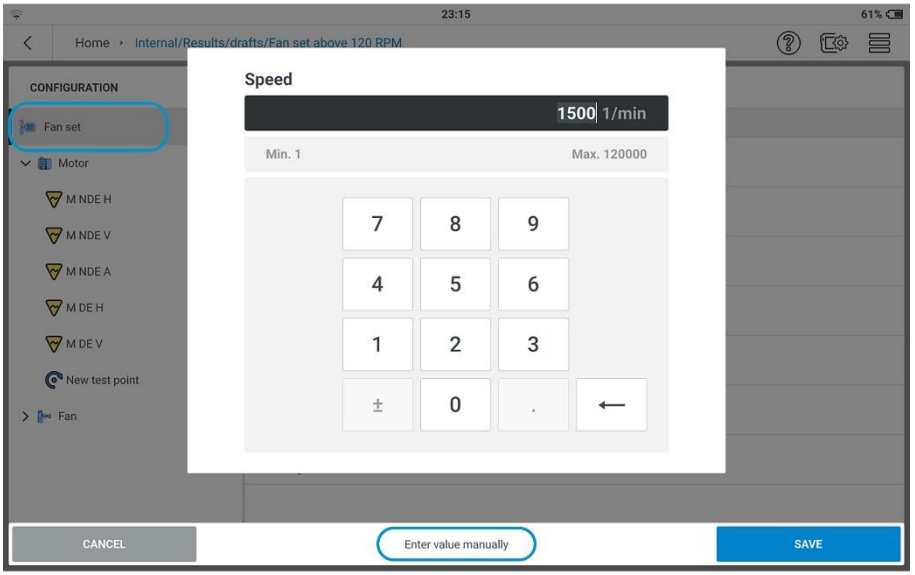
Time waveform is the raw signal used to show informational content of the machine from moment to moment. It is used in low-speed applications, roller bearing damage, gear damage and looseness.

6.4.1.7 Speed

The asset speed can be set via manual entry, speed finder, or the speed reference sensor. The machine and/or asset speed can be measured and/or confirmed with the speed measurement application from the home screen.

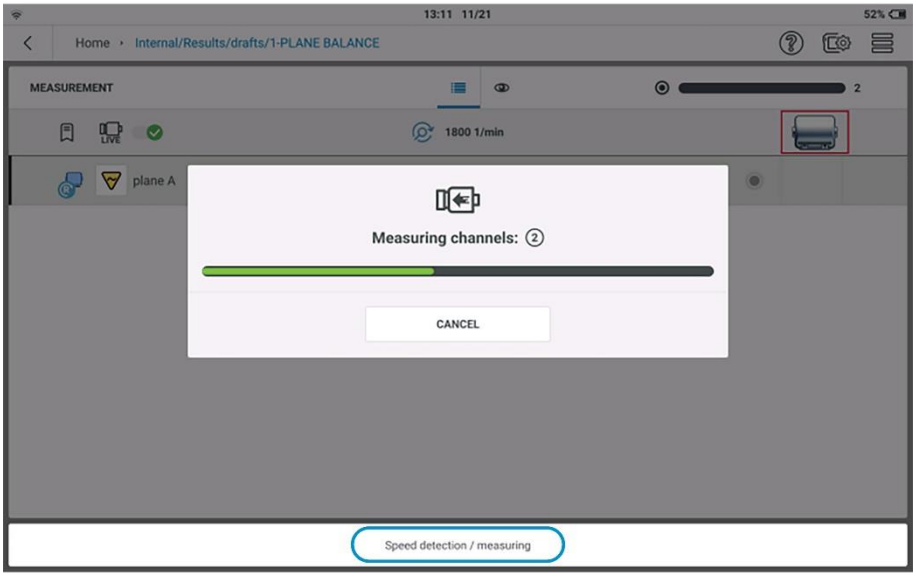
Manual Entry

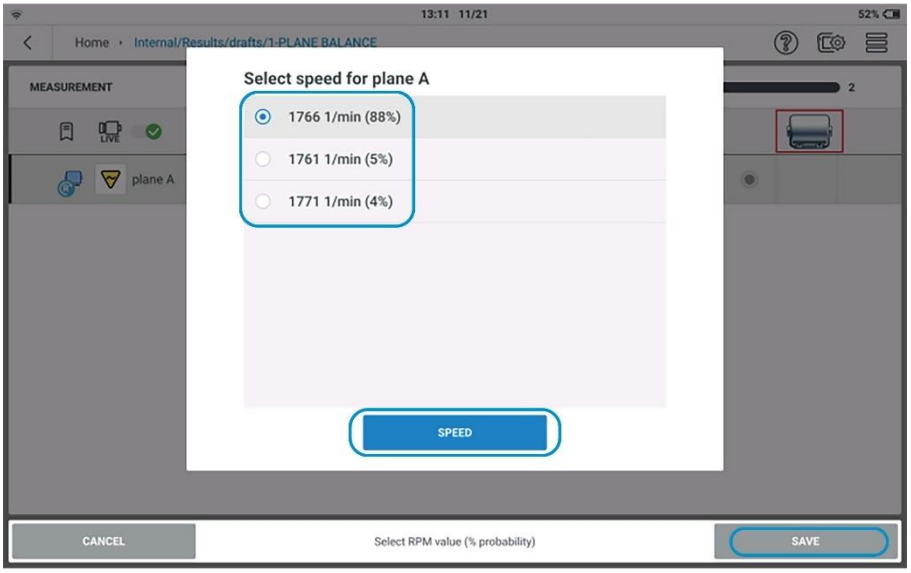
This option is used when an RPM sensor is not available and there is a need to measure an asset that requires the RPM. Examples include roller-bearing conditions and order-based spectra.



Machine Speed Finder

The asset RPM is calculated from the vibration signal at the measurement point. During configuration, the possible asset RPM is entered at the machine train level and speed is set to relative. The speed finder analyzes the vibration signal with regard to the RPM. The RPM values can deviate by up to 15% of the possible value. The measurement point for the speed finder is the reference point for all other measurement locations. The RPM at the other measurement points in a machine train is calculated based on the machine train kinematic model. Start to measure, then select the RPM. Three values calculated from the vibration signal are shown.





- Select the RPM value with the highest probability.
- Tap **SAVE** if the selected RPM value is accurate.

6.4.1.8 Temperature

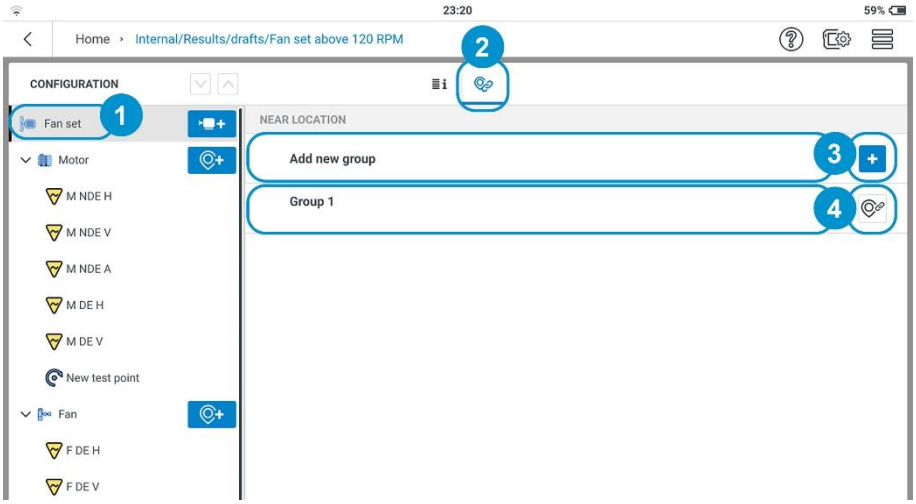
Read the temperature at the measurement location with a separate temperature probe and then enter this value into the SmartBalancer. Select the measurement location tap ***MEASURE*** and enter the temperature using the numeric keyboard.

6.4.2 Near location

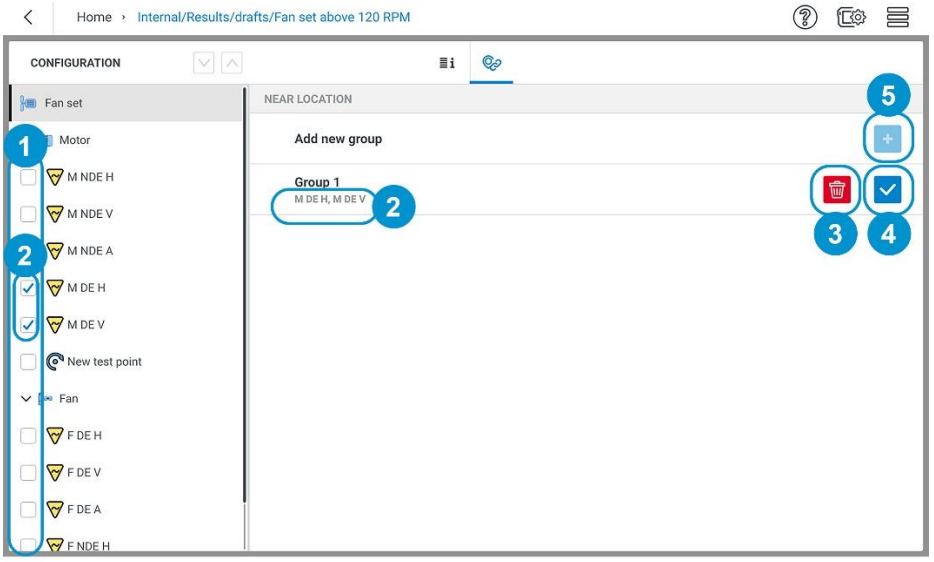
The objective of the near measurement locations or to put together measurement locations is to monitor the measurement locations at the same time. Measurement locations are grouped together and measured simultaneously. This has the advantage that the measured results are comparable as they we obtained under similar environmental and machine conditions. The measurement locations should be close together.

When two or more locations are measured together, it is possible to find the phase difference between the locations. To measure ***Phase***, we need to create near locations.

- Open or create asset to configure.
- Tap the hamburger menu and tap ***Edit***.

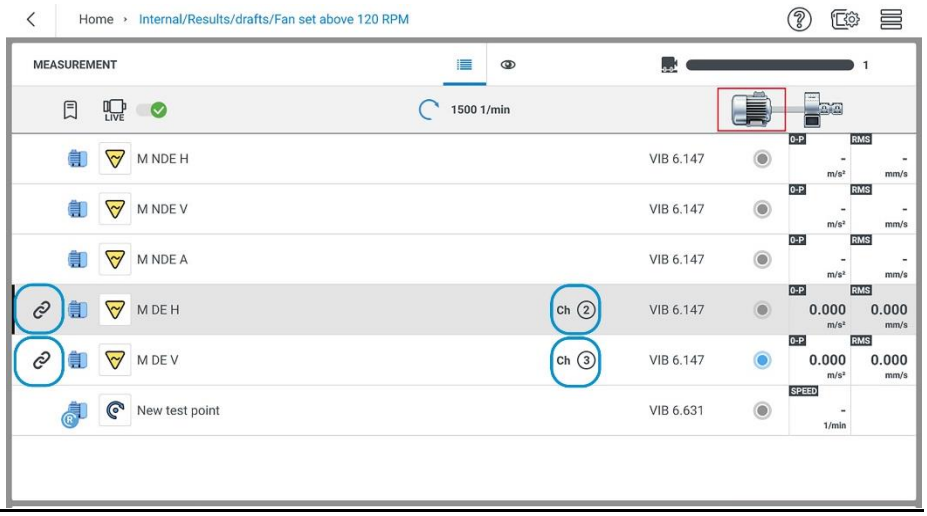


- On the configuration screen tap ***Asset train*** level (1).
- Tap the ***Group*** icon (2) to show ***Add new group.***
- Tap the + (3) to show ***Group 1*** row.
- Tap the ***machine link icon*** (4) to activate all measurement locations.
- The ***Configuration*** screen with all measurement locations active will be shown.



Label	Function
1	Checkboxes are shown on all measurement locations, an indication that all measurement locations are active.
2	Shows the two near locations selected to form a group. In this example – group 1.
3	The trash icon is shown after a near-location group is created. If necessary, Tap the trash icon to delete the group.
4	Tap the check mark icon to confirm the group selection.
5	When the group selection has been confirmed, the ***Add new*** group icon (+) becomes active. Tap the + to add a new near location group if necessary.

- The near location group locations can now be measured at the same time but on different channels. Refer to related topics for information on how to measure ***Phase***.



6.4.3 Phase Measurement

Phase is a measurement of the relative timing between two or more signals. The phase measurement is used in order to detect machine faults where the rotational frequency appears as a peak with elevated amplitude on the spectrum (e.g. unbalances, alignment errors, loose foundation, etc.). The SmartBalancer can measure the phase sonorously (absolute) or the cross channel (coherence) for a relative phase.

Synchronous phase

In synchronous phase, the amplitude and the phase angle of the vibration indicator are calculated from the speed-synchronous components of the vibration signal. An absolute speed point is necessary and a near location must be created to measure the synchronous (absolute) phase. The speed reference sensor is used in this case is a laser sensor.

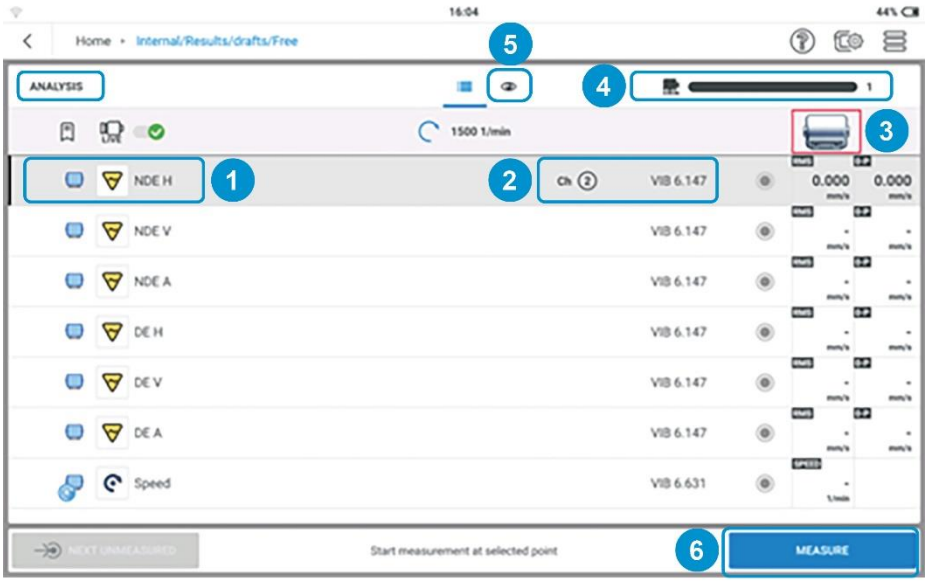
Create a ***Near location*** group to measure the locations simultaneously. (Refer to ***Near location*** section)

Cross channel phase (conference)

In cross channel phase there is no speed point, and multiple channels are used to find the signal amplitudes and the phase difference on the measured channels.

6.4.4 Measurement from a template

- From the home screen open Analysis or the Machine templates list and tap the necessary template.
- Change applications if necessary to be in Analysis mode
- The measurement screen of the selected template is shown.



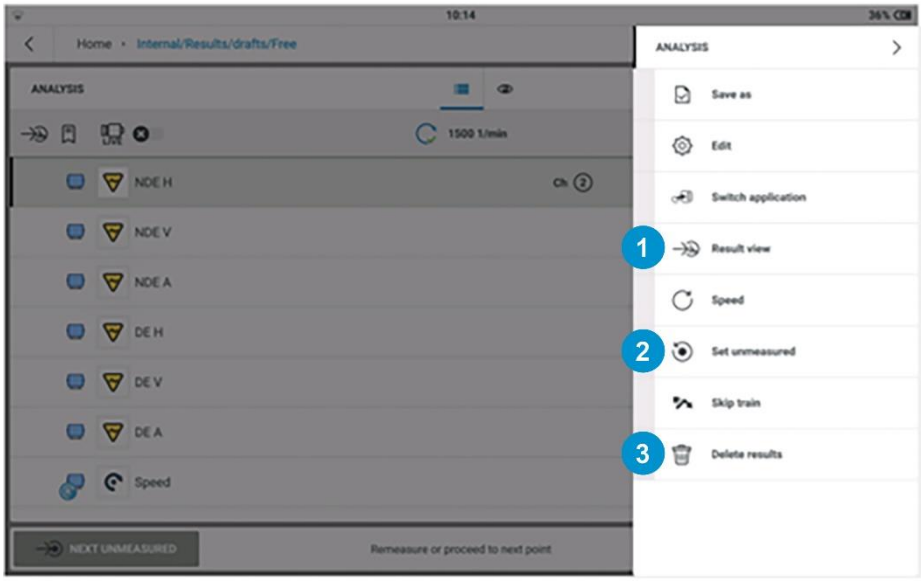
Label	Function
1	Currently selected measurement location.
2	Shows the channel and type of sensor to be used to measure the selected location. The measurement channel and sensor are set in the device settings.

3	Shows the live values. The live vibration and displacement parameters are set when the (eye) is tapped see #5.
4	Tap the progress bar to cycle through a summary of the machine train.
5	Tap the (eye) to show the vibration parameters that can be selected to be shown live on the display. A maximum of two parameters can be shown on the screen.
6	Number of the measurement locations still to be measured on the machine train

- Tap the hamburger menu to see the measurement screen menu items. These menu items are shown when the selected location **HAS NOT BEEN** measured.

Label	Function
1	Used to save the asset results for future use. Tap on the (Pencil) to use the alphanumeric keyboard to edit the name of the asset. Tap ***APPLY CHANGES*** > ***SAVE*** to save the asset in the selected path. Assets saved on the device are located in the file manager.
2	Tap to open the ***Configuration*** screen where the measurement locations can be edited, given measurement tasks, and bandpass values are set.
3	Tap to switch applications from vibration analysis to field balancing or coast down / run up as necessary. With this icon, it is possible to switch from any primary application to another supported application
4	Tap to enter the RPM manually or measure the machine speed with the key phasor.
5	Tap to skip all measurement tasks for the selected location. This symbol  is shown on the skipped measurement location.
6	Tap to skip all measurement tasks for the machine train. This symbol  is shown on the skipped measurement locations on the machine.

When a location **HAS BEEN** measured the following menu items are shown:

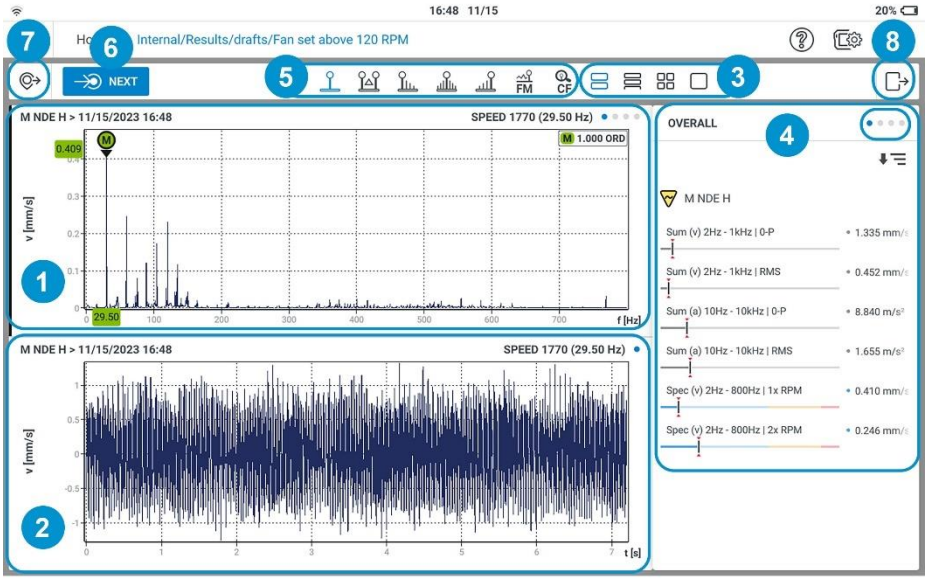


Label	Function
1	Tap to see the results of the selected location.
2	Tap to change the status of the selected location to unmeasured. Then tap ***SET*** to make sure the status changes.
3	Tap to delete the results of the selected location and then tap ***ALL*** or ***LAST***. ***ALL*** deletes all results related to the measurement location. ***LAST*** deletes the results last measured.

- Connect the sensor, cable, and magnet (if required) and mount the sensor to the machine in the position to be measured. Connect the cable to the specified channel on the SmartBalancer 4
- Tap ***MEASURE*** to start measurement. Alternatively, press either of the two device ***ENTER*** buttons.
- After the location has been measured the results can be shown. The option to show the results and hold the results on the screen is set in the ***Results Display*** setting.

6.4.5 Results

After taking a measurement, you can display the following measurement results: overall values, spectrum, and time waveform. The spectrum includes standard spectrum, envelope spectrum, and order-based spectrum. Overall values can be shown in any of the of these vibration amplitude-related parameters: RMS; zero-to-peak (0-P); peak-to-peak (P-P); Crest. These amplitude-related parameters are set under the ***Settings*** menu item ***Results Display***. After a location has been measured, results are shown. Results remain on the screen dependent "Results" above on the ***Results Display*** setting. The shown results are dependent on the measured tasks assigned to the test point. All results are saved on the file. The file is saved in the ***File Manager***.



Label	Function
1	Shows the spectrum for the measurement task assigned to the measurement location. The dots on the top right corner of the spectrum graph shows the number of pages with spectrum and time waveform graphs. Swipe the screen to cycle through the available pages.
2	Shows the time waveform related to the spectrum above.
3	The four icons are used to split the main screen. The split screen is useful when the results for several measurement locations are compared. *(see detail below)*
4	The number of pages that can be shown on this frame are indicated by the number of dots on the right top corner of the frame. The pages are overall values, Max 10, cursors, and frequency markers. Swipe screen to cycle through. *(see detail below)*
5	Cursor family icons
6	Tap **NEXT** to go to the next unmeasured location. If all locations on the machine train have been measured a hint to state completion is shown.
7	Tap to open the ***Measurement Points*** frame. The frame shows all measurement locations on the machine train. To show results of locations already measured for comparison, check the related boxes. *(see detail below)*
8	Tap to close the ***Overall / Max 10 / Cursors / FM Frame*** to enlarge the main screen.

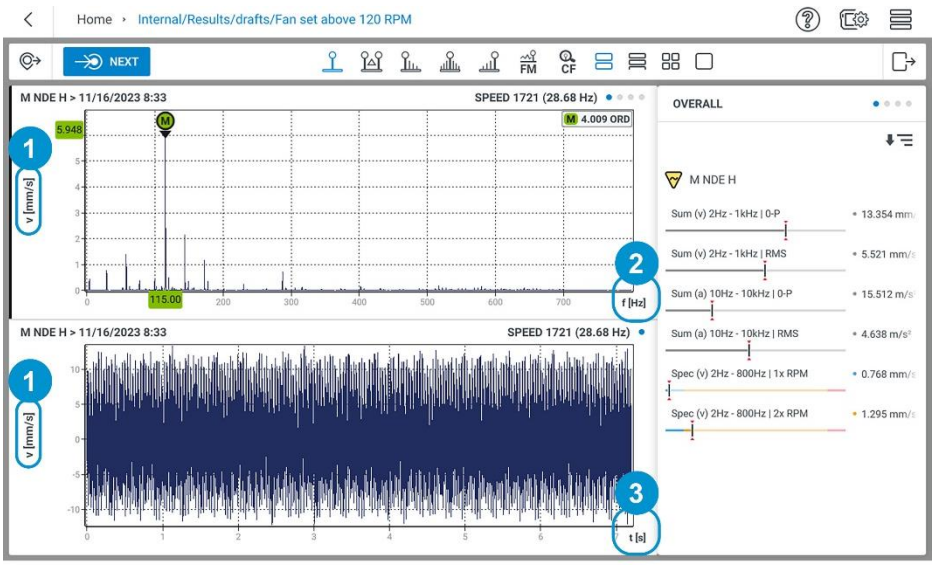
#3 Icons	Function
	Tap to split the main screen into two.
	Tap to split the main screen into three (list view).

	Tap to split the main screen into four (quad view).
	Tap to show the main screen as a single view (full screen mode).

#4 Options	Function
Overall	Shows selected overall values
Max 10	Shows the 10 highest amplitudes in the spectrum and their related frequencies.
Cursors	Used to show the selected value in full digits at the right top corner of the graph.
Frequency Markers	Used to identify the characteristic assets and component frequencies in a spectrum.

The results shown in the SmartBalancer are based on a ***Trending spectrum*** (see ***Trending spectrum*** section).

In results, both the x- and y-axis parameters and/or quantities can be changes as necessary. The y-axis can be made to toggle from a velocity vibration parameter to and acceleration vibration parameter and vice versa. The x-axis can be made to change the x-axis quantity units.



Label	Function
1	Tap the parameter label to toggle the vibration spectrum between velocity and accelerations
2	Tap the quantity unit to change the frequency used in the velocity spectrum. Available units are orders (ORD), cycles per minute (cpm), and Hertz (Hz).
3	Tap the quantity unit to change the time unit used in the timewave form. Available units are seconds (s) and revolutions (Rev).

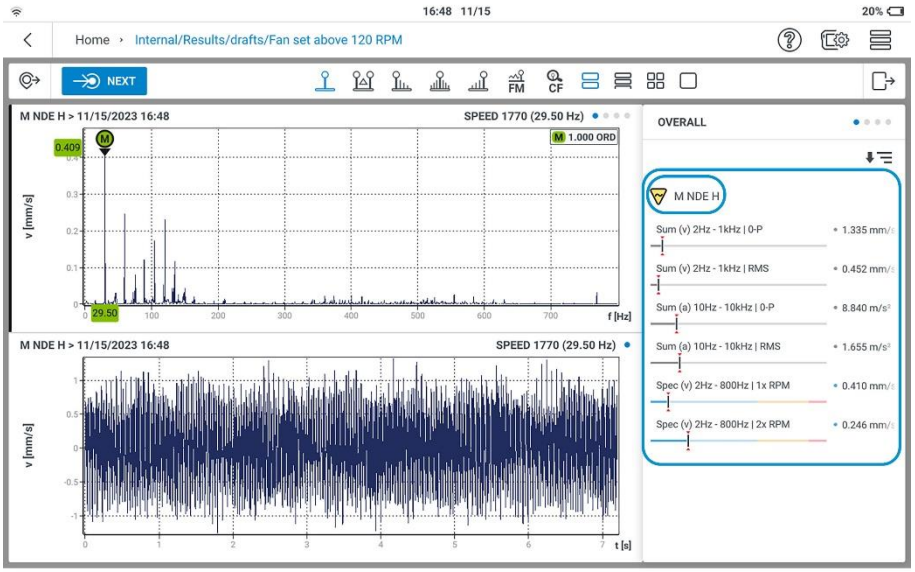
6.4.5.1 Overall Values

Overall values are a simple way to find out whether the condition of machines gets worse or not. The overall values shown for a measure location are related to the overall measure tasks and frequency band for the location.

In the results screen, multiple characteristic values are displayed simultaneously (RMS; zero-to-peak (0-P); peak-to-peak (P-P); Crest). The speed appears if applicable in the upper middle of the screen.

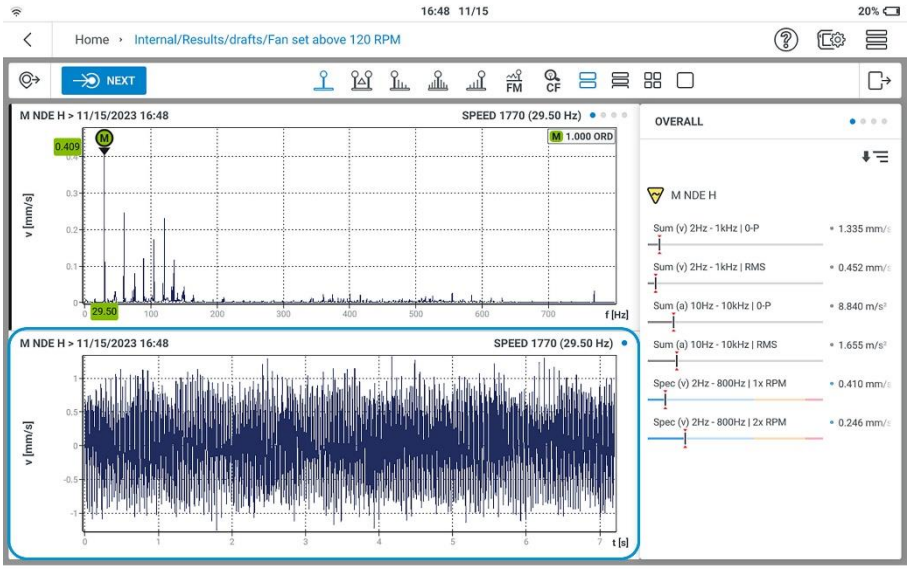
$$0 - P = RMS\sqrt{2}$$

$$P - P = (0 - P) * 2$$



6.4.5.2 Time signal

The measurement result is displayed in the lower left half of the screen. The time waveform is related to the spectrum above. The measurement location, time, date, and speed are all displayed on the graph.



6.4.5.3 Trending Spectrum

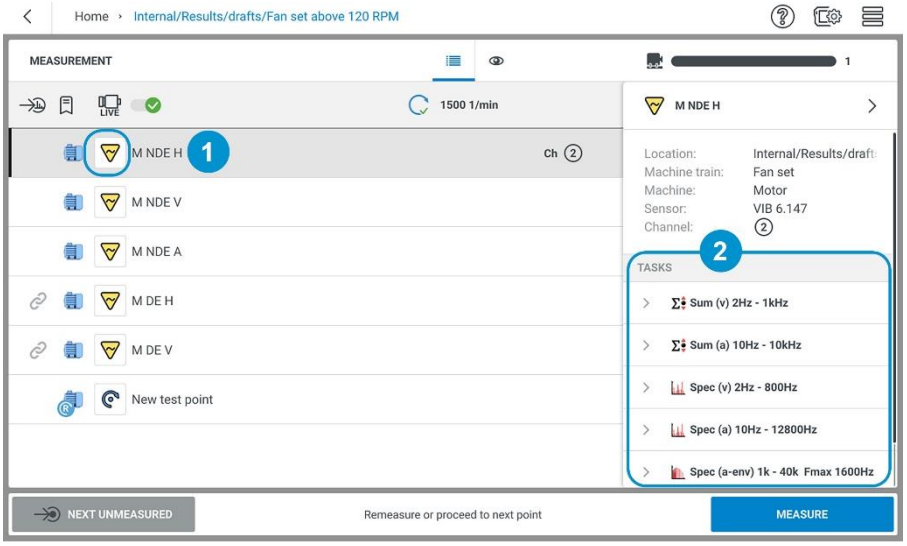
What is a trending spectrum?

A trending spectrum is a mode that measures vibration and delivers the measured signal as a spectrum (standard spectrum, envelope spectrum, or an order-based spectrum), time waveform, and trending parameters. Trending parameters include RMS, 0-Peak, Peak-Peak, Overall values.

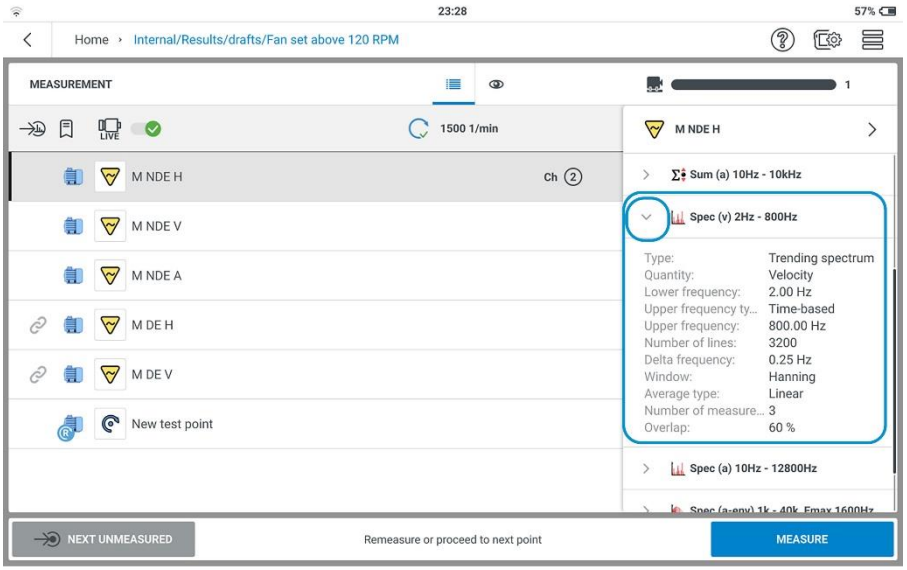
Understanding results

After a location has been measured the results are shown immediately. The results will remain on the display depending on the time options selected under ***Results display*** in settings.

The shown results depend on the applied measurement task. The measurement task can be seen in the measurement screen.

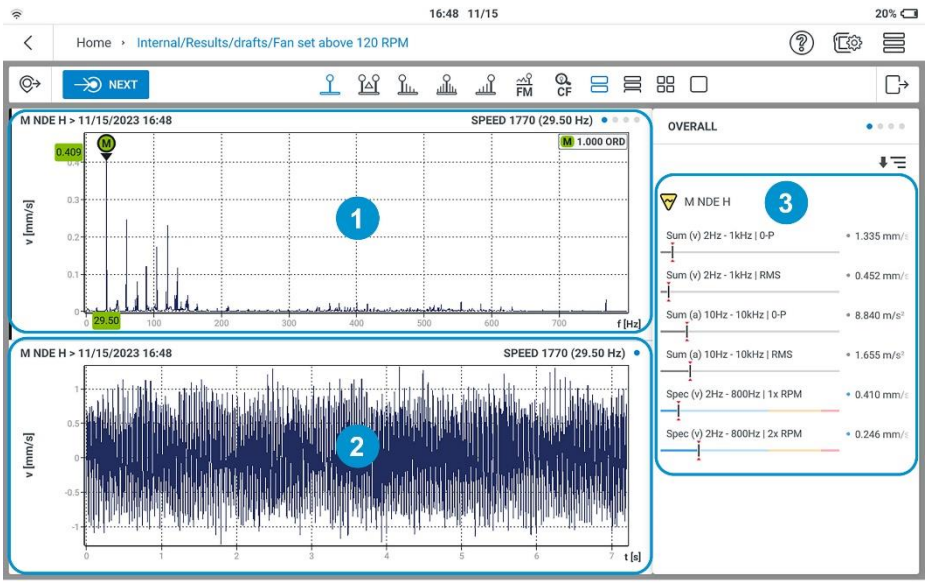


Tap the parameter icon (1) to see the applied measurement task (2) for the selected location.



To see the details of any of the applied measurement tasks, tape the related task drop-down menu.

In the below example, the applied measurement tasks for the location are overall velocity, overall acceleration, Velocity spectrum, Acceleration spectrum, and time waveform (acceleration).



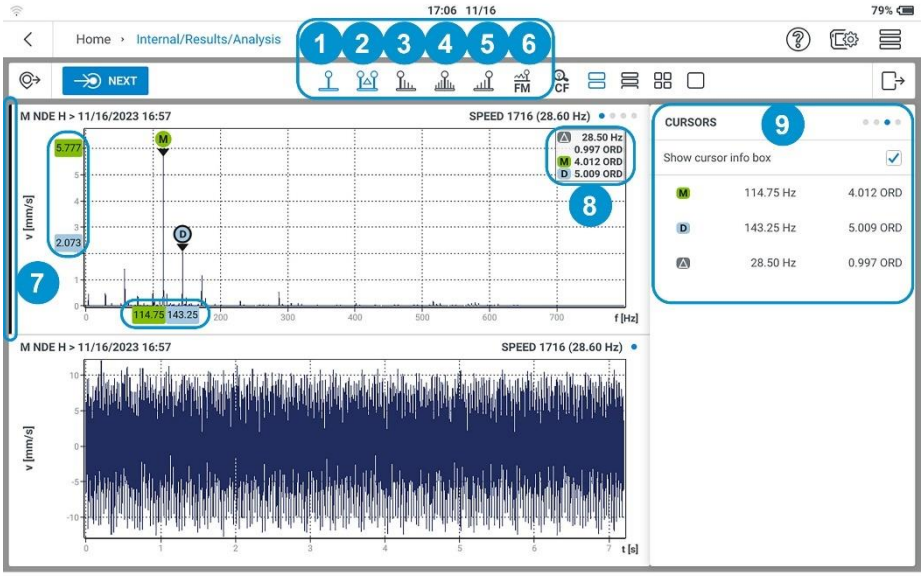
Label	Function
1	The graph shows the velocity spectrum.
2	The graph shows the time waveform signal related to the velocity spectrum.
3	The frame shows overall values. The displayed overall values are based on the selected measurement tasks.

6.4.5.4 Cursor

The cursor functions are used in the results analysis. Cursors are used to evaluated distances in a graph.

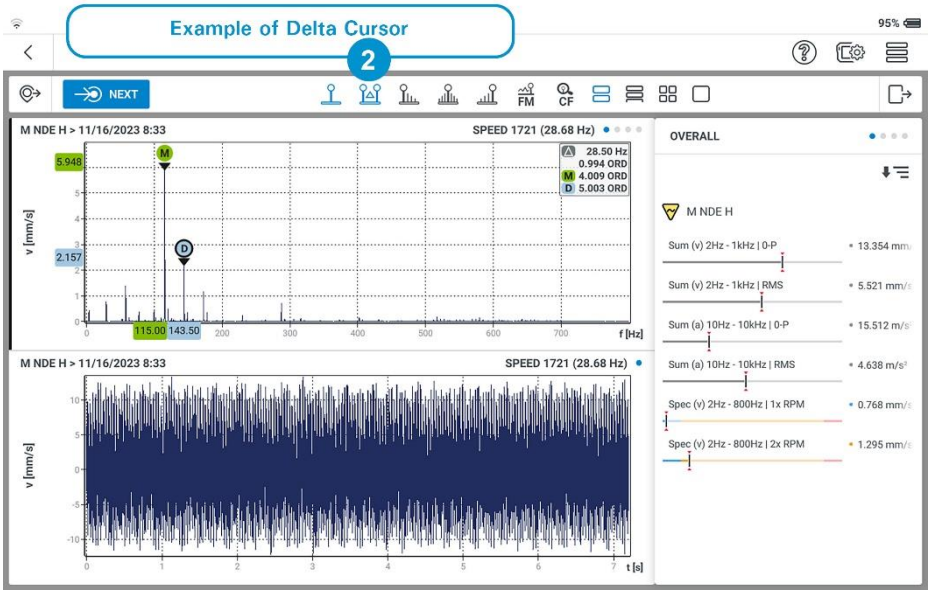
> **Note**: Cursors are only active on the visible sections of the graph. Use the pinch function to zoom in and increase the size of the graph. The cursor function is only active on the visible section of the graph.

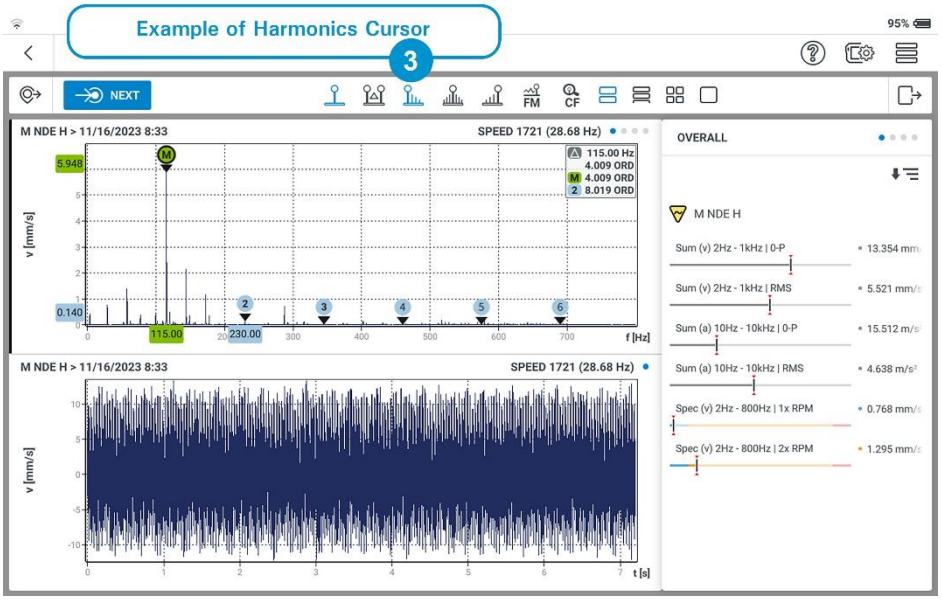
To select a cursor function, tap on the related cursor icon. The selected cursors will highlight blue.

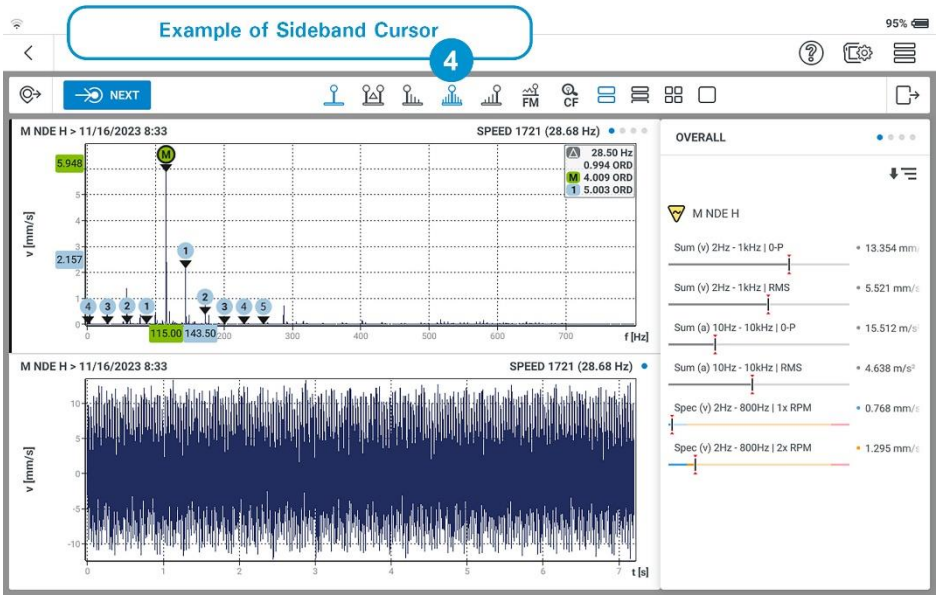


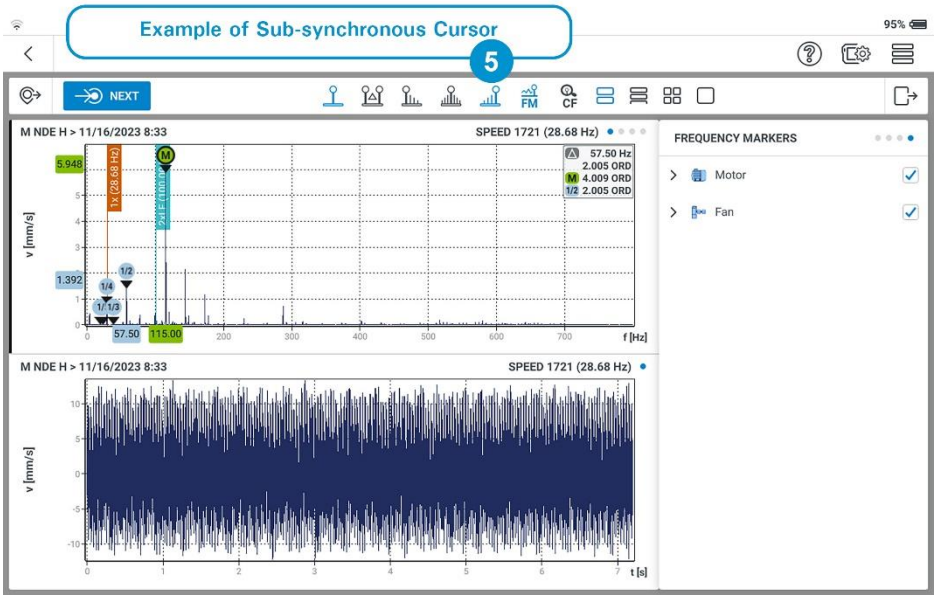
Label	Function
1	The main cursor is label **M** and is used in both the spectrum and time waveform graphs. The main cursor initially moves to the highest measured positive or negative value visible on the graph. To move the cursor, tap the required location on the graph. The cursor moves to the highest point within the required location. The cursor information box (8) shows the frequency at the main cursor in orders.
2	The delta cursor is labeled **D** and is used in both the spectrum and time waveform graphs. The delta cursor always accompanies the main cursor. The delta cursor moves to show the second highest value. The cursor information box (8) shows the difference between the main and the delta cursors. The value shown has the x-axis units. In the spectrum graph, the information box also shows the values for the main and the delta cursors in orders.
3	The harmonics cursors are labeled to a maximum of 6 in the spectrum. The harmonics cursors accompany the main cursor and are equidistant to the main cursor and to each other. The cursor information box (8) shows the difference between the main cursor and the second harmonic. The value shown has the x-axis units. In the spectrum graph, the information box also shows the values for he main and delta cursors in orders.

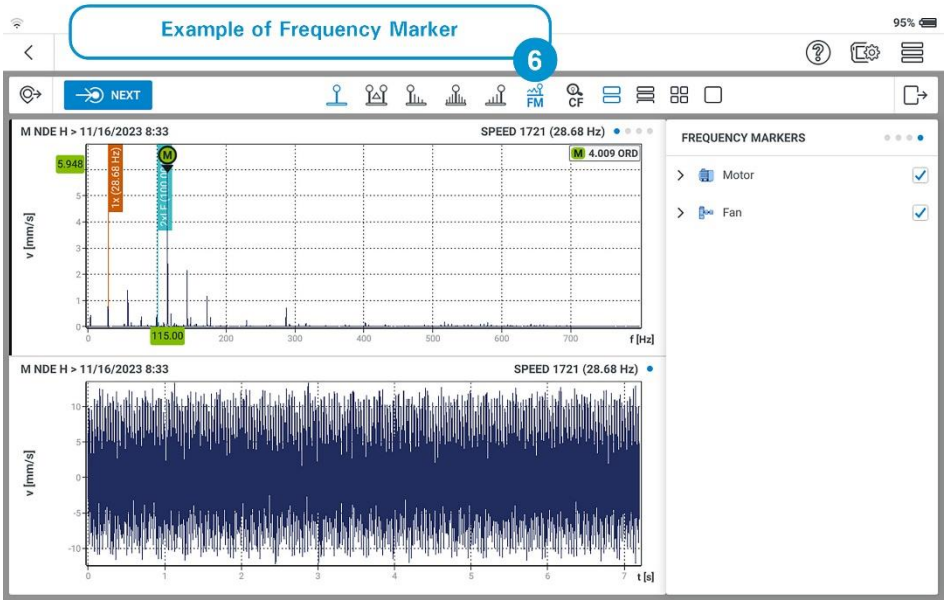
4	The sideband cursors accompany the main cursor and are shown on both sides of the main cursor. In the spectrum, they are labeled to a maximum of 6 on each side of the main cursor. The sideband cursors are equidistant to the main cursor and to each other. The cursor information box (8) shows the difference between the main cursor and the first sideband cursor on the left side of the main cursor. The value shown has the x-axis units. In the spectrum graph, the information box also shows the values for the main cursor and the first sideband cursor on the left of the main cursors in orders.
5	The sub-synchronous cursors accompany the main cursor and are shown at ½, 1/3. ¼, 1/5, and 1/6 of the main cursor frequency. The cursor information box (8) shows the difference between the main cursor and the ½ cursor. The value shown has the x-axis units. In the spectrum graph, the information box also shows the values for the main and ½ cursors in orders.
6	The frequency marker is used to identify the characteristic asses and component frequencies in a spectrum. Frequency markers are related to the used speed. The main cursor shows the frequency at which the asset operates. An additional cursor shows the spectrum at twice line frequency (2x LF). Frequency markers are defined for each hierarchy in the asset. This is done in the kinematic model. Check the necessary hierarchy check box to show the wanted frequency marker.
7	The bold line next to the graph show the currently selected graph. The cursor functions are only active on the selected graph.
8	The cursor information box shows the necessary cursor information.
9	The cursor frame shows both the main and the delta cursor information. This information is available also in the cursor information box (8). The cursor frame also shows information for the currently selected cursor. This could be harmonics, sidebands, or sub-synchronous.











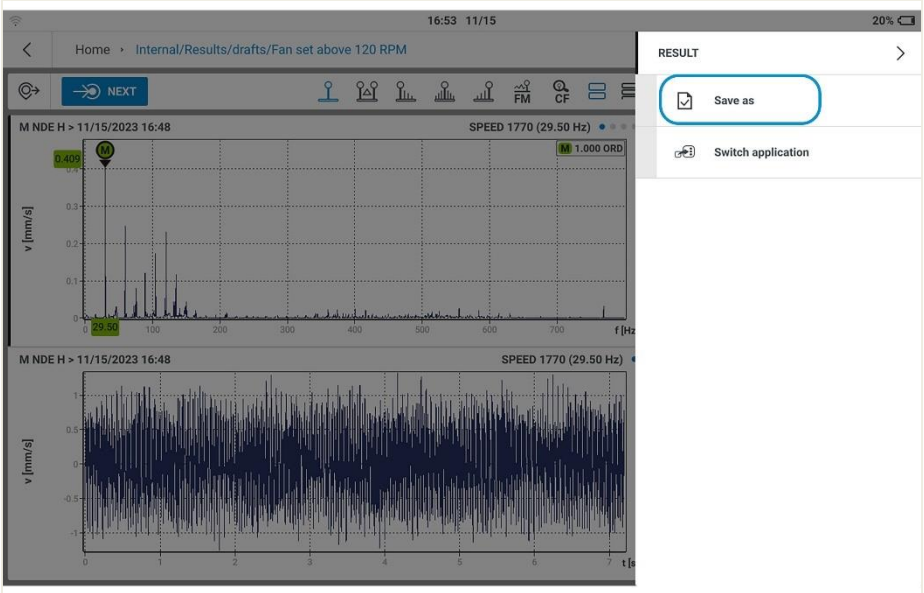
7. Results

7.1 Save results

To save the results against a specific job name in either the balancing or analysis measurements:

- Tap on the hamburger menu.

- Tap ***Save as***
- A default name will appear based on the template name - Tap the ***Name*** and the onscreen keyboard will appear; enter the name you would like the file to be saved as. Tap **APPLY CHANGES.**
- Tap **SAVE -** The results will be saved in the ***File manager.***



Note: All template measurement files that have been used but not saved end up in the drafts folder. This folder is useful if the device runs out of battery power.

7.2 Print Reports

Measured reports can be saved as a PDF for future use and recording purposes on the device. Reports can be created to document the asset vibration and balancing condition as found and after correction if necessary.

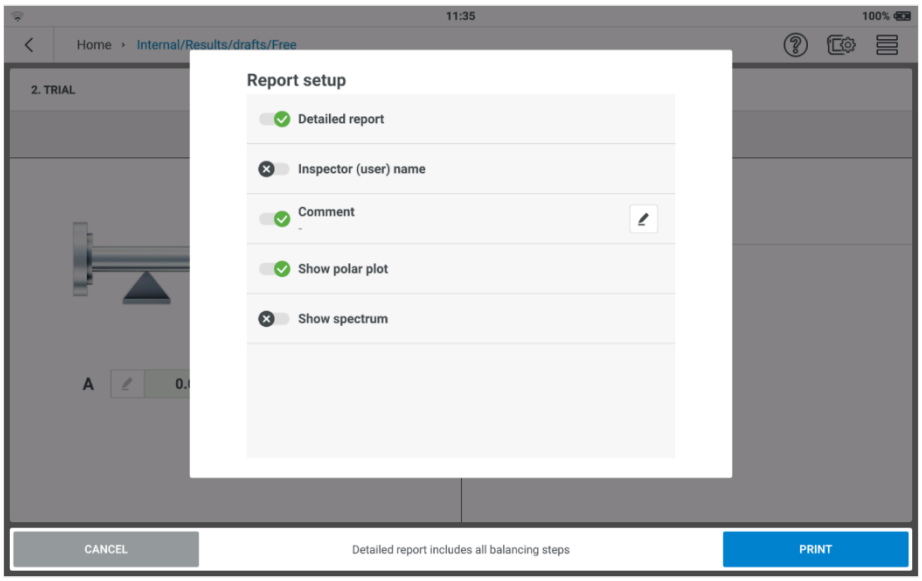
In the machine setup screen (where the balancing weights and the related rotor positions are shown), follow the following steps.

- Tap on the hamburger menu to show the context menu items.

- Tap ***Print*** to show the report setup screen.

- Toggle on or off the items that should appear on the report. Items that can be edited will have the edit icon next to the name.
- Tap **APPLY CHANGES** to confirm entry and tap ***PRINT*** to proceed to create the report.

- Edit the file name as required and then tap ***Save*** to save the report as a PDF in the necessary folder (***Internal/Reports/Balancing***).

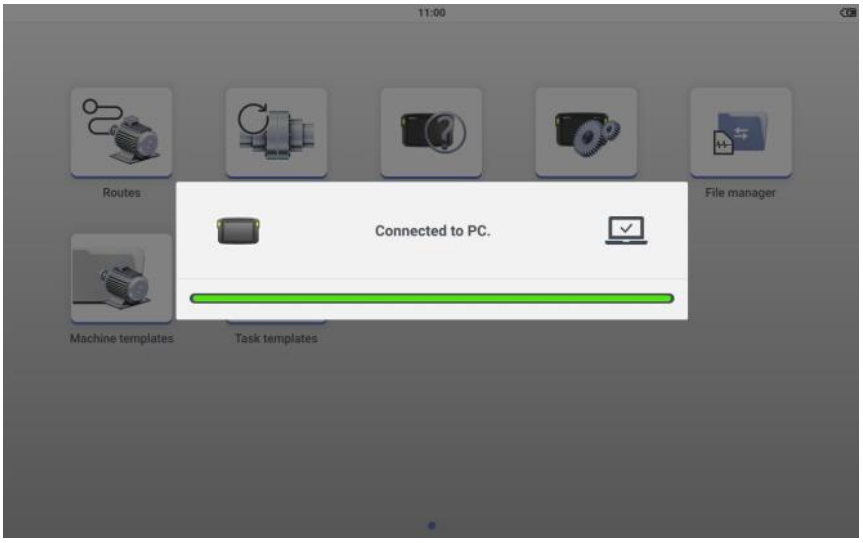


Label	Function
Detailed report	If ***Detailed report*** is toggled on, the report, if created after corrections will include all the balancing steps from the initial run to the trial run with all corrections. If ***Detailed report*** is switched off, the report will include only the initial run and the final correction
Inspector (username)	Inputs name from username field saved under settings
Comment	Add any user input / comments that should be shown on the report
Show polar plot	If toggled on, the report will show polar plot will all balancing steps taken from the initial run to the trial run with all corrections.
Show Spectrum	If toggled on, the report will show the initial run Spectrum and the final correction Spectrum

7.3 Transfer Reports

- Turn on the SmartBalancer 4 and connect the device to the PC. Use the supplied USB-A to USB-C cable.

- Connected to PC should appear on the screen.



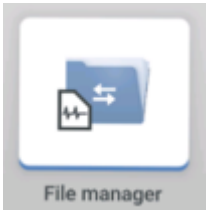
- With the SmartBalancer 4 shown in the File Explorer, double click ***Data*** then ***Measurement Data*** to access the ***reports*** folder.
- Transfer the reports to the necessary location on the PC or to a flash drive for future use.

7.4 Report Logo

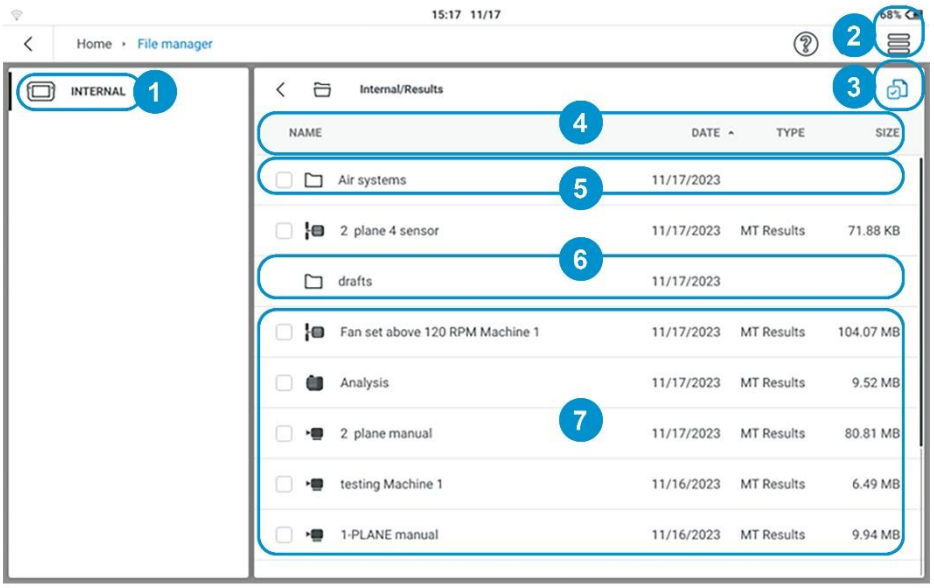
Measured reports are created with the default Schenck logo. If necessary, the default logo can be replaced as follows:

- Rename the replacement logo as ***LOGO.PNG***.
- Turn on the SmartBalancer 4 and connect the device to the PC. Use the supplied USB-A to USB-C cable.
- With the SmartBalancer 4 shown in the File Explorer, double click ***Data*** then ***Measurement Data*** to access the ***Logo*** folder.
- Delete the ***LOGO.PNG*** file in the folder and replace it with the new logo file just created.
- All generated measurement reports will now have the new replacement logo.

8. File Manager

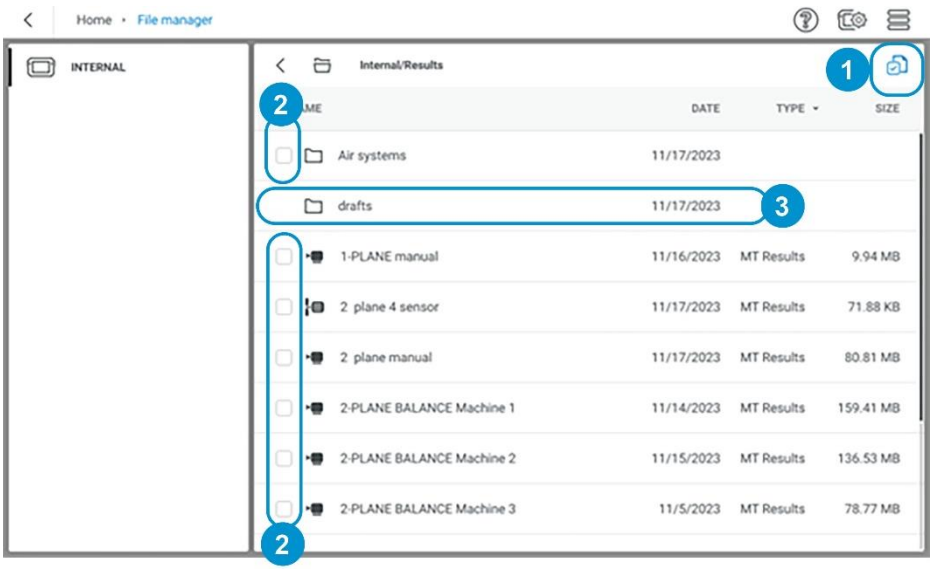


The File manager is used to organize and list the asset results files. The result files come from the machine templates. To access the file manager screen, tap the ***File manager*** icon from the home screen.



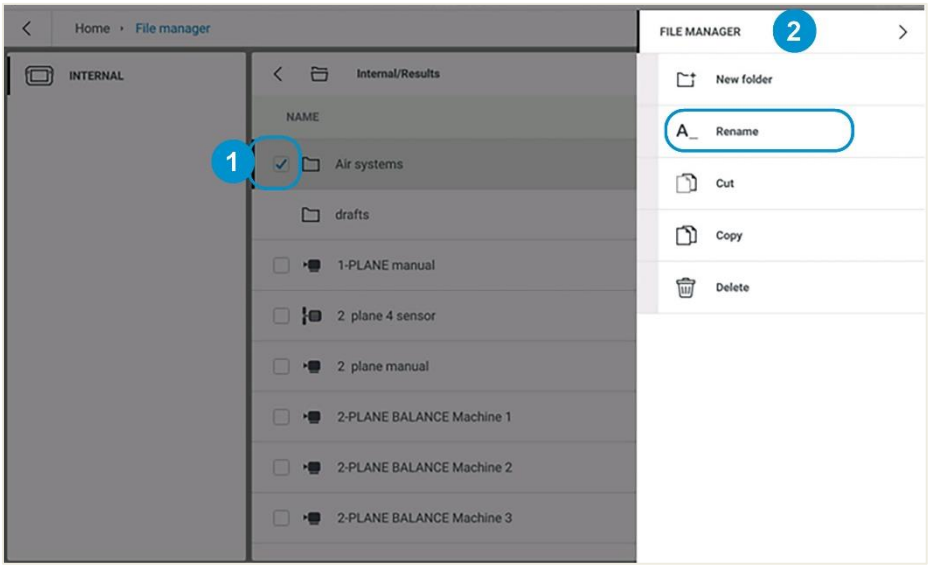
Label	Function
1	Shows the internal file hierarchy with all folders and results files saved on the SmartBalancer.
2	Tap the hamburger menu icon to show the context menu items. If no folder or results file has been selected, the context menu will show only the item ***New folder***.
3	Tap to activate the folders and files check boxes. The icon toggles color between black check boxes (inactive) and blue check boxes (active).
4	Tap any header item to sort the folders and results files by name, date, type, or size. The arrowhead next to the item shows the order in which the folders and the files have been sorted.
5	Shows user-created folders.
6	The drafts folder is a default system folder and cannot be deleted. All template measurement files that have been used but not saved end up in the drafts folder. This folder is useful if the device runs out of battery.
7	Shows user-created measurement template results files.

If the folders and files check box icon is active, then these files and folders can be selected for more steps.



Label	Function
1	Shows check box icon. Tap to activate.
2	Shows folders and the results files check boxes. These appear when the check box icon (1) is active.
3	Shows the drafts folder. This default system folder cannot be checked, thus it cannot be renamed, copied, or deleted. **NOTE**: if the drafts folder is open, the check box icon can be activated, and individual template measurement files deleted.

If the check box icon is active but no folder or file has been checked, the context menu will show only the item ***New folder.*** But if a single box has been checked, the following menu items are shown:



Label	Function
1	Shows user defined folder checked.
2	Shows the context menu items with only one folder or result file checked. **NOTE:** If more than one check box is checked, the context menu item ***Rename*** is not shown.

8.1 Transfer Files Internally

The file manager is also used to transfer result files to different folders.

- From the home screen tap on the ***File Manager*** icon, the folders and results files are then shown.
- Tap and hold the necessary results file a ***context menu*** will appear. Choose either cut or copy.
  - If the necessary results file is in a separate folder tap on that folder to show the file.
- Tap on the folder where the results files are to be transferred and then tap on the hamburger menu to show the context menu.
- Tap paste to transfer the file to the necessary folder.

8.2 Transfer Files to a PC

If necessary, the results files can be transferred between a PC and a SmartBalancer 4. It is also possible to create folders on a PC that can be transferred to the file manager.

- Turn on the SmartBalancer 4 and connect the device to the PC. Use the supplied USB-A to USB-C cable.
- Select SMARTBALANCER 4 > Data> Measurement Data > Results and navigate to ***Results folder***.
- If necessary, create a new folder. This folder will be transferred to the SmartBalancer 4.
- Results files can be moved to other folders on the PC. If necessary, these files can be transferred to another SmartBalancer 4.

Note: DO NOT move files between folders on the device as they will be corrupted. DO NOT rename results files as this action will corrupt the files.

9. Appendix

9.1 Technical instructions

The SmartBalancer is a precision instrument and should be handled as such.

Storage

Use the provided case to transport the system and the related components. If the system is not used for an extended period, the system components must be stored in a cool, dry, and well-ventilated location. Connect SmartBalancer regularly to the power supply to avoid complete discharge of the rechargeable battery. Observe the storage temperature specified in the technical data. Ensure that:

- The storage location is dry.
- The measuring device is not stored in the immediate vicinity of electronic devices which can generate strong electromagnetic fields.
- The air humidity at the storage location does not exceed 90%.

Care

SmartBalancer and the related system components must be kept clean. Wipe the device housing with a soft cloth dampened with a mild detergent. Do not use abrasives or solvents. Use a soft lint-free dry cloth to clean the display.

Never use thinners, spirit, isopropanol, or other aggressive cleaning agents.!.

Maintenance

SmartBalancer is essentially maintenance free, but these points are to be observed:

- The manufacture recommends that the measurement accuracy be checked a minimum of every 2 years. The date for the check is indicated by a label affixed to the back of the device.
- Please return the device to an approved technical site for inspection by the indicated date. Make sure to back up data before you send the device to be inspected or repaired.

Guarantee

The measurement device is guaranteed for 1 year. The guarantee is invalidated if service work is carried out by unauthorized persons.

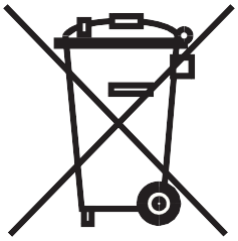
Spare parts, accessories

Only original spare parts and accessories must be used. Information on this point can be found in the SmartBalancer product catalogue.

Disposal

Dispose of old SmartBalancer devices in a professional and environmentally sound manner. Delete personal data on the product before disposal and remove batteries that are on integrated into the electrical system before disposal. Dispose of batteries separately.

In countries of the European Union in which the EU Directive 2002/96/EG "Waste Electrical and Electronic Equipment" (WEEE) has already been implemented in national law, the following regulations apply:



- SCHENCK products which come under this Directive are labelled with the symbol shown at the left.
- The return and proper disposal of electrical and electronic devices after use is carried out by the manufacturer.
- WEEE-Reg.-No. DE41252901

This means for you as the end-customer:

- All electrical and electronic SCHENCK products, and electrical and electronic accessories (e.g. cables, sensors, etc.) must be disposed of through SCHENCK or its appointed disposal partner. This product must under no circumstances be allowed to be get into private domestic or municipal waste.
- Information on the relevant disposal partner is available:
  - from your SCHENCK sales outlet
  - from your SCHENCK authorized dealer
  - on the SCHENCK homepage

The battery must be completely discharged when sending in for disposal.

9.2 Technical data

Parameter	Details
Measure channels	
Number	6 synchronous analog channels 2 trigger points
Channels 1-6	Frequency range:0 to 50 kHz Voltage: -20 to + 20 V Input impedance: 70 KΩ IEPE Line drive
Connectors	1 and 4: Single axis sensor and VIBCODE 2,3,5, & 6: single axis sensor
Dynamic range	108dB (total)
Sampling rate	Up to 131 kHz per channel (Trigger 1 MHz)
Signal Processing	6 x 24 bit ADCs (Trigger 2 x 14 bit)
Measure range / accuracy	Vibration acceleration: dependent on sensor Shock pulse: -10dBsv to 80 dBsv +/- 2 dBsv
Speed (RPM)	120 to 80,000 rpm +/- 0.1% or +/1 1 cpm
Fulfilled standard	DIN ISO 2954:2012 (2-1 kHz, 10 Hz – 1 kHz, 10-10 KHz)
Display	
Type	Capacitive touchscreen Optically bonded for high contract and increased shock resistance
Active area	220 x 137 mm (7 7/8” x 5 25/64”) 1280 x 800 pixels
Size	256 mm (10 5/64”)
Color depth	16.7 million colors
Viewing angle	<150º
Operation	Muti-touch, gestured controlled Glove compatible
Illumination	Backlit, adjustable
Ambient light sensor	Yes

Parameter	Details
Power supply	
Battery Type	Lithium-Ion rechargeable battery
Nominal voltage	7.2 V
Energy density	72 Wh
Charge time (typical)	6.5 hrs (0 to 100% @ 25°C / 77°F) 3.5 hrs (0 to 80% @ 25°C / 77°F)
Charge temperature	10°C to 40 °C (50°F to 104 °F)
Operation time (typical)	8 hours (based on brightness at 50%, sensor measures in preview mode)
Charger	100-240V ~, 50-60Hz (input) 12 V 3 A (output)
Energy saving mode	Yes
Computer	
Processor	ARM Quadcore 1.6 Ghz
Operating elements	Multi-touchscreen, ON/OFF button, 2 ENTER buttons
Memory	microSD card, 256 GB for measured data, permanently installed 4 GB RAM
USB	1 x USB 2.0, device interface
LED	1 x RGB LED (Display for battery and charge statuses)
Environment / General	
Connections	Charge socket for charger USB type C port for data cable 2 x plug-in connector (8-pole) for signal cable 4 x plug-in connector (3-pole) for signal cable 2 x plug-in connector (4-pole) for trigger
Housing	2-component housing: Premold – PC (LEXAN), black Overmold – TPE (thermolast), black
Dimensions	Approximately 326 x 210 x 56 mm (12 53/64” x 8 17/64” x 2 13/64”) [L x W x H]

Parameter	Details
Weight	Approximately 2.2 kg (4.85 lbs)
IP Rating	IP 65, dust-proof and spray water-protected
Temperature range	Operation: -10°C to +50 °C (14°F to +122 °F) Storage: -20°C to +60 °C (-4°F to +140 °F)
Humidity	0% to 90%, non-condensing
Certification	CE, RoHS, UK CA
	Output Channels (Trigger 1 and 2)
Frequency range	0.1 to 1000 Hz
Resolution	0.05 Hz
Frequency range	10 Hz to 20 kHz

9.3 Balancing quality stages and groups of rigid rotors

Overview of the quality classes to DIN ISO 1940; this can be used to set the balancing quality in the machine setup.

Quality level	Examples of rotors or machines
630	Crank assemblies of rigid-mounted four-stroke engines and elastic-mounted ships' diesel engines
250	Crank assemblies of rigid-mounted, fast-running 4-cylinder diesel engines
100	Crank assemblies of rigid-mounted, fast-running diesel engines with six and more cylinders
40	Vehicle wheels, rims, wheel sets, propeller shafts, crank assemblies of elastic-mounted fast-running 4-cylinder engines with six and more cylinders
16	Crank assembly individual components of car, truck and locomotive engines, crank assemblies of engines with six and more cylinders with special requirements
6,3	Fans, flywheels, circulating pumps, engineering and tooling components
2,5	Impellers of jet engines, gas and steam turbines, turbo-blowers and generators
1	Magnetophone and phono-drives Grinding machine drives
0,4	Fine grinding machine armatures, shafts and discs, centrifuges

9.4 Messages during balancing

Remove balancing weight?

After every balancing run, the balancing weight can be left on the rotor or removed. Answer this inquiry with KEEP or REMOVE.

Measurement stopped due to missing speed information!

No signal is being received from the speed sensor. Possible causes: Signal path interrupted, unfavorable lighting conditions, incorrect orientation of the reference pick-up optic to the reference mark.

The speed fluctuations are too great or deviate too much from the speed measured in the preceding balancing run. Wait until the machine has reached the balancing speed before starting the measurement