Ultrasound Solutions

Ultrasound Solutions

VIGILANT
Powered by SDT

USER MANUAL

Version 3 – 2021

Table of contents

1 Introduction

1.1 Note to customer

This manual contains information about how to install and use your *Vigilant* unit. We recommend carefully reading and understanding this manual before using the device.

Following the instructions will help you reduce damages or malfunctions of the system, avoiding downtime and maintenance costs. We recommend keeping a copy of this manual available for consultation at all locations that you might need, and in a readable condition.

When using this product, it is necessary to be knowledgeable about the information in this manual and any instrumentation connected to it. Also, it requires general safety information, in addition to the safety information provided in this manual.

Depending on the options purchased with the equipment *some of the functions described in this User Manual might not be available to you*.

If the *Vigilant* module combines with other instrumentation and then resold or transferred as part of assembly, be sure that following manual gives to the end user.

When disposing of a product, follow the local laws and regulations.

In no event will **Vigilant** be responsible for errors, omissions or inconsistencies that may contain in this manual, nor for indirect and consequential damages either, including any lost profits or savings resulting from the use or application of this equipment.

Information in this document is subject to change without notice. It does not represent a commitment on part of **Vigilant**. The information in this document is not all-inclusive and cannot cover all unique situations.

The examples and diagrams in this manual are included solely for illustrative purposes. **Vigilant** cannot assume responsibility or liability for actual use based on the examples and diagrams due to the many variables and requirements associated with any installation.

1.2 Symbols used

The following symbols and paragraph styles indicate information of special interest:

This label identifies information intended to draw attention to potential sources of danger for personnel, environment, system or machinery.

This label identifies information that provides essential advice to follow to understand and apply the product.

3 Standards

Vigilant has been designed and tested to meet the following directives and standards.

3.1 CE Compliance

This product meets the essential requirements of the applicable European Directives as follows:

- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)
- 2011/65/EU; ROHS-2

3.2 EMC

The product is tested to meet the Electromagnetic Compatibility (EMC) EU Directive, by applying the following standards:

- *EN 61000-6-1:2007 EMC.* Immunity standard for residential, commercial, and light-industrial environments.
- *EN 61000-6-3:2007/A1:2012 EMC.* Emission standard for residential, commercial, and light-industrial environments

3.3 Electrical security

The product has been designed and tested to meet the following electrical security standards:

- *UNE-EN 60950:2007.* Information Technology Equipment Safety Standard

3.4 Restriction of Hazardous Substances Directive (RoHS)

All the components, subassemblies and supplies used to manufacture the product complies with the European Union *2011/65/EU* directive on the restriction on using dangerous substances in manufacturing electronic and electrical appliances (RoHS-2).

3.5 EU Waste Electrical and Electronic Equipment (WEEE) Directive

In August of 2005, the European Union (EU) implemented the EU WEEE Directive *2002/96/EC* and later the WEEE Recast Directive *2012/19/EU* requiring Producers of electronic and electrical equipment (EEE) to manage and finance the collection, reuse, recycling and to appropriately treat WEEE that the Producer places on the EU market after August 13, 2005. This Directive aims to minimize the volume of electrical and electronic waste disposal and to encourage reuse and recycling at the end of life.

If you have purchased **SDT** branded electrical or electronic products in the EU and intended to discard these products at the end of their useful life, please do not dispose of them with your other household or municipal waste. **SDT** has labeled its branded electronic products with the WEEE Symbol (figure) to alert our customers that products bearing this label should not be disposed of in a landfill or with municipal or household waste in the EU.

Instead, please be aware that **SDT** makes a return and collection system available to you, free of transportation and reuse and/or recycling costs.

4 Safety information

4.1 General

The **Vigilant** monitoring system is designed to meet the safety regulations. However, its safety can be at risk if the equipment is installed or used by unqualified staff, used improperly, or not inspected and maintained.

Installation, operation, and maintenance of the system should only be undertaken by specialist personnel and following the safety and accident prevention regulations.

Repairs of the system should only be undertaken by **SDT**, or by personnel authorized by **SDT.**

It must be ensured during operation, installation, or maintenance that all safety instructions have been followed, along with all safety regulations that might apply.

4.2 Installation and wiring

Before starting the installation, work read the instructions delivered with the equipment. Stop the installation work if you have any doubt and contact your distributor or **SDT** for assistance.

Be sure that main power is off and will stay off until the installation work ends. Check that the equipment is voltage-free by using a voltage tester. You should always install the equipment isolated from the power supply or any electrical power source.

Inspect all components to be installed. Check they are all in good condition and do not present any damage. Reject components that contribute any damage.

Check that all materials to be installed are compliance with EU directives or international regulation concerning electrical safety.

Foreign materials, like protective material used for transportation, dirt, or any other pollutant, must be removed before installing the equipment.

Choose installation tools that are safe and suitable for the working environment.

Check all components have been professionally installed and connected. Wiring should follow these requirements:

- Use 17 to 22 AWG copper conductors (AWG 20 recommended) for wiring the equipment. For a ground terminal an AWG 17 size conductor is suggested.
- Use a minimum size of AWG 17 for grounding the DIN rail.
- Solid or stranded conductors are allowed.
- Ensure all cables and terminals are in proper condition and do not show any visual defect.
- Cables should not be twisted or allowed to run over sharp edges.

- Make sure that cables are arranged so do not disturb or have any effect on control functions.
- Wire end ferrules must be used for stranded conductors.
- Soldering the conductor is forbidden.

4.3 Environment and enclosure

The *Vigilant* modules supplies as “open type” devices, meaning it should be installed in an enclosure suitable for the environment conditions present and prevent any damage to personnel.

See NEMA or IEC standards for further information about the degree of protection provided by the different types of enclosures.

The equipment is intended for use in Pollution Degree 2 Industrial environment, in overvoltage Category II applications, at altitudes up to 2000 meters.

See Specifications for environment specifications applied for the equipment.

4.4 ATEX

The equipment has not been designed to be installed in potentially explosive atmospheres.

When using the equipment in potentially explosive atmospheres it must be installed following and complying with the national and international regulations. Final user should be responsible to ensure the safety of the system when installing the equipment in this type of environment.

4.5 Power supply and grounding

Power requirements for the equipment are given at the Specifications. Be sure that the installation meets those specifications before powering the device.

Failure to meet the power specifications may result in a risk for personnel or damage to the equipment.

Make sure, before powering the equipment that no pending wiring work is present that might be a risk for personnel or the installation.

Before installing the equipment, calculate the total power required for all the *Vigilant* modules in the cabinet. Refer to the specifications for the requirements that must comply with the power supply.

Grounding ensures safe electrical circumstances and helps avoid potential electromagnetic interferences and noise. Make sure ground has been connected correctly and securely, in compliance with current regulations, before switching on the equipment.

The equipment must connect to ground using the screw terminal marked with the earth IEC symbol and provided in one of the connectors. Make sure that the protective earth conductor is connected correctly to that ground terminal. Additionally, the equipment makes a chassis ground connection through the DIN rail, which in turn must relate to the ground.

Make sure to use DIN rail with good conductive properties. It is recommended to use steel DIN rails. Do not use DIN rails made of plastic or poor conductor materials. Ensure the DIN rail is not oxidized or corroded or presents any other defects resulting from improper chassis grounding.

For metallic enclosures it is a highly recommended enclosure that is connected to ground to avoid potential EMI or noise interferences going into the equipment.

Failure to ensure a correct ground connection may result in an electrical risk and cause the equipment to work in an unfavorable operating condition.

See Electrical installation for the wiring details about how to connect the power supply and grounding on the equipment.

4.6 Batteries and battery charging

The *Vigilant* has a rechargeable internal lithium-polymer battery as its auxiliary power supply. The integrated battery recharges automatically when the device is connected to the main DC power adaptor. The equipment battery is assembled inside, under a cap located in the back of the instrument and closed by screws. See chapter dedicated to Replacement of internal components to read more about the battery and its possible replacement.

The system has been designed for a specific battery model, which also includes an integrated electrical protection system. In no event should the battery be replaced with a different model.

Access to the battery for replacement, if necessary, must be carried out by personnel authorized by the product manufacturer or distributor.

4.7 Transport and storage

Transportation and storage of the equipment must only be done using the original packing provided on its delivery. Be sure the packing is in good condition and does not present significant damages.

Protect the equipment against humidity during its transportation and storage, even when using the original packing.

Do not use the equipment if it presents damage after transportation or storage due to improper or careless handling.

Please place it in a location free from direct sunlight, high temperature or humidity, or the corrosive environment when storing the equipment. See Specifications for the specific environment conditions for the transportation and storage.

5 System Description

5.1 Introduction

Vigilant Online Machinery Supervisor is a state-of-the-art monitoring system whose purpose is to provide users with the measurements required for assessing the condition of the machinery or equipment being monitored.

Vigilant is a smart solution for protection, **condition monitoring** and failure mode identification of critical machinery. It can work as a standalone system, it does not require a permanent connection to a computer or software, while still measuring and protecting the equipment, storing data or even communicating scalar measurements to other systems via Modbus-TCP protocol.

It accepts both static and dynamic signals from most kinds of sensors typically used for condition-based monitoring: vibration, temperature, ultrasound, thermal images, video, speed, motor current, oil condition parameters, load, process, etc.

Vigilant is a small size and low consumption hardware device. It integrates a web server that provides an interface for users through a web browser, without installing any software. With that web interface the user can configure and access all data being measured in the unit, along with all the types of graphs required for its visualization and analysis (trends, spectrum, waveform, parameter tables, etc.). It also provides data storage with enough capacity for enabling monitoring of extended periods. The advantages of this new technology are:

- It eliminates the need for a local server, and therefore its maintenance is also eliminated.
- It can be connected directly to the Internet, so the measurements can be accessed from any part of the world using a computer or device connected to the Internet and a web browser.
- It is not required to pay for software licenses to access the data.
- Access is not limited to several computers or devices.
- Obsolescence is avoided by applying automatic updates.
- It is very intuitive, accelerating the learning curve and allowing users to access all the start functionality.
- Reduce the initial investment by simplifying the monitoring system.
- The system includes 8 analog inputs with simultaneous high-frequency sampling. V8-L version adds 4 additional low-frequency sampling analog inputs.
- *Vigilant* also includes bidirectional communication via Modbus-TCP protocol for its integration with external systems.

6 Design

6.1 External appearance

In the front and back sides of the *Vigilant* several pluggable terminal blocks allow connecting wires both for sensor signals and power supply. All these terminals are to be connected only to SELV-LPS (safety low-voltage) lines.

Vigilant also has an RJ45 jack port on the left part of the case's front for Ethernet communications (100Base-TX). The Ethernet port is to be connected only to indoor routed networks.

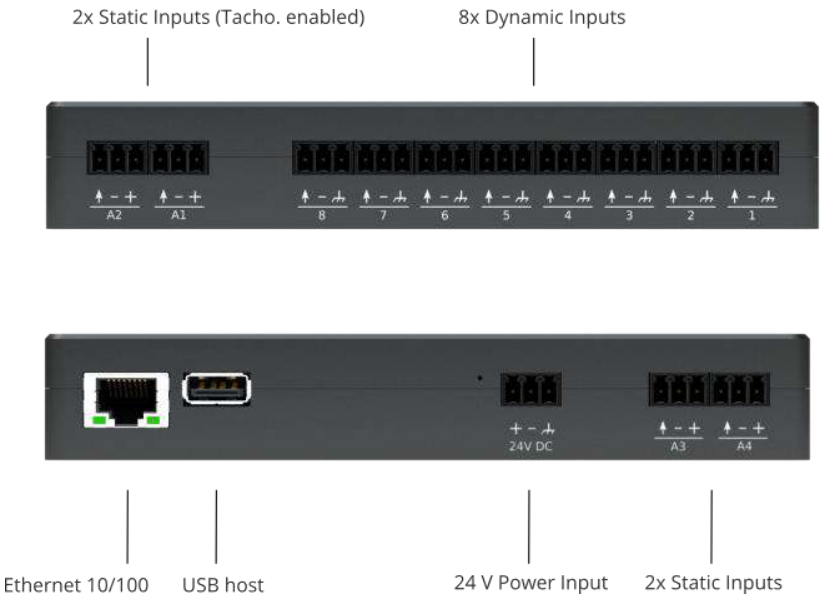
Next to the RJ45 port, a USB connector (A-type) plugs a slave device. This port is not implemented yet and cannot be used.

On the top of the instrument, several LED indicators give information about the device's state and the signals being read.

The following chapters contain some images with more detailed information about the *Vigilant* and its hardware.

6.2 Standard model

The Permanent or -P version of the *Vigilant* has 8 main inputs (high-speed) and 4 additional auxiliary inputs, for static analog sensors or tachometers.



6.3 Indicators

The following table describes the light indications (LEDs) available in the system:

LED	Color status	Description
Status	White	Entering power-up or power-down stage.
	Blinking blue	Unit starting or shutting down in normal mode
	Blinking red	Unit starting or shutting down in rescue mode

	Solid blue	Unit is on and ready. Power supply is ok.
	Solid red	Unit is in rescue mode.
Ethernet connector	Yellow or green	Link/Activity
Input ports (Any type)	Off	The input channel is either disabled, or if enabled, it is processing the sampling data.
	Green	Green | Channel is measured, and no alarm is detected for all the measurements done on the channel.
	Orange	Channel is measured and at least one of the measurements of the channel is in warning or alert condition.
	Red	Channel is measured and at least one of the measurements of the channel is in alarm or fault condition.
Output ports	Off	Output is disabled. Output terminals are in the default state (inactive).
	Green	Output is enabled. Output terminals are in the non-default state (active).
	Red	(Only for current outputs) Output is enabled but the system is not able to configure the current setting because it is not powered.

7 Specifications

7.1 Vigilant-Permanent

The following table shows the specifications for the large version of the *Vigilant* device:

High Speed Inputs

Number of high-speed inputs	8
HS Inputs sampling rate	512 to 51200 Hz
DC Range	±24 V
AC Range	24 Vpp
IEPE Sensors drive current	5.5mA @20V
Resolution	16 bits
Input configuration modes	Dynamic, Static, Digital, Pulse Train
Harmonic distortion	-70 dB
Accuracy	1%
Dynamic range	110 dB
Point types	Dynamic, Static, Tachometer

Auxiliary Inputs

Number of auxiliary inputs	4
LS Inputs sampling rate	Up to 200 Hz (1 sample for each capture)
DC Range	±24 V
Resolution	16 bits
Power output	+24 V
Input configuration modes	Static, Digital, Pulse Train (A1 and A2 only)
Accuracy	1%
Point types	Static, Tachometer

Signal Processing

Spectral lines (bins)	100, 200, 400, 800, 1600, 3200, 6400, 12800
Time waveform samples	128 up to 262016
Window types	Hann, Hamming, Blackman, Rectangular
Processing modes	Waveform, Spectrum & Waveform, Demodulation, Long Waveform, Demodulation, Long-Waveform

Filter types	Butterworth, Bessel, Chebyshev
Number of averages	1 up to 32
Overlap	0% up to 99%

System General Features

Internal Storage (OS)	4 GB
Main CPU	ARM Cortex™-A9 Quad Core (NVIDIA® Tegra™ 3)
CPU clock	1.4 GHz
RAM	1 GB
Storage Capacity (Database)	4 GB
USB ports	1 Host
Internal Storage (OS)	4 GB
Status indicator	RGB LED
Analog channels indicator	12x Red/Green LEDs
Network communication	IEEE1588 Ethernet 10/100
Power Supply	20-26 Vdc, 24 Vdc nominal
Power consumption	< 12 W

Mechanical Features

Mounting	Standard 35 mm DIN rail
Size	162.2x95x27 mm
Weight	0.55 Kg
Temperature range	-30 to +44.5 °C
Humidity	95% RH

8 Installation

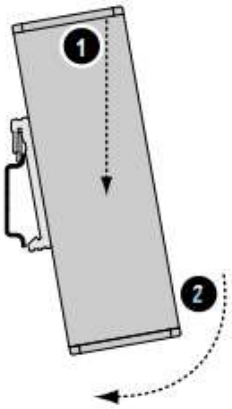
8.1 Mechanical assembly

The *Vigilant* system was not designed as an “enclosed type”. That means that it generally requires installation into an external enclosure prepared for the application site’s environmental conditions.

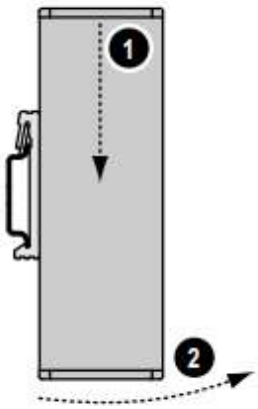
The equipment includes an accessory to be mounted on standard DIN rail (35 mm rail). Using the accessory installed at the back of the casing, the equipment can be arranged on a DIN rail fastened to the mounting panel of the enclosure.

On the picture below it can be seen the backside of the *Vigilant*, where this DIN rail accessory is shown:

The following table describes the steps for assembling or removing the *Vigilant* from the DIN rail.



To fasten the *Vigilant* onto the DIN rail, align it with the DIN rail connector, press firmly on top and push the lower end into position.



To remove the *Vigilant* press firmly on top and pull the lower end away from the DIN rail.

The Vigilant includes a forced ventilation system that regulates its temperature. However, to guarantee its proper cooling, the enclosure’s temperature must be kept within the allowable limits (see Specifications). It must consider the heating caused

by all components within the enclosure, installing a forced ventilation system if required.

Allow some free space around the air input grid and equipment's fan output to ensure its proper cooling. To improve its cooling, remove any insulation material close to the unit and confirm the free circulation of air around the device.

Outdoor installations are particularly susceptible to condensation. This should be avoided by installing the corresponding components within the enclosure. Direct sunlight and high ambient temperatures should be avoided. It is recommended to separate the *Vigilant* unit from any external heat source that could cause high temperatures.

It is the assembler's responsibility to ensure the environmental conditions described at the specifications of the unit.

9 Electrical installation

9.1 Connectors

Connections for I/O channels and power supply are achieved by using pluggable screw terminal blocks. In both cases the *Vigilant* use the same type of connector, a 3-pole pluggable screw terminal block with **3.81 mm pitch**. The following picture shows this type of terminal block:

This type of connectors admits wires from 0.2 up to 1.5 mm². However, it is recommended to use 0.5 mm² wires (AWG 20).

All the inputs and outputs of the *Vigilant* may only be connected to SELV circuits. SELV stands for Safety Extra Low Voltage. For *Vigilant*, maximum voltages range ±24Vdc. That applies both for power and signal connections, including the main and auxiliary inputs.

Vigilant also has a RJ45 jack port on the left part of the front of the case used for Ethernet communications (100Base-TX).

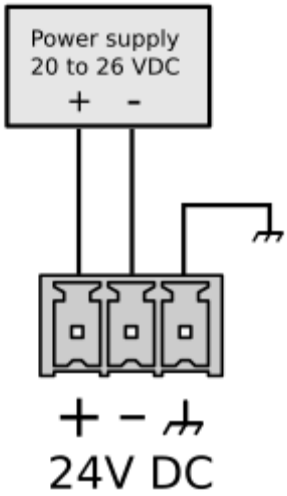
The Ethernet port is to be connected only to indoor routed networks.

Next to the RJ45 port there is an USB connector (A-type) used to plug slave devices.

USB port is yet not implemented and cannot be used for any purpose.

9.2 Power supply

The *Vigilant* must be powered with a nominal 24 VDC LPS power supply. Only SELV / LPS complying with IEC 60950-1 / EN 60950-1 / VDE 0805-1 must be connected to the power supply terminals. Voltage can vary from 20 to 26 VDC, as described in the specifications (see Specifications).



The maximum power consumption is below 12W (500mA under 24 VDC).

The *Vigilant* case, DIN clip and chassis ground terminals are connected (more information in next section: Ground connection.

It requires a CE power supply certified (or equivalent) to power the equipment. The power supply must be permanently earthed and must be connected to the ground of the installation.

Be aware that the voltage supplied will be used internally for powering the IEPE sensors, which in turn might require a minimum voltage supply to power them correctly.

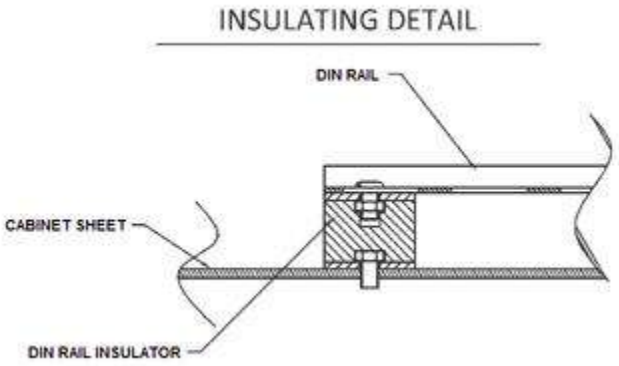
9.3 Ground connection

All the connectors for the main analog inputs of the *Vigilant*, and the power input connector, have a terminal for chassis ground connection. All those terminals are connected in between and, in turn, both to the *Vigilant* case and the DIN rail clip.

Grounding provides a safe electrical operating system and helps avoiding potential EMI and electrical noise that can cause unfavorable operating conditions in the unit. Follow the grounding requirements described in this chapter to ensure the system's safe operation and minimize noise interferences.

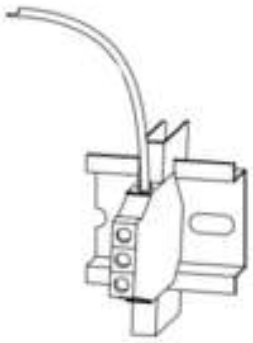
Some installations, to avoid noise problems, may require a ground connection for sensors and instrumentation separated from the safety ground, which is typically connected to the cabinet casing. In such cases the Vigilant must be connected to the instrumentation ground, and it must be ensured that the DIN rail where the Vigilant is supported is isolated from the safety ground.

The following graph shows an example of how to isolate the DIN rail from the cabinet.



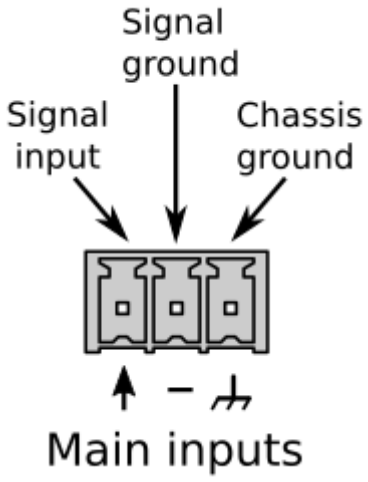
It is recommended to connect the *Vigilant* ground terminal to the instrumentation ground and the DIN rail where the *Vigilant* is supported.

The DIN rail can be grounded connecting it directly to the ground bus (as shown above), or by using a rail grounding terminal (shown below).



9.4 Main inputs

The main inputs or *high-speed inputs* of the *Vigilant* share the following configuration:

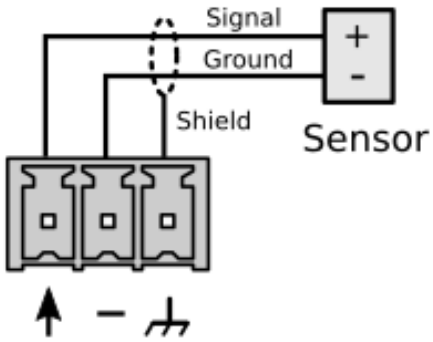


These inputs admit voltage signals in the range of ±24 V (24 Vpp in AC mode). They have been designed to accommodate fast signals coming from sensors like accelerometers, tachometers or displacement probes. Of course, they can also read slower signals like temperature probes or others.

As all the main input connectors include a signal ground (0V reference) terminal, as shown in the image. All those terminals, labeled as "-", are connected internally to the circuit 0V reference, and they are also in electrical contact with the negative terminal of the power input.

The signal terminal of the main inputs *Vigilant* connect to a current source of about 5.5 mA, activated for powering ICP/IEPE transducers, like many accelerometers.

A typical connection between the high-speed inputs and any generic sensor shows in the following picture:

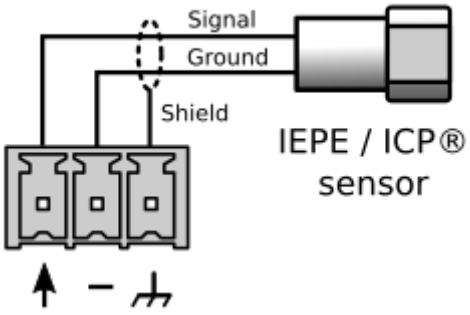


This scheme is valid for any kind of sensor with external power supply and voltage output (either analog or digital).

In the following sections there will show the typical connection between different types of sensors and the main inputs:

9.4.1 IEPE transducer

The system can power IEPE (also known as ICP) accelerometers and velocimeters connected to the main inputs connected just as shown below:



The system supplies 5.5 mA (approx.) to the sensor for the IEPE power. This option can be activated by software.

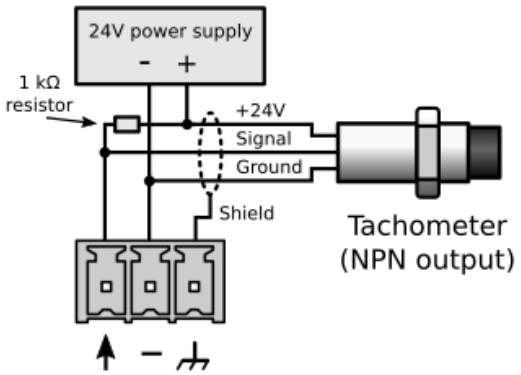
It is recommended to use a shielded cable to avoid noise in the signal, as shown above. Ensure this shield is grounded. To avoid loops and noise, make sure just one of the cable's sides connects to ground. Typically, grounding is done in the cabinet side.

9.4.2 Periodic Pulse Signal (Tachometer)

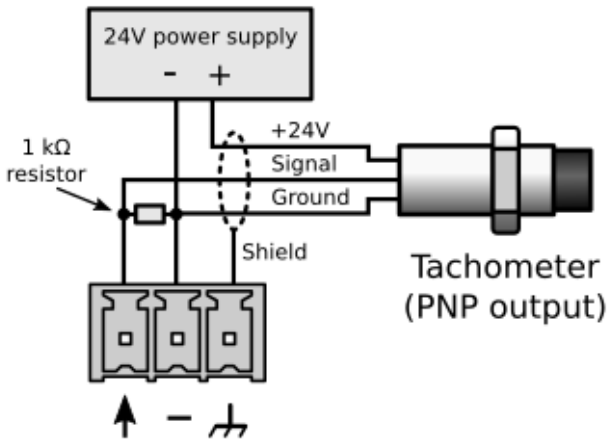
Main inputs may also be configured for detecting the speed from a periodic pulse signal. The pulse detection of the signal is based on a trigger voltage (threshold) and a hysteresis value defined by the user.

Tachometers are used mainly to detect the speed of a rotating machine. Typically, tachometers are based on proximity sensors. Most used sensors are magnetic (Hall effect) and optical (infrared transducers). In either case, most industrial proximity sensors can be powered at 24 V, and they usually have an open collector output.

In case the sensor has an NPN output type, the standard connection between the sensor and the main inputs would look like this:



In case the sensor has a PNP output, the connection would look like this:

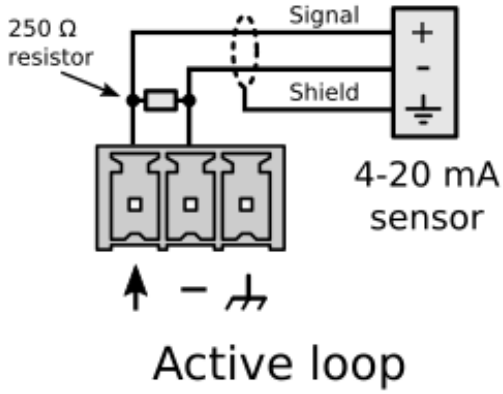


It is recommended to use a shielded cable to avoid noise in the signals. The shield must be grounded at one side of the cable (typically at the cabinet side).

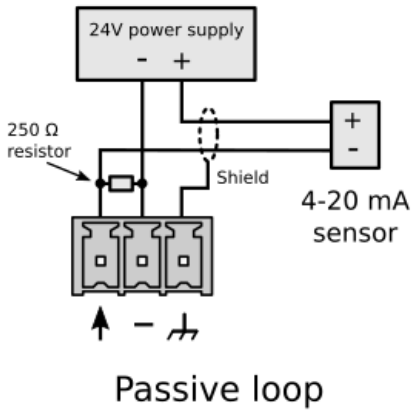
9.4.3 4-20 mA Input Signal

It is possible to configure dynamic inputs to measure 4-20 mA current loop signals. This kind of current loop is an industry-standard commonly used in many applications. They have the advantages of simplicity and noise immunity and have a large international user and equipment supplier base.

To read this type of signals from the main primary inputs, must connect a resistance on the terminals to convert the current signal into a voltage. The following graphs show the wiring required for both active and passive 4-20 mA loop sensors:



Many sensors in the market can use the current loop for powering themselves, without needing any other power source (*passive loop*). However, the terminals of the *Vigilant* do not have the possibility of powering the sensors in that way. Thus in between the sensor and *Vigilant* must add an external power source:



It is recommended to use a shielded cable to avoid noise in the signals. The shield must be grounded at one side of the cable (typically at the cabinet side).

9.4.4 Digital Inputs

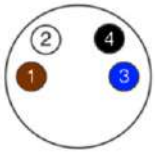
Main inputs can be configured as a digital input. This means the channel will measure a value of 1 (true) or 0 (false) depending on the signal's DC voltage. A hysteresis applies close to this setting value. The user can configure both DC voltage and hysteresis.

As an example, if the threshold is set up in 1 V, and hysteresis is defined in 0.1 V, the input will measure a value of 1 when the DC voltage of the input goes above 1.1 V. And then it will measure a value of 0 when the voltage goes below 0.9 V.

9.4.5 CONMONSense Sensor 0-10v

Note that the sensor needs an external 24VDC supply capable of delivering at least 40 mA. Utilizing the power supply supplied with the Vigilant is acceptable or a separate dedicated power

supply can be used.

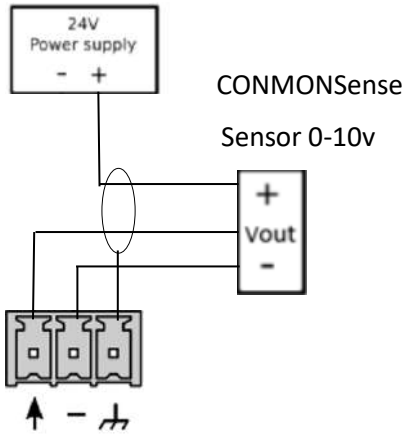


1 = 24VDC Power supply (+) (Brown Cable Wire)

2 = Voltage output (V out) (White Cable Wire)

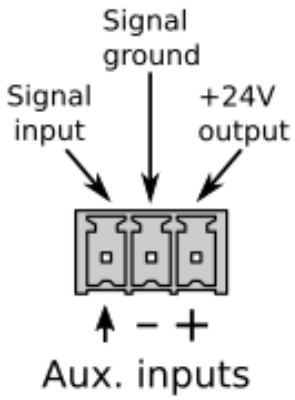
3 = 0V (-) (Blue Cable Wire)

4 = Communication line (should be left floating if not used) (Black Cable Wire)



9.5 Auxiliary inputs

The connectors for the auxiliary analog inputs available in the *Vigilant-P* has the following configuration:

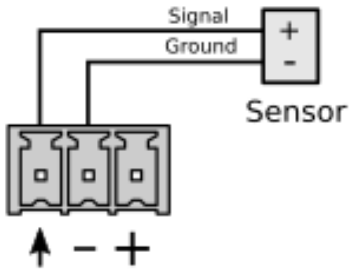


The auxiliary inputs admit voltage signals in the range of ±24 V and design to read analog signals at slow rates.

As it is shown in the image, all the auxiliary inputs connectors include a signal ground (0V reference) terminal. All those terminals, labeled as "-", are connected internally to the circuit 0V reference, and they are also in electrical contact with the negative terminal of the power input.

The auxiliary inputs connectors also have a terminal with a +24 V power output, available for powering external sensors or peripherals. All those terminals, labeled as "+", are connected internally to the circuit +24 V power input.

A typical connection for a generic sensor to these inputs, with self is shown in the following picture:



This scheme is valid for any kind of sensor with external power supply and voltage output (analog or digital).

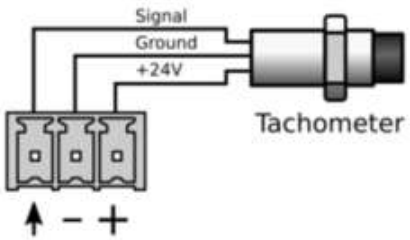
In the following sections will show the typical connection between different kinds of sensors and the auxiliary inputs.

9.5.1 Periodic Pulse Signal (Tachometer)

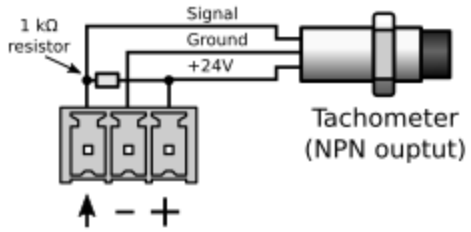
Some of the auxiliary inputs may also be configured for detecting the speed from a periodic pulse signal. The pulse detection of the signal is based on a trigger voltage (threshold) and a hysteresis value defined by the user.

Tachometers are used mainly to detect the speed of a rotating machine. Typically, tachometers are based on proximity sensors. Most used sensors are magnetic (Hall effect) and optical (infrared transducers). In either case, most industrial proximity sensors can be powered at 24 V, and they can be powered from the +24 V output terminal.

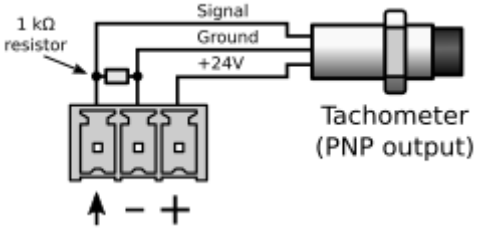
The connection between the auxiliary inputs and a tachometer with analog or digital inputs would look like this:



In case the sensor has a NPN output type, the normal connection between the sensor and the auxiliary inputs would be something like this:



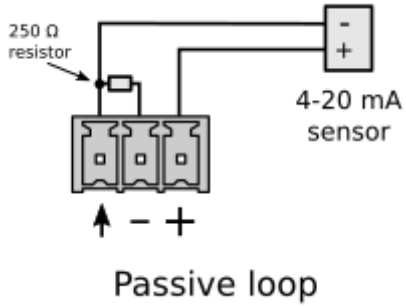
In case the sensor has a PNP output, the connection would look like this:



9.5.2 4-20 mA Signal

Dynamic inputs can be configured to measure 4-20 mA current loop signals. This kind of current loop is an industry-standard used in many applications. They have the advantages of simplicity and noise immunity and have a large international user and equipment supplier base.

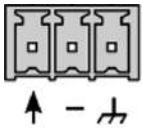
In order to read this type of signals from the main inputs a resistance must be connected on the terminals in order to convert the current signal into a voltage. The following graphs show the wiring required for a passive 4-20 mA loop sensor:



9.5.3 Digital Inputs

Auxiliary inputs can be configured as a digital input. That means the channel will measure a value of 1 (true) or 0 (false) depending on the signal's DC voltage. A hysteresis applies around this value. The user can configure both DC voltage and hysteresis.

As an example, if the threshold is set up in 1 V, and hysteresis is defined in 0.1 V, the input will measure a value of 1 when the DC voltage of the input goes above 1.1 V. And then it will measure a value of 0 when the voltage goes below 0.9 V.



10 User Interface

This section describes the user interface of the *Vigilant* Machinery Supervisor.

10.1 Introduction

Vigilant comes with an embedded web-based user interface that can access any operating system, including tablets and smartphones.

The user Interface allows to configure the unit, access its general settings, and show the measured data. The interface is divided into 4 different components:

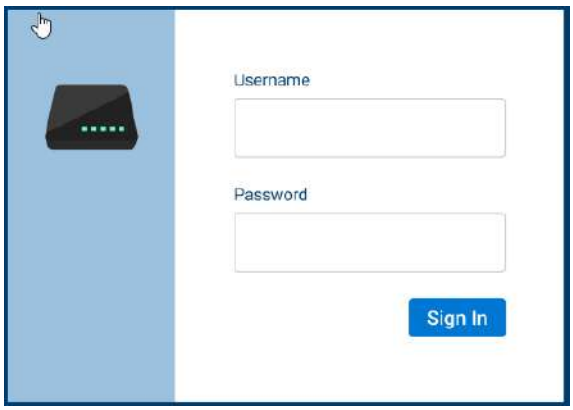
- *System*. Provides information about the status of the *Vigilant* and allows the user to configure its general settings.
- *Configuration*. Configures the different monitoring components of the *Vigilant* (inputs, sensors, processing modes, parameters, measuring points, alarms, etc.).
- *Dashboard*. This interface shows the data measured by the *Vigilant* unit.
- *Manual*. Shows the manual of the *Vigilant*.

It is strongly recommended to use Chrome or Mozilla Firefox as the web browser. The interface optimizes for both browsers. Other web browsers might not work correctly.

10.2 Access

The following steps describe the way to access the configuration interface. By default, the user interface will show the *Dashboard* application.

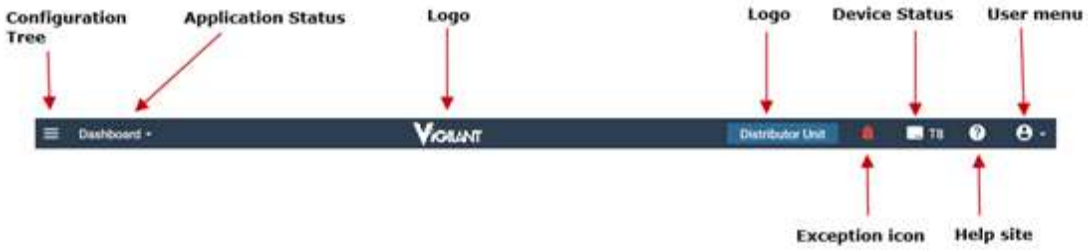
- Connect the Vigilant to your device or network using an Ethernet cable.
- Find out the IP address of the unit. By default, the Vigilant is supplied with the following IP address: 192.168.0.150.
- Change the IP address of your device, so both are in the same logical Ethernet network (netmask).
- Start your web browser and type the IP address of the Vigilant unit on the web address.
- The browser will show the login box.



Enter the username and password and click on “Sign in”. The Vigilant has a predefined user called admin. The password of admin is unique for every Vigilant unit. Please refer to the documentation provided in the original package of the unit.

10.3 Navigation bar

The following picture shows the navigation bar, the main toolbar for the User Interface and its components. It appears at the upper part of the web page and shares by all the different modules of the interface:



10.3.1 Configuration tree

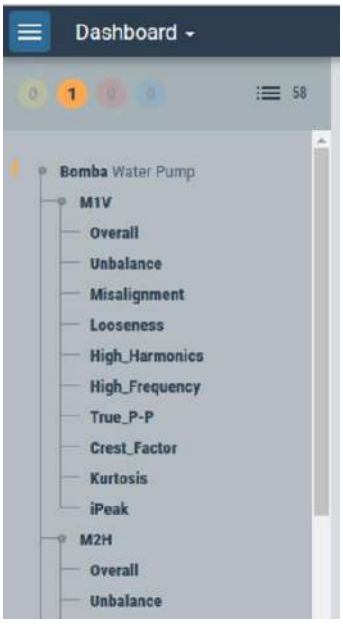
On the left of the navigation bar, you will normally see this button:

This button will show or hide a tree structure on the left of the screen.

In the main user interface, the Dashboard, this structure will show the system's measurement configuration. When instead of the Dashboard, shows Main Configuration or System Configuration, the button will have a similar behavior, in those cases showing or hiding their respective menu trees.

Below the *configuration tree* button, in the Dashboard, the application will show four colored circles, with a number inside. This is the Alarm Toolbar. Those circles represent the *active alarms* that the system is detecting at this moment. The numbers indicate the specific number of alarms of each type. The colors of the circles range from warning (yellow) to danger (red). If the numbers inside are above zero, the circles will shine brighter.

When the configuration tree is open, the alarm toolbar will be located above the configuration tree, in horizontal:

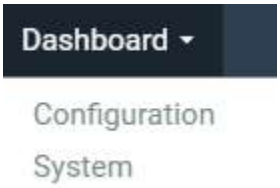


If the configuration tree is hidden, then the alarm toolbar will be located on the left, in vertical direction:

10.3.2 Application status

The navigation bar shows in this area the application's parts in which we are currently located.

Clicking on the pull-down menu, the interface will show us the rest of the available applications, and clicking on any of the list, we will access them.



Selecting an item of the list will change the interface into the correspondent application. In the following chapters, you can read a detailed description of all the available applications.

The Dashboard application is shown by default when accessing the system.

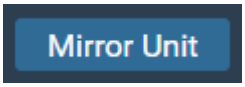
10.3.3 Exception indicator

Occasionally, a red bell-shaped icon will appear in the upper right part of the navigation bar. This symbol represents that the system has detected some event or exception, and it requires some attention by the user:

Clicking on the icon will show a more descriptive message for the specific event. Usually, those events may be:

- Software Licenses are about to expire.
- Storage capability of the system is reaching its limit.
- Problem or exception occurred while trying to store data.
- Other kind of internal error (undefined).

10.3.4 Special unit indicator



In some cases, an indicator with a blue background will appear in the top bar indicating that the application is not a regular V8 unit. These cases are the following:

- Distributor Unit: This indicates the V8 is a special demonstrative unit, with all the licenses activated but not intended to be used in commercial applications.
- Demo Unit: This text is displayed only on Demo servers. Demo servers are virtual devices with sample data, used for showing the application for commercial purposes. Their behavior is like Mirror units with the exception that they are not related with any real V8 device.

10.3.5 Device status

On the right the toolbar shows the logo of the system and an info button:

After clicking on it, a window will appear with information about the unit (serial number, hardware, and firmware versions).

Clicking on *Full status info* will show the status page of the system configuration (See Status).

10.3.6 Help button

This button opens the manual of the system in a separated navigator tab (in PDF format).

From firmware version 0.8.0 the manual of the *Vigilant* is no longer integrated in the embedded application. Since the manual is on the website of **Vigilant**, you will need to have direct internet connection in order for this link to work properly.

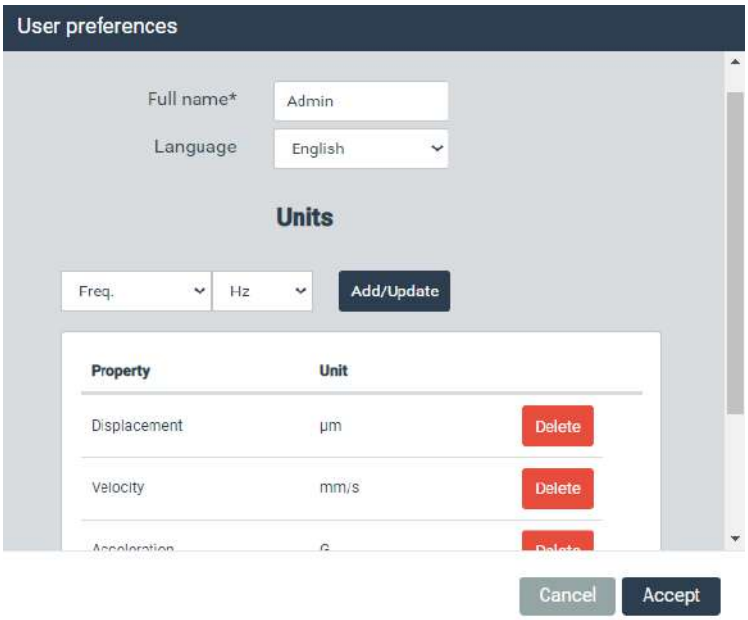
10.3.7 User

Clicking on the icon on the top right corner of the Dashboard:

we will access to the following menu:

Menu option	Description
Preferences	Access to the specific preferences for the active user.
Export desktops	Export a JSON file with the desktop layout configuration from the active user and unit preferences.
Import desktops	Import a JSON file with desktop layout information and unit preferences.
Rename tags	This menu allows changing machine's tags from the active desktop configuration, such as adapting the widgets to the new name of the machines that may have been changed in the configuration.
Logout	Logout current user and go back to the start page.

When clicking on the *Preferences* button, we will access to another menu that looks like this:



Field	Description
Full name	Defines the name that will be shown for this user on the interface.
Language	Selects the language in which the interface will be shown for that user. Currently the languages available are: English and Spanish.
Units	Sets the user preferred units for some properties.

The *Units* form allows users to select specific units to be used when determinate properties are displayed in the Dashboard. Properties that have not been configured in this menu will be displayed using the default (base) unit.

To add a new unit preference, select the left control property, and then the appropriate unit in the right control. Then, click on *Add/Update* to include it in the list, and it will be ready to be used as a preference. To modify properties that are already in the list, they must be previously deleted and then added again.

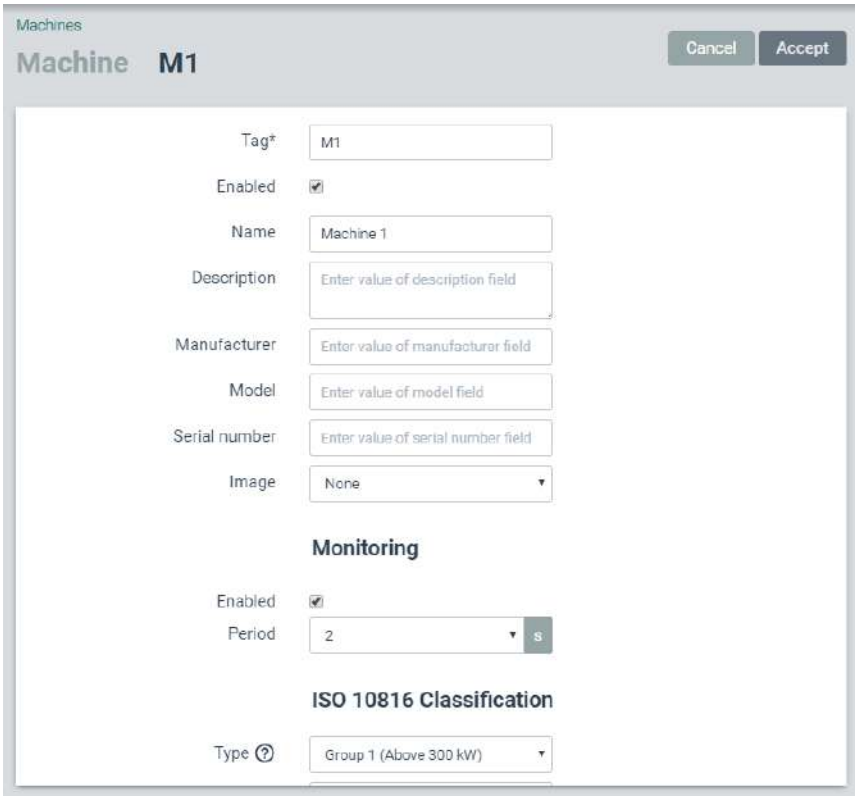
See section Units to add any magnitude or unit to the system.

10.4 Basic interface elements

The interface provides 2 different types of views: forms and lists.

10.4.1 Forms

Forms contain different fields where the user can introduce information, by writing free text or by selecting a value from a pull-down list. Most of the time, these fields classify into sections to understand and organize the different options available. The following picture shows an example of a form.



Users can edit those fields inside a box and with a white background indicated. Those fields with gray background or outside of a control box indicate they are just informative. On the other hand, those fields with an asterisk by its label indicate that they must fill in; otherwise, the changes in the form will not be accepted.

After changing any fields in the form, the user can either store the changes on the database or discard them, using the Accept or Cancel buttons.

Icon	Description
Accept	Saves the changes made on the form into the configuration database.
Cancel	Restores the value of the fields of the form to the previous values and exits the form.

All the changes made on the different forms are stored automatically on the configuration database after clicking on the Accept button. However, they are not applied into the *Vigilant* until the Apply button from the toolbar is used.

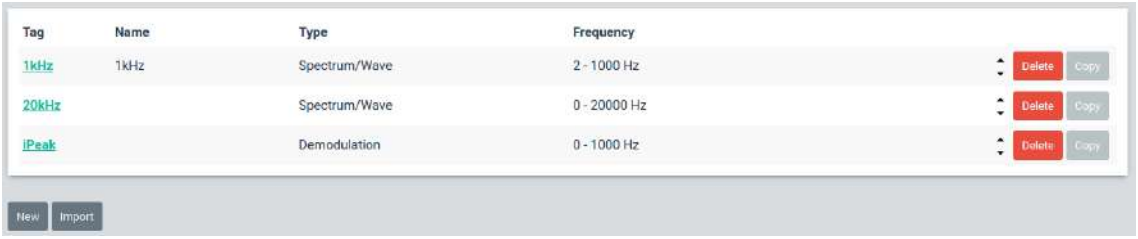
In some cases, the field provides a help text. This appears when it is left blank and shows an example or a tip about how to introduce the information correctly.

Some forms provide direct links to configuration forms of different elements belonging to the item being configured. They are marked with a blue background.

Clicking on the button "…" will show the list for the corresponding type of component.

10.4.2 Lists

Lists provide a set of rows, which refer each of them to an item or object (machines, sensors, users, alarms, etc.). The following picture shows an example of a list:



Elements of the list can be edited by clicking on any of those. The interface will show some buttons that provide edit options, on the right end or at the bottom of the list (Move-up, Move-down, Delete, Copy, New, Import, etc.). The following table describes these options:

Icon	Description
▲	Moves the item of the list one position up.
▼	Moves the item of the list one position down.
Delete	Deletes the item from the configuration database. The interface will ask for a confirmation for this action by a pop-up window.
Copy	Copies the item selected and creates a new one with the same options. The interface will show a pop-up window, requesting some information about the new item (Tag, Name, etc.).
New	Creates a new item of the list and shows its configuration form.
Import	Imports an item from a different list into the current one. For example, It can copy a dynamic point from a point's lists of a different machine into the current one. A pop-up window will appear to select the copied from a different location and to introduce some information about the new item (Tag, Name, etc.).

Select file	A modal form will appear, enabling the user to select a file.

The interface allows the lists to be ordered by the user. This can be done using the *Move-up* and *Move-down* buttons.

10.4.3 Expression Editors

In some parts of the Configuration interface, it is possible to define Logical Expressions to set up how the system will behave and react to the state of the parameters that are being monitored.

These logical rules are configured using an editor like the one that it is shown in the following figure:

Those expressions must be built based on system variables, combining some of them in a logical sentence that the system will evaluate and determine to be True or False.

The *expression editor* has a list of the available system variables that could be used in the expressions. That will be inserted automatically on the expression field by selecting a variable, helping on its writing. It also provides the different possible logical and arithmetic operators to combine the variables and build a logical expression.

The system checks automatically if the syntaxes of the expression are correct. If not, it shows an *Invalid Expression* message.

Expression editors are used to configure Output connections, machine States, and several parts of Storage Strategies.

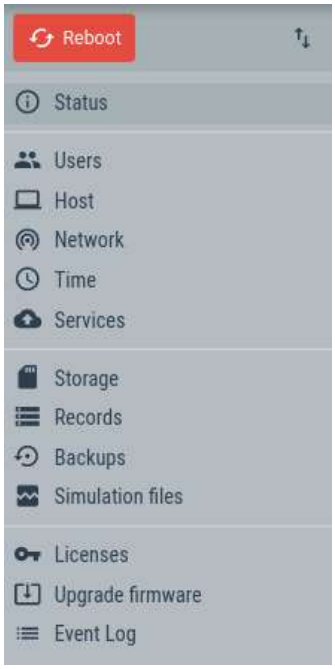
11 System Settings

11.1 Introduction

The System Settings interface provides information about the status of the *Vigilant*, and allows the user to configure some properties related to system administration, connectivity, data storage, user management, etc.

11.2 Menu Tree

On the left side of the screen, a vertical toolbar shows the list of the different sections and menus available in this part of the application for the System configuration:



Icon	Description
Reboot	Clicking on this button will reboot the unit. A window will ask the user to confirm the action.
⇅	Access the System maintenance form, where the user can restore default *Vigilant* settings and import and export system and user configurations.
Status	Show general information about the unit and its status.
Users	Allows the administration of the users within the system.
Host	Define the network information about the unit, including name and description.
Network	Configure the network interface.

Time	Set the date and time of the unit, and activates and configures the NTP client, for time synchronization through the Internet.
Services	Enables and configures several network services: Backups, and Email notifications.
Storage	Select the type of storage to be used by the system or disable the storage. Shows information about the status of the SD card and executes actions like formatting it.
Records	Provide information about the data blocks and records stored in the unit for each machine and allows removal within a time range. It also allows you to rebuild the database from the data blocks or records stored.
Backups	Shows the list of available backups of the device's data. The Backup service must be enabled for this menu to show any data.
Simulation files	Allow loading and managing simulation archives, which are special sound format files (WAV) used to simulate machine vibration files.
Licenses	Shows a list with all the different modules of the *Vigilant* and inform if they are enabled in the unit or not.
Upgrade firmware	Show the firmware version and check if a new firmware is available.
Event Log	Show the internal events occurring in the system in real time.

11.3 Status

This form shows the status of the *Vigilant* unit and provides additional general information.

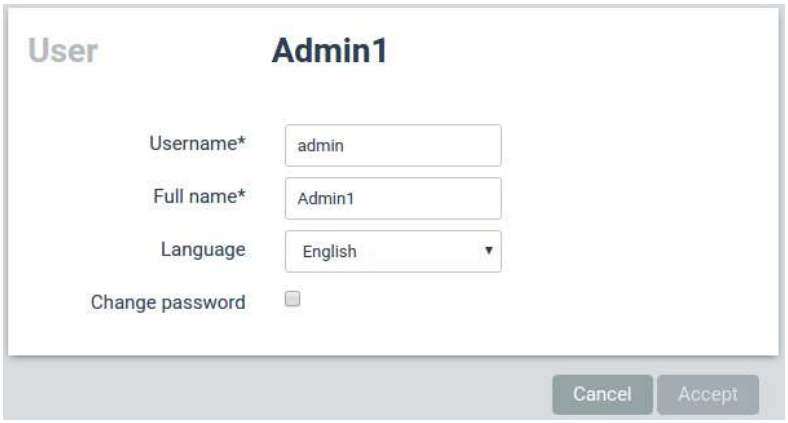
Field	Description
Name	Shows the name of the unit assigned by the user on the *Host* configuration form (see *Host*).
Description	Description of the unit as configured by the user on the *Host* configuration form (see *Host*).
Serial	The serial number identifies the unit. This identifier is set up at the factory and cannot be changed by the user.
Model	Shows the model of the *Vigilant* unit.
Hardware version	This field shows the version of the hardware.

Firmware version	This field shows the version of the firmware installed on the unit.
Hostname	This is the identifier that the device will have when trying to access it in the local network.
MAC Address	The MAC (Media Access Control) address is the unique hardware number that the instrument will use when connecting to an Ethernet network.
Using DHCP	Indicates if the device is using a fixed IP address (set by user) or if it is using an external DHCP server to get one.
IP Address	Indicates the Internet Protocol v4 address the device is using.
Gateway	Indicates the IP address of the network node from which the instrument is connected to the Internet.
Network mask	A netmask is a 32-bit mask used to divide an IP address into subnets and specify the network's available hosts.
Input Voltage	Shows the external power voltage provided to the unit.
Battery Voltage	Shows the voltage provided by the internal battery of the unit.
Board Temperature	Shows the current temperature present on the motherboard. Normal temperatures range up to 55°C.
CPU Temperature	Shows the current temperature of the main processor (CPU). Normal temperatures range up to 65°C.
UTC Time	Shows the UTC date and time configured on the unit. They can be changed on the Time settings (see *Time*).
Local Time	Shows the local date and time. The unit reads the location from the device that shows the interface.
Uptime	This field indicates the time elapsed since the *Vigilant* unit was turned on.
Configuration	This field indicates the last date and time when a new measurement.
applied at	configuration was applied to the unit.
RAM	Shows the percentage of RAM which *Vigilant* unit is currently being used.
Storage	Shows the percentage of storage capacity being used.
Records	Shows the percentage of available number of Records being used by the machines. It shows only the worst case, in case there were several machines in current configuration.

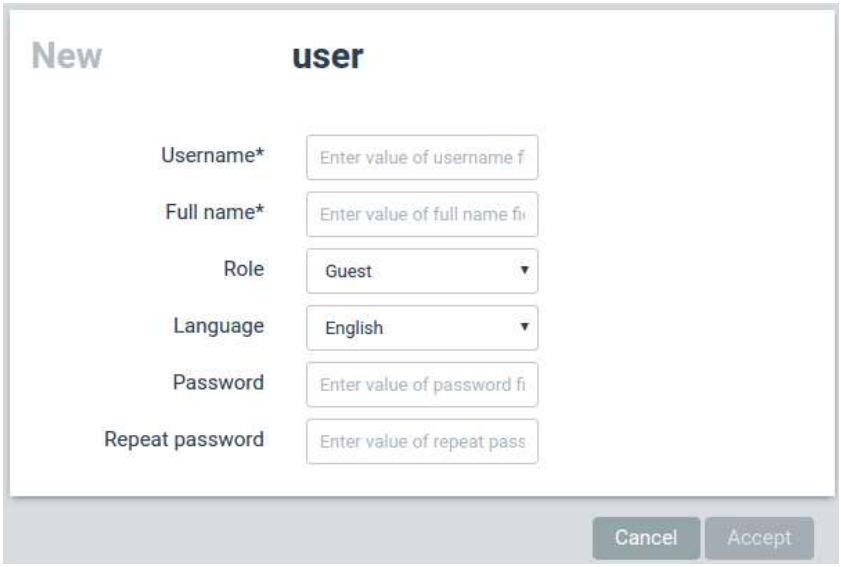
11.4 Users

This form shows a list of the users currently defined on the *Vigilant* unit.

Clicking on one of them will edit the user options.



Click on the New button to create a new user.



Field	Description
Username	Sets the user identification name. It must be unique within the system.

Full Name	Defines the full name of the user.
Role	The role defines the user rights within the *Vigilant* unit. These are the available roles: • *Administrator*. This role allows the user to modify any configuration of the system and acknowledge and remove alarms. • *Analyst*. This role allows the user to acknowledge and remove alarms, and editing the machine monitoring configuration, but it does not allow to change the *System* options. • *Guest*. This role allows the user to acknowledge and remove alarms, and access the data captured by the device, but without making any modifications. All roles allow the users to access the dashboard interface and change the layouts of the *Widgets*.
Language	Sets the language of the interface for the user.
Change Password	Allows to change the password when marked this check box.
Password	Sets the password of the user.
Repeat password	Repeats the password for its confirmation.

Only users with *Administrator* role will be able to modify the *Users* options.

Clicking on the *Delete* button will delete the user. The interface will ask for confirmation.

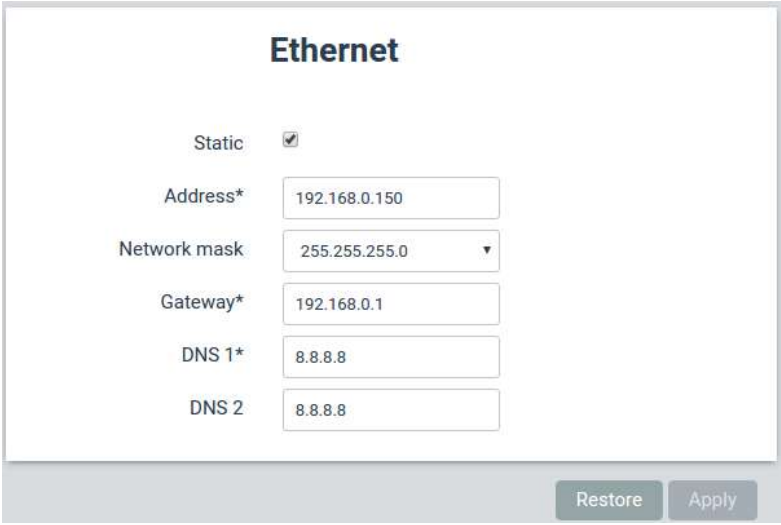
11.5 Host

Defines the name and description and hostname of the *Vigilant* unit. The user can change them to correctly identify the unit.

Label	Configuration tool
Name	This field allows the user to define a name for the *Vigilant* unit. Use a unique name within your network.
Description	Sets a user-defined description of the unit.

11.6 Network

This form allows the user to configure the Ethernet interface of the *Vigilant* unit.



Field	Description
Static	Allows the user to configure the static IP address of the *Vigilant*. If not checked the *Vigilant* unit will try to get its IP using DHCP protocol.
Address	Configures the IP address of the unit.
Network Mask	Sets the network mask, which is a 32-bit mask used to divide the IP address into subnets and specify the network's available hosts (define the subnet).
Gateway	Sets the network gateway. This may be the computer that controls the network traffic in your company network, or also the device provided by your internet service providers (ISP) to give you access to the internet.
DNS1	Defines the primary DNS server. It is the job of the DNS to convert the host names to the IP addresses of the web servers.
DNS2	Defines the secondary DNS address.

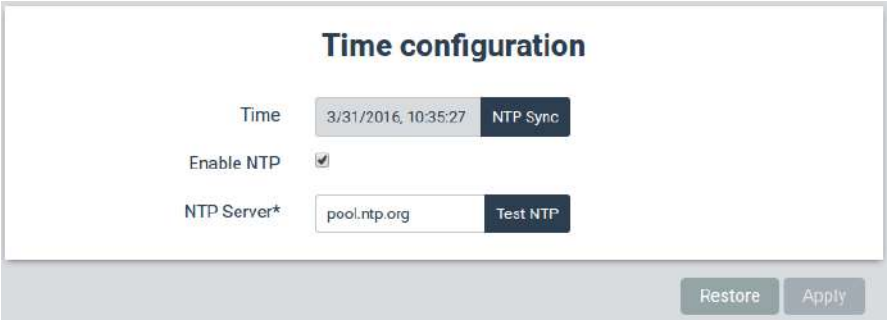
This menu is basic to set up the device and be able to access it in the future.

If you are not sure about the meaning of any of these terms, it is advisable to contact your IT service or ISP provider.

11.7 Time

Shows the date and time of the unit and allows the user to change its configuration.

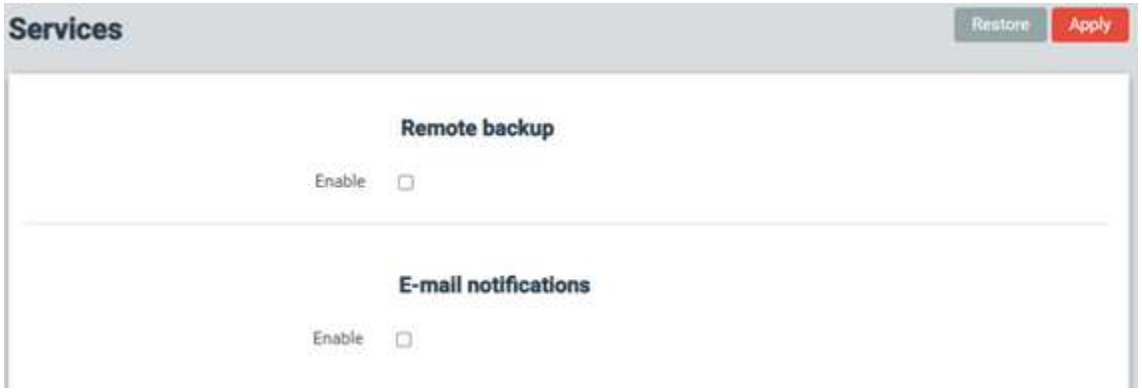
The system may be configured to keep in time by synchronizing with a NTP Server. Required Network Ports must be open. Network Time Protocol (NTP) is a networking protocol for clock synchronization between computer systems over packet-switched, variable-latency data networks.



Label	Configuration tool
Time	Shows the date and time set on the unit.
Enable NTP	Enables the time synchronization with a NTP server.
NTP Server	Defines the address of the NTP server. This field appears only if *"Enable NTP"* checkbox has been marked.
NTP Sync	Synchronizes the time of the unit with the NTP server.
Test NTP	This button provides a connection test with the NTP server. Only appears if *"Enable NTP"* checkbox has been marked.
Local Sync	Synchronizes the time of the unit with the time of the computer or device where the user interface is shown. This button is only shown when the *"Enable NTP"* checkbox is unchecked.

11.8 Services

This section allows configuring the 3 types of services that the Vigilant integrated: Remote Backup and E-mail Notifications.



Some of these services require special network configurations, specifically the *Vigilant* must have access to certain Network Ports . Ask your ISP provider to check if communication through those ports is available.

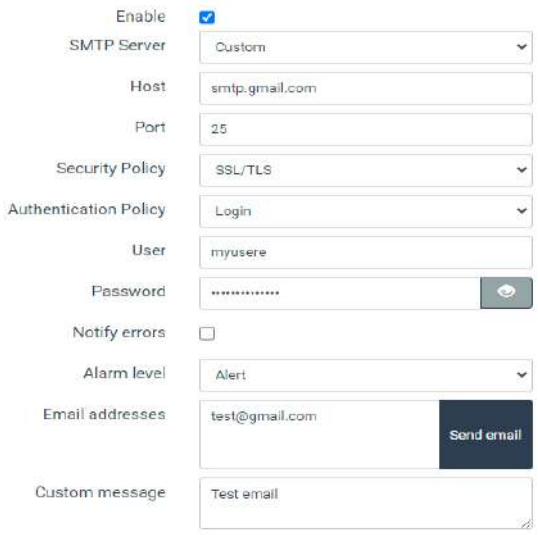
11.8.1 Remote backup

The *Remote backup* service allows periodic backup copies of all the information and configurations contained in the *Vigilant*.

Currently, the system only enables the possibility to create backups in the **Vigilant** network. This service guarantees the user a higher level of security about the integrity of its measurement data. Whenever it is needed, user can access those Backups to restore them, totally or partially, in the *Vigilant* device.

Field	Description
Enable	Enables the automatic backup service.
Next backup	Selects the date and time when the first backup will be executed.
Backup period	Sets the waiting period until the following backups are executed after the first one, so that they are performed periodically.

11.8.2 Email notifications



The *Email Notifications* service allows sending an email to a set of contacts, specified by the user, every time a condition is met. That condition may be a specific alarm level (generic for all the machines defined in *Configuration*) or an error in the system. Users can customize emails with a user-defined message.

This form also gives the possibility of sending a test email to verify that the email addresses and the network configuration are correct.

Field	Description
Enable	Enables the notifications service. When checked, the form shows the rest of the parameters for this service.
SMTP Server	Select which email server to use for the notifications. In case of selecting *Default*, the **Vigilant** server will be used, and most of following fields won't be necessary.
Port	Usually SMTP works with port 25, but it can also work with 587.
Security Policy	SMTP email transfer does not provide encryption. If you want to make your connection more secure, it is a good choice to use a STARTTLS or SSL/TLS extension that employs a separate port for encrypted communication.
Authentication Policy	Authentication method for user logging in email server. Vigilant accepts *plain* and *login*.
User	User for accessing the email server.
Password	Password provided by your ISP.
Notify errors	When checked, the system will also send emails whenever an error is detected.
Alarm level	Select the minimum alarm level that will trigger the email notification.
Email addresses	Configure the set of email addresses to which the emails will be sent.
Custom message	Specifies a user-defined message which will be included in the body of the notification emails.

The *Notifications* service is limited to a maximum of **1 email** maximum per day.

The notification email will send only once, the first time that meets the condition. It will include information about all the alarms and errors since the last notification email was sent.

The system will not send more than one email on the same day, even if more critical alarm levels are reached. It will always wait a minimum of 24h before sending new emails.

On the other hand, the system will only send a single email for a certain alarm. Alarms that have already been noticed will not be indicated in new emails, that will only show new alarm appearances since the last notification. Until that alarm is acknowledged by an analyst in the Alarm Toolbar of the *Vigilant*, that specific alarm will not generate any new warning emails.

The automatic notification emails generated by this service will look like this:

Status report: machine Caja_Sincronismo_Salida

- Device model: TWave T8 simulator
- Device serial: 8081234
- Date/Time: 11-01-2019 13:05:04 UTC

Level	Source	Value/Message	Date/Time
Error	Caja_Sincronismo_Salida:1A	Signal minimum is beyond sensor limit (-1.760 < 0.000)	11-01-2019 12:54:40 UTC
Alert	Caja_Sincronismo_Salida:1A:Overall	6.177 mm/s	11-01-2019 12:54:40 UTC
Error	Caja_Sincronismo_Salida:2A	Signal minimum is beyond sensor limit (-1.743 < 0.000)	11-01-2019 12:54:40 UTC
Error	Caja_Sincronismo_Salida:3A	Signal minimum is beyond sensor limit (-1.747 < 0.000)	11-01-2019 12:54:40 UTC
Alert	Caja_Sincronismo_Salida:3A:Overall	6.021 mm/s	11-01-2019 12:54:40 UTC
Error	Caja_Sincronismo_Salida:4A	Signal minimum is beyond sensor limit (-1.888 < 0.000)	11-01-2019 12:54:40 UTC
Error	Caja_Sincronismo_Salida:5A	Signal minimum is beyond sensor limit (-1.656 < 0.000)	11-01-2019 12:54:40 UTC
Error	Caja_Sincronismo_Salida:6A	Signal minimum is beyond sensor limit (-1.725 < 0.000)	11-01-2019 12:54:40 UTC
Alarm	Caja_Sincronismo_Salida:6A:Overall	7.806 mm/s	11-01-2019 12:54:40 UTC
Alert	Caja_Sincronismo_Salida:2A:Overall	5.515 mm/s	11-01-2019 12:54:42 UTC
Alert	Caja_Sincronismo_Salida:4A:Overall	6.446 mm/s	11-01-2019 12:54:42 UTC
Alert	Caja_Sincronismo_Salida:5A:Overall	7.056 mm/s	11-01-2019 12:54:42 UTC

- Device model: specific model and reference of the system.
- Device serial: serial number of the device.
- Date/Time: UTC time when the snapshot was taken and condition was met.

The Date/Time indicated in the notifications email are always in generic UTC/GMT time, because the system does not have information about the local time in the place where the user is receiving the notifications.

11.8.3 Rsync and FTP services

In previous versions of the V8 software, there were two other services that could be activated in this section: Rsync and FTP. They are no longer visible in the Services menu, but they are still available and are activated by default.

Rsync is a service that allows incremental backups of files or folders. Only new or modified files are copied, making the backup process very efficient. The *Vigilant* unit works as a *Rsync* server, so it is required a *Rsync* client in your computer to use this service.
See https://en.wikipedia.org/wiki/Rsync for more information. The *Vigilant* unit does provide this backup service for the folders where all the data and configuration files are stored.

The *FTP* service provides a way to upload and download files into or from the *Vigilant* unit. Like the *Rsync* service the *Vigilant* unit works as a *FTP* server, so requires an *FTP* client in your computer to use this service. The *Vigilant* shares through *FTP* the folders where all the data and configuration files are stored.

Field	Description
Rsync user	Rsync clients must use “rsync” as their username.
Rsync password	Use the default *admin* password provided with the instrument.
FTP user	FTP clients must use “ftp” as their username.
FTP password	Use the default *admin* password provided with the instrument.

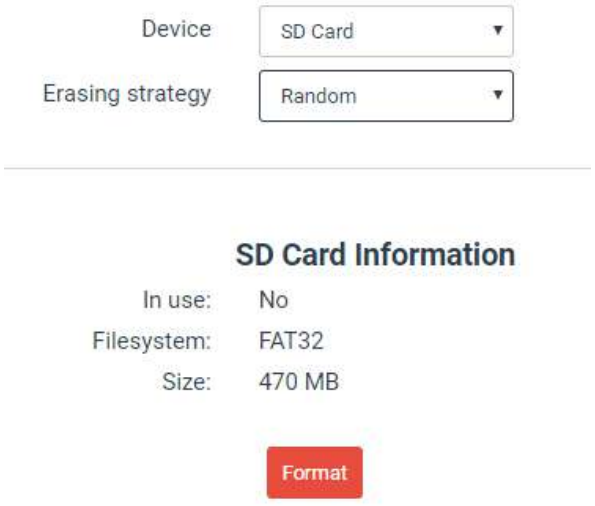
11.9 Storage

This form allows configuring how the *Vigilant* uses the flash memory.

By default, the device employs an internal micro-SD card for permanently storing data. Since firmware version 0.7.0, this internal memory is not essential, and the system can work without the SD card or even with a card that is damaged. In such a case, the device will not be able to permanently store any measurement data and will notify that event in the Exception indicator. See Micro-SD card maintenance section for more details.

This form allows setting the *Vigilant* strategy to erase old *Snapshots* when the number of records has reached its limit (10000 records is the maximum by default) or when the external flash memory is getting full. The system needs space for storing new data. The options are:

- *Oldest* strategy is based on *FIFO* records, so that the new records will occupy the place of the oldest ones.
- The alternative is using a *Random* strategy to randomly remove old records to make room for new ones. This strategy is useful for storing information from the machine for a long time because this strategy’s long-term effect is lowering the information density (less number of records) from the oldest periods while having more current information density.



Field	Description
Device	Select the internal flash memory (microSD card) or none. In this latter case, trends and timelines will not be available.

Erasing strategy	Select *Oldest* or *Random* strategies.
In use	Indicates if the system's SD card is being used or not (although being detected and available).
Filesystem	Indicates the file format detected in the SD card (usually FAT32 or EXT3).
Size	Total amount of space in the microSD card.
Format	This button is only available if the SD is *NOT* in use and allows erasing all the data in the card and formatting it.

Changes in this menu will only apply after a **reboot** of the system. For instance, the micro-SD can only be formatted if it has not been in use during system start-up.

11.10 Records

This menu shows the degree of occupation of the device's internal storage memory, how this usage is shared between different types of data to be stored. It also allows erasing entirely or partially the data to free space.

If the storage device (micro-SD card) is not in use, i.e. it is disabled, this menu will remain inactive.

The *Vigilant* stores the data in its internal flash memory using different file formats.

All information related to a set of measurements of the machine taken simultaneously (monitoring period) is stored together, in what we call *Snapshots*. Long-Waveforms are stored separately, but their files also reference of a *Snapshot* to which they are related.

These *Snapshots* stores in the flash memory as "records". The system currently allows a maximum of 10,000 records per machine, regardless of the actual space occupied by these records, depending on the number of spectra and waveform files that each snapshot contains.

On the other hand, the system also uses a *MySQL* database for data storage and classification. This database stores simplified information about the temporal trends of the different parameters, speed and condition of the machines, etc.

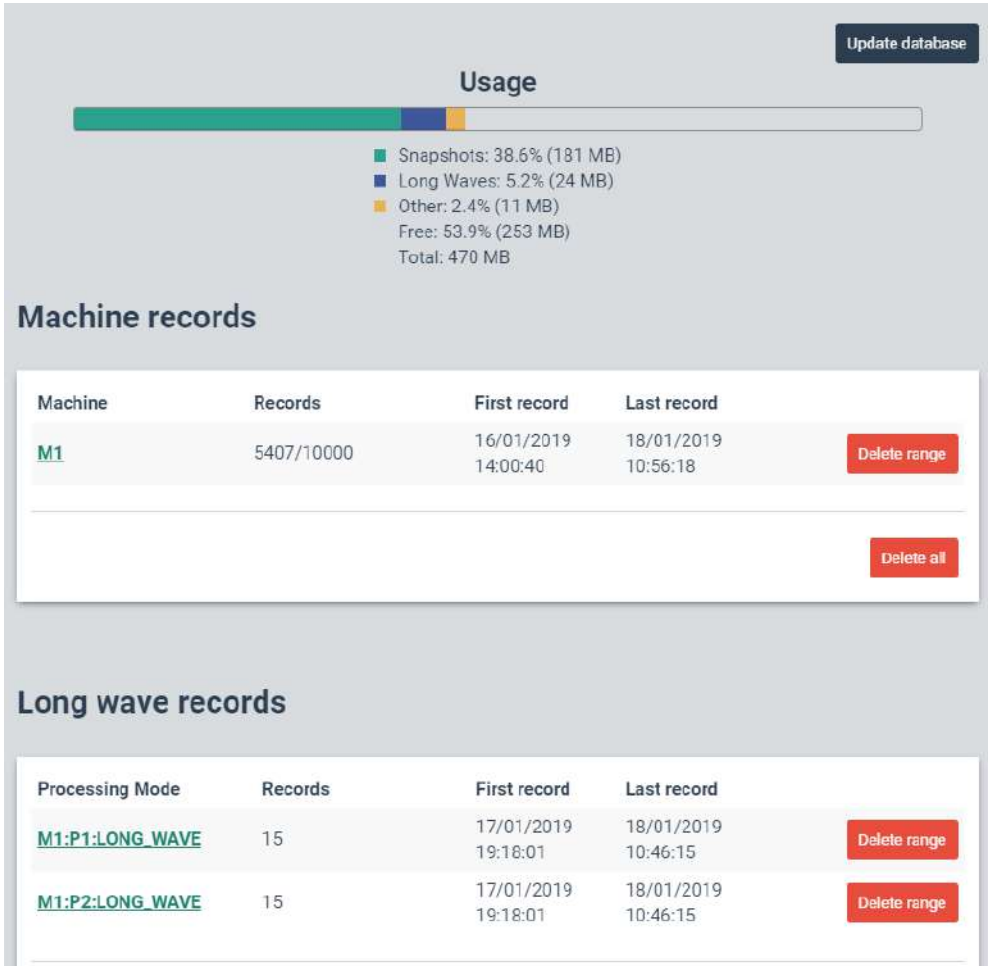
The system updates the database when new measurements are stored. It also makes a periodic automatic backup of the database in the flash memory, and just before shutting down the system.

This allows the system to restore the trends in RAM when restarting the unit quickly.

This form also allows reconstructing the trends database reading the *Snapshots'* data stored in the flash memory. This option is useful when you suspect that the database may corrupt or when the user recovers data from a backup.

The form shows two different tables: one for the general registers (parameters, waveforms and spectra) and another one for the Long-Waveform files.

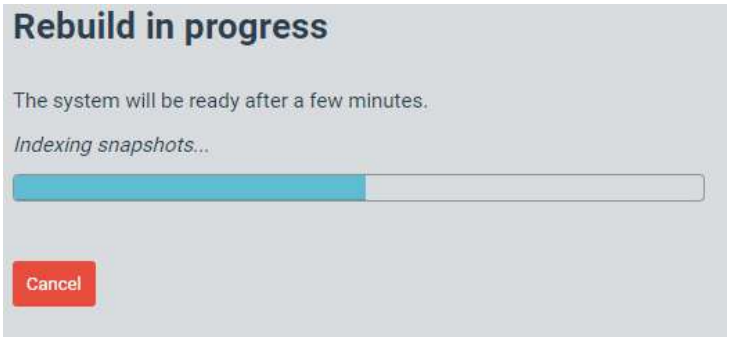
At the top of the form, a bar graphically displays the memory percentages used for each of the storage formats.



Field	Description
Machine	Shows the list of machines that have been configured on the *Vigilant* and have any unit.
Processing Mode	In the case of long-wave records, they separate depending not only on the machine but also the original Processing Mode related to the storage.
Used	Informs if the machine/Processing Mode is being actively monitored by the *Vigilant* unit in current configuration.
Records	Shows the number of records or *Captures* of each type stored on the internal memory.
First record	Date and time of the first *Capture* stored for the machine.
Last record	Date and time of the last *Capture* stored for the machine.
Delete range	Deletes the machine *Captures* stored within a time range.

Rebuild	Rebuilds the Redis database into RAM from the *Captures* stored in the flash memory.
Delete all	Deletes all the *Captures* stored on the internal flash memory for all the machines.

As said before, clicking on the *Update database* button in the top of the form, the system will rebuild the internal MySQL database of trends and temporal data by reading all the *Snapshot* files available in the flash memory. While executing this process, the following screen will be displayed until the database is ready again to be used:

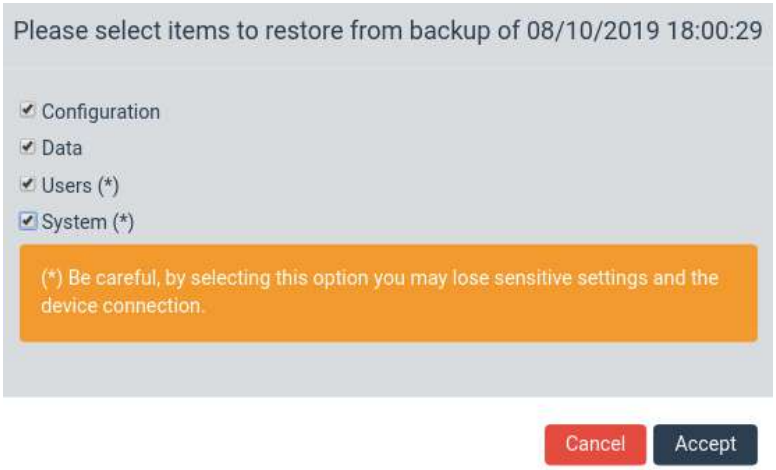


11.11 Backups

This form shows the list of backups of system data currently available in **Vigilant** network. The following information is shown for every file:

- Date: Date and time when the backup was created.
- Id: Unique identifier used to catalogue the files.
- FW. Version: Software version installed in the device when creating the backup.
- Name: Tag created by the user to use as a reference for identifying the content of the backup.

User can *Name*, *Restore* or *Delete* any of the backup files in this list. *Name* allows creating a tag name to identify the backup file. Clicking on the *Restore* button, the system will ask what part of the system data is needed to be restored (only the machine configuration and data, or also the system and user configurations):



You must enable Remote backup service to set up the configuration for generating new backups.

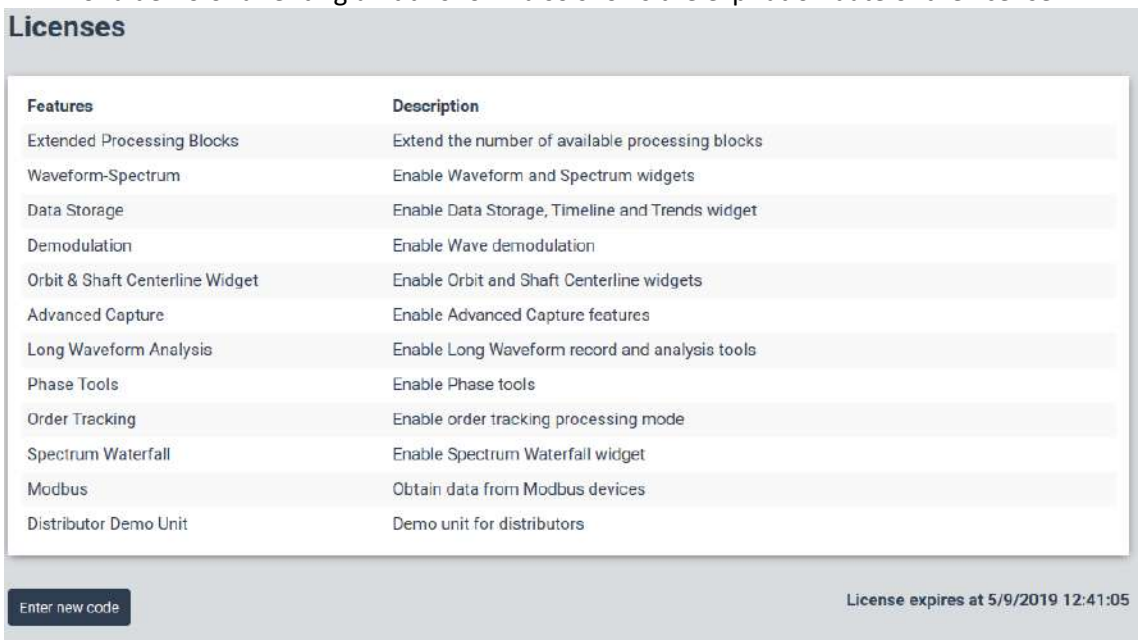
11.12 Simulation files

This section will find options to manage the simulation files loaded into the system, loading new files, or deleting the files already present in the system.

Please refer to the Appendix A to get more information about how to generate your simulation files.

11.13 Licenses

Shows a list with all the modules or features that have activated for this specific *Vigilant*. Please refer to Appendix B about Optional software features to see the complete list of available modules. In case of a demo or a renting unit this form also shows the expiration date of the license:



Once the license of a certain device is expired, the system will stop displaying the standard interface, and will redirect any user directly to this form. When the licenses are about to expire, e.g. they will expire in two weeks or less, the Exception indicator in the navigation bar urge the user to do something to extend the period of license.

While not having an active license, the system will continue to capture and store data normally. However, they will not be accessible to the users until any license is activated again.

Contact your *Vigilant* system provider to obtain a new license. They will send you an alphanumeric code that can be copied and pasted into the pop-up menu that appears when you click on the button on this form. If the code is right, the corresponding licenses will activate, and the device will resume its regular operation after restarting.

11.14 Upgrade firmware

This form shows the current firmware version of the *Vigilant* unit and allows upgrading it to the last version available. See the chapter about Upgrading the firmware to learn more about this process.

If the unit has the *Offline upgrade* module activated (Optional software features), the firmware updates by selecting a file in your local PC or network location. Otherwise, you will need direct connection to the Internet to execute the Upgrade.

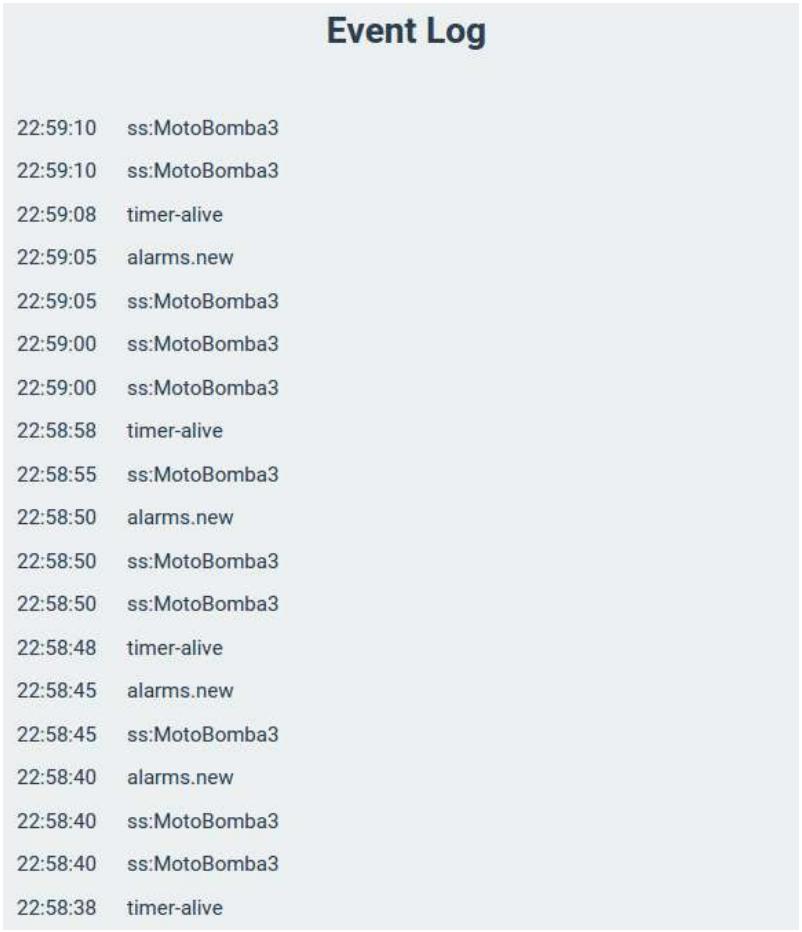
If the *Upgrade from server* option is selected, the button *Check for new updates* will verify if there is a new version of firmware available for the device. If that is the case, clicking on the *Upgrade* button will download and install all the files required for upgrading the firmware.

Below the current firmware version ID, the interface shows if it will look for new firmware in a *Stable* or in a *Testing* repository instead. The last options allow loading beta releases of the firmware. Only **Vigilant** personnel can change this setting.

11.15 Event Log

This menu shows the events occurring in the system. This option helps to know the unit's activity (captures, storage, event triggers, errors, alive heartbeat, alarms, etc.).

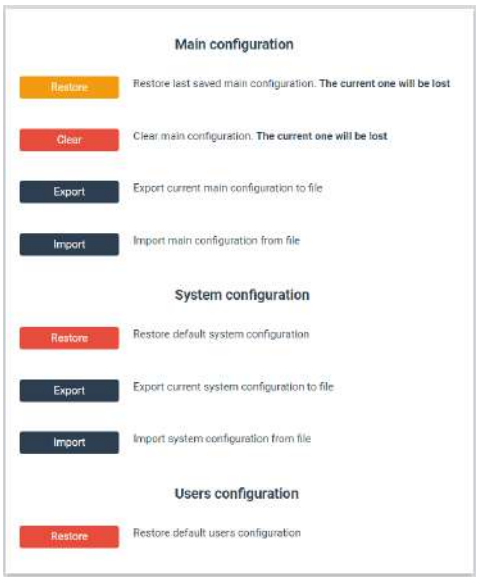
The interface will present a list of events, which will be updated in real time. The last event will appear at the top of the list and will show the date/time at which the event was triggered.



11.16 System maintenance

The *System maintenance* menu can be accessed through the icon on top of the System menu:

This section allows user restoring the default settings of the *Vigilant* units and importing and exporting user and system configuration files.



11.16.1 Main configuration

Field	Description
Restore	Restores last saved main configuration. Current settings will be lost.
Clear	Clear main configuration: erase all machines, points, and sensors. Main configuration will get empty.
Export	Exports into a file called *conf.db* the information related to the machines and measurements configuration: points, parameters, processing modes, sensors, etc.
Import	Imports into the *Vigilant* unit the *conf.db* file containing all the configuration settings for a machine or group of machines: points, processing modes, parameters, sensors, etc.

11.16.2 System configuration

Field	Description
Restore	Restores default system configuration: static IP set at 192.168.0.150, all services disabled, etc. Current settings will be lost.
Export	Exports into a file called *system.db* all the configuration options contained in the *System* interface.
Import	Imports into the *Vigilant* unit the *conf.db* file containing all the configuration settings for a machine or group of machines: points, processing modes, parameters, sensors, etc.

11.16.3 Users' configuration

Field	Description
Restore defaults	Restores the default user's configuration: Deletes all users other than *admin*, restores the *admin* user's default password and deletes user preferences in the *Dashboard*.

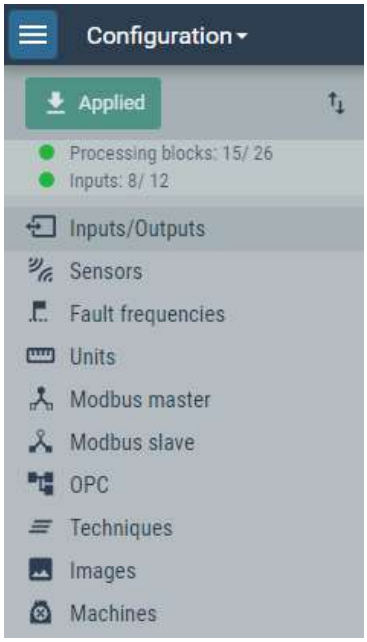
12 Configuration

12.1 Introduction

In this section shows how to configure the *Vigilant* unit's monitoring options, including its *Inputs, Sensors, Machines, Points of measurement, Processing Modes, Storage Strategies*, etc. It describes the *Configuration* interface, its usage and defines all the available fields and concepts in the system for a correct monitoring configuration.

12.1.1 Toolbar

The *Configuration* interface shows a vertical Toolbar on the left, which allows the user to access the different configuration options on the upper part of the Toolbar. It lists the *Machines* defined in the unit.



Option	Description
Apply	This button applies the changes made in the configuration database to the *Vigilant* unit.
⇅	Shows the *System maintenance* tools (see System maintenance)
Processing blocks: X/X	The processing blocks indicate the capacity of the device to execute different *Processing Modes* simultaneously. This bar indicator shows the resources available in the device.
Inputs X/X	Indicates which physical inputs of the instrument are being used. This bar indicator shows the device's resources.
Inputs/Outputs	Configures the physical inputs and outputs (connectors) of the *Vigilant* unit.

Sensors	Defines the sensors to be used on the system.
Fault Frequencies	Defines the fault frequencies that will be available in the system to be assigned to the dynamic points.
Units	Sets the properties and units available on the system.
Modbus master	Sets properties to configure the *Vigilant* as client in the network, asking other devices for their register's values (Optional software features).
Modbus slave	Sets properties to configure the *Vigilant* as server in the network, allowing other devices to read different parameter values.
OPC	Sets properties to configure the *Vigilant* as OPC-UA client for connecting to OPC endpoints and be able to read or write nodes (Optional software features).
Techniques	Defines the techniques that will be able to be assigned to the different points.
Images	Defines the images available on the system to be assigned to a machine.
Machines	Configures the machines to be monitored with the *Vigilant*. The Toolbar shows the list of machines defined on the unit, which give access to their particular configuration components (see Machines).

12.1.2 Processing Blocks

The *Processing Blocks* are a way to measure the device's capability to execute simultaneous operations with the data coming from the different inputs.

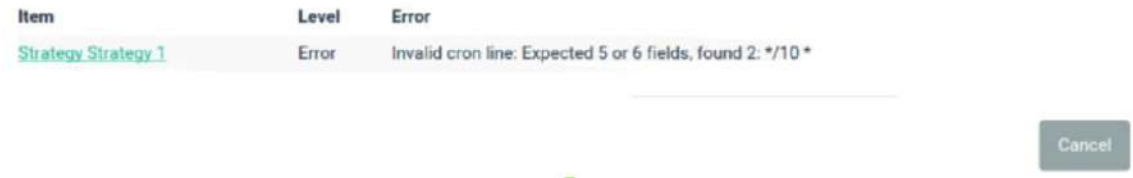
Each input of the *Vigilant* unit can link to a measurement *Point*. If the Point is *Dynamic* type, it can have different Processing Modes .The data coming from the sensor is analyzed simultaneously in different ways (e.g. high and low frequencies, different filter settings, applying demodulation, etc.).

Each Processing Mode configured for a Dynamic Point consumes one Processing Block. Maximum number of Processing Blocks is 16 by default, although it can be expanded to a total of 24 processing blocks (Optional software features).

Users can add more Points and Processing Modes to those Points until there are no more Inputs to configure, or also until the system has reached its maximum number of Processing Blocks available.

12.1.3 Apply button

The *Apply* button located at the upper part of the toolbar checks the monitoring configuration and applies the changes. If found some errors, the interface will show a list of mistakes, as shown below. The link of the error allows accessing the form that contains the error.

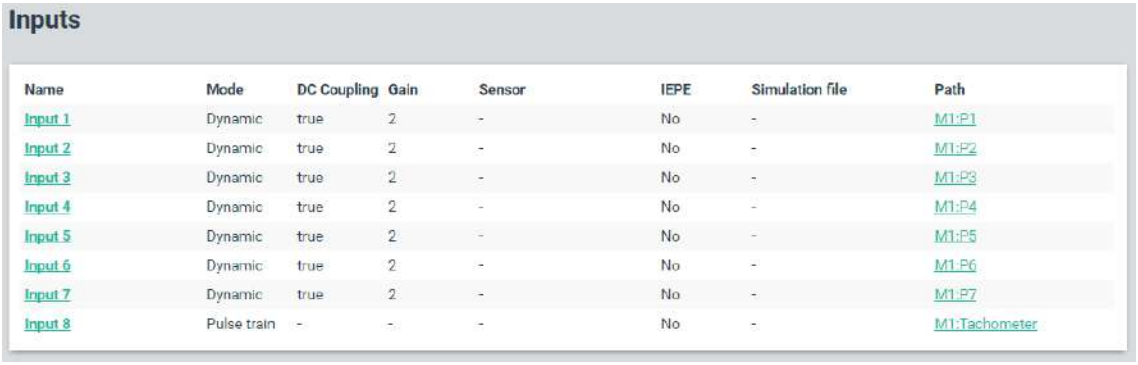


If it hasn't found errors, the system will ask for confirmation to apply the configuration. Clicking on the *Apply configuration* button will apply the configuration into the *Vigilant*, which will start monitoring with the new configuration options, changing the Apply button's label into "applied".

All changes made on the configuration interface will store on the configuration database. However, they will not be applied into the *Vigilant* until the configuration errors are checked, and the Apply configuration button is clicked.

12.2 Inputs/Outputs

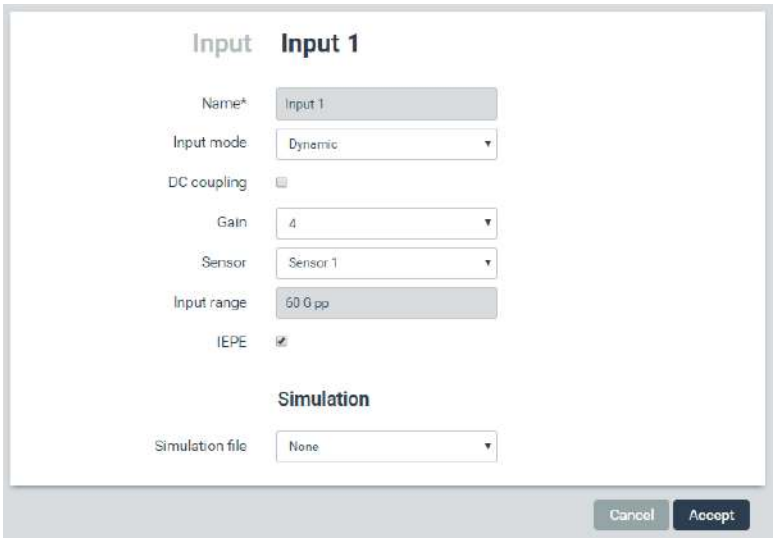
This menu allows configuring the input and output channels of the *Vigilant* device. By clicking on this option, the interface will show the inputs.



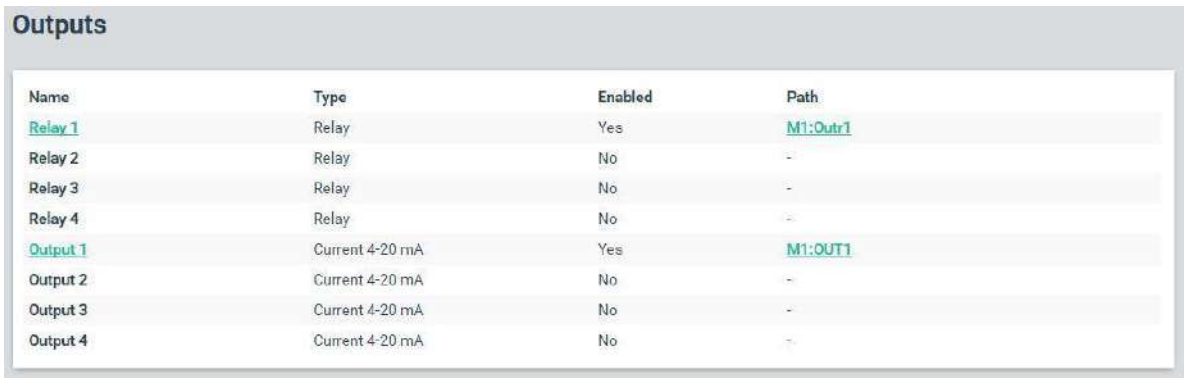
Field	Description
Name	Shows the input channel that will be configured.
Mode	Defines the type of operation that will be used for this input: • *Dynamic:* For high sampling rate analog voltage signals. • *Voltage:* For low sampling rate analog voltage signals. • *Resistance*: For particular inputs reading resistance. • *Pulse train*: This type is intended for pulsed voltage signals. Measures the frequency of the pulses in Hz. The trigger level and hysteresis can be set up by the user. • *Digital*: Digital voltage signals. Returns a value of 1 when the signal goes above the trigger value, returning a 0 otherwise. A hysteresis band is created around this trigger value. The user can set both values.
DC Coupling	By marking this checkbox, the DC component of the signal will not be filtered out. It only applies to *Dynamic analog* input types.
Gain	Defines the gain or amplification ratio that will apply to the signal of the input. This option modifies the range, or maximum amplitude the input will be able to measure, considering the maximum voltage for the channels is ±24 V. Only applies to Dynamic and Static Analog type inputs.
Sensor	Selects the sensor assigned to the input channel. Only shown for *Dynamic* and *Static Analog* type inputs.
IEPE	Activate IEPE current source to power the sensor.

Simulation	Selects a file containing a simulation signal that will replace the input signal for that channel. The simulation signal contained in the file will be replayed continuously.
Path	Indicates the actual Machines and measurement points that are using this analog input to acquire monitoring data. Clicking on the link will lead to their configuration.

Clicking on one of the items it will lead to the configuration menu the corresponding input, where some additional parameters are available:



Field	Description
Input range	Shows the maximum signal amplitude peak to peak that will be able to measure the input channel depending on its gain and sensor sensitivity.
Threshold	Selects the voltage value that will be used to trigger a *Pulse train* input mode.
Hysteresis	Sets a hysteresis around the threshold voltage that triggers the pulse detection. For instance, an hysteresis of 0.1V and a threshold of 1V will make the system detect the pulse when the signal goes above 1.1V, and stops detecting it when the signal goes below 0.9V
Edge	Selects if the pulse signal will be detected from its raising or from its falling side.

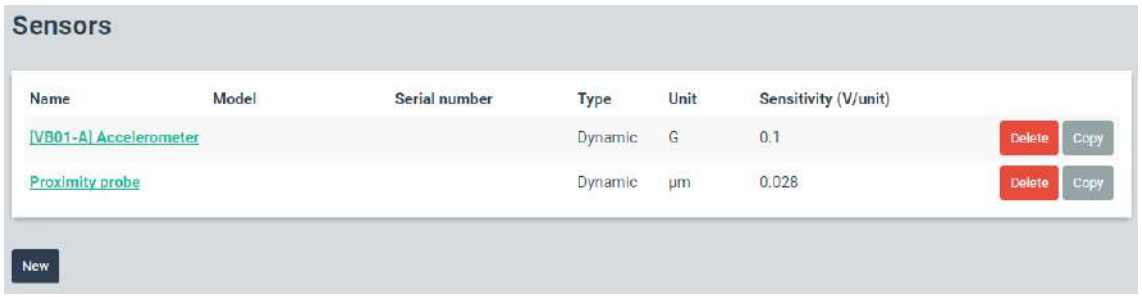


Field	Description
Name	Shows the list of the available output ports.
Type	Indicates the type of output port: • *Relay*. • *Current 4-20 mA*.
Enabled	Indicates if the output is being used.
Path	Indicates the path of the Machines and output connections that are using this analog. Clicking on this link will bring to the Output connections configuration.

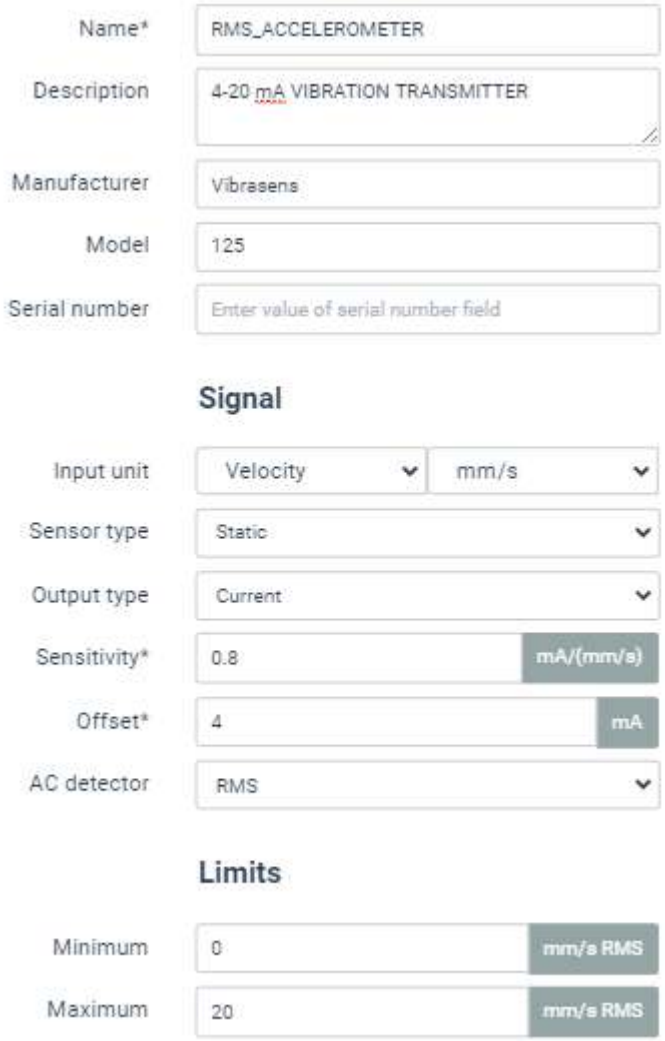
Note that these output ports will no directly configured here, but instead, we will need to configure them under the Output connections menu in machine configuration.

12.3 Sensors

This section configures the sensors that will be connected to the *Vigilant* inputs. By clicking on this menu option, the interface shows the list of sensors available on the unit.



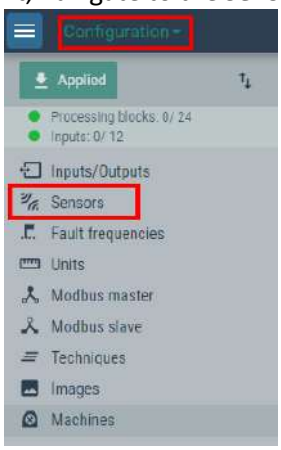
Click on one of the items of the list to configure the corresponding sensor.



12.3.1 CONMONSense Sensor 0-10v Configuration

Sensor configuration

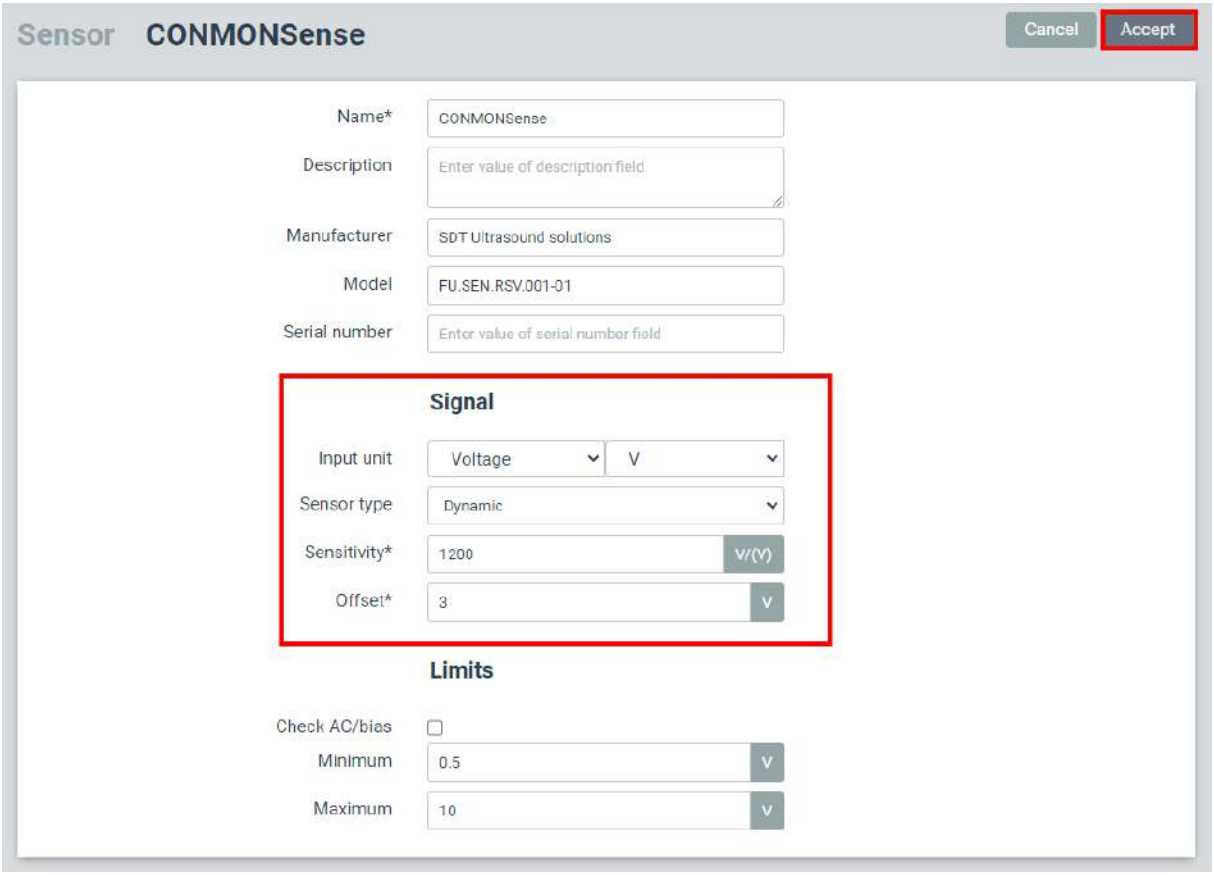
a. When you are logged to your Vigilant, navigate to the ***Sensors*** menu under the ***Configuration.***

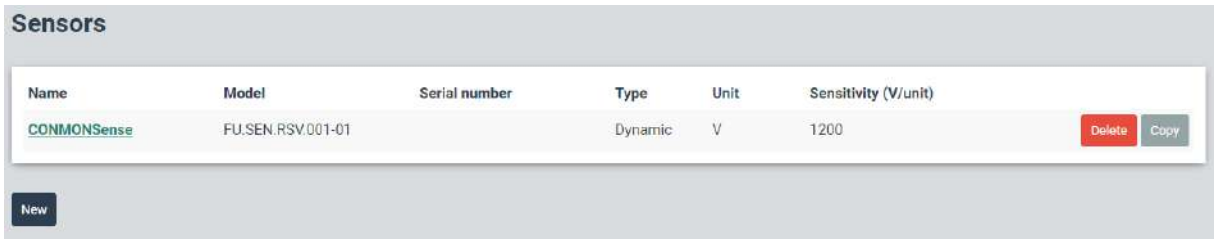


b. Create a new sensor by clicking the ***New*** button.

c. Fill the fields with the following values:

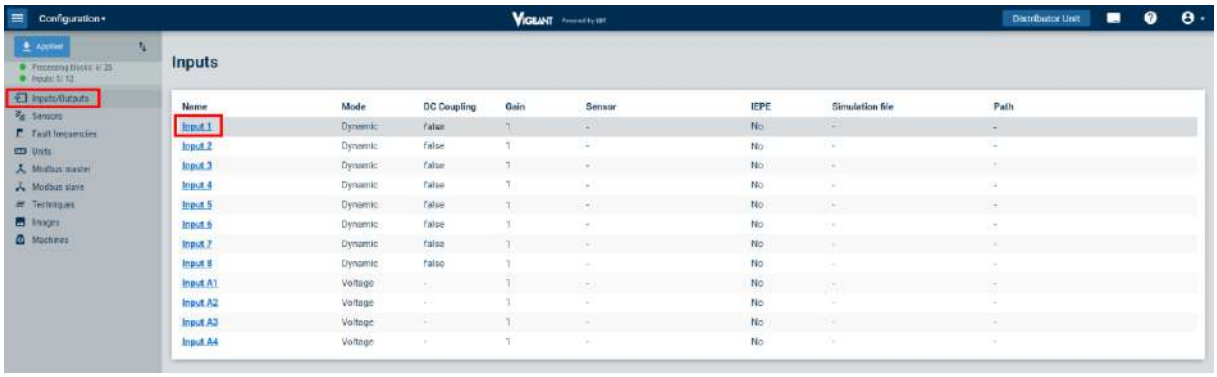
- ***Name***: does not really mater, you can use any name that helps you to identify the sensor. Here we use *CONMONSense.*
- Others non-mandatory fields (*description*, *manufacturer*, *model*, *serial number*) do not mater and you can fill them with whatever you think useful for your needs.
- ***Sensor type***: Dynamic
- ***Unit***: Voltage [V]
- **Sensitivity:** 1200
- ***Offset voltage***: 3
- The limits fields are not mandatory, but you can fill them if you want to monitor the offset voltage:
  - ***Maximum*** 10
  - ***Minimum*** 0.5
- Terminate by clicking the ***Accept*** button.



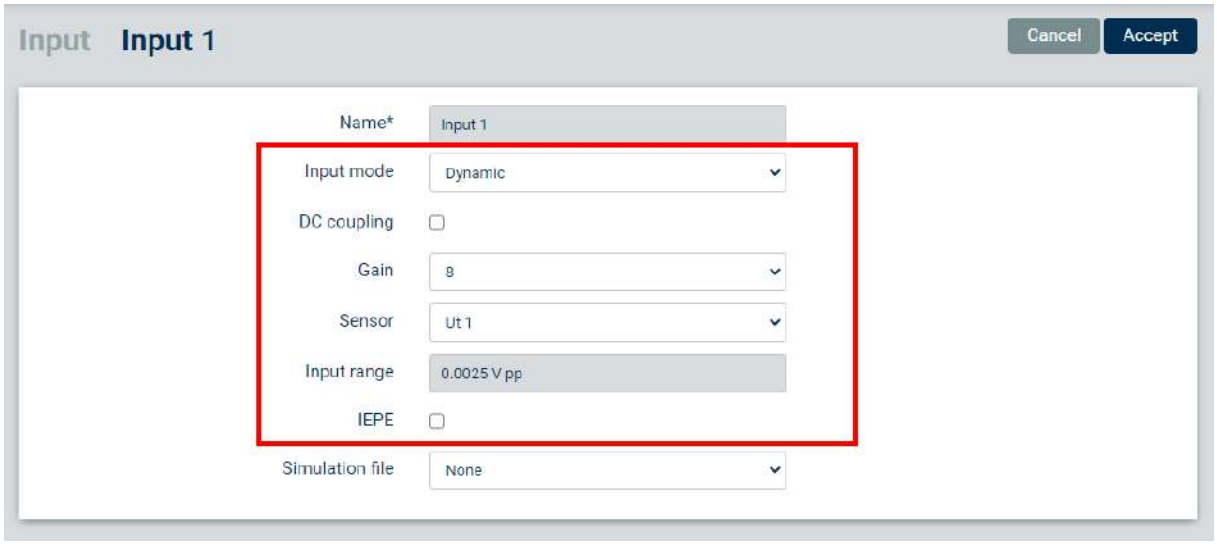


Input configuration

a. Navigate to the ***Inputs/Outputs*** menu and click on the input number physically connected to the sensor (for this example we assume that the CONMONSense sensor is connected to the input 1)



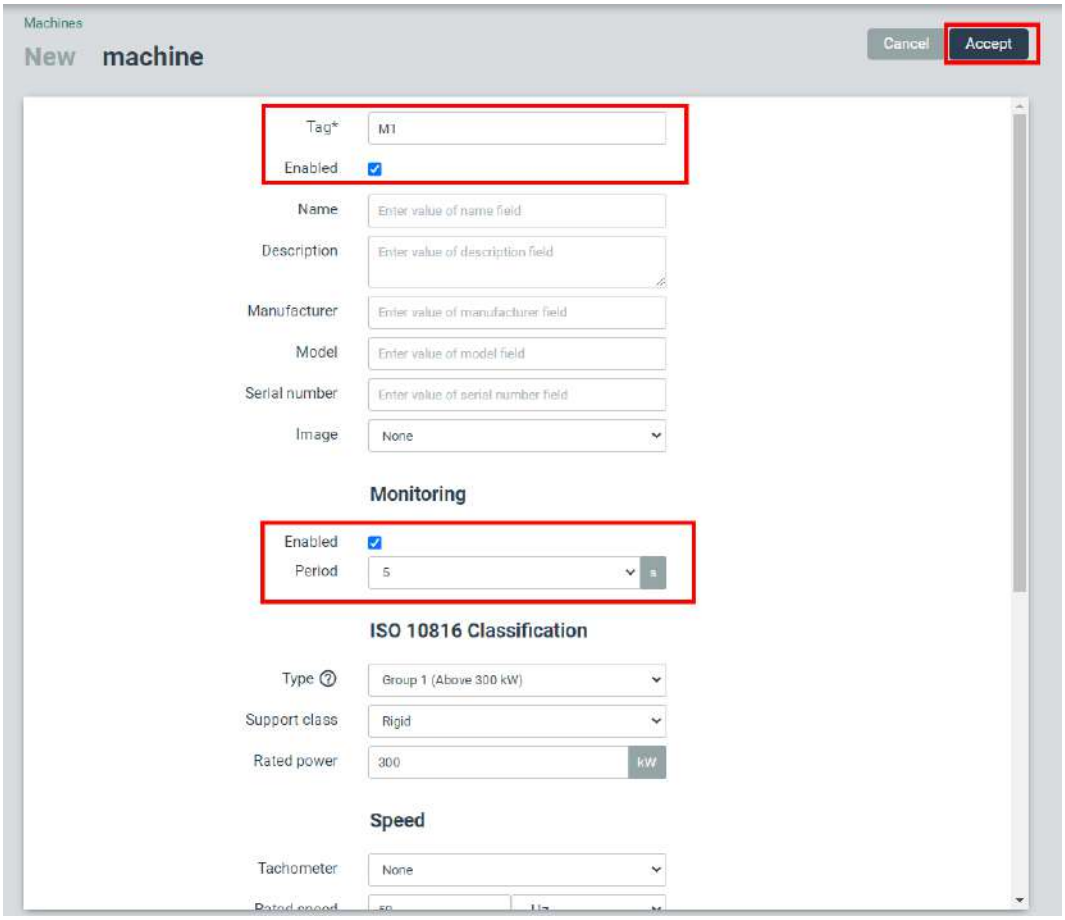
- ***Input mode***: Dynamic
- ***Sensor***: select CONMONSense
- ***Gain:*** 8 (this is the best suited gain in order to measure the full CONMONSense range)
- ***DC coupling***: checked if you want to monitor the bias voltage, unchecked if you only want to monitor the sensor signal.
- All other fields should be left unchanged.
- Validate by clicking the ***Accept*** button.



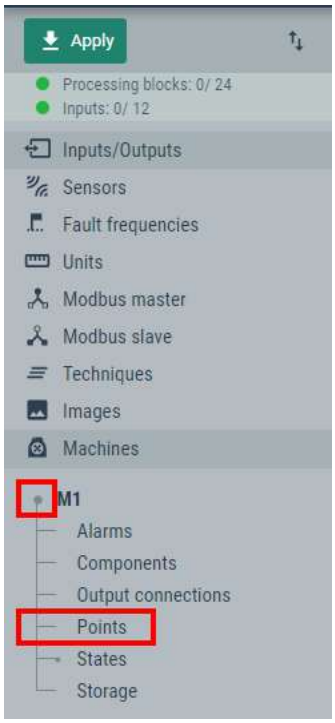
Machine configuration

a. Navigate to the ***Machines*** menu and create a ***New*** machine.

b. Fill the fields with your machine information (all non-mandatory fields are optional) and make sure than both ***Enabled*** check boxes are checked. You can also modify the monitoring ***Period***. It sets the time between 2 data acquisitions (for more information please refer the the Vigilant user manual).

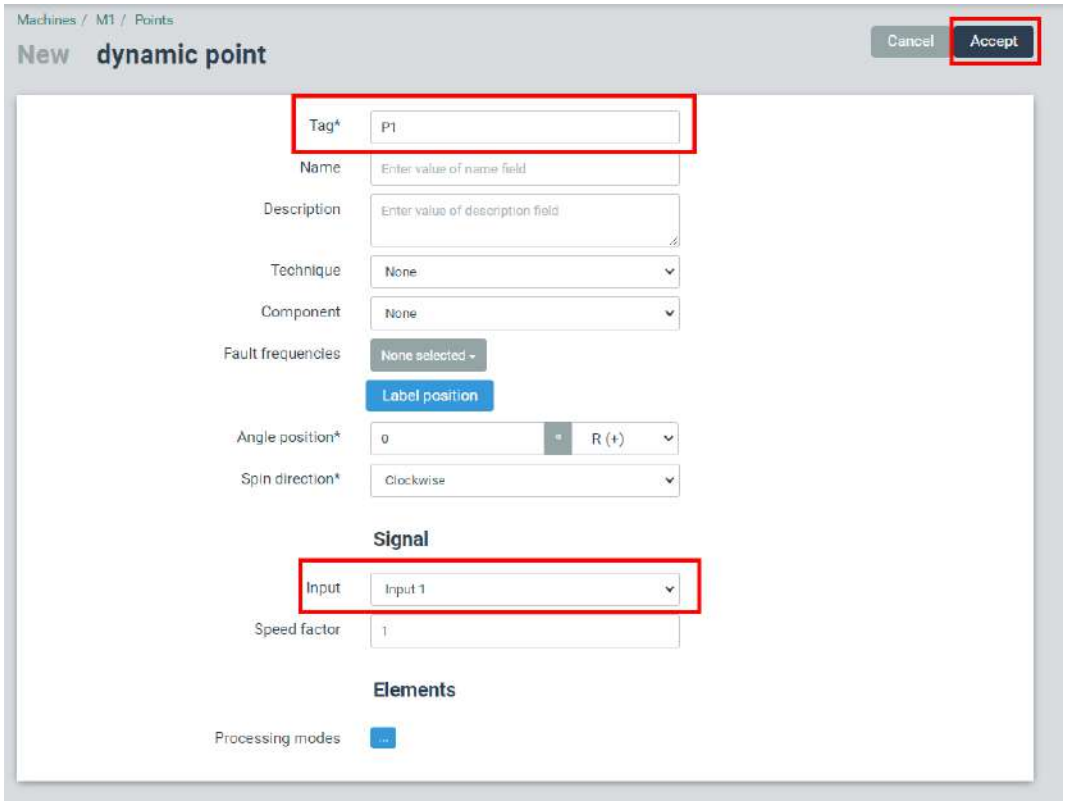


c. Create a new ***Dynamic point*** by navigating to your newly created machine menu.



↓

d. Set a name to identify your measurement point and select the input associated to this point.

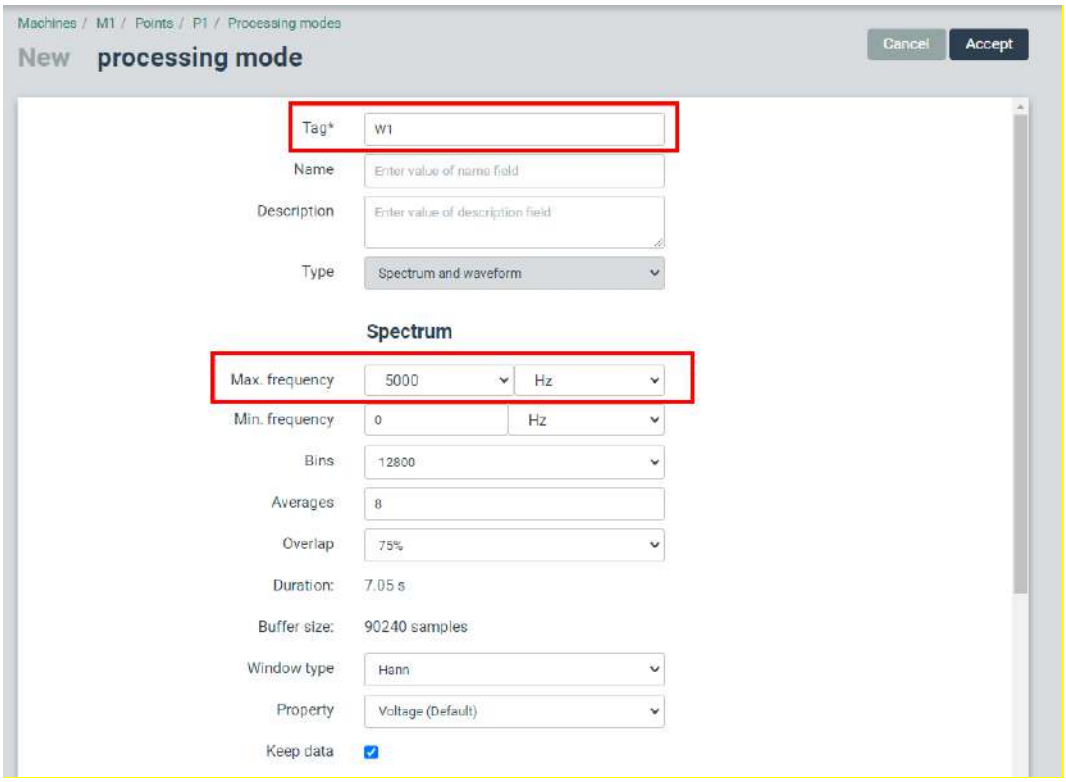


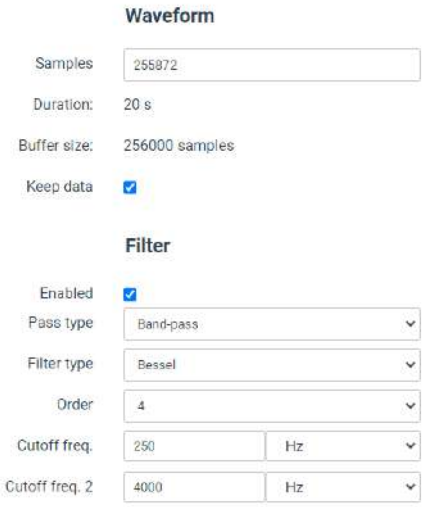
e. Navigate to the ***Processing modes***

For this example, we will create 3 processing modes:

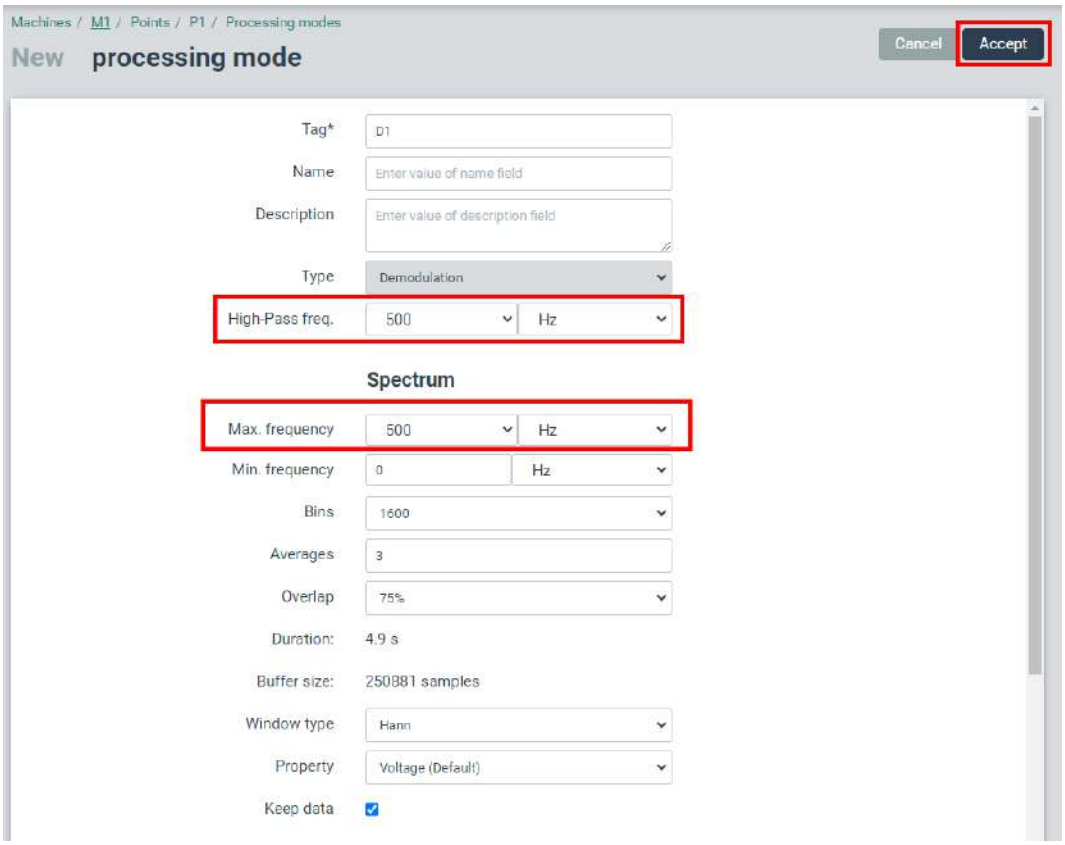
- Spectrum and waveform
- Demodulation
- Long Waveform

- Spectrum and waveform
  - ***Tag***: use a name to identify the processing mode
  - ***Max. frequency***: 5000 [Hz]
  - ***Keep data***: checked in order to visualize the graph in the Desktop window (see below)
  - You can configure the parameters for ***windowing*** and ***filtering***. If you are not used to this configuration, use the default values.

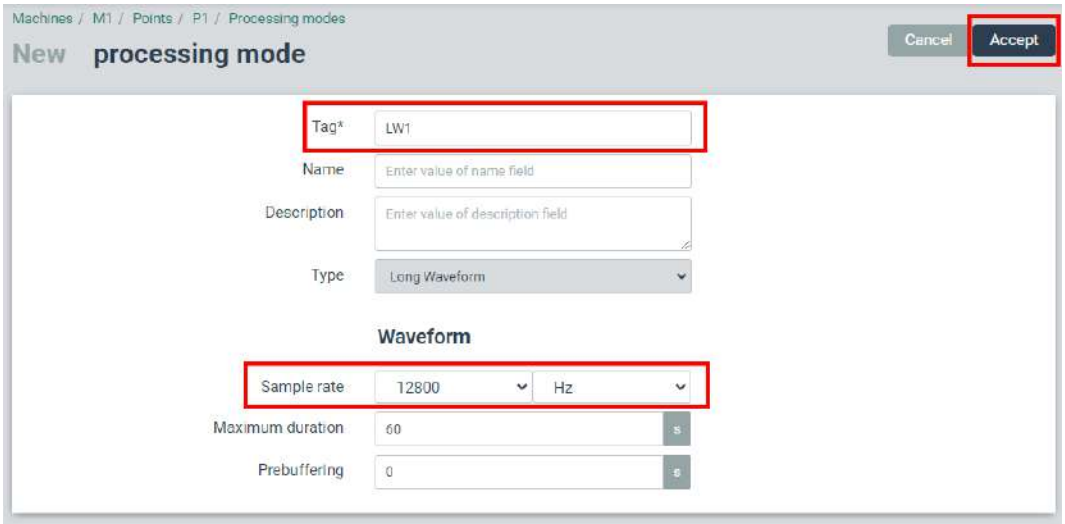




- Demodulation
  - ***Tag***: use a name to identify the processing mode
  - ***High-Pass freq.***: 500 [Hz]
  - ***Max. frequency***: 500 [Hz]
  - You can modify the ***Bins*** and ***Averages*** in accordance to your needs as long as you do not exceed 256000 samples for the ***Buffer size***
  - *Keep data*: checked in order to visualize the graph in the dashboard window (see below)
  - You can parametrize ***demodulation waveform*** and ***filter*** if you are interested by the envelope time waveform (not used in this example)



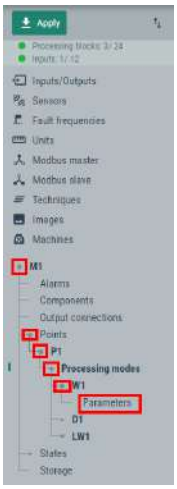
- Long Waveform
  - ***Tag***: use a name to identify the processing mode
  - ***Sample rate***: 12800 [Hz]
  - ***Maximum duration***: configure the desired dynamic waveform duration.



f. Define ***Parameters***

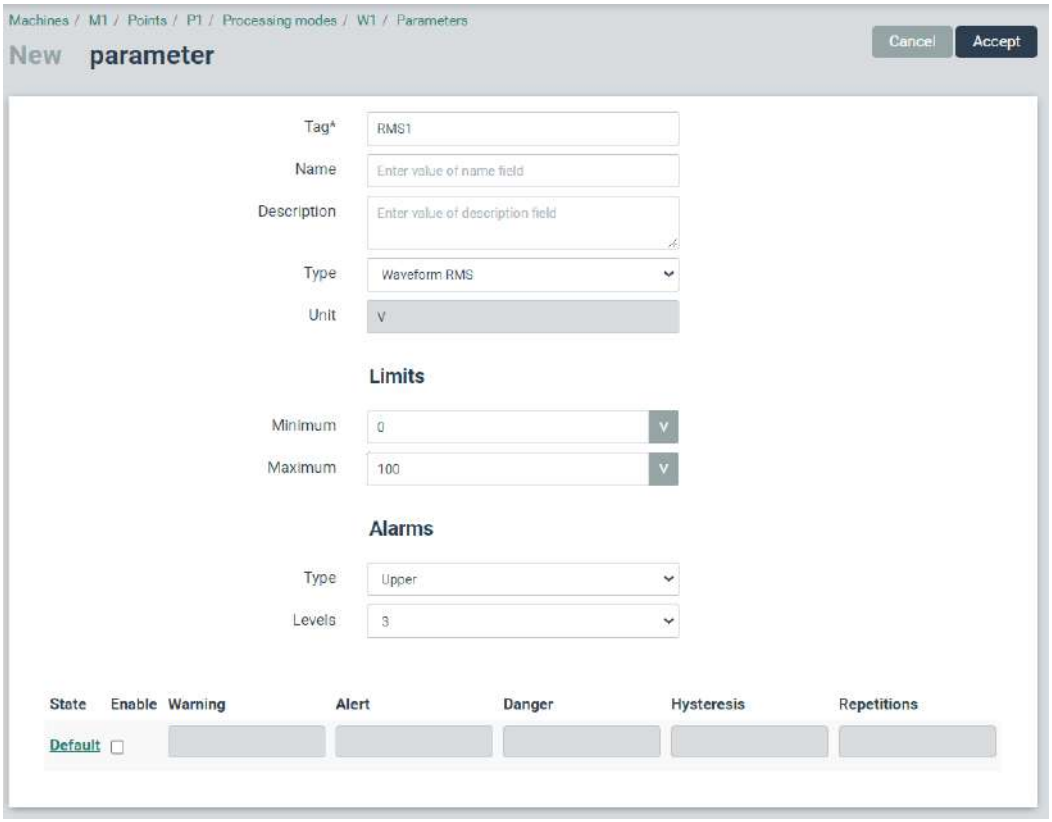
For each processing mode a set of parameters can be configured. We will configure 3 of them for the Waveform processing mode

- RMS
- Peak
- Crest-Factor

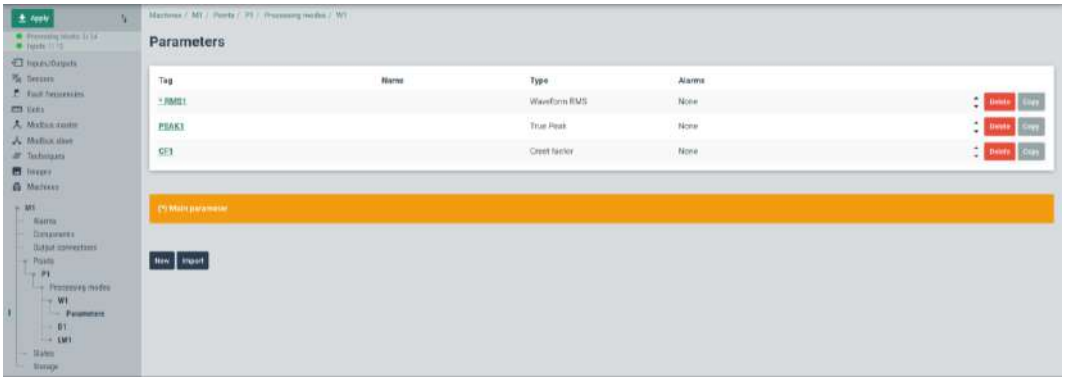


↓

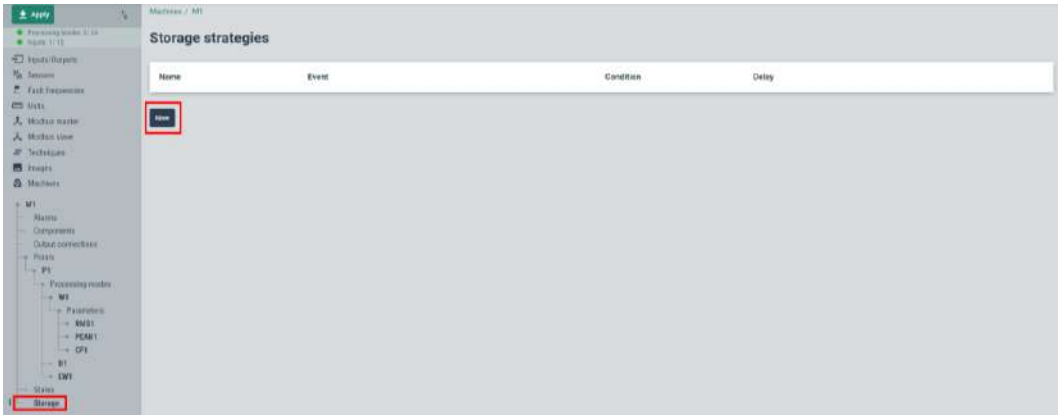
You can choose and configure the parameter and defining the limit values as well as the alarms according to your application needs.



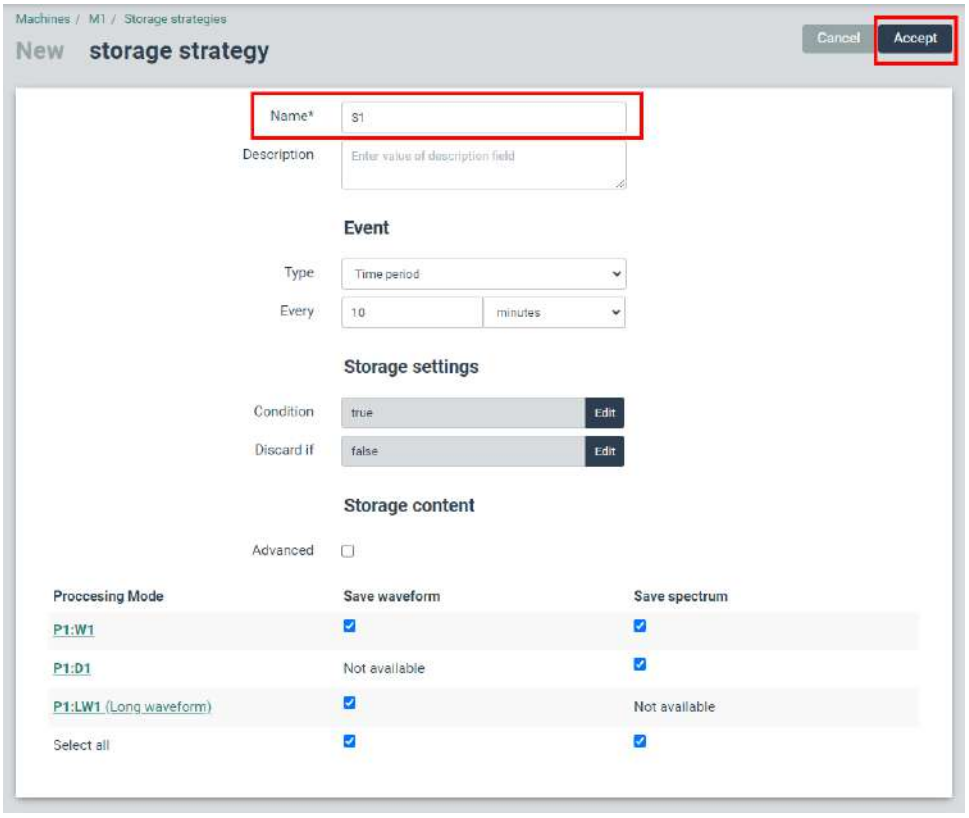
Steps are the same for all other parameters.



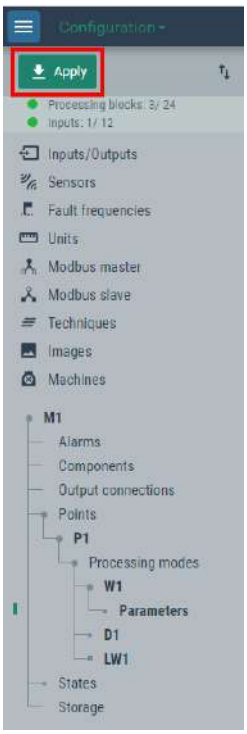
g. Navigate to storage and create a new ***Storage strategies***



- Select the storage period and the data you want to save.
- Validate by clicking the ***Accept*** button.



h. Apply the whole configuration by clicking the ***Apply*** button.



12.3.2 Information

Field	Description
Name	Identifies unequivocally the sensor. It can contain numbers, upper and lower characters. Special characters or blank spaces are not allowed.
Description	This field provides a description of the sensor.
Manufacturer	Defines the manufacturer of the sensor.
Model	Defines the model of the sensor.
Serial number	Sets the serial number of the sensor.

12.3.3 Signal

Field	Description
Input Unit	Sets the magnitude/property measured by the sensor, and its units. Both the units and magnitudes will be selected from a pull-down menu. The units and magnitudes available are defined on the Units section.
Sensor Type	Defines if the sensor provides a static or dynamic signal.
Output Type	Sets the type of output provided by the sensor. In most cases, it will be voltage.

Sensitivity	Sets the sensitivity of the sensor in volts per engineering units, as defined in the previous field.
Bias voltage	Value in volts of the signal offset provided by the sensor.
AC detector	Defines the detector type (if any) associated with the value measured for the static signal (RMS, Peak, Peak-Peak or none). Applies only to *Static* sensors type.

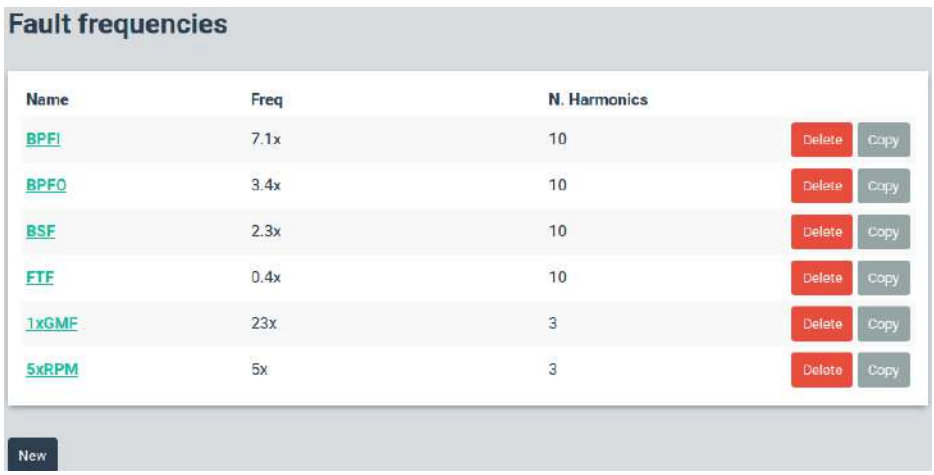
12.3.4 Limits

Field	Description
Check AC/bias	This checkbox defines if both the DC and AC components of the signal must be validated by the system (applies only for dynamic sensors type).
Minimum	Defines the minimum value allowed for the signal provided by the sensors.
Maximum	Defines the maximum value allowed for the signal provided by the sensors.
Maximum Peak	Defines the maximum peak value allowed for the AC component of the signal provided by the dynamic sensor. Applies only for dynamic sensors type when *Check AC/bias* is checked.
Min. bias voltage	Sets the minimum value in volts allowed for the DC component of the signal provided by the sensor. Applies only for dynamic sensors type when *Check AC/bias* is checked.
Max. bias voltage	Sets the maximum value in volts allowed for the DC component of the signal provided by the sensor. Applies only for dynamic sensors type when *Check AC/bias* is checked.

12.4 Fault Frequencies

Fault frequencies are objects that represent a frequency associated to a fault or condition of the machine. These objects can be assigned to dynamic points to show them on the spectrum Widgets of the Dashboard.

By selecting this menu option, the interface will show the list of Fault frequencies configured, which allows to edit, delete, or create new ones.



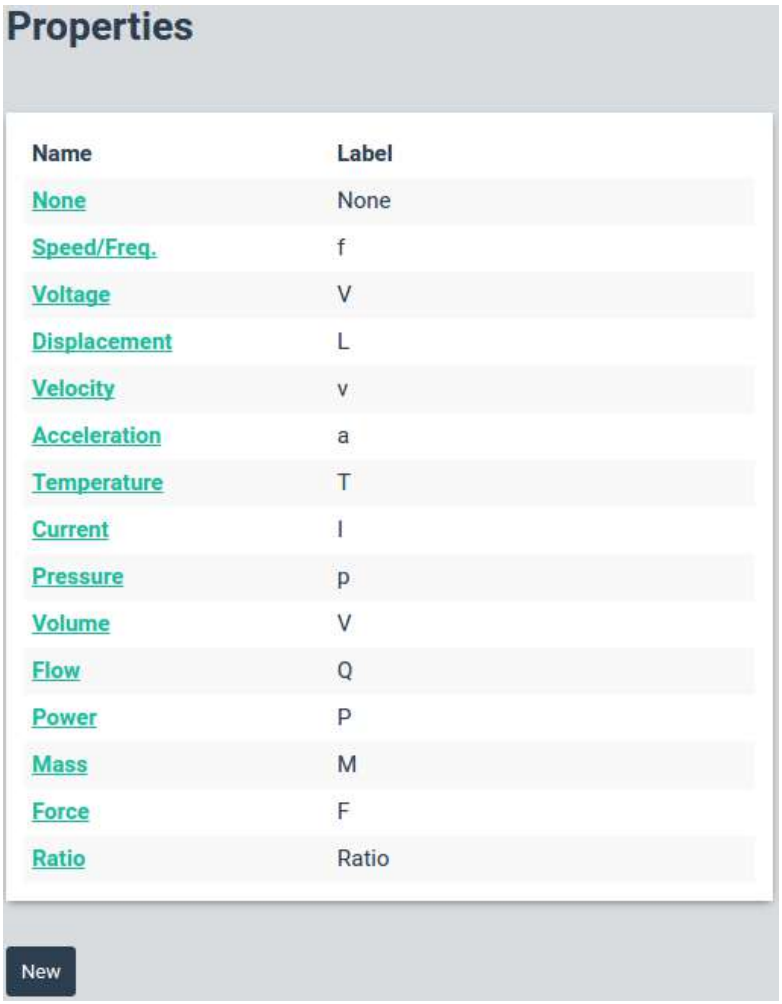
Click on one of the list items to configure the corresponding fault frequency or in the New button to add a new one.

Option	Description
Name	Identifies unequivocally the *Fault frequency*. It can contain numbers, upper and lower characters. Special characters or blank spaces are not allowed.
Description	This field allows the user to include a description of the *Fault frequency*.
Use order	Select this option to define the fault frequency in orders.
Freq	Defines the frequency of the object. It can be defined in either Hz/CPM or in order units, depending on if the *Use Order* checkbox is selected or not. Order units are based on the RPM of the point. In the example above the fault frequency is set as 3.56 times the RPM defined for the point. If *Use Order* checkbox is not checked the user can select either CPM or HZ units to define the frequency.
Nb. of harmonics	Sets the number of harmonic lines to show on the spectrum.

12.5 Units

This option defines the *Properties* and *Units* that will be available on the system and may be linked to the Sensors.

The *Vigilant* comes with a list of factory predefined properties:



New properties (e.g. a chemical concentration of any substrate) can be defined by the user.

The system also includes a set of predefined units, linked to the above properties. New units may be defined for the predefined properties and for the new properties defined by the user:

Units

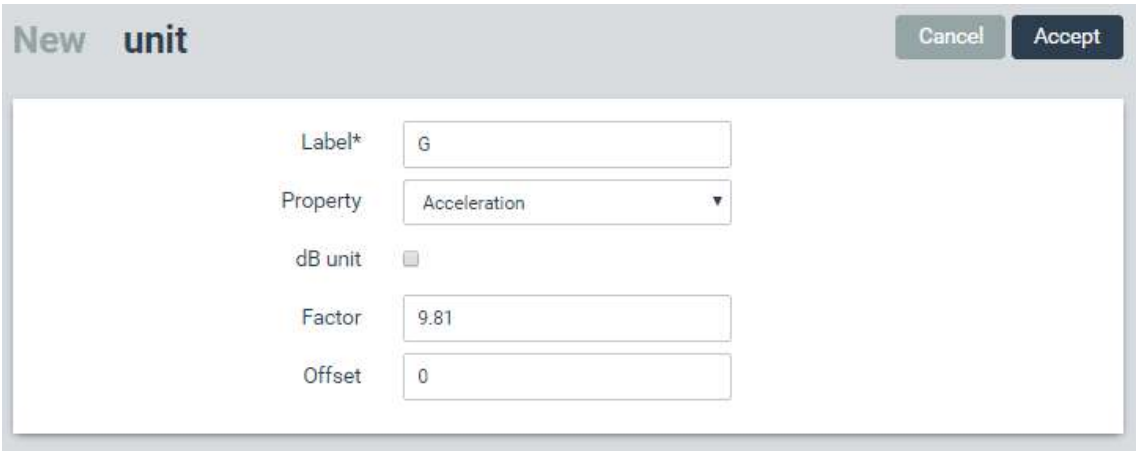
Label	Property	Factor	Offset	dB Reference
	None	1	0	-
Hz	Freq.	1	0	-
CPM	Freq.	0.017	0	-
V	Voltage	1	0	-
kV	Voltage	1000	0	-
mV	Voltage	0.001	0	-
µV	Voltage	1e-06	0	-
m	Displacement	1	0	-
ft	Displacement	0.305	0	-
cm	Displacement	0.01	0	-
mm	Displacement	0.001	0	-
mil	Displacement	2.54e-05	0	-
µm	Displacement	1e-06	0	-
m/s	Velocity	1	0	-
cm/s	Velocity	0.01	0	-
mm/s	Velocity	0.001	0	-
G	Acceleration	9.81	0	-
m/s²	Acceleration	1	0	-
cm/s²	Acceleration	0.01	0	-
mm/s²	Acceleration	0.001	0	-
°C	Temperature	1	0	-
°F	Temperature	0.556	-17.78	-
K	Temperature	1	-273.1	-
A	Current	1	0	-
mA	Current	0.001	0	-
Bar	Pressure	1	0	-
PSI	Pressure	0.069	0	-

The predefined *Properties* and *Units* are read only and cannot be deleted or edited (except *dB reference* field of the *Units*). Those created by the user may be erased by pressing on the *Delete* button.

The following form shows the fields that define a new *Property*.

Option	Description
Name	Identifies the *Technique* unequivocally. It can contain numbers, upper and lower characters. Is not allowed special characters or blank spaces.
Label	Text that will be used on the *Dashboard* to identify the property.
Integrates to	Selects the Property it will convert to when integration is selected.

The following form shows the fields that define the *Units*.

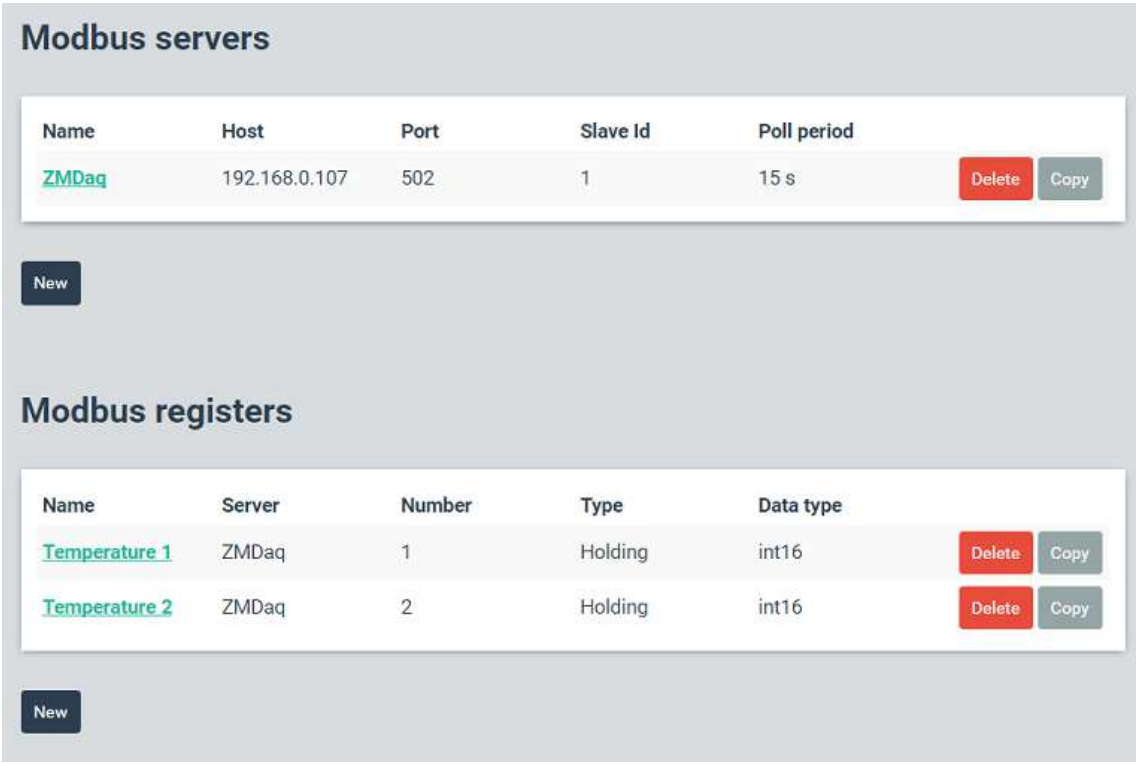


Option	Description
Label	Text that identifies unequivocally the *Unit* within the system It can contain numbers, upper and lower characters. Is not allowed special characters or blank spaces.
Property	Property associated to the *Unit*.
dB unit	Configures the unit to use a linear scale (if this checkbox is not selected) or logarithmic scale (if selected)
Factor	Sets the factor that will be applied to the measurement to convert its units into the Unit being configured.
Offset	Defines the offset applied to the measurement to convert its units into the Unit being configured. This value will be subtracted from the measurement after applying the unit factor.
dB Reference	Sets the reference value (in default units) for the dB calculation, in case of dB units.

12.6 Modbus master

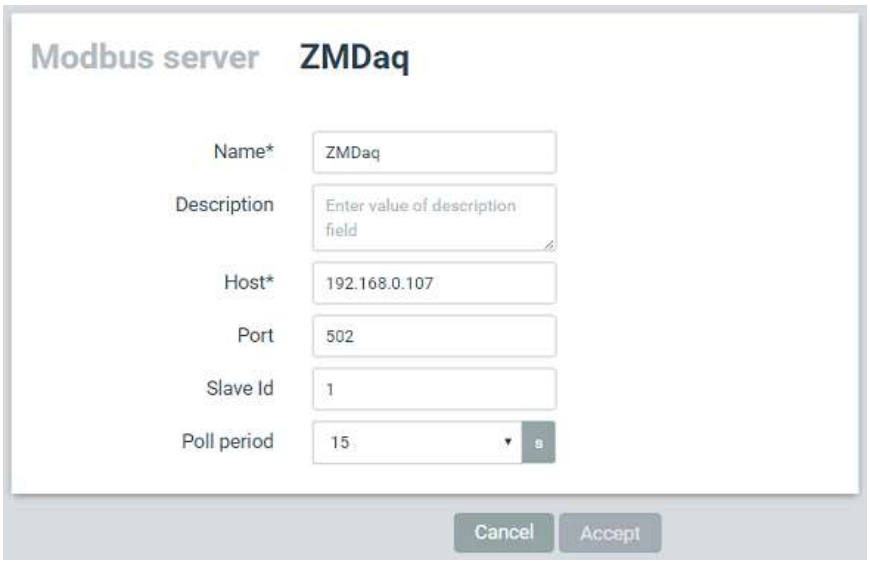
The Modbus Master module allows connecting to external instruments such as sensors or PLCs to read values and use them for the machine supervision (Optional software features).

This menu defines the *external devices* that will act as Modbus servers, and also the internal *registers* in those devices that will be read by the *Vigilant*.



The menu includes two separate forms that allow the configuration of external Modbus data sources.

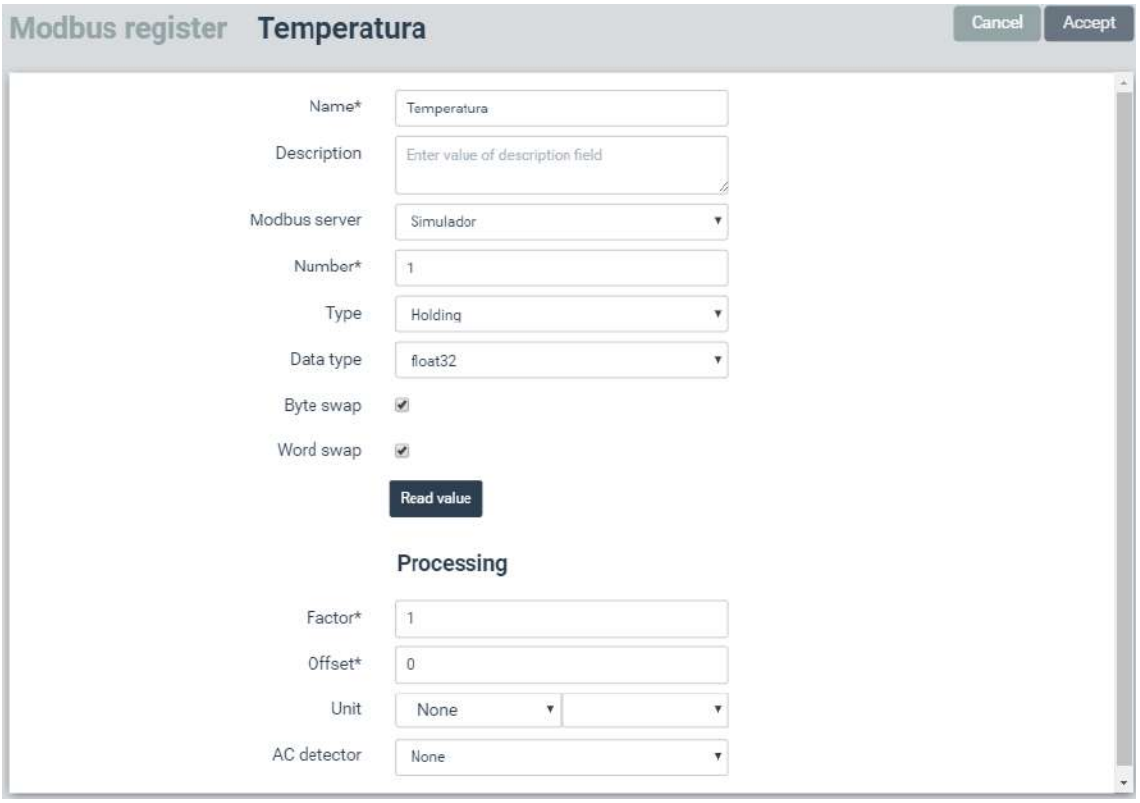
The first form shows the fields that define the external Modbus *servers*:



Option	Description
Name	Identifies the *Server* unequivocally. It can contain numbers, upper and lower characters. Special characters or blank spaces are not allowed.
Description	Text of description, for user notes only.
Host	IP or web address of the device that will act as Modbus server.

Port	Number of TCP port that the server has reserved for Modbus communications. By default, the port number is 502.
Slave Id	Slave number of the server in the Modbus network.
Poll period	The reading of the *Modbus registers* on each server will be done on specific periods defined by this parameter.

A second form shows fields to define the specific Modbus *registers* that are available to read in the previously defined servers:



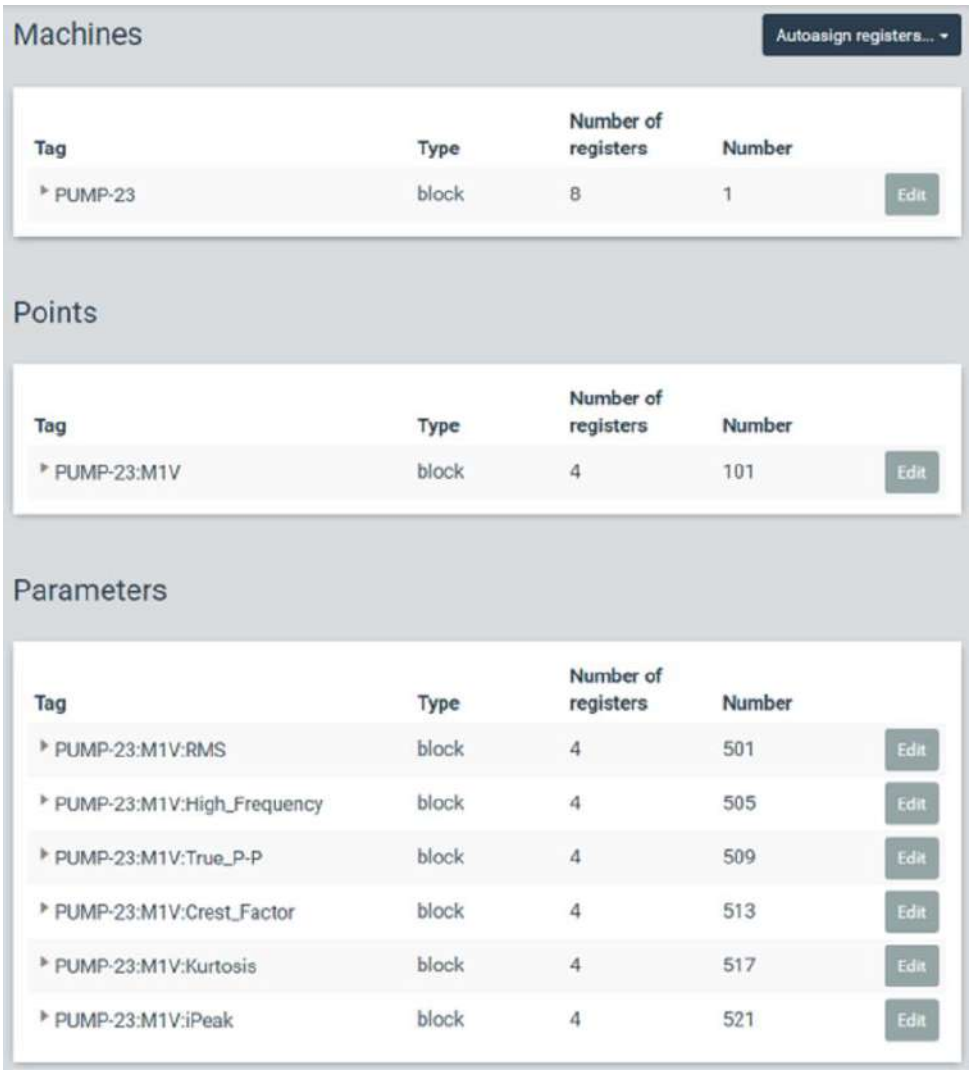
Option	Description
Name	Identifies unequivocally the *register*. It can contain numbers, upper and lower characters. Special characters or blank spaces are not allowed.
Description	Text of description, for user notes only.
Modbus server	Indicates which *Modbus server* this register is related to.
Number	Indicates the Modbus address or register number.
Type	Set up the type of register: coil (binary), discrete input: • Coil (binary) • Discrete input (binary) • Input • Holding.
Data type	Sets the numeric data type in order to allow operations with it: • Int16: integer number, 16 bits. Takes 1 Modbus registers.

	• Int32: integer number, 32 bits. Takes 2 Modbus registers. • Float: float number, 32 bits. Takes 2 Modbus registers. • Unsigned int16: unsigned integer number, 16 bits. Takes 1 Modbus registers. • Unsigned int32: unsigned integer number, 32 bits. Takes 2 Modbus registers.
Byte swap	Swaps the position of 2 bytes in a Modbus register. Box unchecked indicates no swapping.
Word swap	Swaps the position of 2 words (each one 16 bits) in a 32-bit data type. Box unchecked = no swapping.
Read value	Executes a single reading of the specific register, to evaluate that the rest of the configuration is OK.
Factor	Calibration slope factor to be applied to the register data, in order to convert the number to the desired format.
Offset	Calibration offset value for the register data
Unit	Selects the magnitude and unit to be used with the data of the Modbus register.
AC detector	Selects AC Detector (RMS, peak, p-p) for the previously defined unit, in case it was necessary.

By default, Modbus registers are codified in *Big Endian* format. Using the swapping options, it is also possible to read numbers in *Little Endian* format.

12.7 Modbus slave

This option configures the *Vigilant* device as a Modbus server, allowing external systems the access to any internal variable.



Access to the Modbus registers must be done using the *Vigilant* IP address in the local network and the TCP/IP port number 502. Slave ID number of the *Vigilant* is always 1. The menu includes three forms that allow setting up Modbus input register numbers to any element of the interface:

- Machines
- Points
- Parameters

New elements may be automatically added to the list, using the *Auto-assign registers* button. It can be selected only to add the unassigned components, or to reassign all of them.

Option	Description
Tag	Identifies unequivocally the *element* that will access in the *Modbus register*. Users can expand the tags corresponding with elements with sub elements (blocks) to see those blocks.
Type	Indicates what kind of data it is: block (a group of different elements accessible in different registers), Int16, float, etc.
Number of registers	Amount of Modbus input registers occupied by this element, including different sub-elements.

Number	Number of the register.

The different elements in the forms have different sub-elements. The register number indicates the initial address where users can read this element, but each has other sub-elements found at different Modbus registers.

Moreover, some values include long data format types that do not match with standard Modbus Int16 input registers, so they are stored using more than one register. The addresses and format type for the entire Modbus field are well indicated in the forms.

Machines	Points	Parameters
Speed	vbias	value
Load	alarm	alarm
state	error	error
alarm		
error		

The variables of the *Vigilant* are listed as *input registers*, in the standard PLC address format (30000+ addresses). Float values are displayed in big-endian mode (most significant part in lower register).

12.8 OPC

12.8.1 About OPC

The OPC (OLE for Process Control) is a communication standard industrial process control and supervision, based on Microsoft technology, which offers a standard interface for communication, that allows individual software components to interact and share data. OPC communication is done through a Client-Server architecture. The OPC server is the data source (such as a plant-level hardware device) and any OPC-based application can access as a client to read/write any variable offered by the server.

Vigilant implements OPC-UA, which is the best-known evolution of the classic OPC technology. It is a cross-platform industrial communication technology, open, service-oriented, secure, and with rich information models that incorporates all the characteristics of classic standards but defining secure and platform independent communication mechanisms. The main difference with classic OPC is that it is limited to communicating data between SCADA applications and sensors. However. its objective is to go further so that it can communicate with all the company's applications through all business layers.

To achieve this transversality, OPC-UA incorporates high-security features natively. The first of these is the possibility of full encryption of messages. OPC UA allows encryption with AES-128 and AES-256 bits. It is also possible to implement SSL and HTTPS communications. The OPC UA information model provides servers with a standard way to expose objects to clients. Objects are composed of other

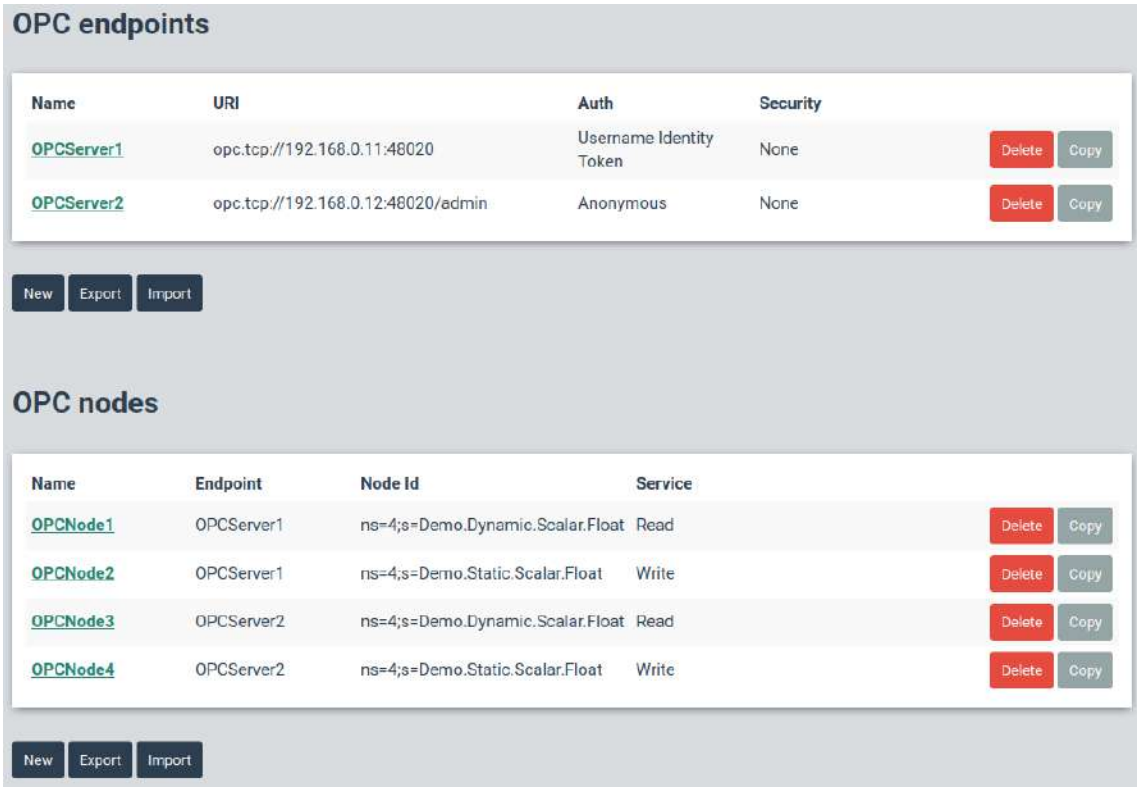
objects, variables, and methods, and they allow relationships with other objects to communicate themselves.

The set of objects with their information that an OPC UA server makes available to customers is called its “namespace”. The OPC Object model elements represent in the namespace as a set of Nodes described by attributes that can allow different services: among others, their reading and/or writing according to the assigned permissions.

12.8.2 OPC UA client in Vigilant

The *Vigilant* allows to be used as an OPC-UA client allowing the connection to one or more OPC Endpoints to execute reading and/or writing services with one or more OPC Nodes (Optional software features).

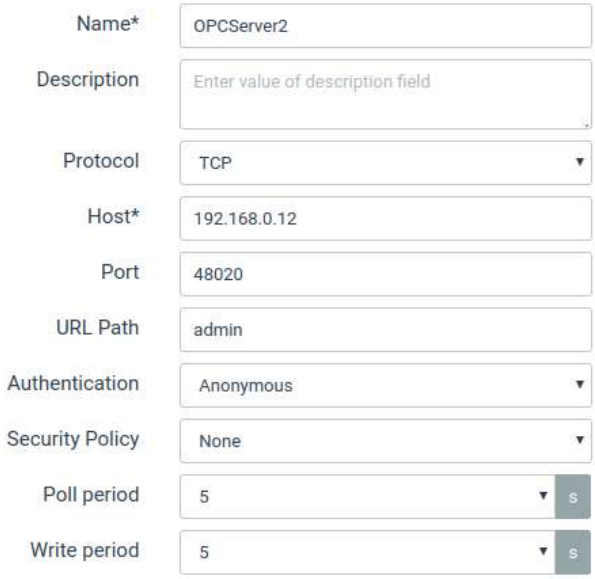
Through the OPC configuration menu, the user can create, clone, edit or delete OPC endpoints and nodes. The menu includes two separate forms that allow the configuration of external OPC endpoints and nodes:



It is also possible to import from CSV or export to CSV text files both OPC endpoints and nodes.

12.8.3 OPC endpoints

The first part of the OPC form shows the list of external *OPC endpoints*. Clicking on one element of the list, or clicking on the *New* button, you will access to the following form, where you will be able to create and configure the OPC endpoints:



Option	Description
Name	Identifies the *Endpoint* unequivocally. It can contain numbers, upper and lower characters. Special characters or blank spaces are not allowed.
Description	Text of description, for user notes only.
Protocol	Only the TCP option is allowed.
Host	IP or web address of the device that will act as OPC endpoint.
Port	Number of TCP port that the server has reserved for OPC communications. By default, the port is 48020.
URL Path	Additional URL to the server URI (optional).
Authentication	Type of authentication used for access control. Allowed types are: - Anonymous. - Username Identity Token: in this case the user must define the User/Password fields.
Security Policy	Only the None option is allowed.
Poll period	Period for updating values of the nodes that belong to the server and are configured to execute read service (node reading period).
Write period	Update period of values of the nodes that belong to the server and are configured to execute write service (node writing period).

12.8.4 OPC nodes

In OPC-UA every entity in the Namespace is a node, with its unique NodeId consisting of 3 elements:

- NamespaceIndex: The index within the server Namespace table that the server uses as a Namespace URI.
- IdentifierType: Identifier type (numeric, opaque, string or GUID).
- Identifier: Identifier of the node that has to be unique within the space defined by the NamespaceIndex.

See the following examples of OPC nodes:

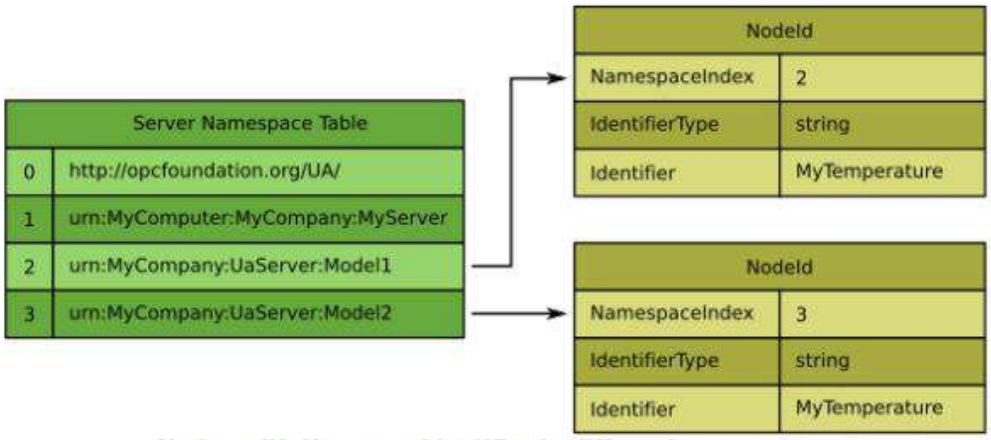
NodeId	
NamespaceIndex	2
IdentifierType	numeric
Identifier	5001

NodeId	
NamespaceIndex	2
IdentifierType	opaque
Identifier	M/RbKBsRVkePCePcx24oRA==

NodeId	
NamespaceIndex	2
IdentifierType	string
Identifier	MyTemperature

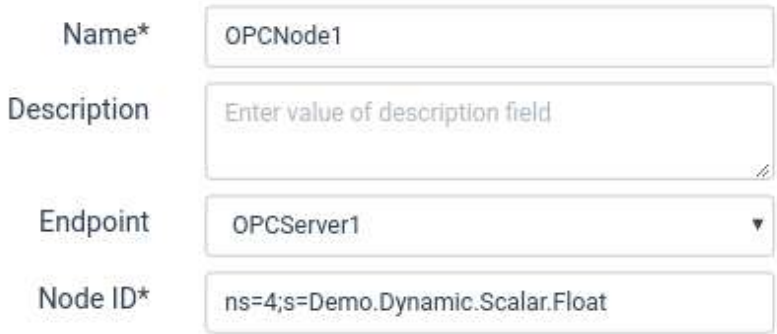
NodeId	
NamespaceIndex	2
IdentifierType	GUID
Identifier	09087e75-8e5e-499b-954f-f2a9603db28a

Examples for different types of NodeIds



Nodes with the same identifier in different namespaces

To define a new node in *Vigilant* user must enter the following fields of the form:



***NodeID examples** (OPC UA NodeId Concepts)*

<ns=2;s=MyTemperature>	*namespace index 2, string identifier*
<i=2045>	*namespace index 0, numeric identifier*
<ns=1;g=09087e75-8e5e-499b-954f-f2a9603db28a>	*namespace index 1, GUID identifier*
<ns=1;b=M/RbKBsRVkePCePcx24oRA==>	*namespace index 1, Opaque/ByteString identifier*

Option	Description
Name	Name of the node.
Description	Optional detailed indication of the node content.
Endpoint	OPC endpoint previously configured.
Node ID	Identifier of the OPC node.

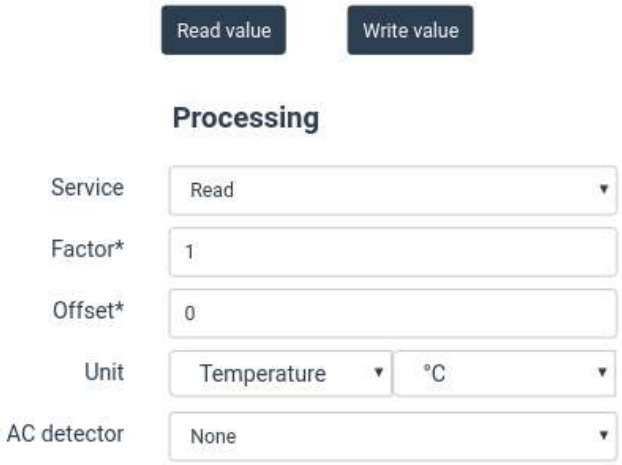
To define the identifier of a node, V8 uses a XML notation whose format is:

```
` ns = <namespaceIndex>; <identifiertype> = <identifier> `
```

Depending on whether the user wishes to use the node for reading or writing, he must choose the appropriate service in the following field of the form. The form also has two buttons that allow testing the node for both reading and writing services.

Reading nodes

If you choose the Read service, the node value is read each Monitoring Period and adjusted by the additional parameters in this form, so that it can be used as an input source for a monitoring static Point in any machine. For nodes used for reading service, the user must additionally configure the following fields:

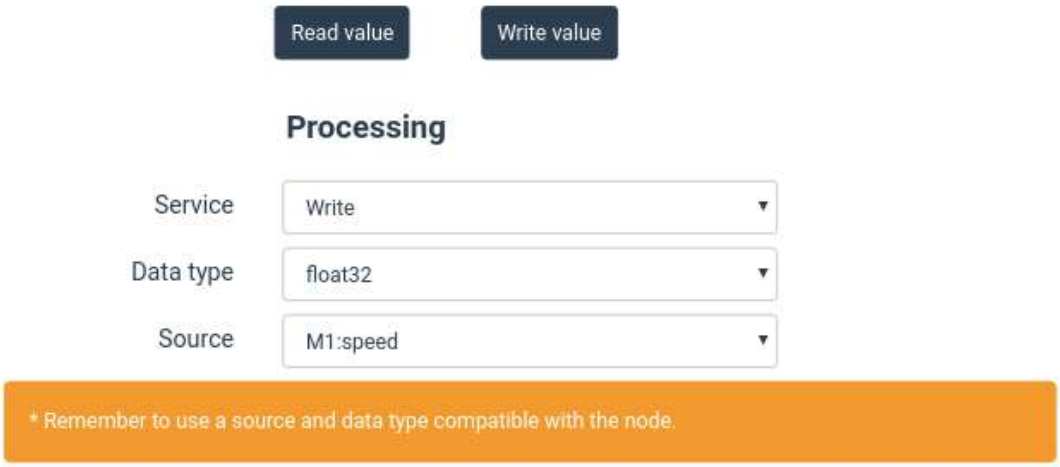


Option	Description
Factor	Calibration slope factor to be applied to the register data, in order to convert the number to the desired format.
Offset	Calibration offset value for the register data.
Unit	Select the magnitude and unit to be used with the data of the OPC node.
AC detector	Select AC Detector (RMS, peak, p-p) for the previously defined unit, in case it was necessary.

The assignment of OPC nodes as reading points for a machine is simple, and very similar to how it is done with the Modbus master. The user will simply have to create a new static type point and in the form select the OPC option and the node that you want to use as an input source.

Writing nodes

If the Write service is chosen for the OPC node, each Monitoring Period will write to that node the current value of a data source corresponding to system variables. In this case, the user must additionally configure the following fields in the form:

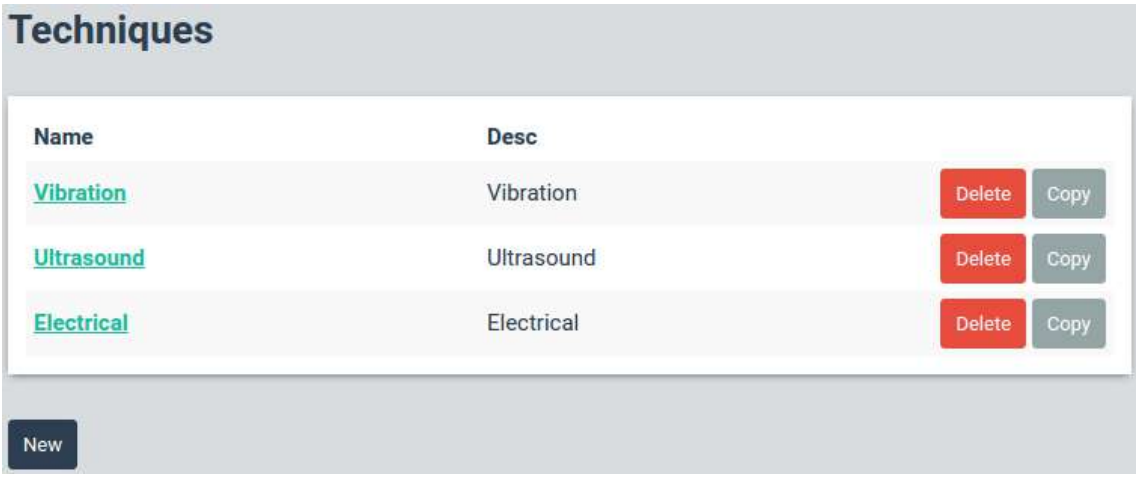


Option	Description
Data type	the type of data that allows you to write the configured node and to which the Source value is to be converted before writing to that node.
Source	Select the variable to be used as the node's data source.

12.9 Techniques

This option defines the *Techniques* that will be available on the system. This allows the user to classify the points as part of a predictive *Technique*.

By selecting this menu option, the interface will show the list of *Techniques* configured, which allows to edit, delete or create new ones.

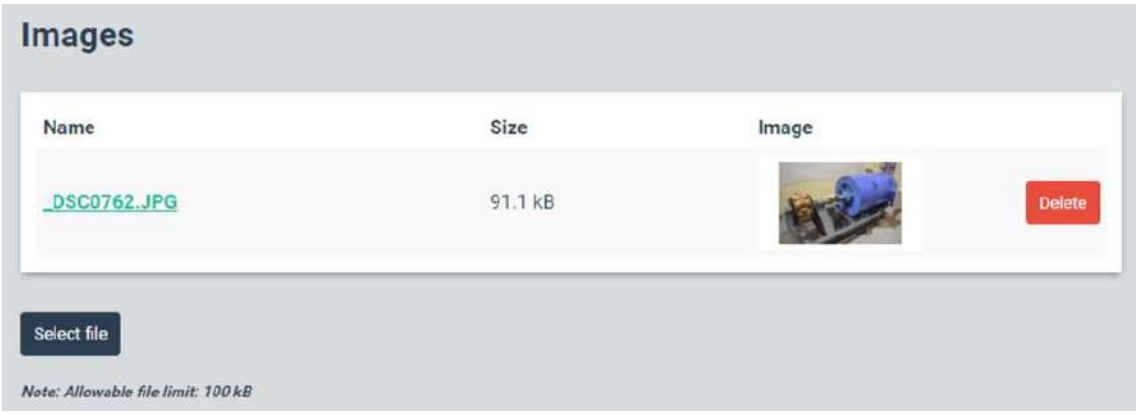


Option	Description
Name	Text that identifies unequivocally the *Property* within the system. It can contain numbers, upper and lower characters. Special characters or blank spaces are not allowed.
Description	This field allows the user to include a description of the *Technique*.

12.10 Images

This option defines the *Images* that will be available on the system. This allows the user to assign an image to the machine. This image will be used on the *Dashboard* to represent the machine using the Mimic *Widget*.

The interface will show the list of *Images* defined currently on the system by selecting this menu option.



The button *Select File* will ask the user to select an image file to add to the list. Clicking on the Delete button will remove the image from the list. Press on the name in order to view the image in large format.

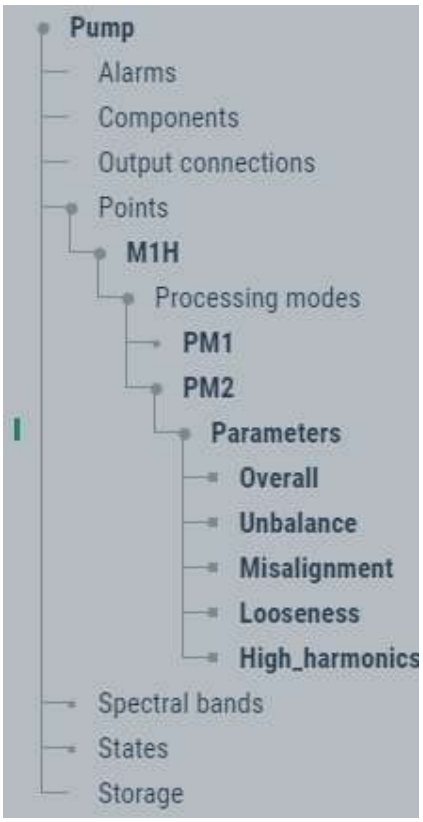
12.11 Machines

Machines are the main objects for setting the monitoring configuration in the *Vigilant* unit. They are composed of different basic objects: *Alarms, Components, Output connections, Points, Spectral Bands, States and Storage strategies*. The configuration of all these basic elements within the machine defines the monitoring behavior of the unit.

Points, in turn, contain the objects *Processing Modes*. These objects define the different types of measurements that will be performed on each particular point. They define the sampling frequency, number of samples to measure, signal processing and filtering, etc. For each point up to 4 *Processing Modes* can be defined. Each *Processing Mode* can include several objects called *Parameters*.

These objects are scalar measurements calculated by the unit (Overall values, spectral bands, peak to peak values, DC values, crest factor, kurtosis, etc.) using the different signals defined on the *Processing Modes* of the point.

The following image shows an example of the different types of components and its hierarchy for a machine called Pump.



Those items of the tree in bold represent the names of the objects that the machine is composed of, while those not in bold represent the type of elements in the hierarchy.

By clicking on the items related to the machine's type of components, the interface will show on the right the list of objects defined of that type. By clicking on the elements, the interface will show their configuration form.

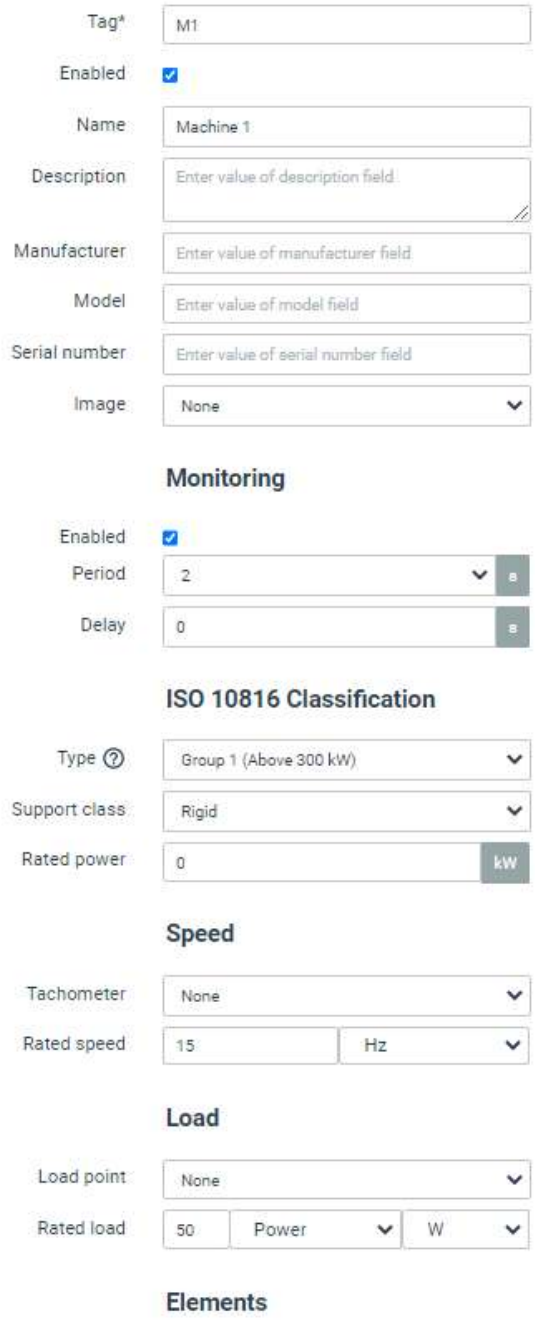
The following table describes the different objects that define the configuration of the machines.

Objects	Description
Alarms	Simple configuration of the alarm levels applied to all the parameters extracted for monitoring the machine, showing all of them in a single list.
Components	Defines the parts of the machine (e.g. motor and pump). Points can be assigned to a machine component.
Points	Measures' locations on the machine. Points are associated to a sensor and input channel on the *Vigilant* unit. There are 3 types of points: *Dynamic*: Those associated with a dynamic input. *Static*: Those associated with a static or digital input. *Tachometer*: Those associated with a Pulse train input. • The data source of static and tachometer points may be a physical input of the *Vigilant* unit or a digital Modbus address.
Spectral Bands	Defines the different bands that will be used to configure the RMS value from the spectrum measurements.

States	Define the different machine conditions or states that the *Vigilant* unit will consider. They allow the user to define different *Storage strategies* and apply different alarm limits for the measurements depending on these machine states.
Storage	These elements define what measurements will the *Vigilant* store in the database. They are defined by selecting an event and setting a condition. See Storage Strategies for more information (Optional software features).
Processing Modes	These objects set the signal processing that will be applied to the inputs of the *Vigilant* (filtering, enveloping, rectification, etc.), and defines the properties of the spectrum and waveform that will be measured (sampling frequency, window type, resolution, averages, number of samples, etc.). For each point the system can measure several *Processing modes*.
Parameters	These are scalar measurements that are calculated from the time signal configured at the *Processing Mode* and using different mathematical algorithms (overall values, spectral bands, crest factor, kurtosis, etc.).

The machines defined on the unit will be shown on the configuration tree, below the “Machines” label. Alternatively clicking on Machines on the configuration tree the interface will show the list of machines:

From this list the machines can be deleted or copied by using the buttons on the right of each item. Clicking on one of the machines of the list, or on the tree, the interface will show its configuration. Click on the “new” button to create a new machine from scratch.



12.11.1 Information

Field	Description
Tag	Text that identifies unequivocally the machine. Only ASCII alphanumeric characters are allowed, including".", "-", and "_". Any other special characters or blank spaces are not allowed. The first character must be alphanumeric. Maximum length is 25 characters.
Enabled	Activates the machine for being shown in the interface. Disabling this option will cause the *Vigilant* unit to ignore the machine on the Dashboard.
Name	Text used on the *Dashboard* to identify the machine.

Description	Text describing the machine in order to help the user with its identification.
Manufacturer	Defines the machine manufacturer.
Model	Defines the model of the machine as set by the manufacturer.
Serial Number	Identification of the machine as defined by the manufacturer.
Image	Assigns an image to the machine. This image will be shown in the *Dashboard* using the *Mimic Widget*.

If the machine is disabled, by unselecting the Enable button, the Configuration toolbar will reflect this by putting a "(DISABLED)" text indication beside the machine Tag.

12.11.2 Monitoring

Field	Description
Enabled	Activates the machine for being monitored. If the checkbox is not pressed, new data will not be measured. The stored data of the machine will still be available in the Dashboard, and the machine can still be referred from any widget. Just, new measurements will not be taken.
Period	Sets the refreshing rate of the measurements in seconds. This is independent on the sampling time required for each *Processing modes* due to the *Vigilant* units' pre-buffering capabilities.
Delay	Establish a certain amount of time to wait before starting acquisition after a configuration change. For example, this is useful because several types of sensors require a stabilization time before giving valid measures.

If the monitoring is disabled, by unselecting the Enable button, the Configuration toolbar will reflect this by putting a *"(Monitoring off)"* text indication beside the machine Tag.

12.11.3 ISO 10816 Classification

The ISO 10816-3 standard is one of the most used by vibration analysts to establish reference values in the calculation of vibration levels for any given machine.

The following parameters allow classifying the machine within one of the categories provided in that standard, from which users can estimate average vibration values and set automatic alarms.

The machine types covered by ISO 10816-3 include:

- Steam turbines with power up to 50 MW.

- Steam turbine sets with power greater than 50 MW and speeds below 1500 CPM or above 3600 CPM (not included in ISO 10816-2).
- Rotary compressors.
- Industrial gas turbines with power up to 3 MW.
- Generators.
- Electrical motors of any type.
- Blowers or fans.

Field	Description
Type	Significant differences in design, type or bearings require a separation into different machine groups. See description below for each group.
Support class	Given apart the consideration about the machine types, they can be mounted on rigid or flexible supports, which affects greatly expected vibration.
Rated power	Last factor affecting the expected vibration for a given machine is its maximum power. The norm covers values from 15 kW up to 3 MW

ISO 10816-3 Machine Types:

- *Group 1*: Large machines with rated power above 300 kW (400 HP); electrical machines with shaft height >=315 mm. These machines normally have sleeve bearings. The range of operating or nominal speeds is relatively broad and ranges from 120 CPM to 15000 CPM.
- *Group 2*: Medium-size machines with a rated power above 15kW up to and including 300kW; electrical machines with shaft height 160 mm <= H < 315 mm. These machines normally have rolling element bearings and operating speeds above 600 CPM.
- *Group 3*: Pumps with multi vane impeller and with separate driver (centrifugal, mixed flow or axial flow) with rated power above 15kW. Machines in this group may have sleeve or rolling element bearings.
- *Group 4*: Pumps with multi vane impeller and integrated driver (centrifugal, mixed flow or axial flow) with rated power above 15kW. Machines in this group mostly have sleeve or rolling element bearings.

12.11.4 Speed

Field	Description
Tachometer	Sets the point that will be used to measure the speed of the machine. It may either be a pulse tachometer point or a static point with speed output format.
Rated speed	Nominal speed of the machine. It can be defined in CPM or Hz.
Speed factor	Applies the factor defined in this field to the tachometer measurement. A value of 2 for example will double the speed measurement. Only available when the speed of the machine is defined from a tachometer measurement.

The machine's speed can also be calculated using the parameter "Frequency extraction" on a dynamic point. To use a parameter as a speed reference, the system needs to get it from an actual machine point. This may be accomplished creating a *Static Point* of *Formula* type and linking its value to the value of the frequency parameter.

12.11.5 Load

Field	Description
Load point	Set the static point used to measure the load of the machine.
Rated load	Nominal load of the machine. It can be defined in any of the magnitudes and units set up in the system.

12.11.6 Elements

Field	Description
Alarms	Quick access to the machine alarms menu, which allows quick and easy configuration of alarm levels for all the parameters.
Components	Shows all the *Components* objects type the machine is composed of. Clicking on one of them will access its configuration form.
Points	Shows all the *Points* defined on the machine. Clicking on one of them will access its configuration form.
States	Shows all the *States* defined on the machine. Clicking on one of them will access its configuration form.
Storage	Shows all the *Storage Strategies* defined on the machine. Clicking on one of them will access its configuration form.

The following chapters will describe the configuration of the *Components, Points, States, Strategies, Processing Modes and Parameter* objects that compose the machine. Their configuration will define the monitoring behavior of the unit.

12.12 Limits

The *limits* of a parameter indicate the expected full-scale range for that parameter, only for visualization purposes.

That means that it establishes the minimum and maximum values that will be displayed in some widgets, like the "Online Value Widget".

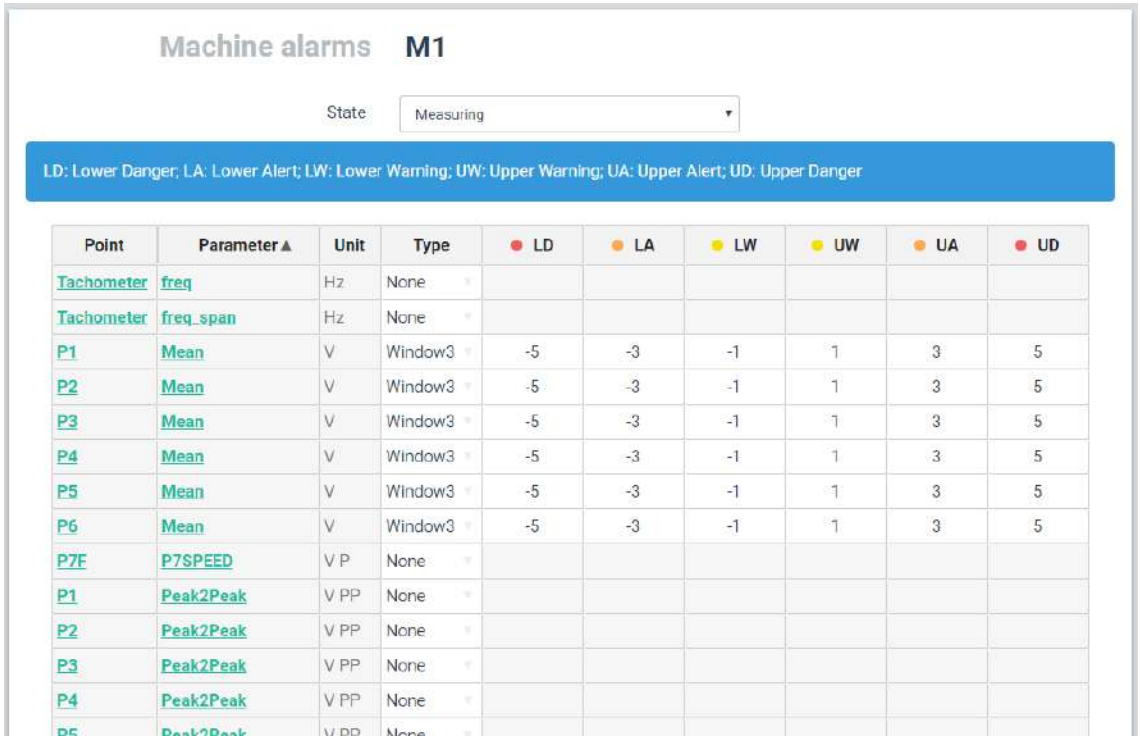
12.13 Alarms

The machine alarms list allows quicker and easier access for the predictive maintenance analysts to more easily define the alarm levels for the different monitoring parameters defined for a specific machine.

The alarms in this menu are the same as those in the lower part of the Parameters forms. Instead of manually defining the alarms once at a time, this menu allows you to copy and paste the alarm values between some parameters and others and sort them easily.

It is also possible to change the type of alarm, from among the six possible varieties: zone alarms, high value, and low value alarms, each with two or three levels.

- With the mouse context menu (right click) or keyboard combinations (*CTRL+C* and *CTRL+V*) it is possible to copy and paste cells from one row to another.
- It is also possible to copy the cells' contents by selecting a group of them and dragging the mouse without releasing the left selection button.



Point	Parameter	Unit	Type	LD	LA	LW	UW	UA	UD
Tachometer	freq	Hz	None						
Tachometer	freq_span	Hz	None						
P1	Mean	V	Window3	-5	-3	-1	1	3	5
P2	Mean	V	Window3	-5	-3	-1	1	3	5
P3	Mean	V	Window3	-5	-3	-1	1	3	5
P4	Mean	V	Window3	-5	-3	-1	1	3	5
P5	Mean	V	Window3	-5	-3	-1	1	3	5
P6	Mean	V	Window3	-5	-3	-1	1	3	5
P7F	P7SPEED	V P	None						
P1	Peak2Peak	V PP	None						
P2	Peak2Peak	V PP	None						
P3	Peak2Peak	V PP	None						
P4	Peak2Peak	V PP	None						

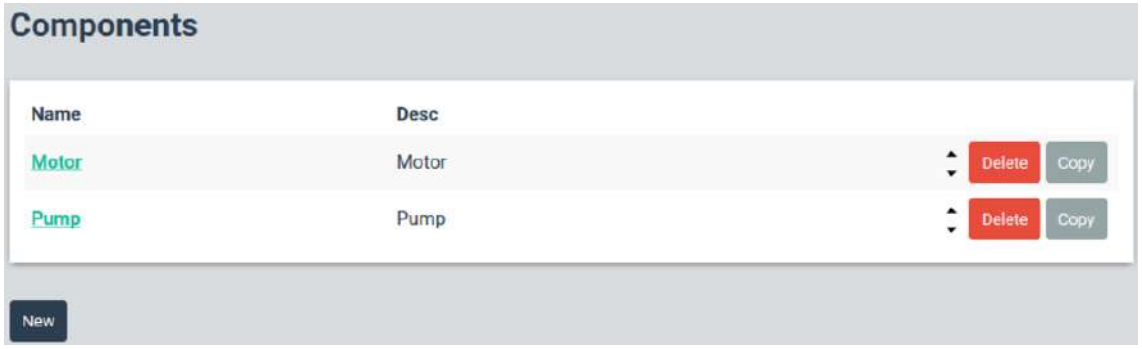
It is very important to remember to save any changes made (Accept button) before navigating another part of the application. Otherwise, the temporary changes will be lost, and when returning to the alarm menu, the values shown will be the same as they were originally.

The table will present different values according to the machine state selected in the control that appears above the table.

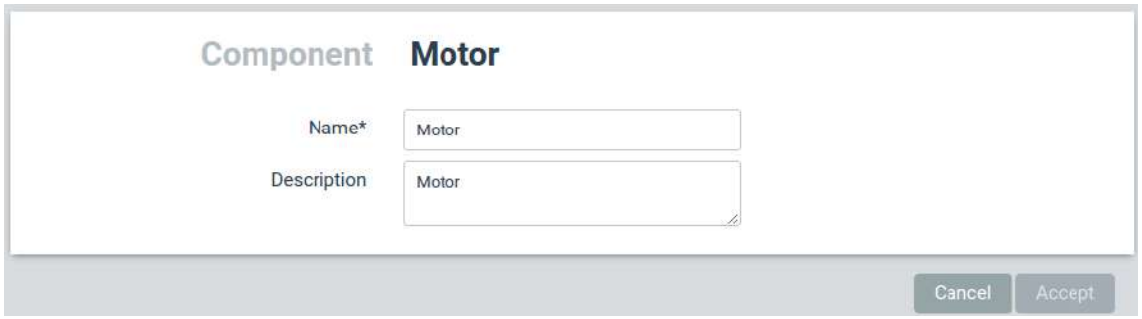
12.14 Components

Components define the different parts the machine is composed of. Points can be assigned to one of the components depending on where they are installed on. These components have only an informative function.

By selecting this menu option, the interface will show the list of *Components* defined currently on the machine.



Clicking on one of the components will show its configuration form.



Field	Description
Name	Text that identifies unequivocally the machine. Only ASCII alphanumeric characters are allowed, including ”.”, “-”, and “_”. Any other special characters or blank spaces are not allowed. First character must be alphanumeric. Maximum length is 25 characters.
Description	Allows the user to include a description of the *Component*.

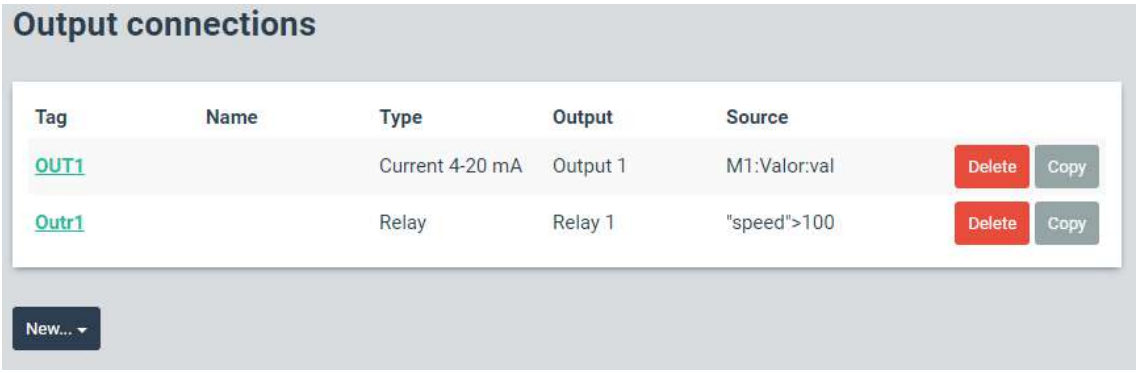
Components are useful when using the Orbit widget. If two points are assigned to the same component, the system will then check the correct angle configuration, so that the orbit will display meaningful data.

12.15 Output connections

The *Output connections* menu defines which outputs in the *Vigilant* are linked to this specific machine and how should they behave. This option could be useful, for example, for triggering external signals in case of an alarm.

In the menu Inputs/Outputs you can check if the device has physical output ports for machine outputs.

The *Outputs* menu shows a list of the actual outputs that are linked to the machine, and allows creating more, as long as there are still free physical output ports available.

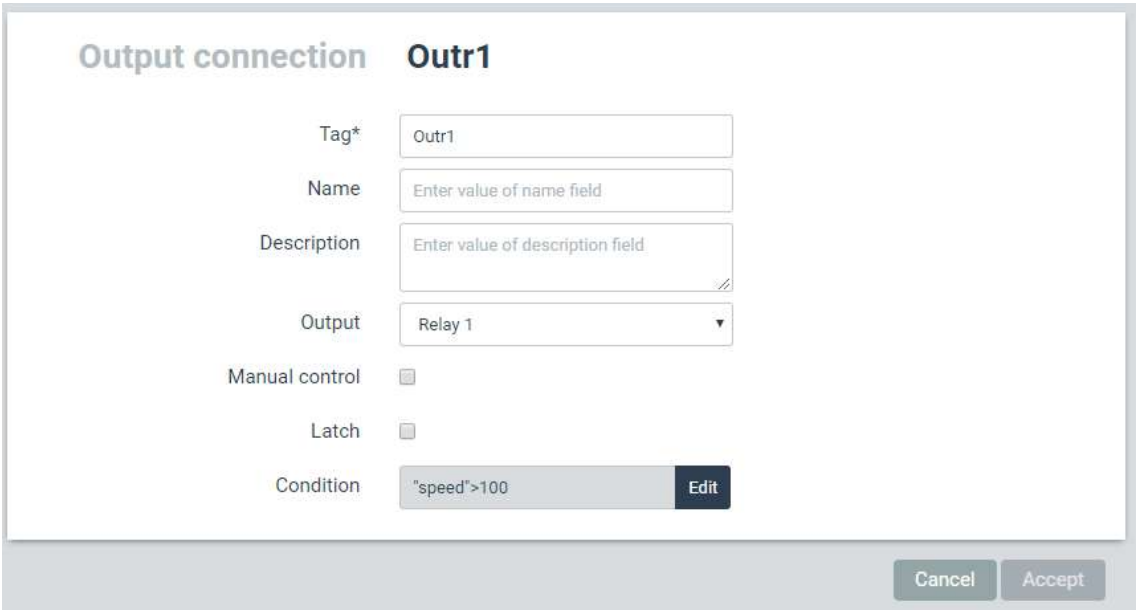


When creating a new output for this machine, we will need first to select the type of output, depending on the actual outputs available at the instrument:

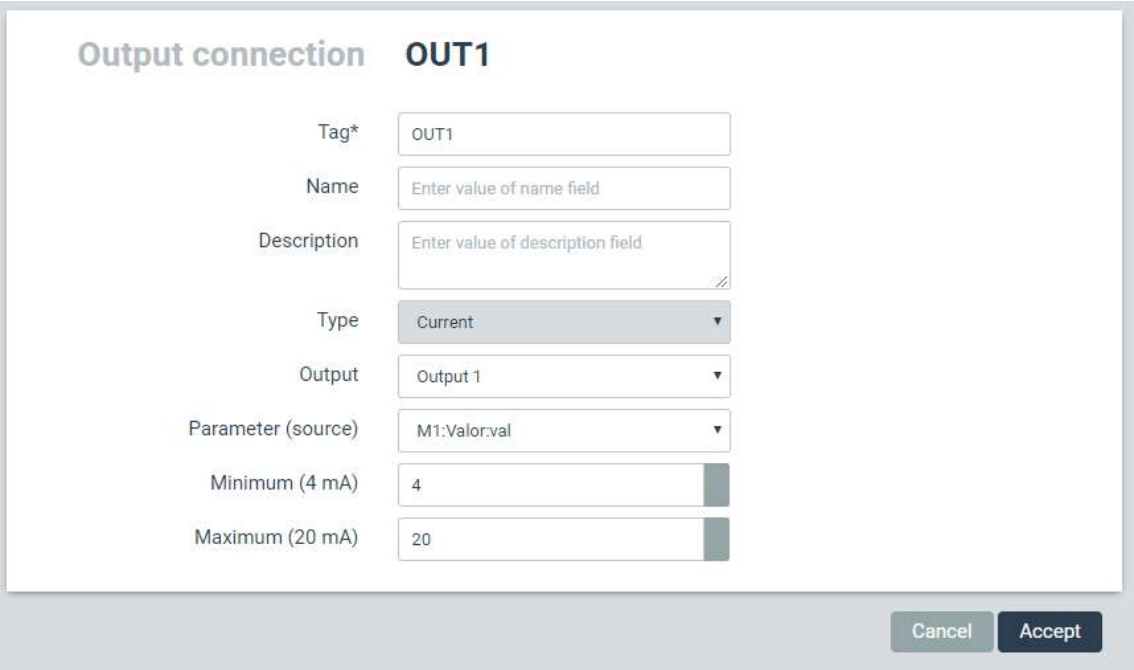
- *Relay output*: digital switches that alternate between two different states, one of them normally closed (NC) and the other normally open (NO), depending on a logical expression.
- *Current output*: Current loop outputs, which will take an analog value that can range from 4 to 20 mA depending on an arithmetic expression.

Field	Description
Tag	Text that identifies unequivocally the output. Only ASCII alphanumeric characters are allowed, including ".", "-", and "_". Any other special characters or blank spaces are not allowed. First character must be alphanumeric. Maximum length is 25 characters.
Name	Text used on the *Dashboard* to identify the output.
Type	Indicates the type of output port: • *Relay*. • *Current 4-20 mA*.
Output	Indicates the physical output port (hardware reference) that is linked to this *Output connection.*
Source	Indicates the logical or arithmetical expression that is being used for controlling the output.

If you click on one of the tags or create a new element, the interface will display another menu to enter more parameters. The menus are different depending on the type of output:



Field	Description
Tag	Text that identifies the output.
Name	Text used on the *Dashboard* to identify the output. If none is given, the tag will be used.
Description	Allows the user to include a description of the *Output*.
Type	Indicates the type of output port.
Output	Selects the actual physical output available in the device that links to this *Machine Output*.
Manual Control	Enables the buttons in the system menu and status bar for activating or deactivating manually the outputs.
Latch	Selects if the status of the output will remain activated once the activation *Condition* is over. Then, after the output gets activated, it requires user action to deactivate it manually.
Condition	Establish a logical condition which will regulate the activation of this output. This is a Logical Expressions in which we can use any internal parameters of the system.



Field	Description
Tag	Text that identifies the output.
Name	Text used on the *Dashboard* to identify the output. If none is given, the tag will be used.
Description	Allows the user to include a description of the *Output*.
Type	Indicates the type of output port.
Output	Select the actual physical output available in the device that links to the *Machine Output*.
Parameter	Select a system variable that will be used for the arithmetical calculation of the value to be configured in the output.
Minimum	Select the minimum admissible value for the previous parameter. Any value of the parameter lower than the one selected will result in an output of 4 mA, which is the minimum possible.
Maximum	Select the maximum admissible value for the previous parameter. Any value of the parameter higher than the one selected will result in an output of 20 mA, which is the maximum possible.

By adjusting the maximum and minimum values of the parameter it is possible to assign output values proportionally to that parameter, according to the equation of a line.

By using *Formula* type points as an intermediate step it is possible to generate almost any complex behaviors that are desired for the analog outputs.

12.16 Points

Points are the objects where all the measurements the *Vigilant* unit performs for the machine will be associated to. They are linked to an input source of data that bring information about the asset that is being monitored.

Depending on the source of the data, the *Points* may be classified in the following types:

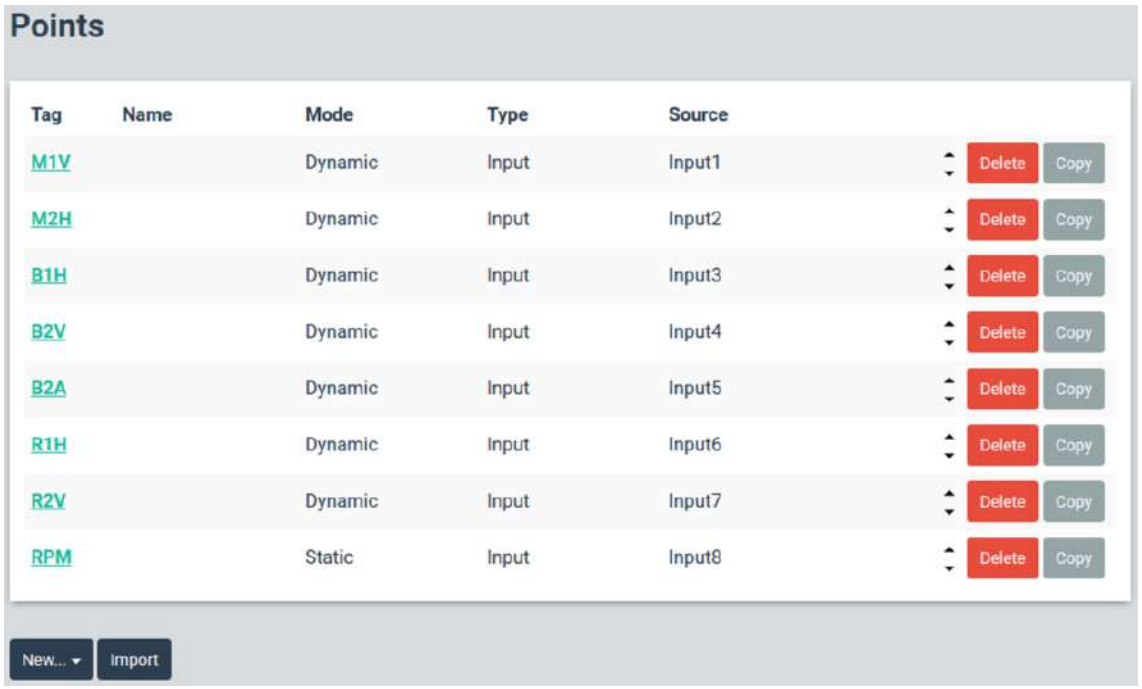
- *Input:* If the data is coming from physical input of the *Vigilant* unit, in any configuration (either dynamic, static, pulse train, etc.).
- *Modbus:* If the source of the data is a digital Modbus address coming from an external system.
- *Formula:* The *Vigilant* allows defining formulas operating with different parameters and data sources, to build complex data correlations.

The points may also be classified in three different modes, in function of the nature of their data and how it will be shown in the Dashboard:

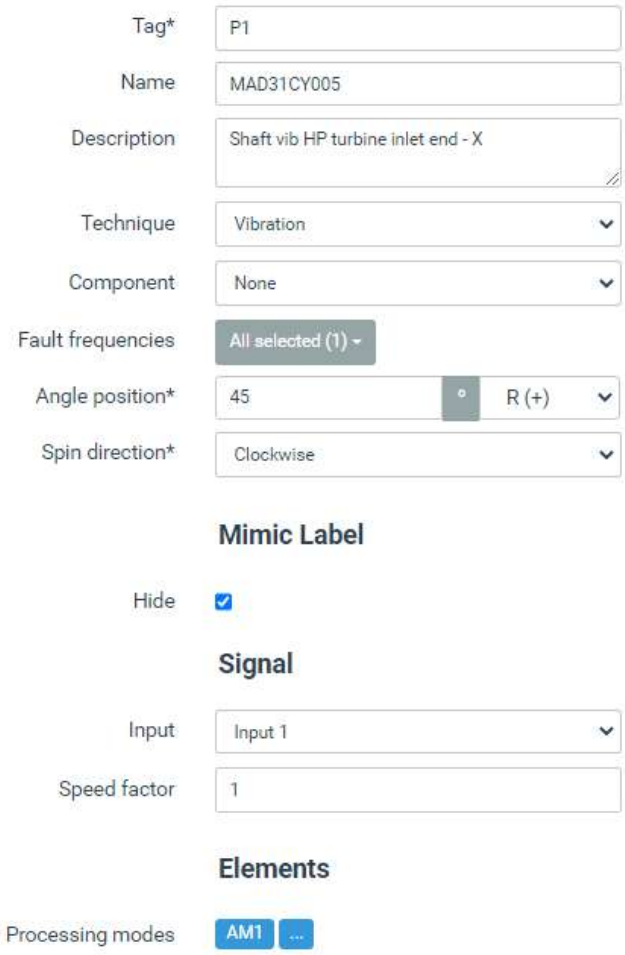
- *Dynamic points:* Those associated to a dynamic input, so that spectral analysis could be applied to them.
- *Static points:* Static points are associated with analog or digital readings. The source for these readings can be an input from the device (static analog or digital), a Modbus point, or a formula.
- *Pulse Tachometer points:* Pulse Tachometers are special points because their value can be used to define the speed of the machine, which is a relevant parameter of the system, and the pulses will also be used for phase calculations. Tachometer points must be linked to pulse train inputs.

It is not necessary to define a Pulse Tachometer point to calculate the speed of a machine. The speed can also be read from Static or Modbus points, and even from Static points calculated from a formula.

Selecting this menu option, the interface will show the list of points defined currently on the machine.



Clicking on one of the components will show its configuration form:



12.16.1 Information

Field	Description
Tag	Text that identifies unequivocally the point. Only ASCII alphanumeric characters are allowed, including ".", "-", and "_". Any other special characters or blank spaces are not allowed. First character must be alphanumeric. Maximum length is 25 characters.
Name	Text used on the *Dashboard* to identify the point.
Description	Allows the user to include a description of the point.
Technique	Sets the technique associated to the point.
Component	Selects the machine component to be assigned to the point.
Fault Frequencies	Selects the Fault frequencies assigned to the point. It only applies to dynamic points. Clicking on the button will present the list of all *Fault frequencies* defined on the system and allows the user to select the ones that will be associated to the dynamic point.
Angle position	For a dynamic point, this sets the angle at which the sensor is connected. Note that 0° corresponds to the vertical of the machine. The angle can be selected to be clockwise (R) or counterclockwise (L). Angle references always looking from the conductor side of the machine.
Spin direction	Rotation direction of the component that the point is connected.

The system will not allow to define two points from the same component to have identical or parallel angle positions.

12.16.2 Mimic Label

Defines the location the point will take on the picture associated with the machine. It will be shown in the Mimic Widget.

Just click on the portion of the picture where you want to place the label associated to the point. The rest of the labels will be also shown, with a different format, to help you select the best placement.

Activate the *Hide* button if you do not want the point to be displayed on the Mimic widget.

12.16.3 Signal

Field	Description
Type	Selects the type of source the point will get the data from. It could either be a physical input or a Modbus input source.

Source	Selects the physical input (channel) of the *Vigilant* assigned to the *Point* or the Modbus address, depending on the type of signal selected in the previous field.
Speed factor	Factor that will be used to calculate the speed associated with the Point and its measurements. It is calculated by multiplying the machine speed by the value in this field. It only applies to dynamic points.
Unit	Shows the units associated with the measurement read from a static or tachometer input.

12.16.4 Elements

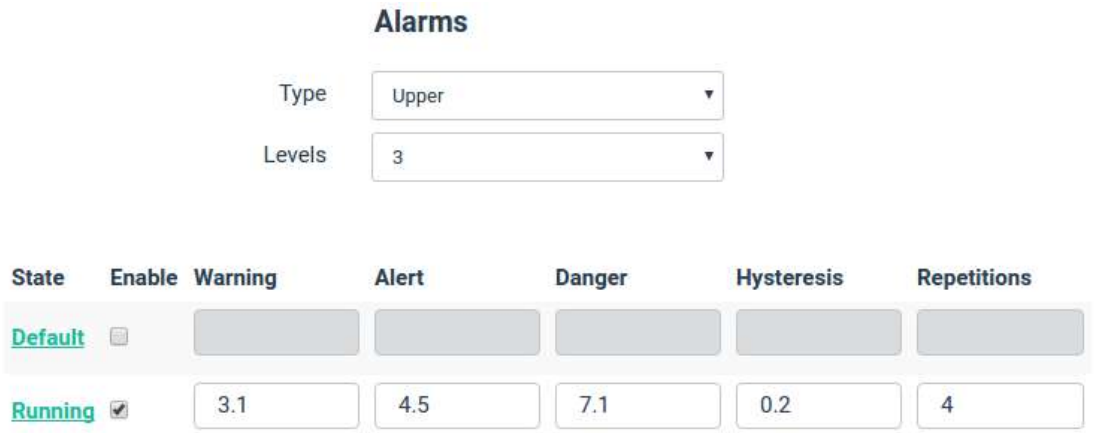
Field	Description
Processing modes	Shows all the *Processing modes* defined for the point. Clicking on one of them will access its configuration form. Only applies to dynamic points.

12.16.5 Alarms

The alarm fields only apply to static or tachometer points. The following picture shows an example of this section.

The enable check box for the corresponding machine state must be marked to change the alarm levels, hysteresis, and repetitions.

In case this check box is disabled no alarm levels will set for the corresponding machine state.



Field	Description
Type	Defines the type of alarms that will be associated with the measurement. It only applies to the static and tachometer points. They can either be Upper, Lower or Window. • *Upper*: alarm levels are above normal values. • *Lower*: alarm levels are below normal values. • *Window*: alarm levels are within a window. If values go outside the window the measurement will go into alarm.

Levels	Defines the number of limit levels the system will consider. Selecting 3 the system will define 3 alarm levels: Warning, Alert and Danger. Selecting 2 the system will define only Alert and Danger levels.
State	Shows the machine states. The system can define different alarm levels for each of the machine states.
Enable	This check box enables or disables the alarm for a state.
Warning	Sets the *Warning* alarm level for the state. It only shows up when the number of levels is set to.
Alert	Sets the *Alert* alarm level for the state.
Danger	Sets the *Danger* alarm level for the state.
Hysteresis	Sets the amount of hysteresis around the alarm limit. The value entered is an absolute value. This value is added to or subtracted from the alarm levels (e.g. warning, alert, ...) to determine the alarm state of the parameter, so that the state tends to remain unchanged. E.g. for passing from alert to danger, the parameter must reach the danger level plus the hysteresis value. Hysteresis helps when the parameter value is close to one of the alarm levels, so that the alarm state is not changing in every monitoring period.
Repetitions	Number of previous consecutive measurements with the parameter fulfilling the alarm condition that will be necessary for the alarm to be activated effectively. Some examples: • 0 repetitions: the alarm will be triggered as soon as the parameter meets the alarm condition. • 1 repetition: the alarm will be triggered at the time of the second consecutive measurement that meets the alarm condition. • 2 repetitions: the alarm will be triggered at the time of the third consecutive measurement that meets the alarm condition.

12.17 Processing Modes

The *Processing Modes* are entities that define the way the data coming from a *Dynamic Point* will be processed: sampling rate, filters, enveloping, rectification, etc.

The *Processing Modes* define how to calculate spectra and extract waveforms coming from the data read at the Dynamic Point, and which parameters will be calculated from each of them. One single Dynamic Point can have multiple *Processing Modes*, e.g. with different sample frequency and other different parameters.

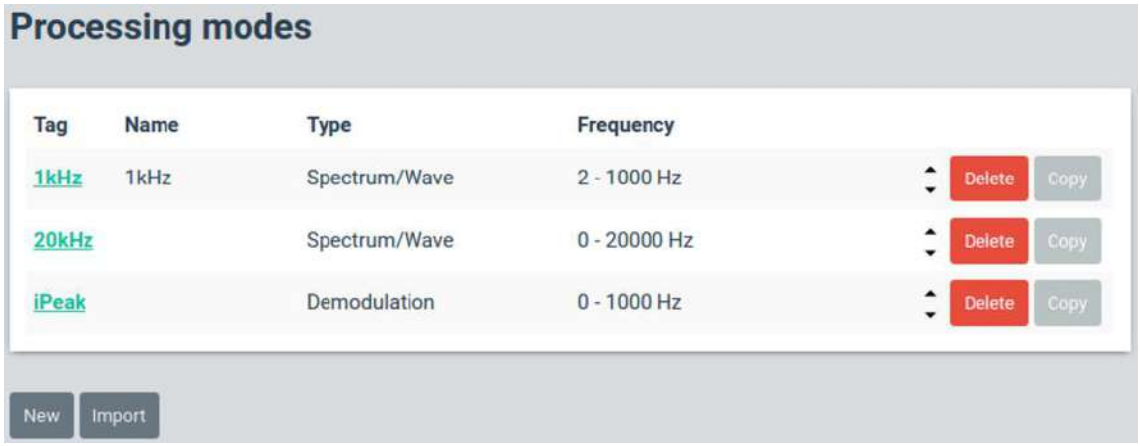
All the signals in the Vigilant are always sampled at the same time, despite coming from different Points or Processing Modes, even if they are captured with different sampling frequency.

The Processing Modes perform all this processing in real-time. This activity needs a lot of CPU resources. To control the amount of resources needed, the configuration web has a bar indicator, which indicates how many Processing Blocks is using the current configuration, and how many more are there available.

- Each *Processing Mode* of a *Dynamic Point* employs at least one *Processing block*.
- *Static Points* do not consume Processing Blocks.

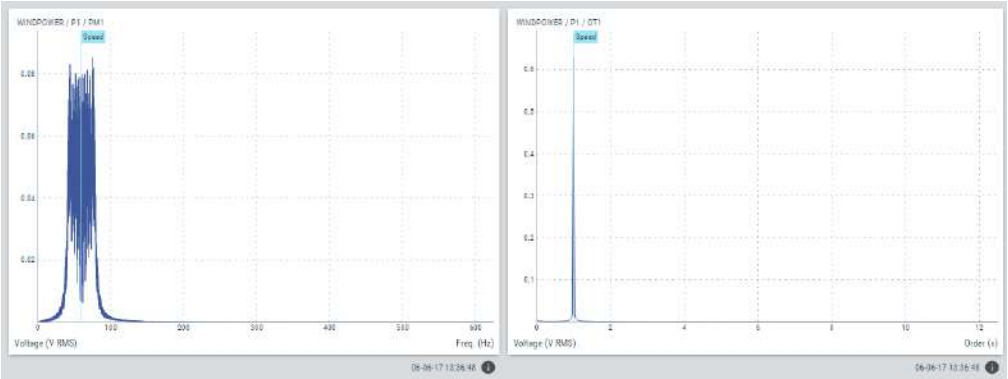
Processing Blocks are a limited resource. Different versions of the *Vigilant* may have a different number of them available (e.g. 16 or 24 total blocks).

Clicking on the menu option will show the list of Processing Modes.

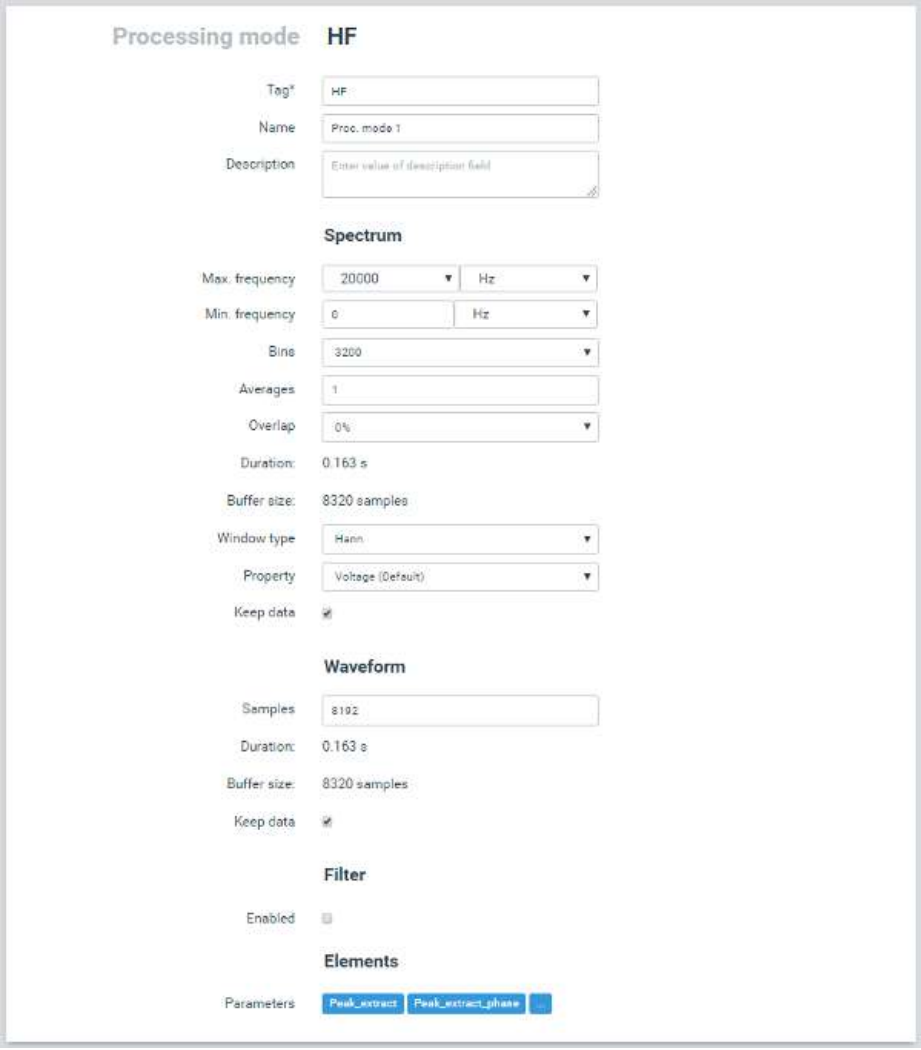


There are available several types of different Processing Modes. Some of them may not be selected without the specific license:

- *Waveform only*: Measures only a waveform. It does not calculate the spectrum.
- *Spectrum and waveform*: Measures both waveform and spectrum.
- *Demodulation*: (Optional software features) This mode extracts waveform and spectrum by using the **demodulation** technique, which is useful e.g. to detect ball-bearing failures at high frequencies.
- *Long Waveform*: Captures and stores a long duration waveform, up to several minutes. This is not done on every monitoring period, only when there is any storage strategy configured to save it on disk. Long Waveforms are useful, for example, for storing the full transitory process of the start-up or stop-down of a big turbine, which could in certain occasions last several minutes.
- *Order Tracking* (Optional software features) This technique transforms the original asynchronous sampled signal (with a constant sample rate) into a synchronous signal, with the same amount of samples per cycle of the rotating shaft. After order tracking processing, waveforms are referenced to angles or cycles, instead of time, and spectra are always shown in orders. This processing mode is very useful for machines where the rotational speed is not constant (Optional software features).
- As it can be seen in the following figure, the normal spectrum (left) from a machine with changing speed is “noisy”, it shows various peaks with reduced amplitudes, while the order tracking spectrum (right) shows a clear peak on the bin corresponding to the machine’s 1x order.



By clicking on one of the items of the list the interface will show the *Processing mode* specific configuration form. Anyhow, most of the fields are similar in the forms of the different types of *Processing modes*:



12.17.1 Information

Field	Description

Tag	Text that identifies unequivocally the *Processing Mode*. Only within a *Dynamic point*. Only ASCII alphanumeric characters are allowed, including: ".", "-", and "_". Any other special characters or blank spaces are not allowed. First character must be alphanumeric. Maximum length is 25 characters.
Name	Text used on the *Dashboard* to identify the *Processing Mode*.
Description	Allows the user to include a description of the *Processing Mode*
(High-Pass freq.)	This parameter is only available in *Demodulation* and sets the frequency cut-off for the high-pass filter used in the calculations.

12.17.2 Waveform

Field	Description
(Sample rate)	Defines frequency of the sampling rate that the system will use. If the Processing Mode also includes a spectrum, this field will not be available: the sampling rate is defined by the spectrum.
Samples	Defines the number of samples of the waveform that will be shown on the *Dashboard* and will be stored on the database.
Duration	Shows the time duration of the waveform in seconds depending on the number of samples and maximum frequency defined for the *Processing Mode*.
Buffer size	Shows the number of buffer points needed to calculate the signal waveform, based on actual samples setting and filter options.
Keep Data	Keeps or discards the waveform measure after calculating all the parameters associated to the *Processing mode*.

12.17.3 Spectrum

Field	Description
Min. Frequency	Sets the minimum frequency of the spectrum.
Max. Frequency	Sets the maximum frequency of the spectrum.
Bins	Selects the number of lines of the spectrum. The system allows up to 12.800 lines.
Overlap	Sets the signal overlapping between averages in %.

Duration	Shows the actual duration of the original waveform needed to calculate the spectrum with user settings. It depends on number of bins, averages, overlap and filter settings.
Buffer size	Shows the number of buffer points needed to calculate the signal waveform. It depends on number of bins, averages, overlap and filter settings.
Window Type	Selects the type of window for the signal processing. The options are *Rectangular, Hann, Hamming* and *Blackman*. By default this window is set to *Hann*.
Property	Defines the property of the spectrum. The signal will be integrated or double integrated if required.
Keep Data	Keeps or discards the spectrum measure after calculating all the parameters associated to the *Processing mode*.

12.17.4 Filter

Field	Description
Enabled	Sets if the filter is activated.
(Before demodulation)	This option is only available for demodulation processing modes and, if enabled, changes the behavior of the filter so that it will be applied before any other processing, which is needed for example if the filter is used to remove noise from the original signal. Otherwise, the filter will be applied after the waveform is processed.
Pass Type	Selects the type of filter to be applied: *high pass, low pass, band pass*.
Filter Type	Selects the filter to be used: *Butterworth, Bessel, Chebyshev*.
Order	Selects the order of the filter: 2, 4 or 6.
Cutoff Freq.	Sets the cut-off frequency of the filter.

12.17.5 Elements

Field	Description
Parameters	Shows all the *Parameters* defined for the *Processing mode*. Clicking on one of them will access its configuration form.

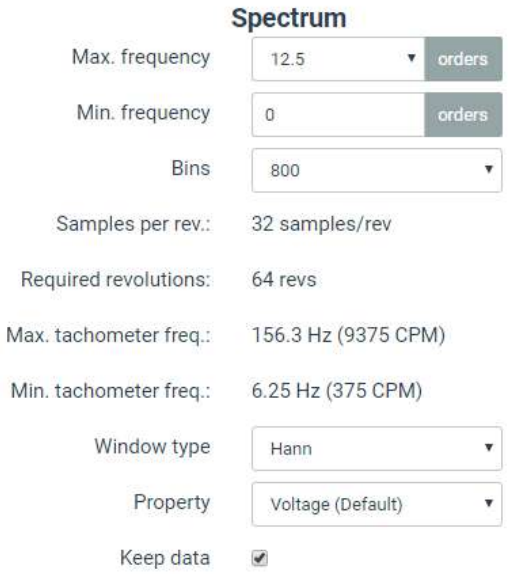
12.17.6 Long-Waveform

The configuration menu for this type of Processing Mode is slightly different from normal waveforms:

Field	Description
Sample rate	Defines frequency of the sampling rate that the system will use.
Maximum duration	Defines the maximum time duration of the waveform, in seconds. Note that this duration may not be achieved if a stop condition is detected before. See storage strategies for more info. *Maximum duration of long waveforms is 1800 seconds (1/2 hour).*
Prebuffering	Sets the amount of time prior to the capture event that will be stored with the rest of the signal. Takes advantage of the HW data buffers of the *Vigilant*. *Maximum pre buffering duration is 30 seconds.*

12.17.7 Order-Tracking

The configuration for spectra coming for this type of *Processing Mode* is slightly different than for asynchronous spectra:



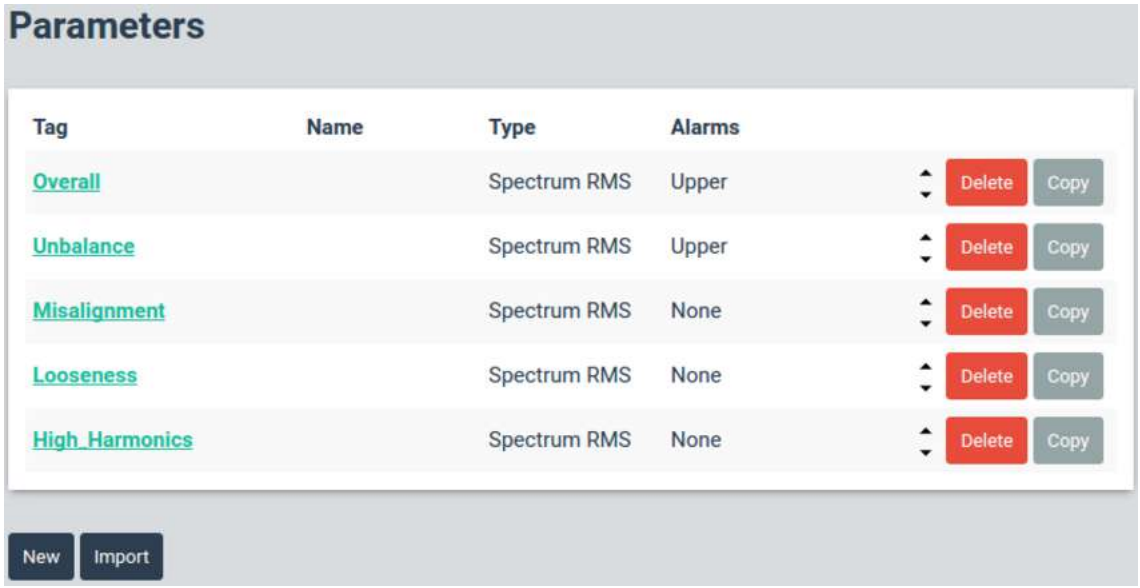
Field	Description
Samples per rev.	Indicates the number of samples that the converted waveform will have for each tachometer cycle.
Required revolutions	Number of full cycles that the system has to sample in order to calculate the spectrum with the required settings of maximum and minimum frequency and number of bins.
Max tachometer freq.	Maximum expected tachometer frequency in order to execute the calculations according to the rest of parameters.
Min tachometer freq.	Minimum expected tachometer frequency in order to execute the calculations according to the rest of parameters.

12.18 Parameters

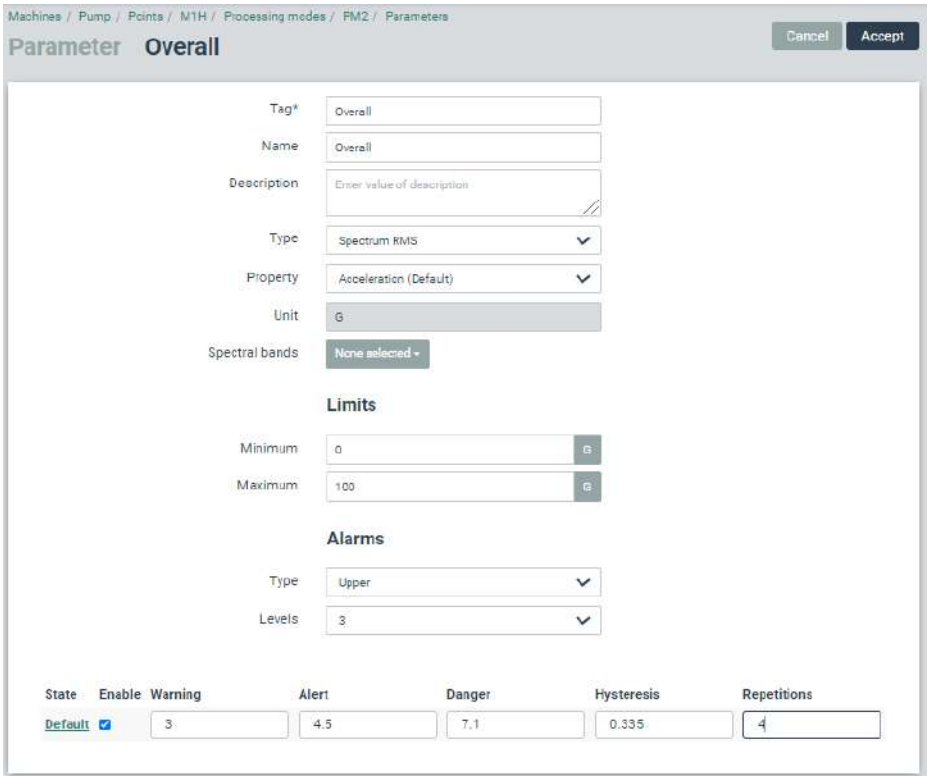
The *Parameters* define the scalar values that will measure in each *Processing Mode*. These parameters are calculated from the spectrum or from the waveform taken in the corresponding *Processing Mode* using different algorithm types or data processing.

Long-Waveform processing modes do not allow to configure any parameter. Anyhow, they can be extracted later using the Dashboard tools.

By selecting this menu option, the interface will show the list of *Parameters*.



The configuration form of each *Parameter* can be accessed by clicking on any of the items of the list.



12.18.1 Identification

Field	Description
Tag	Text that identifies unequivocally the *Parameter*. Only ASCII alphanumeric characters are allowed, including ”.”, “-”, and “_”. Any other special characters or blank spaces are not allowed. First character must be alphanumeric. Maximum length is 25 characters.
Name	Text used on the *Dashboard* to identify the *Parameter*.
Description	Allows the user to include a description of the *Parameter.*
Type	Sets the processing or algorithm used to calculate the parameter: • *Mean*. • *Wave RMS*. • *True Peak*. • *True Peak-Peak*. • *Spectrum RMS*. • *Calculated Peak*. • *Calculated Peak-Peak*. • *Frequency extraction.* • Peak extraction. • *Crest factor*. • *Kurtosis*. • *Peak-Phase* (Optional software features).
Property	Defines the property of the *Parameter*. The signal will be integrated or double integrated if required.
Unit	Shows the units of the *Parameter*.
Spectral Bands	Allows to select the bands that will be used to calculate the RMS value from the spectrum.

12.18.2 Parameter types

In the following table there is a description of the physical meaning of the different type of parameters:

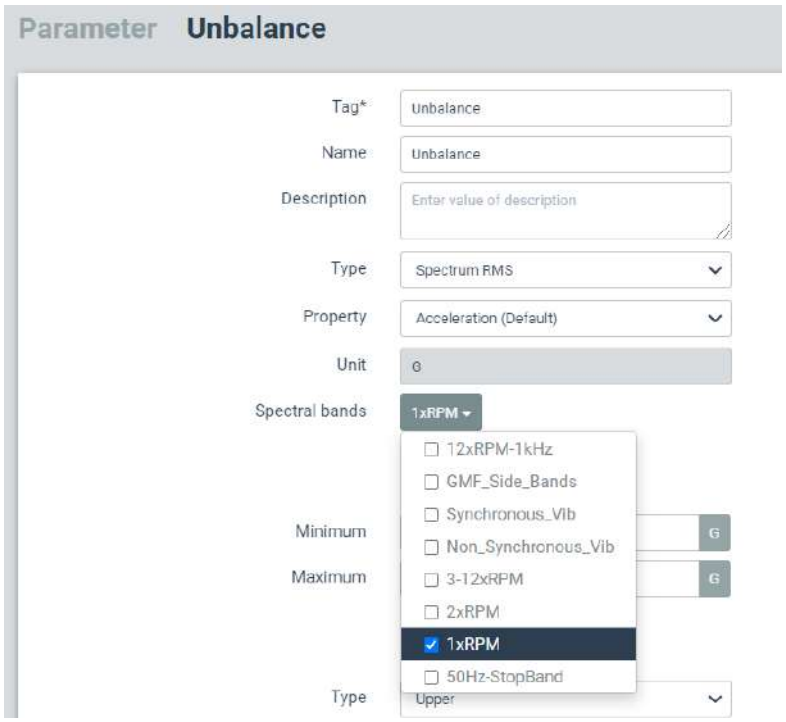
Parameter	Description
Mean	Calculates the DC component of the signal. It is the average value of the samples.
Waveform RMS	Measures the RMS value from the waveform. The RMS is also known as the quadratic mean, and it is a magnitude of the signal’s power or strength.
True Peak	In AC mode this parameter measures the maximum absolute peak amplitude of the waveform. In DC coupling mode the peak amplitude is the difference between the mean and peak amplitude value.
True Peak-Peak	Measures the difference between the highest and lowest amplitude peak of the waveform.

Spectrum RMS	Measures a RMS value from the spectrum. It could either be calculated from the whole frequency content of the spectrum or by defining one or multiple bands. See parameter field *Spectral bands*.
Calculated Peak	Measures the theoretical peak value from the RMS value, which in turn can either be calculated from the whole frequency content of the spectrum or by defining one or multiple bands. See parameter field *Spectral bands*.
Calculated Peak-Peak	Calculates the theoretical peak-to-peak value of the signal from the RMS value, which in turn can either be calculated from the whole frequency content of the spectrum or by defining one or multiple bands. See parameter field *Spectral bands*.
Frequency extraction	Measures the frequency of the highest peak of the frequency range of the spectrum given by the user. This is useful, for example, to determine the speed of the machine from the reading of the dynamic sensors.
Peak extraction	Measures the actual amplitude of the highest peak of the frequency range of the spectrum given by the user.
Crest factor	Calculates ratio between peak value to the RMS value of a waveform (e.g. 1.4142 for a sine wave).
Kurtosis	Calculates the so-called “fourth moment” of the signal, which is also a measure of the “tailedness” of the signal.
Peak-Phase	It is a double parameter with a real part or module (the Peak) and an argument (the phase). Indicates the deviation in time between two signals (a point and the tacho). The parameter needs a *minimum tachometer frequency* to do the calculations, proportional to the *Processing Mode* sampling frequency. The parameter can also be calculated for the main tachometer frequency, but also for any higher-order (up to the 4th order moment). (Optional software features)
Smax	Smax is defined by ISO 7919-1 as the maximum peak to peak shaft vibration. Thus, e.g. for a circular orbit, Smax and the X or Y vibration are identical, and in the case of a pure elliptical orbit, the Smax would be the value of the longest axis. The parameter is calculated from the data of two different points, linked together under the same machine component, with the same units, and they also must have defined a similar processing mode (at least with the same sampling rate).

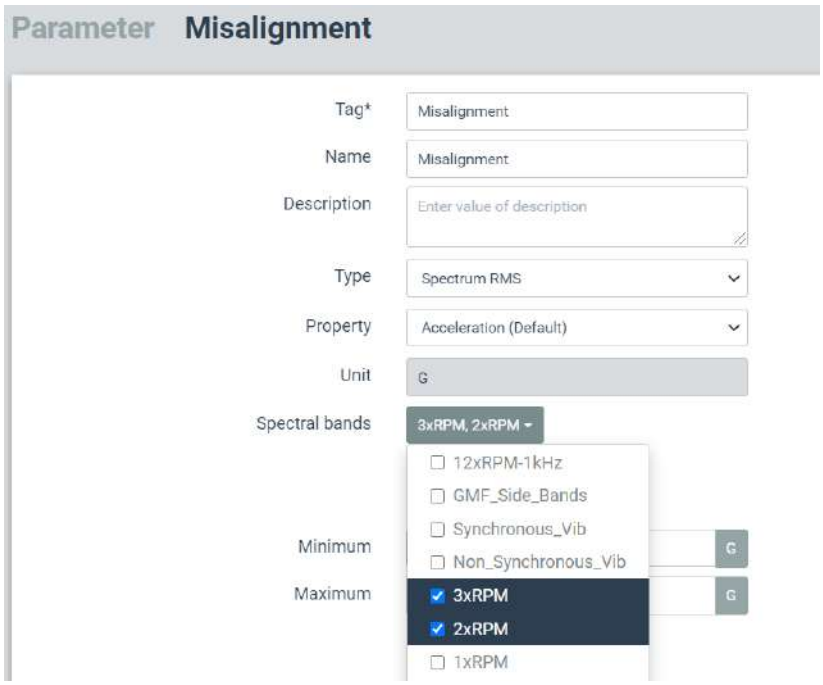
12.18.3 Spectrum RMS

The parameters configured as *Spectrum RMS* are calculated using *Spectral bands*. These *Spectral bands* are independent components of the database that define a frequency range or a set of frequency ranges (see chapter 12.19). The *Spectrum RMS* parameters can be associated with one or more *Spectral bands*, and its output is calculated as the RMS value of the frequencies included on them. In case that no *Spectral bands* are associated with the *Spectrum RMS* parameter the system will calculate the *Spectrum RMS* using all the frequencies of the spectrum.

The example below shows a *Spectrum RMS* parameter named “Unbalance”. This parameter was associated with the *Spectral band* named “1xRPM”. This will make the system calculate the RMS from the spectrum using just the frequency range defined on that *Spectral band* called“1xRPM”.



Multiple *Spectral bands* can be associated with *Spectrum RMS* parameters. In those cases, the RMS value will be calculated using the frequency ranges defined on each of those bands. In the example below a parameter called “misalignment” was configured as *Spectrum RMS* type. The frequency range of that parameter was defined using the *Spectral bands* 2xRPM and 3xRPM simultaneously, which makes the RMS value to be calculated using the spectrum frequencies included on those bands.



In case that multiple *Spectral bands* associated with a parameter have overlapped frequency ranges they will be taken into consideration only once on the calculation of the parameter.

12.18.4 Alarms

The parameters allow defining different alarm values to be associated with the measurement.

Field	Description
Type	• *Upper*: alarm levels are above normal values. • *Lower*: alarm levels are below normal values. • *Window*: alarm levels are within a window. If values go outside the window the measurement will go into alarm.
Levels	Defines the number of limit levels the system will consider. Selecting 3 the system will define 3 alarm levels: Warning, Alert and Danger. Selecting 2 the system will define only Alert and Danger levels.
State	Shows the machine states. The system can define different alarm levels for each of the machine states.
Enable	This check box enables or disables the alarm for a state.
Warning	Sets the *Warning* alarm level for the state. It only shows up when the number of levels is set to 4.
Alert	Sets the *Alert* alarm level for the state.
Danger	Sets the *Danger* alarm level for the state.
Hysteresis	Sets the amount of hysteresis around the alarm limit. The value entered is an absolute value. This value is added to or subtracted from the alarm limit to determine its hysteresis range.
Repetitions	Number of measurements that must be in that alarm condition consecutively in order to be activated. A repetition value of 0 means the alarm will be activated as soon as the measurement alarm will be activated with 2 consecutive measurements beyond the alarm level. A repetition value of 1 means that the alarm level.

12.18.5 Alarms ID

Many expressions used in the Configuration of the device may need to refer to the specific alarm level of a *Point*. To indicate the particular alarm status of a point to be used in a Logical Expressions, you will need to use the following constants:

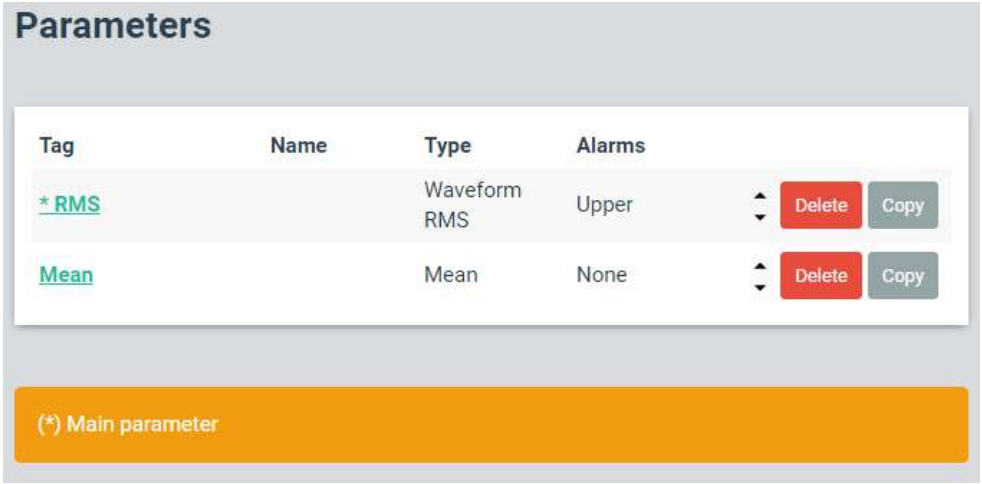
ID	Alarm level
0	No alarm
1	Warning
2	Alert
3	Danger

12.18.6 Main parameter

In the Parameters menu, like in many other menus from Configuration web, there is a list with all the defined *Parameters* for that specific *Point* and *Processing Mode*. Like in similar lists for other elements, a couple of arrows next to the *Delete* and *Copy* buttons allow modifying the order of the *Parameters* in the list.

The first *Parameter* of the first *Processing Mode* defined for a *Point* has a special meaning. It will be the ***Main Parameter***.

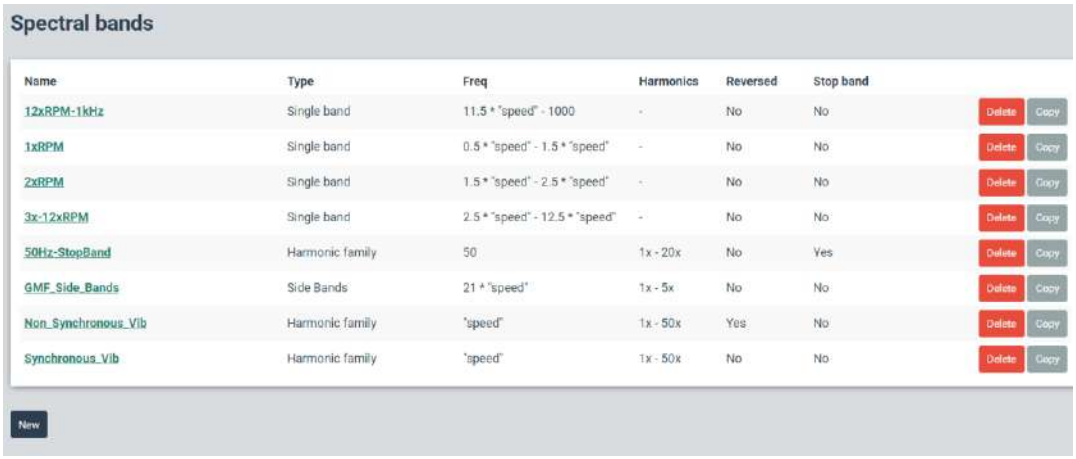
This means that this parameter is the one going to be displayed by default in many *Dashboard* widgets. Users can configure which parameter is going to be by modifying the list orders in the *Parameters* and *Processing Modes* menus.



12.19 Spectral Bands

The *Spectral bands* are objects included in the machine configuration that define different frequency ranges used to calculate *Spectrum RMS, Calculated peak* and *Calculated peak to peak* type parameters.

By selecting this menu option, the interface will show the list of *Spectral bands*. From this list they can be added, removed, and configured.

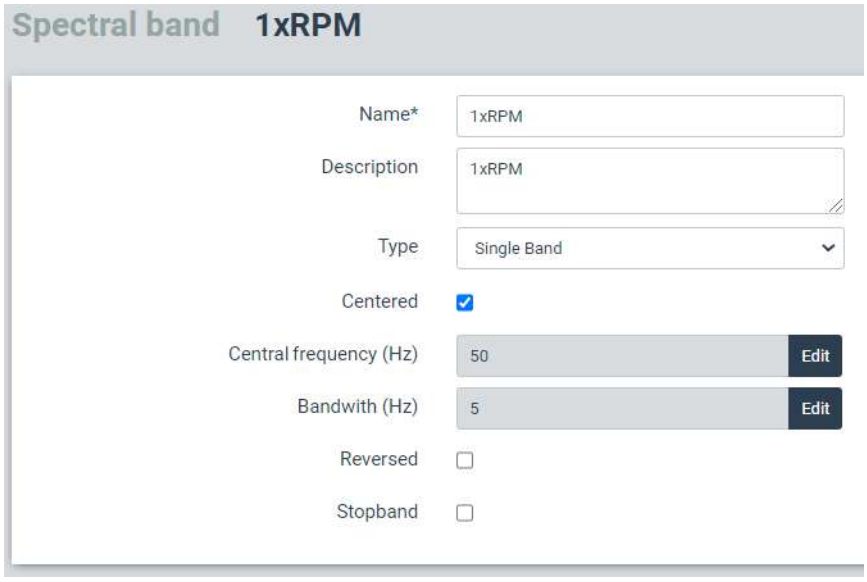


By clicking on one of the items the interface will show its configuration. There are three types of *Spectral Bands* that can be configured: *Single Band*, *Harmonic Family* and *Sidebands*.

Type	Description
Single Band	The single band type of spectral band defines a frequency range using a minimum and maximum frequency.
Harmonic Family	This type of spectral band defines a set of frequency ranges based on a family of harmonics of a fundamental frequency.
Sidebands	This type of spectral band defines a set of frequency ranges based on the definition of the sidebands around a central frequency.

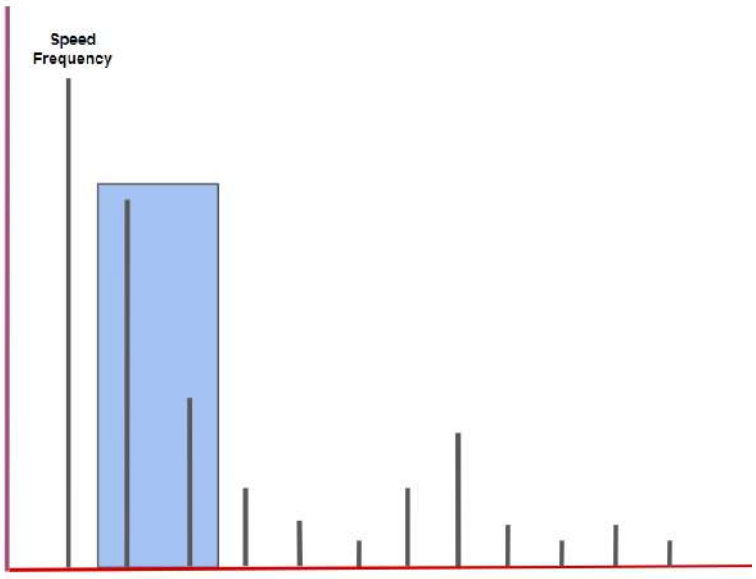
Single Band

The *Single Band* type of *Spectral Bands* defines a single frequency range between 2 frequencies of the spectrum. This can be done using either a minimum and maximum frequency or by a central frequency and a bandwidth.



Field	Description
Name	Sets the unique name of the *Spectral band*.
Description	Defines the description of the *Spectral band*.
Min. Frequency	Sets the minimum frequency of the band. This value can be defined by introducing a value in Hz, or by the result of a formula, whose result will also be in Hz units. Click on *Edit* button to edit this field.
Max. Frequency	Sets the maximum frequency of the band. This value can be defined by introducing a value in Hz, or by the result of a formula, whose result will also be in Hz units. Click on *Edit* button to edit this field.
Central Frequency	Sets the center frequency of the band to be defined. This field appears only if *Centered* check box is marked.
Bandwidth	Sets the width of the band to be defined. This field appears only if *Centered* check box is marked.
Reversed	By checking this box the frequency range is defined including all the frequencies of the spectrum except the ones defined on this configuration form.
Stopband	By checking this box the frequency range defined on this configuration form will not be taken into account on the calculation of the *Spectrum RMS* parameter associated with this *Spectral band*.

The following example shows a frequency range defined as a single band with a minimum and maximum frequency of 1.5 and 2.5 times the speed respectively.



Minimum, maximum and central frequencies, as well as the bandwidth, can be defined as fixed values or by using Logical Expressions. Those fields can be changed by clicking on the Edit button. The Expression Editors will appear, allowing the user to introduce any value or expression.

This formula editor helps the user by providing the list of variables and operators available on the system. Selecting one of them from the corresponding pull-down list the editor will automatically

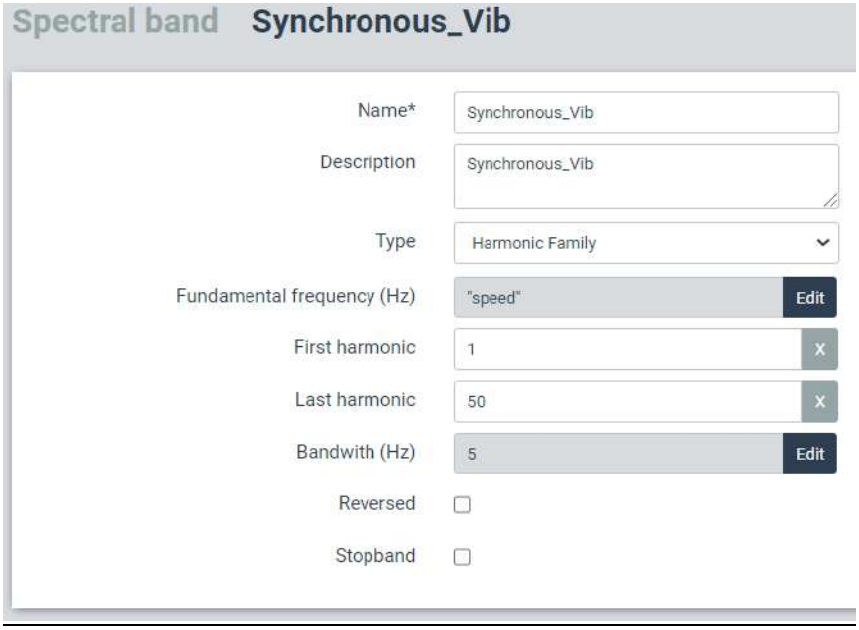
insert the variable or operator into the expression. The system checks automatically if the syntaxes of the expression are correct. If not, it shows an Invalid Expression message.

These expressions make possible defining the frequency band as a function of the speed of the point, for example.

Harmonic Family

This type of *Spectral band* defines a set of frequency ranges based on a family of harmonics of a fundamental frequency.

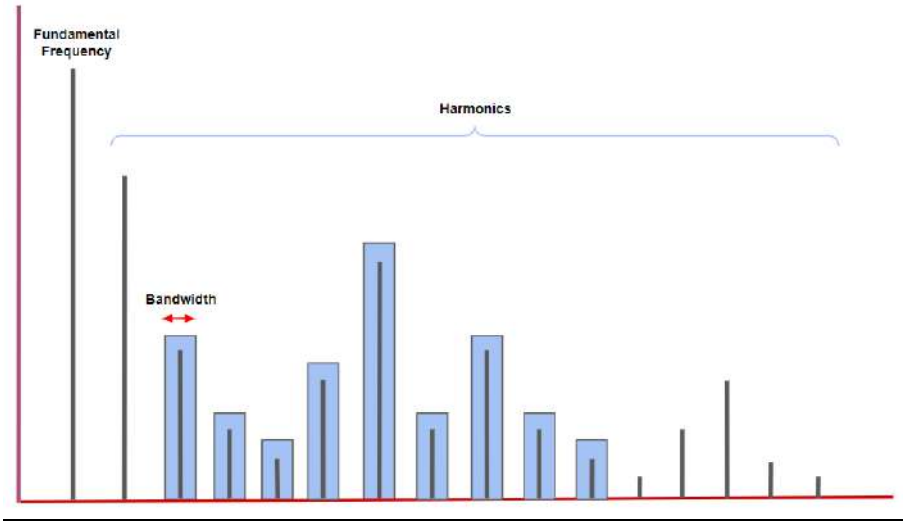
The following image shows an example of this type of *Spectral bands* definition. On it a set of frequency ranges was defined as a family of the speed frequency and its harmonics (up to 50), with a bandwidth of 5 Hz.



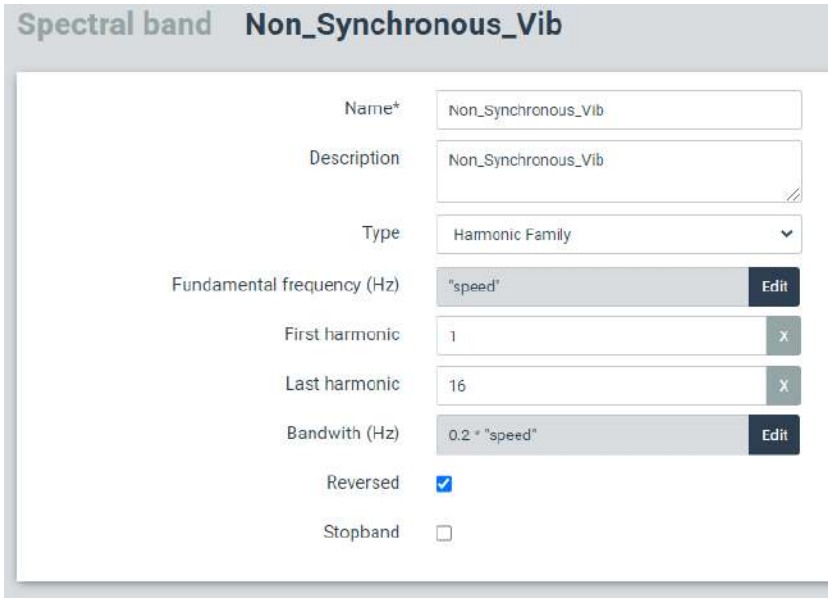
Field	Description
Name	Sets the unique name of the spectral band.
Description	Defines the description of the spectral band.
Fundamental frequency	Sets the fundamental frequency of the harmonic family. This value can be defined by introducing a value in Hz, or by the result of a formula, whose result will also be in Hz units. Click on *Edit* button to edit this field.
First harmonic	Sets the value of the first harmonic that will define the band. A value of 1 defines the fundamental frequency.
Last harmonic	Sets the value of the last harmonic that will define the band.

Bandwidth	Sets the width of the bands. This value can be defined by introducing a value in Hz or by the result of a formula, whose result will also be in Hz units. Click on *Edit* button to edit this field.
Reversed	By checking this box, the frequency range is defined as all the frequencies of the spectrum except the ones defined by the harmonic family.
Stopband	By checking this box, the frequency ranges defined by the harmonic family will not be taken into account on the calculation of the parameter associated with this spectral band.

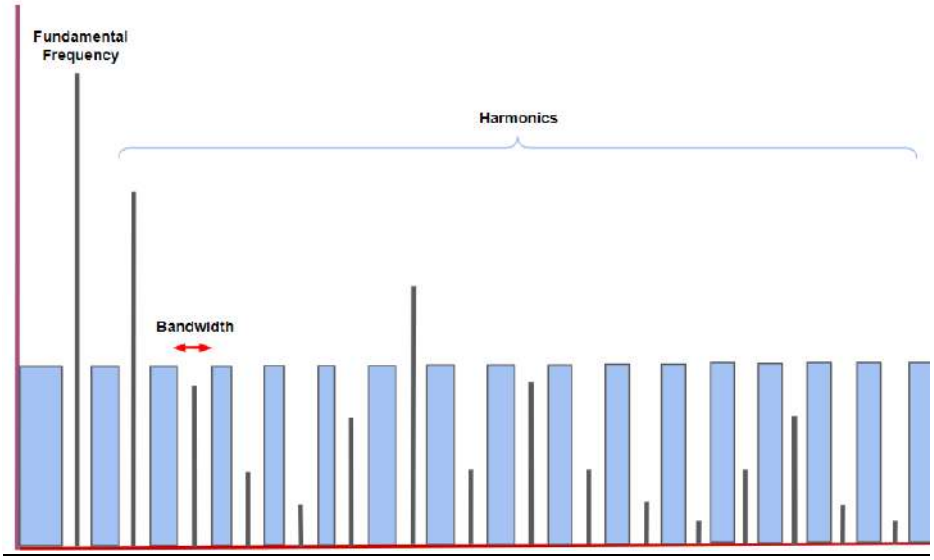
The following image shows the frequency ranges of a *Spectral band* configured as a *Harmonic family*, with its fundamental frequency, its bandwidth, and the first and last harmonics set as 3 and 11 respectively.



This other example shows a *Spectral band* defined as a *Harmonic family*, with the fundamental frequency set as the speed frequency, its bandwidth configured as a fifth of the speed and the first and last harmonic set as 1 and 16 respectively. In this case the reversed checkbox was activated in order to calculate the non-synchronous vibration.

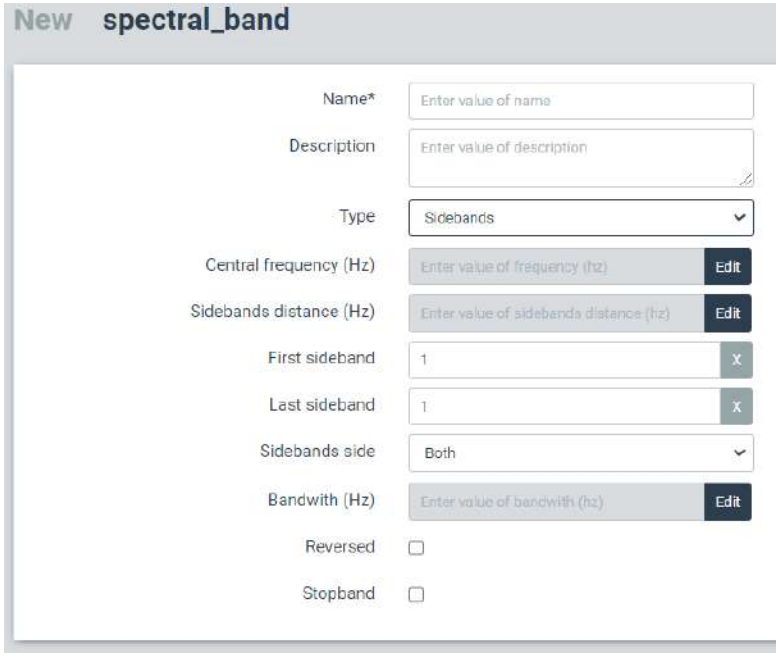


The picture below shows the frequency ranges defined with this configuration above.



Sideband

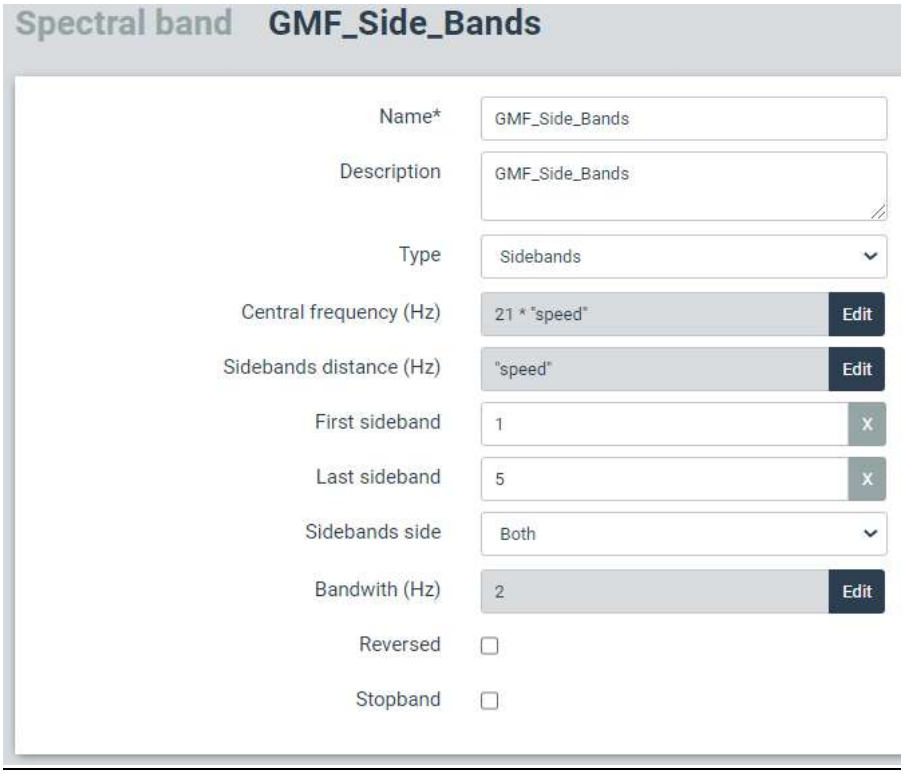
This type of *Spectral band* defines a set of frequency ranges based on sidebands from a central frequency.



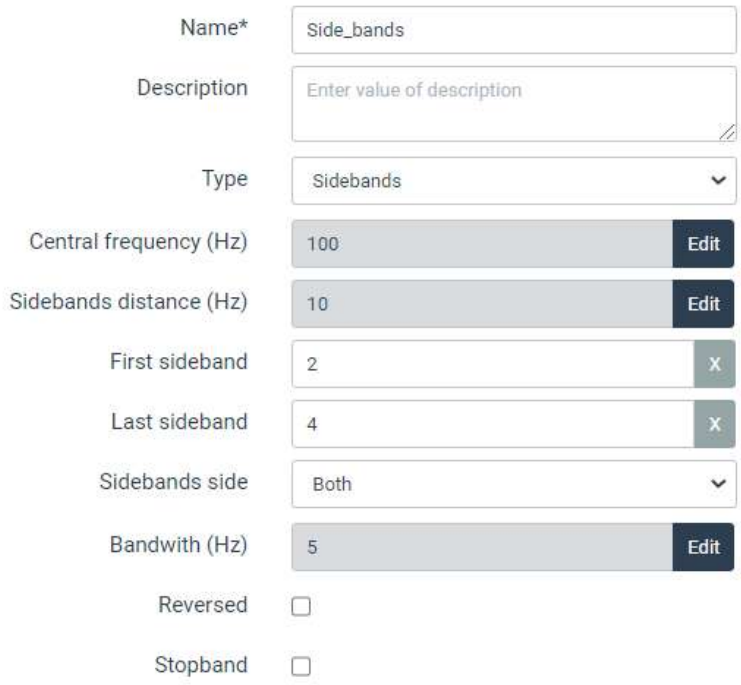
Field	Description
Name	Sets the unique name of the spectral band.
Description	Defines the description of the spectral band.
Central frequency	Sets the central frequency of the sideband. This value can be defined by introducing a numerical value in Hz or by an expression, whose result will also be in Hz units. Click on *Edit* button to edit this field.

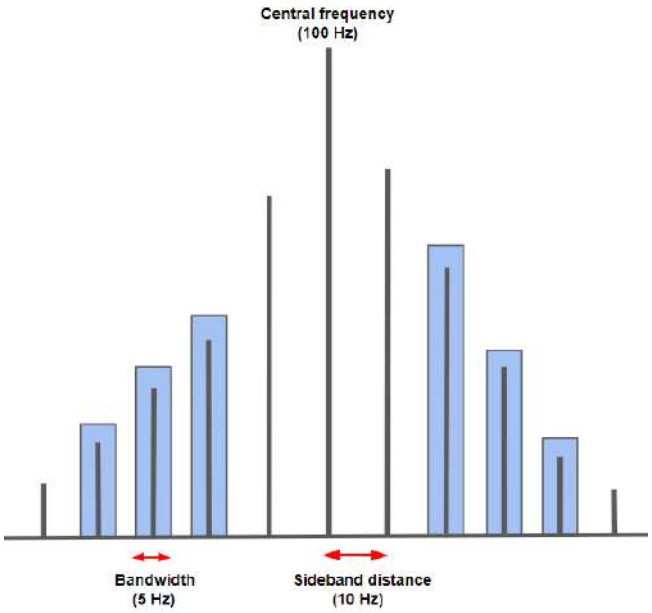
Sideband distance	Sets the distance in Hz between the sidebands.
First sideband	Sets the value of the first sideband. For example, a value of 3 will set as the first sideband a frequency of 3 times the sideband distance from the central frequency.
Last sideband	Sets the value of the last sideband. For example, a value of 6 will set as the last sideband a frequency of 6 times the sideband distance.
Sidebands side	Defines if only the left, the right or both sidebands around the central frequency will be taken into account.
Bandwidth	Sets the width of the band to be defined around each side band. This value can be defined by introducing a value in Hz, or by the result of a formula, whose result will also be in Hz units. Click on *Edit* button to edit this field.
Reversed	By checking this box, the frequency range is defined as all the frequencies of the spectrum except the ones defined on this form.
Stopband	By checking this box, the frequency range defined will not be taken into account on the calculation of the parameter associated with this spectral band.

The following image shows an example of this type of *Spectral bands*. On it a set of frequency ranges was configured with a central frequency of 21 times the speed, 5 sidebands to the left and right with a bandwidth of 2 Hz, and the sideband distance set as the speed frequency.



The following images show a set of frequency ranges defined as a *Sideband* type of *Spectral band*. In this example the central frequency was set at 100 Hz, with sidebands 2 to 4 at both sides, a bandwidth of 5 Hz and a sideband distance of 10 Hz.

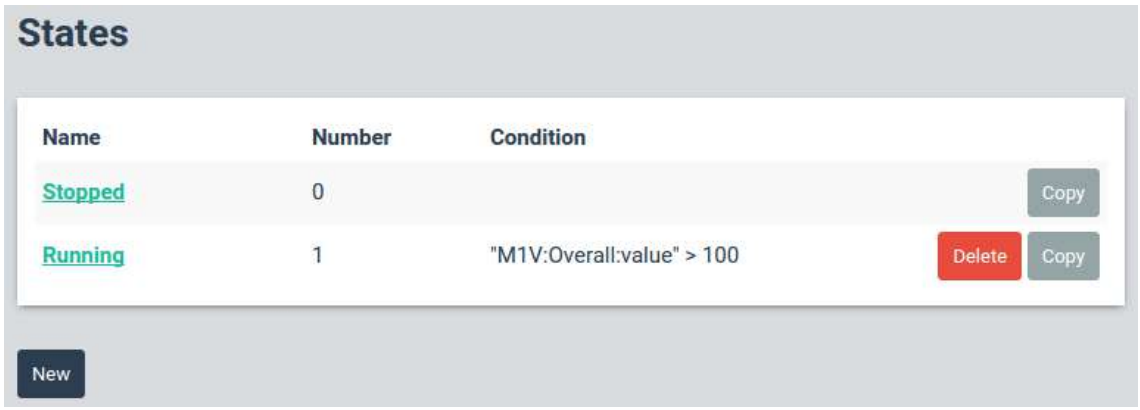




12.20 States

The *States* are objects included in the machine configuration that define the different machine conditions the *Vigilant* will consider. They allow the user to configure particular Storage Strategies and alarm limits depending on these different machine conditions or states.

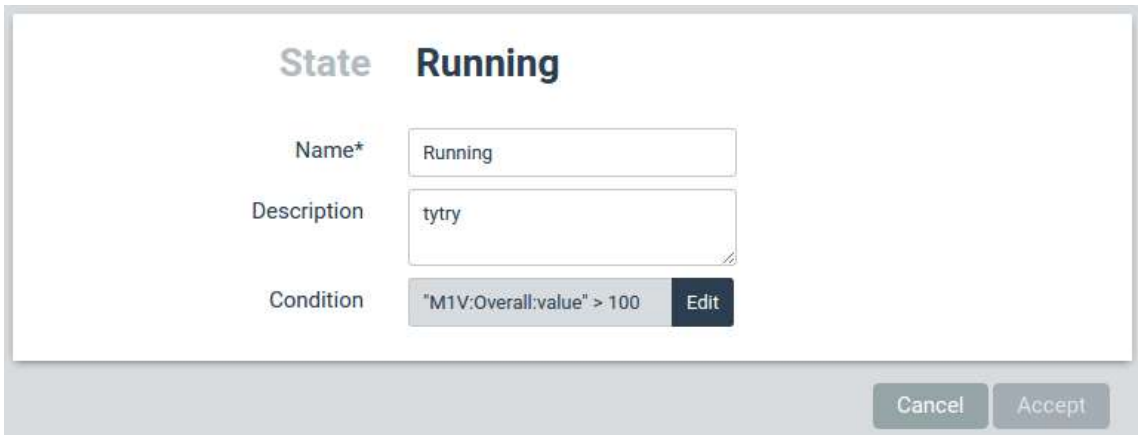
By selecting this menu option, the interface will show the list of States. From this list they can be added, removed, and configured.



The *States* are evaluated based on Logical Expressions . The evaluation of those expressions is done following the order of the machine State list. If one of the expressions is true, then the rest of the State expressions will not be evaluated. So that the machine will take the State whose expression comes true first.

The first *state* of the list is the default one and it is created automatically for each machine. Its name can be changed but it cannot be removed and does not have any expression associated with it. The machine will be set into this State if the other States' expressions are not true.

The following picture shows the configuration form.



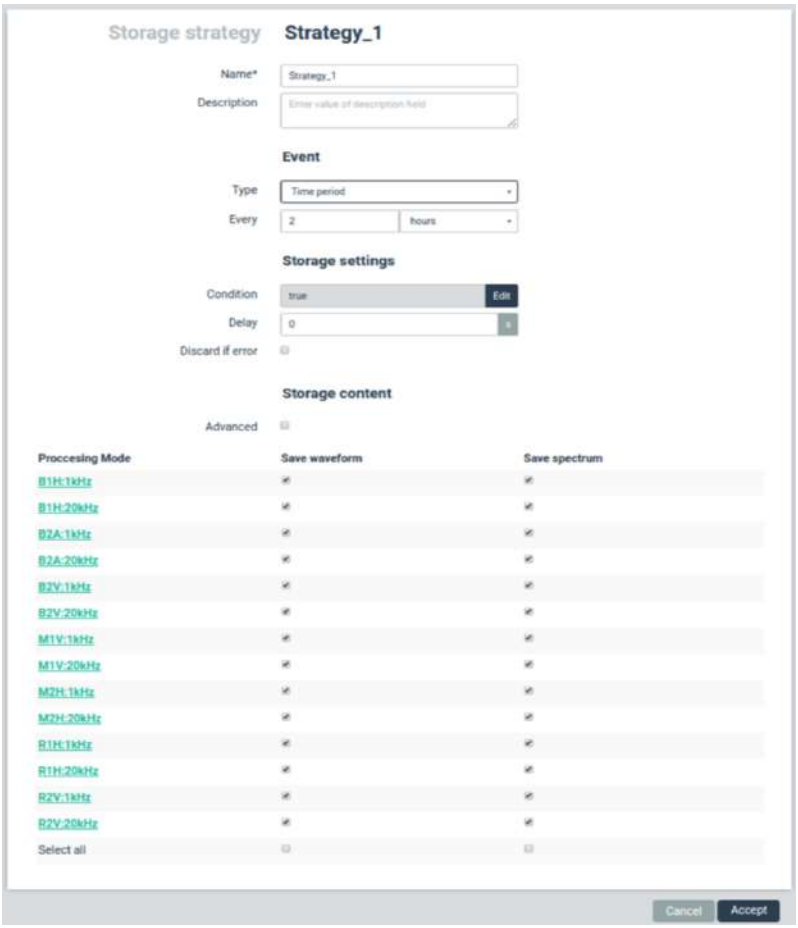
Field	Description
Tag	Text that identifies unequivocally the *State*. Only ASCII alphanumeric characters are allowed, including ".", "-", and "_". Any other special characters or blank spaces are not allowed. First character must be alphanumeric. Maximum length is 25 characters.
Description	Allows the user to include a description of the *State.*

Condition	Sets the Logical Expressions that define the State condition. If the result is true, the machine will be set to that *State*. If not, the system will evaluate the expression of the following machine *State*. Click on the Edit button to introduce the expression using the form. • *Variable:* Provides the list of available variables that can be used on the expression. By selecting a variable this will be inserted automatically on the expression field, helping on its writing. • *Operator*: Provides the list of available operators that can be used on the expression. By selecting an operator this will be inserted automatically on the expression field, helping on its writing.

12.21 Storage Strategies

The Storage Strategies are objects included in the machine configuration that define the data to be stored on the database, and the event and conditions that produce that storage (Optional software features).

Selecting this menu option, the interface shows the list of *Storage Strategies*. Click on any of them to access its configuration form.



12.21.1 Identification

Field	Description
Name	Text that identifies unequivocally the *Storage Strategy*. Only ASCII alphanumeric characters are allowed, including ".", "-", and "_". Any other special characters or blank spaces are not allowed. First character must be alphanumeric. Maximum length is 25 characters.
Description	Allows the user to include a description of the *Storage Strategy*

12.21.2 Event

Field	Description
Type	Defines the type of event that will make the data just measured to be stored on the database in case the expression defined in the Condition field is true. Select one of these options: • *Time Period*: Allows to set a periodic storage of the data. • *Monitoring cycles*: Allows to set the data storage based on the monitoring cycles defined for the machine on its field *Monitoring period*. (Optional software features) • *State change*: Defines a storage event based on a *State* change of the machine. The user will be able to choose the initial and final machine State that will trigger this storage event. (Optional software features) • *Alarm change*: Defines a storage event based on a change in the alarm condition of the machine. The user will be able to choose the minimum alarm condition that will trigger this event. Selecting a value of Alert will trigger the storage event when the machine goes into Alert or Danger alarm, but not if it goes from OK into Warning condition. (Optional software features) • *Advanced (cron line)*: Allows to introduce a time event based on a Cron command.
Every	Sets the period time in minutes or hours to store the data in case *Time period* is selected for the type of event. It also defines the number of cycles that trigger the storage event in case Monitoring cycles is selected.
From State	Sets the initial *State* of the machine state change event. This field only appears in case *State change* is selected for the type of event.
To State	Sets the final *State* of the machine state change event. This field only appears in case *State change* is selected for the type of event.
Alarm level	Sets the minimum alarm condition of the machine that will trigger the Alarm change event.

Cron line	Defines the expression of the *Cron* command. This expression sets the time when the storage event will be triggered. E.g.: • `cron */5 * * * tue` (every 5 minutes on Tuesday) • `cron 5 *` (every hour at hh:05) • `cron *` (every minute) • `cron 50 12 * * *` (every day at 12:50)

Minimum effective period in between two storage operations depends on several factors, like the CPU load, number of Processing Modes being used, number of records already in memory, etc. Times lower than 30 seconds are not guaranteed to be possible.

12.21.3 Storage settings

Field	Description
Condition	Defines a Logical Expressions that must be true in order to store data when the storage event is triggered. Click on the *Edit* button to launch the Expression Editors.
Discard if	Specifies, using a logic expression, which conditions should be met to discard the capture data, avoiding its storage.

12.21.4 Storage content

Field	Description
Advanced	The *Storage content* allows the user to select the waveforms and spectra to be stored (parameters are always stored). If this *Advanced* checkbox is selected the storage of the waveforms and spectrum for each *Point* and *Processing Mode* can depend on a condition defined by another expression introduced by the user.
Save Waveform	Sets whether the waveform will be stored for each *Point* and *Processing Mode*. If *Advanced* mode is selected the user will be able to select a condition for the waveform to be stored by defining an expression. Click on the *Edit* button to introduce this expression.
Save Spectrum	Sets whether the spectrum will be stored for each *Point* and *Processing Mode*. If *Advanced* mode is selected the user will be able to select a condition for the waveform to be stored by defining an expression. Click on the *Edit* button to introduce this expression.

When the storage event is triggered, the system will check if the condition defined on the Storage Strategy is true. In that case the last data measured will be stored (it does not require a new measurement to be performed).

12.22 Logical Expressions

In many of the Configuration interface sections described in this chapter, it is possible to use logical expressions to build flexible rules to configure how the system behaves under specific environmental regulations.

Output connections, machine States , and several parts of Storage Strategies can be configured by creating complex rules based on *logical expressions*.

The expressions are built in the Expression Editors by combining variables and operators. You can surround a subexpression with parentheses to indicate a higher precedence order in evaluating the full expression. Variables are always surrounded by double quotes.

In the following table, the labels “POINT” and “PARAM” must be substituted by the tags of the corresponding point and parameter. Elements surrounded by square brackets are optional. For example, **“[POINT:[PARAM:]]alarm”** means you can write:

- `"alarm"` to obtain the global alarm value of the machine.
- `"B1H:alarm"` to obtain the alarm of the point B1H.
- `"B1H:RMS:alarm"` to obtain the alarm of the parameter RMS from the point B1H.

The following table describes all the variables you can use in the expression editor.

Variable	Description
“POINT:PARAM:value”	Current numeric value of a parameter.
“[POINT:[PARAM:]]alarm”	Alarm code of a machine point or parameter. Possible values are: • 0: No alarm • 1: Warning • 2: Alert • 3: Danger Alarm codes are propagated from the parameters to the point, and from the points to the machine, so that the alarm code of an element reflects the worst case of its children’s alarms.
“[POINT:[PARAM:]]error”	Error code of a machine point or parameter. Possible values are: • 0: No error • other positive integer value: An error has occurred while measuring or processing the value.

“[POINT:]gerror”	Error code in a sub-element of a machine or point. The error may be in one of the parameters, in case of the points, or also in one of the points, in case of the machine. Possible values are: • 0: No error • other positive integer value: An error has been detected.
“POINT:vbias”	Bias of the inputs configured as *dynamic*, in volts.
“speed”	Current rotational speed, in Hz. Note that different points in the same machine may have different speed factors.
“speed_change”	Difference between the current rotational speed and the one measured in the previous stored capture.
“load”	Current load of the machine in the units defined in the configuration.
“load_change”	Difference between the current machine load and the one measured in the previous stored capture.
“t”	The UNIX timestamp at which the current snapshot was captured.
“elapsed_t”	Number of seconds elapsed since the last stored snapshot was captured. The value is initialized to 0 at startup or after a new configuration is applied.
“state”	The state number of the machine the expression refers to.
“t_stX”	Where “X” denotes the ID number of a machine state. This parameter counts the number of seconds spent by the machine in that state since restart or since last change of configuration.
“e_stX”	Where “X” denotes the ID number of a machine state. This parameter counts the number of seconds elapsed since the last storage event with the machine in that state.
“e_strY”	Where “Y” denotes the ID number of a storage strategy. This parameter counts the number of seconds elapsed since the last storage event caused by that storage strategy.

All the values for the system variables are returned in the default units, not taking into consideration user settings (e.g. m/s^2, m, A, Hz).

Operator	Description
or	Logical “or”

and	Logical “and”
not	Logical “not”
==	Logical “equal as”
!=	Logical “not-equal as”
>=	Logical “greater or equal than”
<=	Logical “lesser or equal than”
>	Logical “greater than”
<	Logical “lesser than”
-	Arithmetic subtraction
+	Arithmetic addition
***	Arithmetic multiplication
***	Arithmetic power
/	Arithmetic division
%	Arithmetic modulo

By selecting an operator this will be inserted automatically on the expression field, helping on its writing.

A resulting value from the expression different of 0 is equivalent to *true*. A resulting value equal to 0 is equivalent to *false*. It is also possible to include *False* or *True* words as part of the expression, which take a value of 0 and 1, respectively.

Here are some examples of typical logical expressions:

Expression	Condition to be True
`("speed" > 10) and ("state" > 0)`	Speed is greater than 10 Hz and the state is not “default”.
`("speed" > 10) and ("speed" < 20)`	The speed of the machine is between 10 and 20 Hz.
`("speed_change" > 10) and not "error"`	There has been an increase in more than 10 Hz of speed since last record, and the system is not detecting any measurement error.
`"elapsed_t" >= 60`	At least 60 seconds have passed since last stored snapshot.

12.22.1 Automatic parameters

Most of the parameters available for the logical expressions are those defined by the user in the configuration, but there are also others that are created automatically by the system in certain cases:

Parameter	Description
val	Default parameter of a static point.
freq	Frequency of a tachometer point.
freq_span	Variation of the frequency (in Hz) of a tachometer point that Its value is obtained from all the tachometer periods within the time window of the current snapshot. It can be useful as an indicator of the signal stability.
PARAM_peak	Peak value of a *peak-phase* parameter.
PARAM_phase	Phase of a *peak-phase* parameter, in degrees.

12.22.2 How to create conditional expressions

The syntax used in the V8 for the logical expressions also allows to create conditional formulas type *if...then...else*, even though such operators do not exist directly.

To do this, first you must consider that the expressions that are evaluated to be true take the numerical value 1, and the false ones take value 0. Besides, you must also take into account that V8 uses "lazy evaluation". That is to say:

- In an "or" comparison, if the first operator is evaluated to have a value of 0, then it is no longer necessary to evaluate the second operator.
- With the "and" operator it works in the opposite way: if the first operand is evaluated to be 0, then the second operand is no longer evaluated.

With all of that in mind, it is easy to generate concatenated expressions of type: *if … else if … else*. For example, the expression:

```
val1*(rms < 0.1) or val2*(rms < 0.5) or val3
```

In pseudo-code, that would be equivalent to write:

```
if (rms < 0.1)
    return val1
else if (rms < 0.5)
    return val2
else
    return val3
```

13 Dashboard

13.1 Introduction

The *Dashboard* allows the user to display the data measured and/or stored on the *Vigilant* unit. It also shows the historical or currently active alarms present on the system.

The *Dashboard* displays the data on windows called *Widgets*. The area where these *Widgets* are located is called Desktop. Each *Dashboard* can contain up to 20 different *Desktops*. The layout of each *Desktop* defines the number of *Widgets*, their size and location.

This section shows how to use the *Dashboard* to:

- Show and manage alarms.
- Create and edit *Desktops*.
- Use and configure the different type of *Widgets.*

13.2 Dashboard Layout

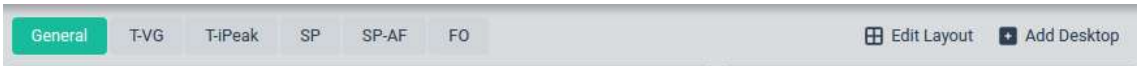
The following picture shows an example of *Dashboard* and its different components.

13.2.1 Desktop Toolbar

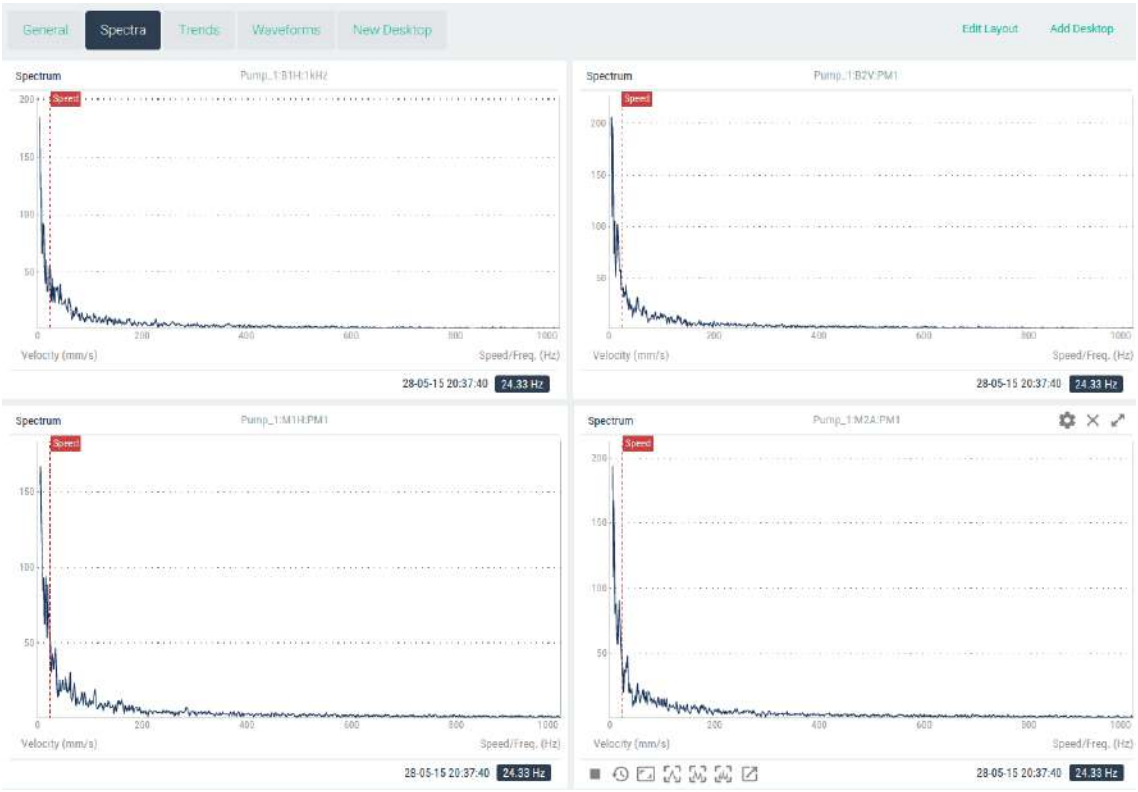
The *Desktop Toolbar* is used to access the different *Desktops* of the *Dashboard*.

The left part of the Toolbar shows the name of the *Desktops* available. Clicking on them will update the *Desktop* area with the corresponding layout of *Widgets*.

The buttons on the right part of the Toolbar (Edit Layout, Add Desktop) are used to edit the layout of the current *Desktop* and add new ones (see *Edit desktop layout*.



On the example below the *Dashboard* is composed of 4 *Desktops* called General, Spectra, Trend and Waveform, and shows the layout and *Widgets* of the one called Spectra.



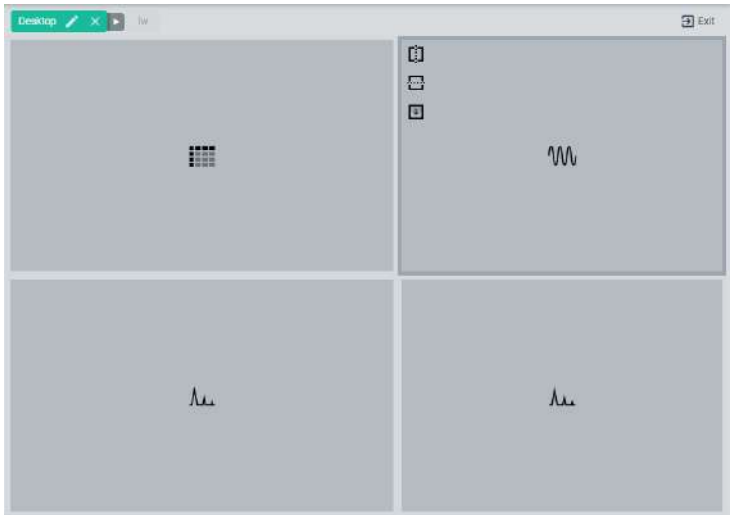
The area below the Toolbar is used for placing the *Widgets* of the *Desktop*. It can contain multiple *Widgets*, and each of them can have a different size and be of a different type.

The following Chapter shows how to define the layout of the *Desktop* and how to select the type of its *Widgets*.

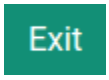
13.2.2 Edit Desktop Layout

The layout of the *Desktop* can be changed by the user. The changes made will only affect that particular user. Each user can have their own customized *Desktops* and layouts.

The button *Edit Layout* of the Toolbar will show the *Desktop* in edit mode, allowing the user to delete it, change its name or change the configuration of the *Widgets* layout. The following image shows the *Desktop* in edit mode.



The following table defines the different options.

Option	Description
Edit Name	Edits the name of the *Desktop*. A pop/up window will appear. Introduce the new name and click on the *Accept* button to change the name or click on *Cancel* button otherwise.
Delete Desktop	Deletes the Desktop. A pop/up window will appear to confirm the actions. Click the *Accept* button to delete the *Desktop* or cancel otherwise.
	Splits the *Widget* vertically in 2 equal parts.
	Splits the *Widget* horizontally in 2 equal parts.
	Merges 2 *Widgets* horizontally into one.
	Merges 2 *Widgets* horizontally into one.
	Merges 2 *Widgets* vertically into one.
	Merges 2 *Widgets* vertically into one.
	Exit the edit mode of the *Desktop*.

The *Split* and *Merge* buttons will only appear when the mouse passes over *Widget*, on its top left corner. When you merge one widget over another, the resulting widget will have the same functionality as the first one where the button was pressed.

Split buttons will only appear if the *Widget* is big enough to be split into 2 parts.

13.2.3 Split Widgets

The following images show some examples of how to split *Widgets*, creating new ones on the process.

The process can continue as necessary for each individual new *Widget*, to create the number of *Widgets* and layout required by the user.

The split buttons will divide the *Widget* into 2 equal ones. The size of each one can be changed though by using the vertical and horizontal division lines.

Passing the mouse over will turn those division lines into green, meaning its position can be changed. Click on them and move it into a new position, changing the size of the *Widgets* at both sides of the line, either vertically or horizontally.

13.2.4 Merge Widgets

The splitting of the *Desktop* changes can be reversed by using the *Merge* buttons. These buttons join 2 *Widgets* back into one.

For merging two *Widgets*, they must have been splitted previously. It is not possible to merge *Widgets* that are nor related one to another.

The following images show an example.

Clicking on the *Merge Horizontal* button will join both *Widgets* into a single one, as shown below.

Once the number of *Widgets* and layout has been defined click on *Exit* button to return to the normal *Desktop* mode.

13.2.5 Select type of Widget

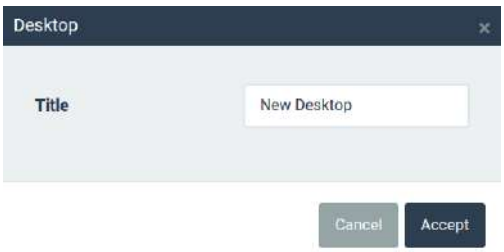
Once the layout has been defined the user can assign a particular type of *Widget* to the different windows of the Desktop layout. The following picture shows an example where no *Widgets* have been assigned to each Window.

Clicking on an empty one, a window will appear, showing the different type of Widgets available, and enabling to use the space for its functionality. Select the corresponding type of *Widget* that will be assigned to the corresponding window (spectrum on the example below).

The *Widget* will show “No Configuration”. By default, no data-source is assigned to the *Widget*. Go to its configuration in order to select the source of data that the *Widget* will present (see *Widgets*).

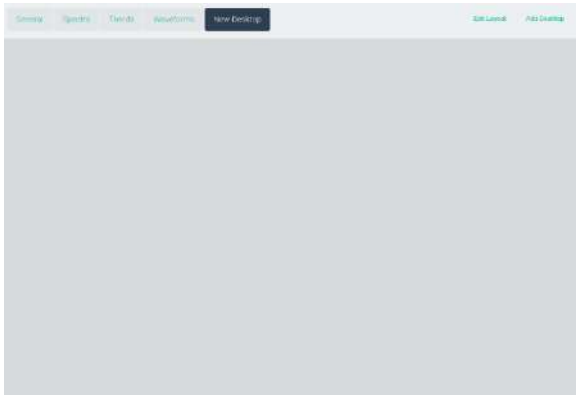
13.2.6 Add Desktop

The button Add Desktop of the Toolbar adds a new one. Clicking on it the following pop-up window will appear.



Introduce the name on the field *Title* and click on the *Accept* button to create the new *Desktop*. Click on *Cancel* to abort the process.

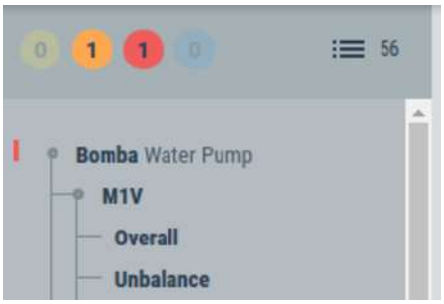
Once it has been created the *Desktop* will show a single *Widget*, filling all its area. See ”Edit *desktop*" *layout* in order to add new *Widgets* or change its layout.



13.2.7 Alarm Toolbar

The *Alarm Toolbar* shows the number of alarms currently active in the system, the number of non-acknowledged alarms and provides access to the historical alarm log.

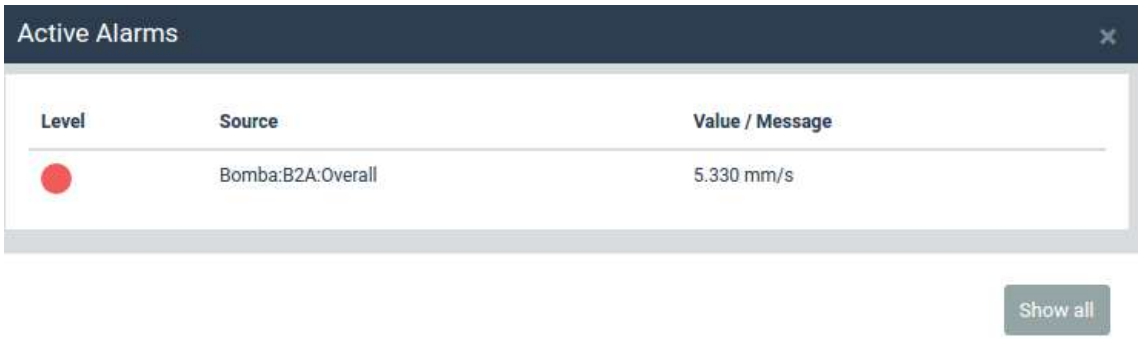
When the database tree is not hidden this toolbar will be shown in horizontal, above the database tree.



The active alarms are represented with circles, with a different color circle for each alarm level (from yellow to red for Warning, Alert and Danger).

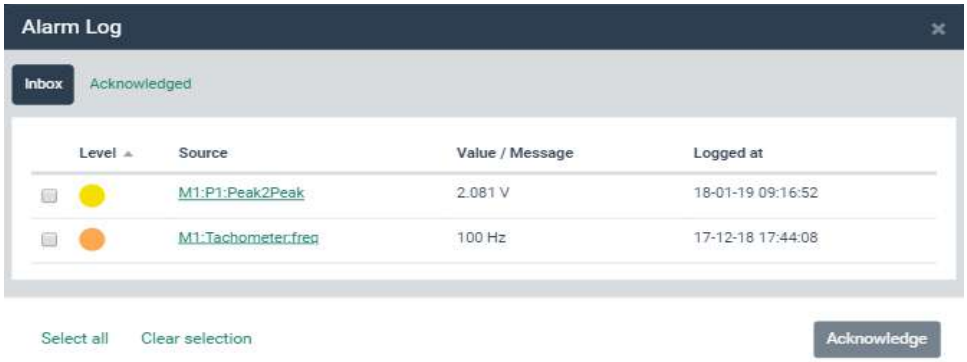
Blue circle represents system errors. The number inside the circle represents the amount of currently active alarms for each type. Clicking on the circles will open a pop-up window that shows the list of active alarms of that type.

Clicking on the *Show all* button, the list will present all the active alarms in the system, no matter what their level.



Besides the active alarm circles, the toolbar has this other icon:

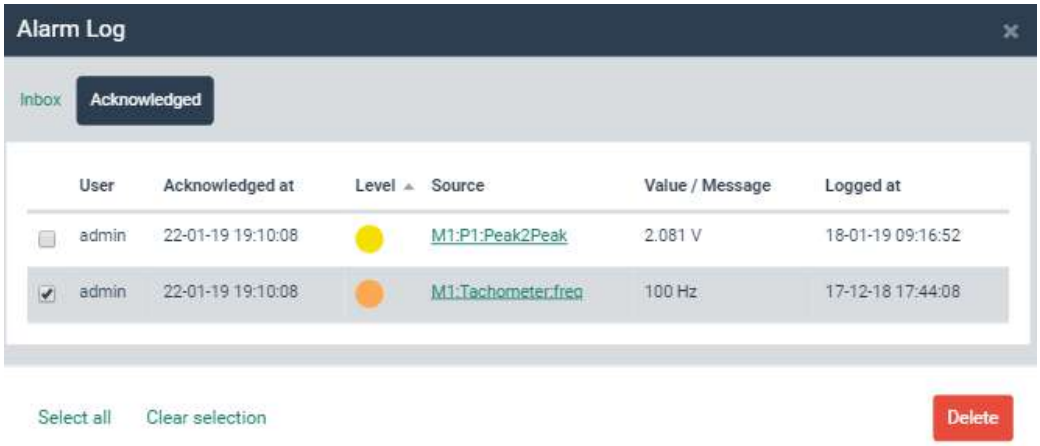
This button will open the **Alarm log**, which is a list of all the historical alarms registered in the system. The number close to the icon indicates the number of alarms currently on that list. Clicking on the button will open the following panel:



Field	Description
Level	Indicates the severity of the alarm. From yellow to red indicating warning, alert, and danger. Blue indicates *error*
Source	List of tags of the elements and sub-elements related to the alarm.
Value/Message	Shows the value of the parameter that raised the alarm/error.
Logged at	Date and time of the first appearance for that alarm/error.

By selecting the list items and clicking on “Acknowledge”, the corresponding alarms will be archived in a second list,shown on this panel, of *Acknowledged* alarms. That should mean that a vibration analyst has reviewed the problem and made any corrective action.

This second list is remarkably similar to the one already described, but it also has additional fields to indicate by whom and when were the alarms acknowledged. Acknowledged alarms may also be permanently deleted.



Alarms must be acknowledged in this menu in order to generate new Notifications it they happen again.

13.2.8 Configuration tree

The configuration tree is shown or hidden by clicking on the following button of the Navigation bar:

This button will show or hide a tree structure on the left of the screen. Here in the Dashboard, this structure will show the measurement configuration of the system: all the machines, measuring points and parameters configured in the *Vigilant*.

If any of the *Parameters* is in any alarm mode, a vertical mark on the left of the tree will identify it with the corresponding color, as shown in the example below:

Clicking on any of the parameters will show up a window with the trend of that measurement and, on the other hand, clicking on the points will show their spectrum. This graph will have the normal functionality of the *Trend or Spectrum widgets*. Pressing ESC will close these windows.

13.2.9 Global play

At the bottom left of the Dashboard you will see the following icon:

The *Global Play* button will make the values of all the widgets to be updated automatically with the latest measurement performed by the *Vigilant*.

The *Play* state will last for a few minutes, and after that will go back to *Pause* mode after a while, in order not to waste data bandwidth.

13.2.10 Global timeline

At the bottom left of the Dashboard you will see the following icon:

This feature allows to synchronize the Timeline function found in many of the widgets described late. It allows setting a specific date and time to be applied simultaneously in all the *Widgets* visible on the active *Desktop*.

Pressing the button will show the date/time selection controls, at the bottom of the application:

Field	Description
Update	Apply the selected date and time to all the visible widgets in the desktop. They will go to the closest stored snapshot to the date and time selected.

Set to now	Selects the machine of the measurements to be shown from the pull-down list.

It is not even necessary to use this selection control. Once the Global Timeline function is enabled, just selecting one stored snapshot in the Timeline of any of the widgets, will do that all the other widgets go also to the same time moment.

With the widgets involving trend values (Trends, Phase Diagram, etc.), it happens something similar. In this case it is the cursor selection tools that will get synchronized. The cursors of these widgets will go to the Timeline selection made on other widgets, and in the opposite way, if the cursor on one of these widgets is moved, it will act as a time selection for the Timeline in the other widgets.

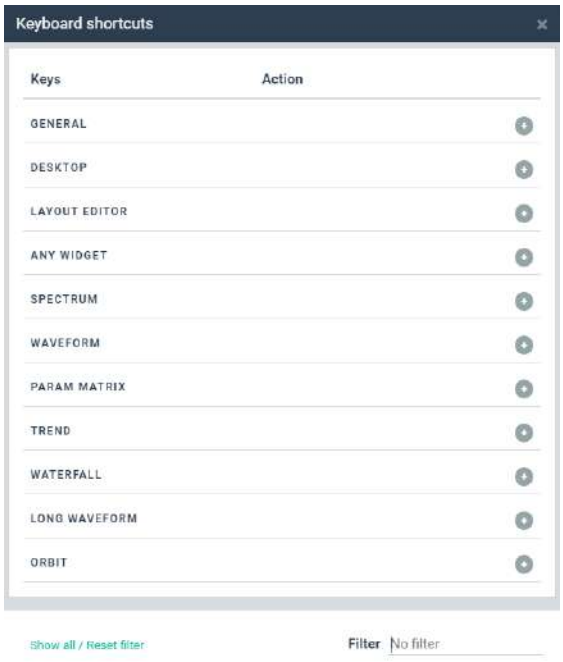
Applying global Timeline will modify the date and time of all widgets that allow the functionality, regardless of whether the specific Timelines were active in the displayed widgets.

These features are especially useful to compare temporal data of several graphs simultaneously, without having to enter the date individually in each of them.

13.2.11 Keyboard shortcuts info

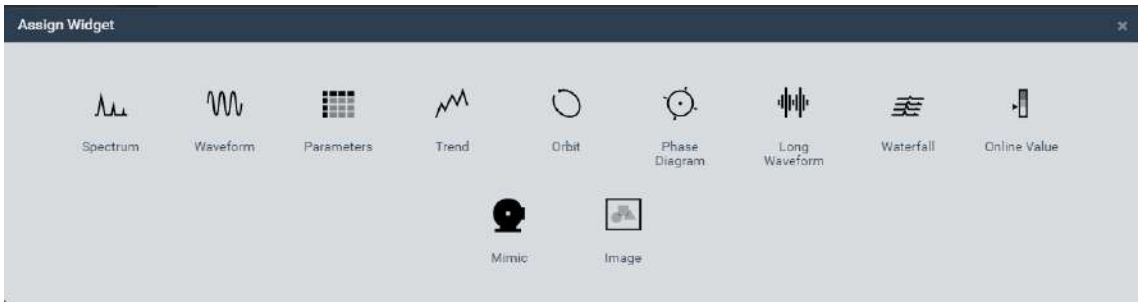
At the bottom of the Configuration Tree the interface shows the following button:

Clicking on it will show a pop-up window with all the Keyboard Shortcuts available for the different *Widgets*.



13.3 Widgets

This Chapter describes the different type of *Widgets*. It shows how to work with them and its configuration options. Widgets can be added by clicking on any blank space in any of the *Desktops* of the *Dashboard*:

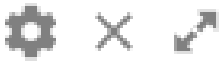


The following table shows the different type of *Widgets* the user can currently create on the *Vigilant* units.

Widget type	Description
Spectrum	Displays the spectrum of a particular measurement point and processing mode. (Optional software features)
Waterfall	Displays the spectra waterfall (3D view) of a point. (Optional software features)
Waveform	Displays the waveform of a particular measurement point. (Optional software features)
Long Waveform	Displays a special long time waveform of a particular point, which is a raw signal of up to several minutes long. (Optional software features)
Orbit	Displays a two-dimensional graph of the space displacement of a rotating shaft, generated from the original waveforms. (Optional software features)
Trend	Presents the trend in time of a parameter or set of parameters.
Phase Diagram	Displays a Bode/Nyquist diagram generated from the peak-phase parameter calculated at one of the points. (Optional software features)
Parameters	Presents all the parameters measured for each point in a matrix format.
Online Value	Displays an indicator with the value of a parameter.
Mimic	Shows a mimic of the machine. Over the mimic the widget will show the measuring points of the machine, and their alarm status.
Image	Displays an image in any of the compatible formats (JPEG, PNG).
Shaft Centerline	Draws a two-dimensional graph with the average radial position of the shaft.

13.3.1 Widget Toolbar

All the *Widgets* have a Window Toolbar at the top. This Toolbar shows on its left the name of *Widget* or the *Machine, Point and Processing Mode* or *Parameter* in case the name is left blank at its configuration. On the right it shows the Window buttons: *Configuration, Remove* and *Maximize*.



The following table describes these options:

Symbol	Description
	Shows the configuration form of the *Widget* in a pop-up window.
	Removes the *Widget* from the Desktop. A pop-up window will appear in order to confirm the action.
	Maximizes the *Widget* size. Click again in this button or outside the *Widget*, or press ESC key, in order to go back to its normal size.

13.3.2 Timeline

The *Timeline* is a graphical tool that allows the user to access quickly to the measurements stored on the database of the *Vigilant* module. Clicking on this button:

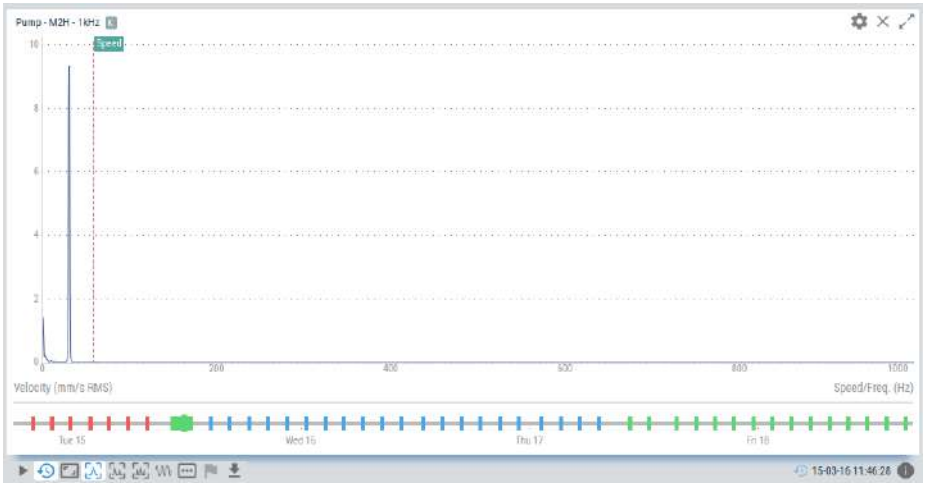
the *Widget* will show up the *Timeline* at the bottom part of the *Widget*.

Each bar of the *Timeline* represents a stored measurement, which is allocated on a temporal line depending on the date and time the measurement was taken. This temporal line can be zoomed in and out. It can also be moved by clicking and dragging to the left and right with the mouse.

The color of each bar shows the alarm condition of the machine when the measurement was taken, which in turn is defined as the worst alarm condition of any of the measurements performed at that date/time. The color allows the user to quickly identify those times at which the machine was in alarm condition or not.

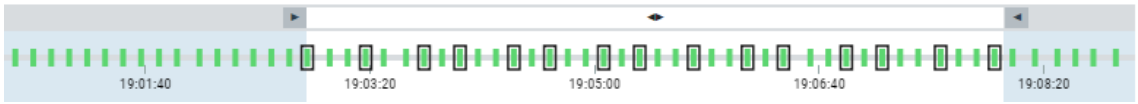
Single snapshot Timeline

In some widgets, like *Spectrum, Waveform, Parameter Matrix* or *Orbit*, the timeline just allows selecting one of the stored snapshots, and the widget will show the data corresponding to that date and time. The following picture shows the *Timeline* on the *Spectrum Widget*:



Range selection timeline

In some other widgets, like the Waterfall, the Phase Diagram, or the Shaft Centerline behaves a little bit different, as it actually allows selecting a range of *Snapshots* to be represented in the chart (not just one):



Each vertical bar on the Timeline represents a stored measurement, including a specific date and time and a color representing its alarm state, like in all the other *Timelines*. This temporal line may also be zoomed in and out. It can also be moved by clicking and dragging to the left and right with the mouse.

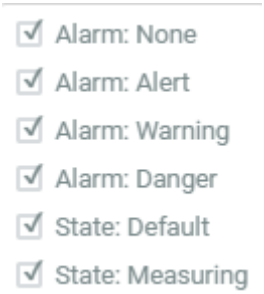
The main difference is that, with the help of the mouse, clicking and dragging the area selector above the timeline, it is possible to select the range of dates from which the data will be displayed.

In the case of the *Waterfall*, some black marks indicate which captures of the Timeline are being effectively represented, since depending on the configuration of the widget not all the spectra will be drawn (See option “number of spectra” in the configuration of this widget). The marks will be distributed in a balanced way among all the available captures in the selected range, and those will be the spectra to be drawn.

13.3.3 Filtering by Alarm or State

Several *Widgets* have the possibility to filter the stored data, only showing records corresponding to the machine in a given state, or a specific alarm status. This can be done by clicking on the following icon:

The selection of the active states or alarms will be done in an emerging selection panel, like the following:

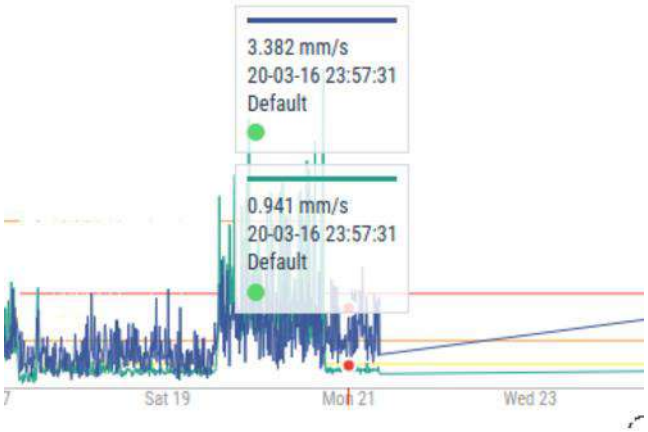


The alarm levels of the recorded data are calculated according to the settings when the data was stored. Those levels may have changed since then, and the interface may be showing incorrect alarm levels to those points, especially in the Trends widget.

13.3.4 Dynamic cursor

Those *Widgets* representing a graphical plot (Spectrum, Waveform, Trend, Orbit) will show a dynamic cursor when moving the mouse over the graph. This cursor is represented with a red spot and is located on the point of the plot vertically aligned with the mouse position. The following example shows this dynamic cursor over a waveform.

On the other hand, when the mouse location is close to the dynamic cursor a pop-up window will appear at the top-center of the *Widget*, showing the X and Y values of the cursor and its units. For multiple trends, the *Widget* will present several windows, one for each trend, as shown below.

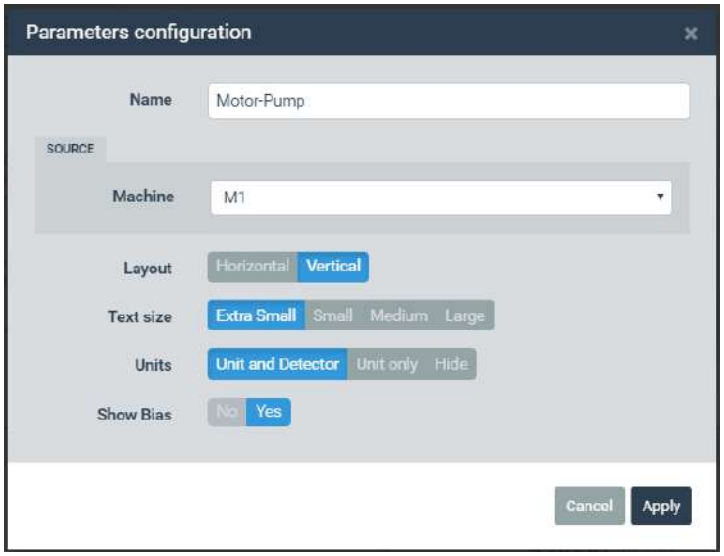


13.4 Parameter Matrix

This *Widget* displays in a matrix format all the parameters measured for each dynamic point of the machine. The *Widget* allows the user to see in a single view the current condition of a machine, with all the latest measurements and its alarms. Historical values can also be accessed through its *timeline* bar.

13.4.1 Configuration

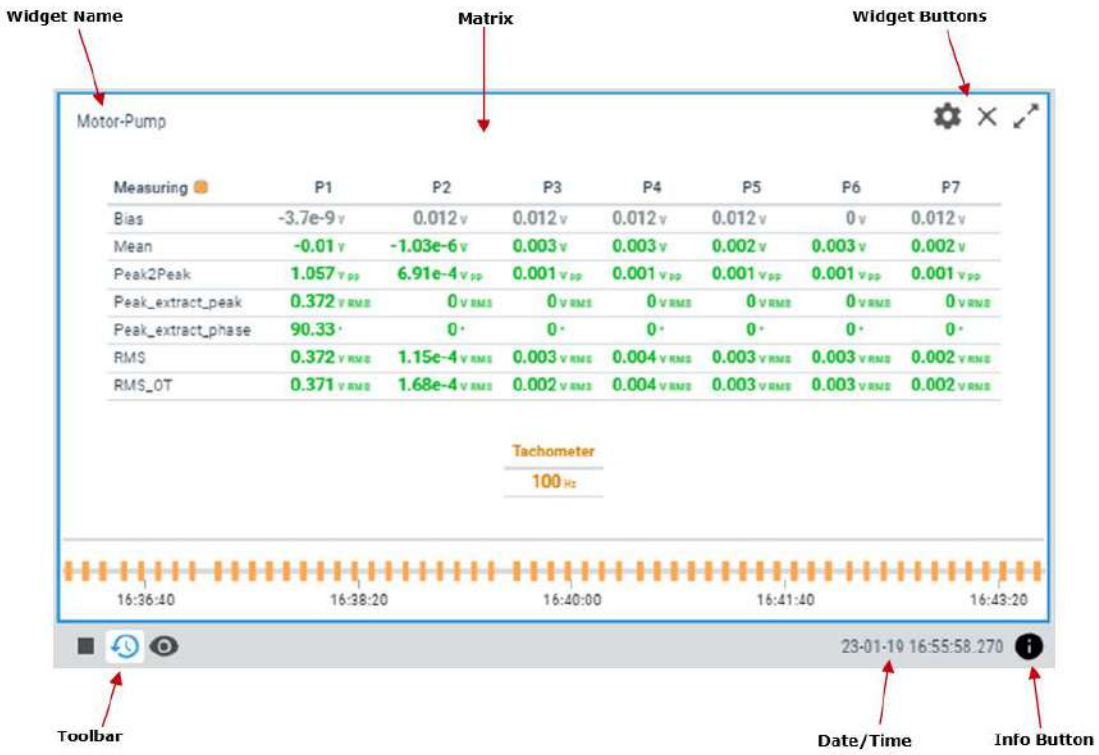
The following picture shows its configuration settings, which may be accessed through the shortcut key “c” or the button in the right corner.



Field	Description
Name	Defines the name to the *Widget*. It will be shown at the upper bar of the *Widget*.
Machine	Selects the machine of the spectrum from the pull-down list.
Layout	Selects the type of layout, either horizontal or vertical, for the parameter matrix. This defines where the static parameters will be shown, either on the right (horizontal) or below (vertical) of the main matrix.
Text size	Selects the size for the text within the cells of the matrix. This can help to adapt the matrix size to the available space on the desktop window. There are 4 size options: Extra small, Small, Medium and Large
Show units	Shows or hides units and detectors of the different parameters of the matrix.
Show bias	Show a new row at the top of the matrix with all the DC values of the input channels associated to each dynamic point.

13.4.2 Display

The following picture shows the Parameter Matrix and its components.



Symbol	Description
▶	The *Play/Pause* button will make the values of the parameter matrix to be updated automatically with the latest measurement performed by the *Vigilant*.
■	*Pause* button will freeze the current values, so the parameter matrix will not be updated with new measurements.
	Shows the *Timeline* of the parameter matrix measurements. The *Timeline* presents in a graphical mode the array of measurement The different captures are ordered by its date/time on the *Timeline* and are represented as a vertical bar. The color of the bar represents the machine alarm status at that date. Clicking on any of these bars will update the matrix with the parameter measurements for that particular date. See *Timeline* for more information.
	Timeline *Filter* button will hide the marks in the timeline that do not match the selected Machine State or Alarm status. Those records will be displayed more diffused in the timeline and it will not be possible to select them.
	Shows/hides the parameter matrix information box. This box shows the following information associated with the matrix: machine name, speed, load, state and alarm condition of the machine at the time selected.

13.4.3 Cell Colors

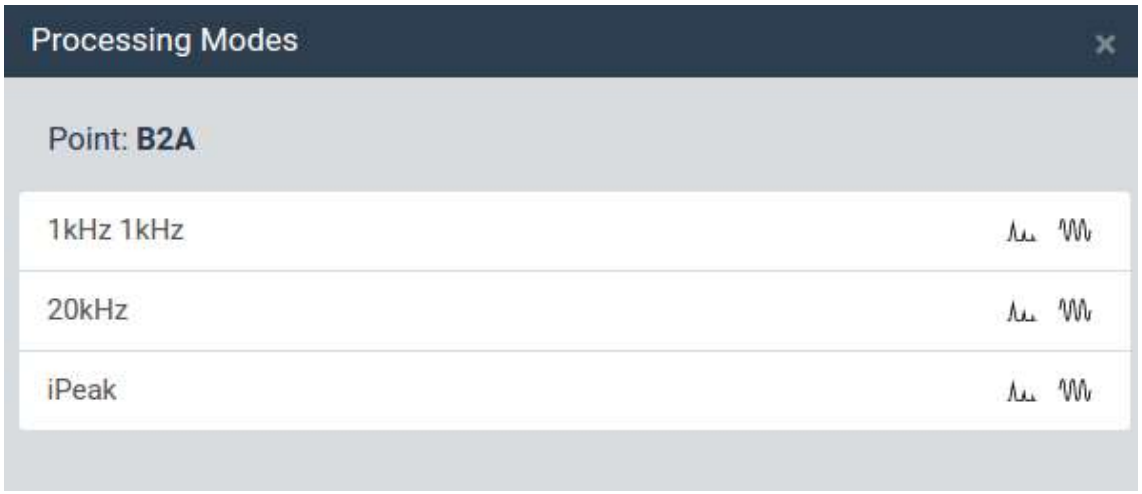
The cell's background colors will be in yellow, orange, or red in case the corresponding parameter reaches the alarm condition Warning, Alert or Danger, respectively. In case the parameter goes above the validation range defined on the configuration of the measurement the cell background will change into blue color.

On the other hand, the background of the dynamic point cell will get the color of the worst alarm condition of any of its associated parameters. In case the validation range of the sensor is out of limits, as defined on its configuration, the dynamic cell point will get a blue background color.

13.4.4 Graph access

By clicking on any of the cells the interface will show a pop-up window with the trend of the parameter selected. This window can be closed by selecting the corresponding button of the window or by pressing the ESC key.

Mouse clicking on the dynamic point cells the interface will present all the *Processing modes* in a list, as shown below.



The symbols on the right of every row show if the corresponding Processing Mode has associated Spectra or Waveforms. If the symbols are painted in black, the graph will exist, but it will not if the symbol is painted in gray.

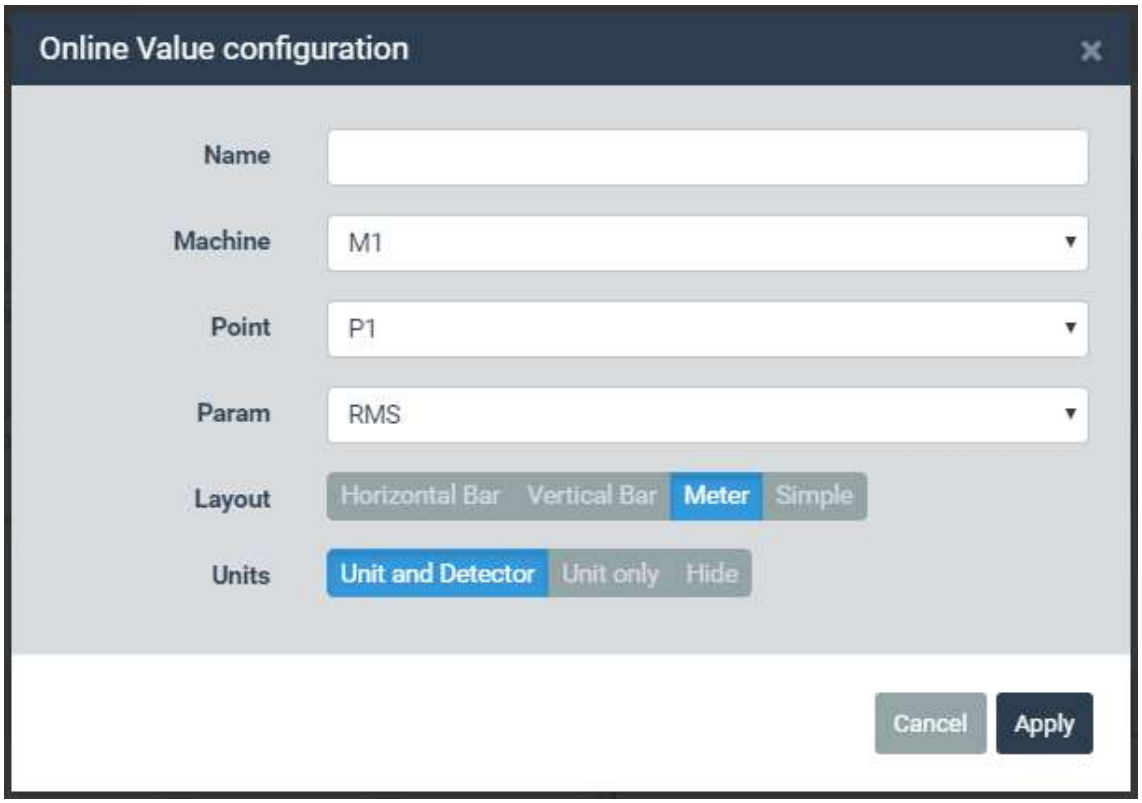
Selecting one of the *Processing modes* a window will show up with the corresponding spectrum measurement. This spectrum window will have the same functionality as the normal spectrum *Widget*. For instance, the associated waveform could be visualized by clicking on the corresponding icon from the window toolbox. In any case, the pop-up window can be closed by pressing the ESC key.

13.5 Online Value

This *Widget* displays the online value of a parameter measure on a dynamic input of the *Vigilant*.

13.5.1 Configuration

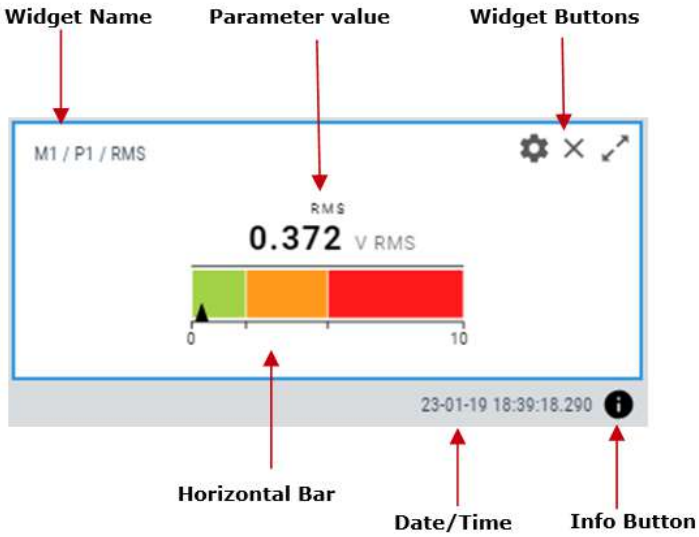
The following picture shows its configuration settings. Once the *Widget* is selected click on the shortcut key "c" or the button to show its configuration form.



Field	Description
Name	Defines the name to the *Widget*. It will be shown at its upper bar.
Machine	Selects the machine of the measurements to be shown from the pull-down list.
Point	Selects the point of the measurement for that source from the pull-down list.
Param	Selects the parameter or measurement to be plotted for that source from the pull-down list.
Layout	Changes the way the Widget will present the information. *Simple* mode will just present the value of the selected measurement, along with its units and detector. *Horizontal Bar* and *Vertical Bar* mode will show a bar in horizontal or vertical direction respectively. *Meter* mode will show a "gauge" type of view of the value.
Units	Displays or hides magnitude units (e.g. mm/s) and applicable detectors (e.g. RMS) for the parameter.

13.5.2 Display

The following picture shows the *Online Value Widget* and its components.



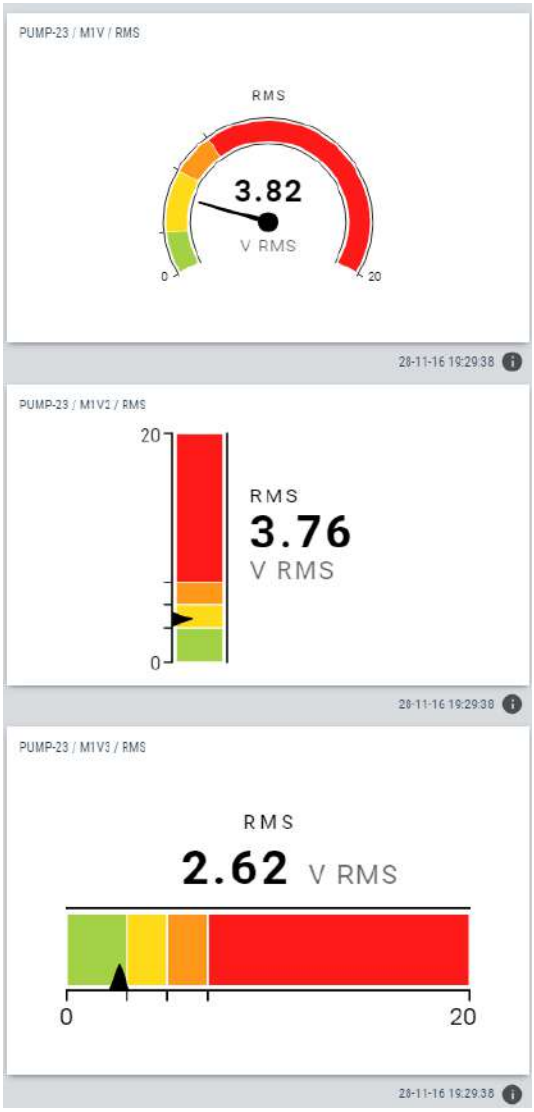
Symbol	Description
	Shows/hides the global value information box. This box shows the following information associated with the measurement: machine name and speed.

13.5.3 Types of graphs

The *Online Value Widget* may be configured to display the data in 4 different chart types: Simple, Horizontal bar, Vertical bar, and Meter.

The Simple type will only display the magnitude, with optional unit and detector, and a small color circle with the given value's alarm status. In the other three cases, the measurement value will be represented by an arrow and a meter, which also displays the different zones corresponding to the different alarm levels configured to that parameters. Thus, it is easy to see how far away the value from the different alarm levels is.

In the following chart it is shown the different kind of meter types available for the *Online Value Widget*:



13.5.4 Access to trends chart

By clicking on the measurement value, the interface will present a window with the trend of the parameter. The graph will have all the options as the trend *Widget*. This window can be closed by selecting the corresponding button of the window or by pressing the ESC key.

13.6 Mimic

This *Widget* displays the image associated to the machine, along with its measuring points.

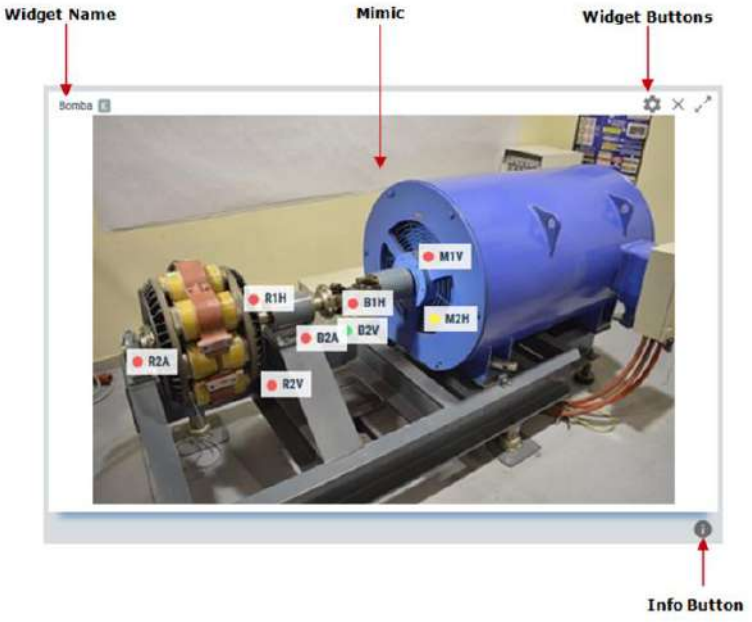
13.6.1 Configuration

The following picture shows its configuration settings. Once the *Widget* is selected click on the shortcut key “c” or the button in order to show its configuration form.

Field	Description
Name	Defines the name to the *Widget*. It will be shown at its upper bar.
Machine	Selects from the pull-down list the machine mimic to be shown.
Show first parameter value	Show value of the *Main parameter* below the label of the points.
Image size	Sets the way the image fits on the space of the *Widget: Normal* will show the image at its normal resolution, Double increases 2 times the size of the image, *Cover all* fits the image file to the total space available on the *Widget*.

13.6.2 Display

The following picture shows the *Mimic Widget* and its components.



Symbol	Description
	Shows/hides mimic information boxes. This box shows the following information associated with the machine: machine name, speed, load, state, and alarm condition.

13.6.3 Points Visualization

The measuring points defined for the machine will be shown in the mimic, represented with a label with its tag. Its location is defined on the configuration of the point, using the "Label" control option, where the user can introduce it graphically.

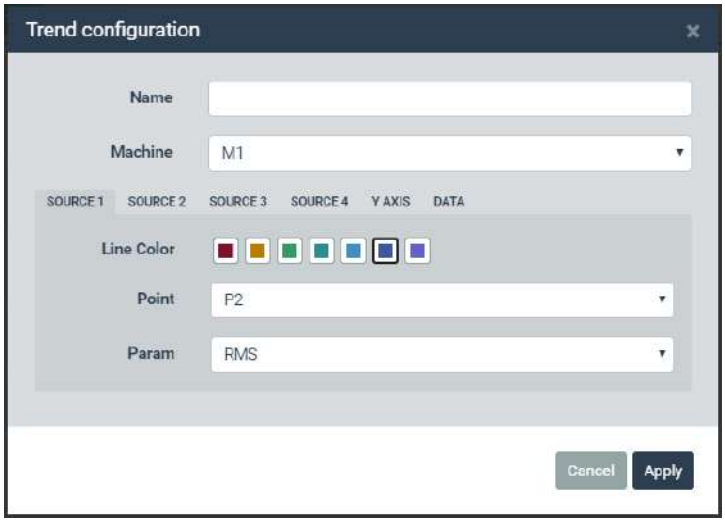
On the left and side of the label the *Widget* shows the alarm condition of the point with a colored circle. Below the label, it is displayed the value of the *Main parameter* of this point. The *Main parameter* is defined in the configuration web.

13.7 Trends

This *Widget* displays a chart of the evolution in time of one or several parameters.

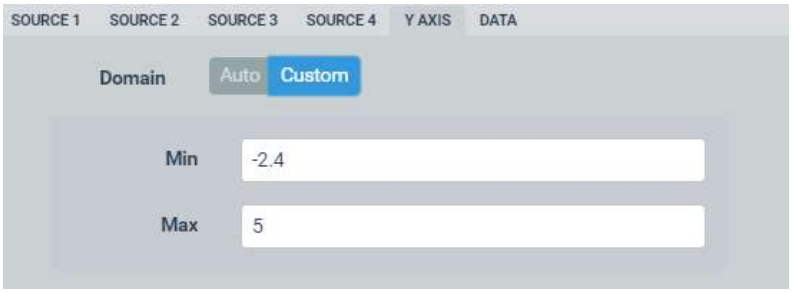
13.7.1 Configuration

The following picture shows its configuration settings. Once the *Widget* is selected click on the button on the top right corner of the widget or use shortcut key "c" in order to show its configuration form.

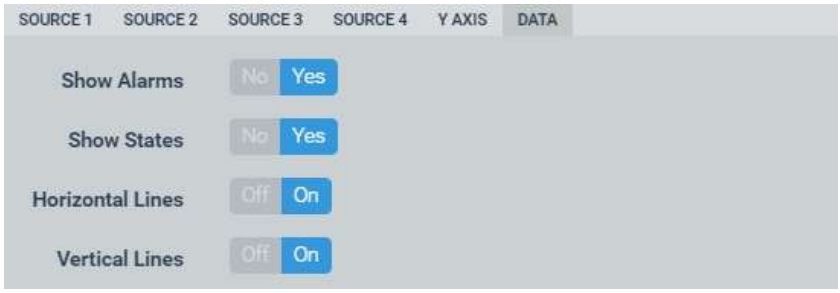


Field	Description
Name	Defines the name to the *Widget*. It will be shown at its upper bar.
Machine	Selects the machine of the measurements to be shown from the pull-down list.
Source[1..4]	From these tabs up to 4 data source or measurements can be selected to be plotted on the *Widget*.

Line Color	Selects the color of the trend line for the particular data source or measurement.
Point	Selects the point of the measurement for that source from the pull-down list.
Param	Selects the parameter or measurement to be plotted for that source from the pull-down list.



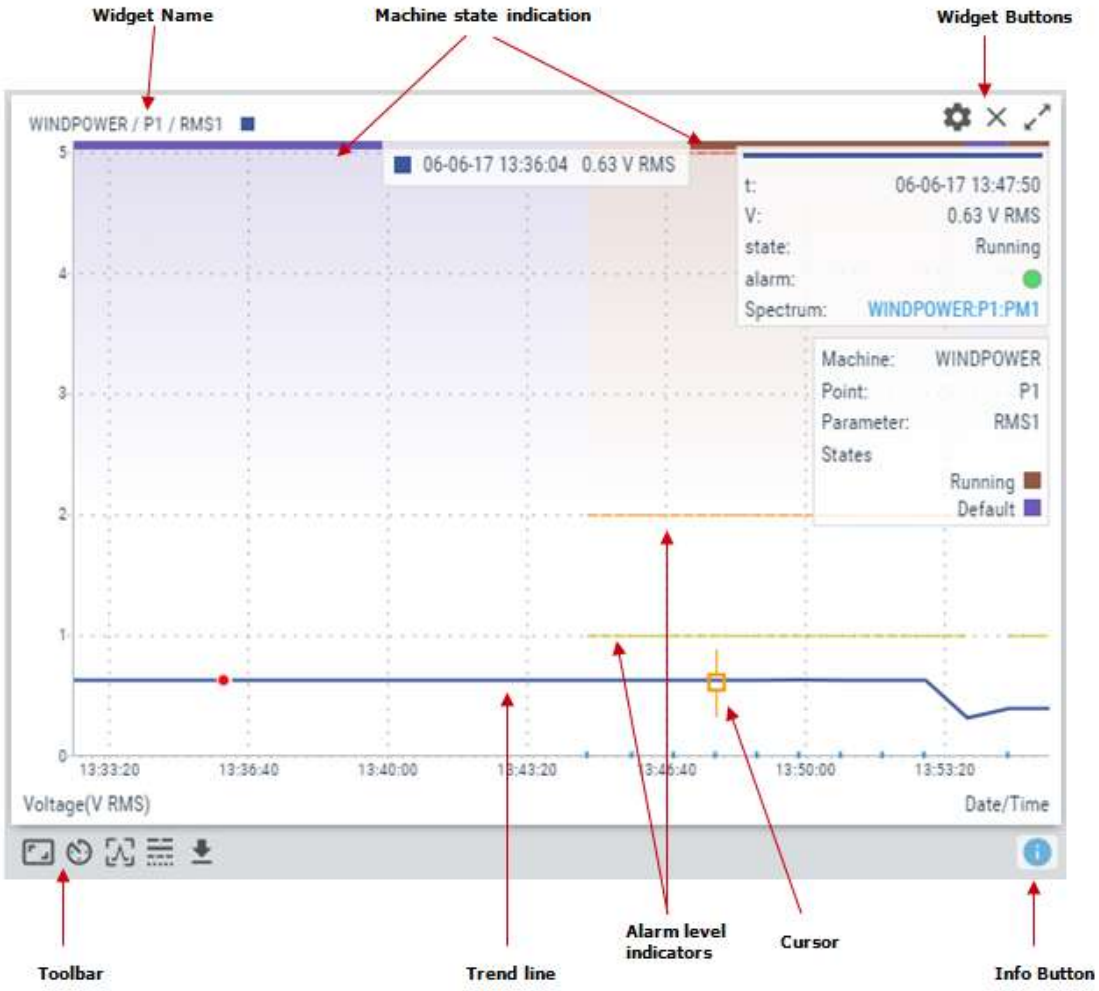
Field	Description
Domain	Sets the maximum and minimum values visible in the Y axis. Note that clicking on the *Reset zoom* button with this the *Custom* option enabled will reset it to the values set in this form.



Field	Description
Show Alarms	Displays horizontal lines on the graph indicating alarm levels corresponding to the parameter that has the focus.
Show States	Displays a shadowed background and with information about the state of the machine at each time period.
Horizontal Lines	Shows or hides horizontal grid lines on the *Widget*.
Vertical Lines	Shows or hides vertical grid lines on the *Widget*.

13.7.2 Display

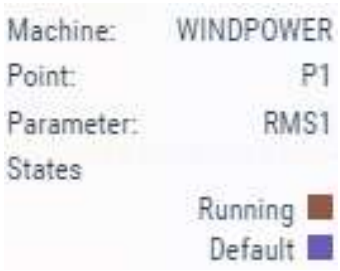
The following picture shows the trend *Widget* and its components.



Symbol	Description
	Sets the current range of the trend from the pull-down list. The time range available are *1 hour, 12 hours, 1 day, 3 days, 1 week, 1 month, 3 months, 9 months, 1 year*.
	Trends *Filter* behaves similar as the timeline filter in other widgets. The button allows selecting which machine state and alarm status to show, and the rest of the points will get hidden. Note that the points' alarm status is calculated when the data was stored and may not match with actual settings.
	Restores the zoom to its normal condition, removing the effect of any previous zoom done on the plot.
	Sets the current cursor as a single cursor type. Clicking with the mouse on the graph will add a cursor to the trend plot.
	Selects the trend that will get the focus on the plot. make the cursor to locate on the corresponding trend.
	Exports the trend values to CSV format and creates and downloads it into a local file.

	Shows/hides trend information box. This box shows the following information associated with each trend: machine, point and parameter, along with the color line for each of them.

Note that the coloured background of the graph is used to show information about the different machine states along time (when this option is activated in the configuration of the widget). The relation in between states and background colours is shown in the info panel of the widget:



13.7.3 Zoom tools

Use the mouse wheel to zoom in and out horizontally on the trend plot. The *Widget* will zoom the trend around the time aligned vertically with the mouse location. After zooming, you can use drag and drop with the left button of your mouse to move the plot left and right.

To make a zoom in a vertical direction locate the mouse over the Y axis and use the mouse wheel. The trend plot will vertically zoom in and out from the location of the mouse. Locate the mouse aligned with the 0 value of the scale to zoom in and out keeping that reference still.

Click on the *Reset zoom* button:

to restore the plot to its normal scaling, removing the effect of any previous zoom done on the plot.

13.7.4 Time range

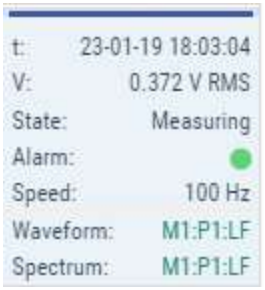
Clicking on the *adjust time-domain* icon.

will allow you to select the default time range that will be shown in the Trend widget, which ranges from 1 hour to 1 year of data in several steps.

13.7.5 Single cursor

Clicking on any part of the graph will add a *Single* type cursor to the trend plot, even if that tool was not yet selected in the main toolbar:

The click will show a pop-up window at the top right side of the *Widget* with some information about the point selected by the user:



- Date and time when the point was measured.
- Value of the signal in that moment.
- State of the machine to which the parameter belongs.
- Alarm status of that machine.
- Speed of the machine.
- Waveform: a quick link to see the waveform related with the parameter (if available).
- Spectrum: a quick link to see the spectrum related with the parameter (if available).

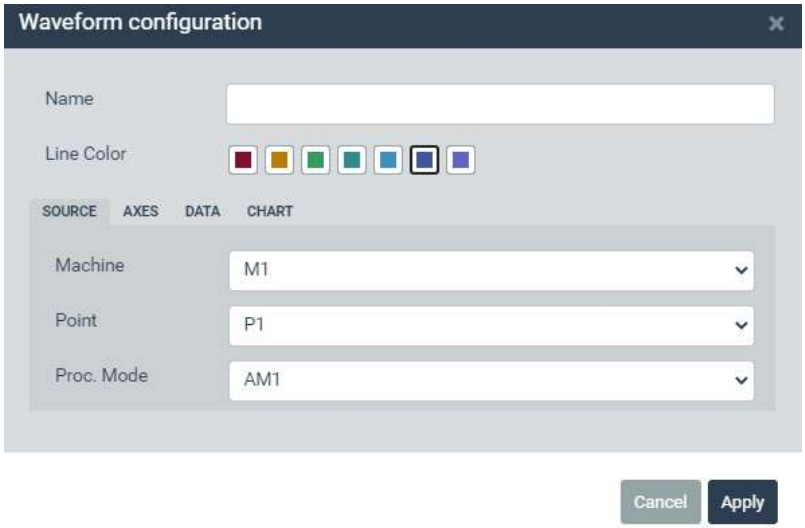
Once the cursor is created clicking on the graph again will move the cursor into that point of the trend vertically aligned with the mouse click position. The cursor can also be moved by pressing on left and right arrows of the keyboard, jumping from line to line of the spectrum. Keys “a” and “s” will move the cursor to the left and right respectively in smaller steps (a tenth of the spectrum resolution).

13.8 Waveform

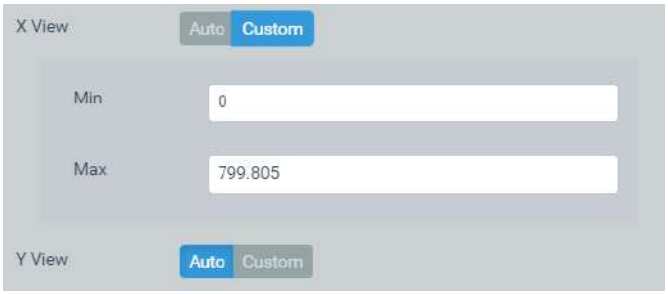
This *Widget* displays the waveform measurement of a dynamic point (Optional software features).

13.8.1 Configuration

The following picture shows its configuration settings. Once the *Widget* is selected click on the shortcut key “c” or the button in order to show its configuration form.



Field	Description
Name	Defines the name to the *Widget*. It will be shown at the upper bar of the *Widget*.
Line Color	Selects the color of the waveform line.
Machine	Selects the machine of the waveform from the pull-down list.
Point	Selects the dynamic point of the waveform from the pull-down list.
Proc. Mode	Selects the *Processing mode* of the waveform from the pull-down list.



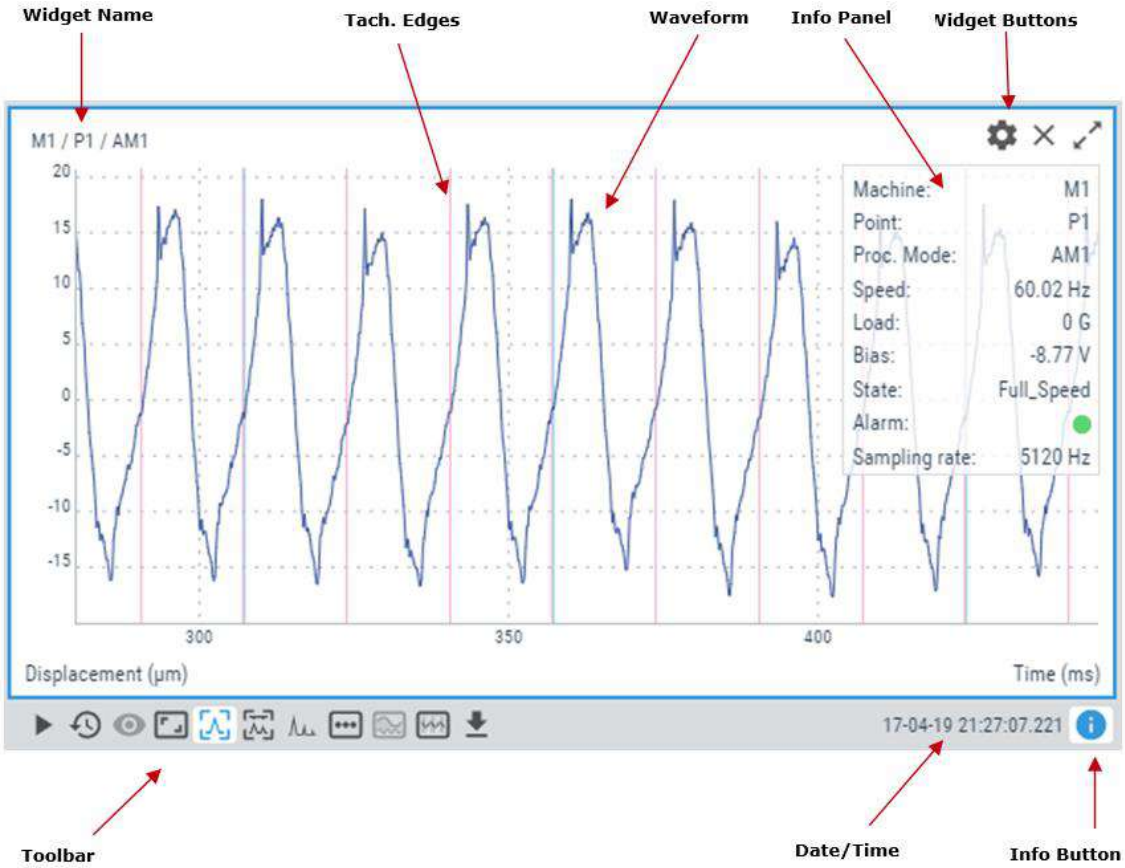
Field	Description
X View	Sets the maximum and minimum values visible in the X axis. They can be manually defined by the user, or just let the graph adjust to the data when Auto option is enabled. Note that clicking on the *Reset zoom* button with this option enabled will reset it to the values set in this form, if Custom setting is selected.
Y View	Sets the maximum and minimum values visible in the Y axis. They can be manually defined by the user, or just let the graph adjust to the data when Auto option is enabled. Note that clicking on the *Reset zoom* button with this option enabled will reset it to the values set in this form, if Custom setting is selected.

Field	Description
Remove DC Component	Subtract mean value (DC component) from waveform points.
Max samples per cycle	Selects the maximum number of sample points to show per machine rotating cycle (in between two tachometer edges) when some type of Synchronous View is selected.

Field	Description
Tacho edges	Shows or hides vertical marks on the *Widget* indicating the position of the tachometer edges. The *Machine* needs to have a *Tachometer point* connected to a *Pulse train* input.
Horizontal Lines	Shows or hides horizontal grid lines on the *Widget*.
Vertical Lines	Shows or hides vertical grid lines on the *Widget*.

13.8.2 Display

The following picture shows the Waveform *Widget* and its components.



Symbol	Description
	The *Play/Pause* button will make the values of the waveform to be updated automatically with the latest measurement performed by the *Vigilant*. The *Play* state will last for a few minutes and will go back to *Pause* mode after a while, in order not to waste data bandwidth.
	Shows the *Timeline* of the waveform measurements. The *Timeline* presents in a graphical mode the array of waveforms stored on this point for the selected *Processing mode*. The waveforms are ordered by its date/time on the *Timeline* and are represented as a vertical bar. The color of the bar represents the machine alarm status at that date. Clicking on any of these bars will update the plot with the waveform for that date. See the Timeline for more information.
	Timeline *Filter* button will hide the marks in the timeline that do not match to the selected Machine State or Alarm status. Those records will be displayed more diffused in the timeline and it will not be possible to select them.
	Restores the zoom to its normal condition, removing the effect of any previous zoom done on the plot.
	Sets the current cursor as a single cursor type.
	Sets the current cursor to *Delta Time* cursor. This will show a center cursor and a family of delta timelines around it. This cursor type is like Sidebands type cursor on the spectrum.
	Shows the spectrum measured along with the spectrum, as defined in the configuration of the corresponding *Processing Mode*.
	Selects the *Processing mode* the *Widget* will show the spectrum from.
	Runout compensation. Requires Order Tracking (Optional software features). Depending on whether a runout Reference signal has already been selected or not, this button may enable several different actions: • Set as reference: Select the current position in the timeline to be used as runout reference. • Remove reference: Disables the signal previously selected to act as a reference. • Go to reference: Moves in the timeline to select the position currently selected to be the runout compensation reference. • Activate/Deactivate: Enables or disables runout compensation. See next sections for a more detailed explanation about Runout Compensation.
	Synchronous view. Requires Order Tracking (Optional software features). Enables several options for waveform representation: • Original: Shows the original (non-synchronous) waveform. X-axis will be represented in time units. • Sync. View: Shows a resampled version of the waveform, so that each rotation cycle has the same amount of points. The X-axis is shown in cycles.

	• Sync. Average: Shows a waveform composed of the average value of all the cycles in the original waveform (they are resampled to calculate the average). The displayed waveform will have all cycles to be identical. • Sync. Average (1 cycle): This option is like the previous one, but only shows one revolution cycle. The cycles of the original synchronous waveform are shown in the background, to allow seeing the effect of the average operation. See next sections for a more detailed explanation about Synchronous View.
	Exports the waveform values to CSV format and creates and downloads it into a local file.
	Shows/hides a waveform information box. This box shows the following information associated with the measurement: machine, dynamic point, processing mode, machine speed and load, sensor bias voltage, machine state and alarm condition, maximum and sampling rate of the waveform.

13.8.3 Zoom

Use the mouse wheel to zoom in and out horizontally on the waveform plot. The *Widget* will zoom the waveform around the sample aligned vertically with the mouse location. After zooming-in use drag and drop with your mouse to move the plot left and right.

In order to make a zoom in a vertical direction, locate the mouse over the Y axis and use the mouse wheel. The spectrum plot will vertically zoom in and out.

Click on the *Reset zoom* button:

to restore the plot to its normal scaling, removing the effect of any previous zoom done on the plot.

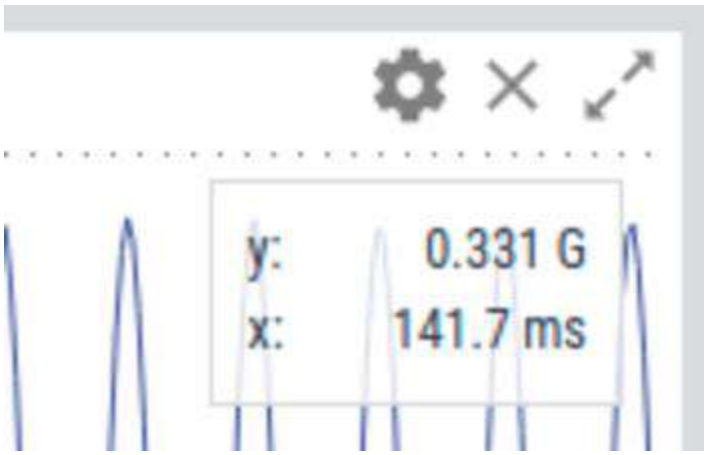
13.8.4 Cursors

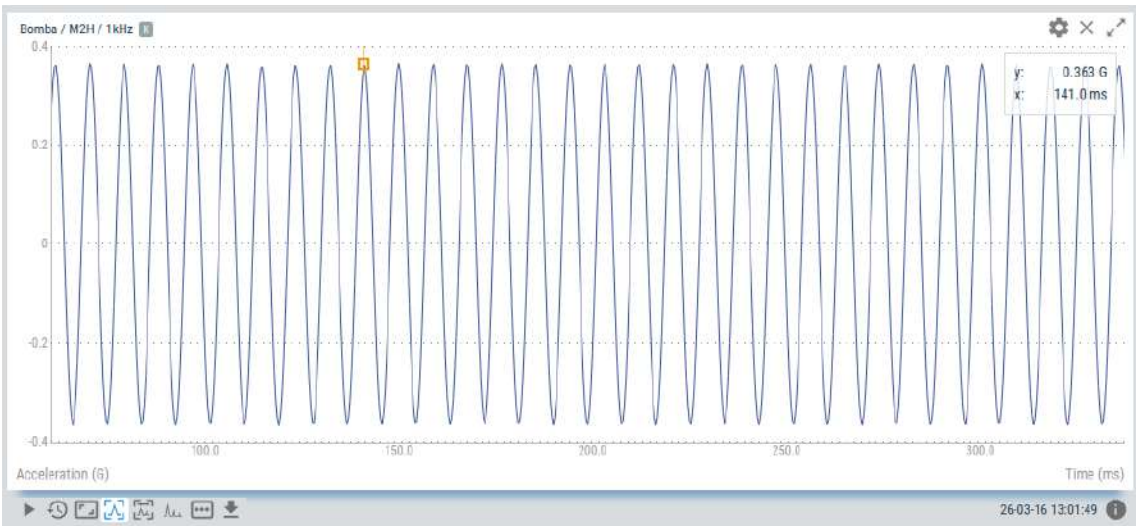
Cursors allow the user to mark any point of the waveform. The *Widget* provides 2 different type of cursors: *Single*, and *Delta Time*. The cursor type can be selected using the following icons.

Single cursor

After selecting the *Single* cursor icon:

clicking on the graph will add a *Single* type cursor to waveform. This will show a pop-up window at the top right side of the *Widget* with the amplitude and time values of the waveform point where the cursor is located.





Once the cursor is created clicking on the graph again will move the cursor into the line of the waveform point aligned with the mouse click position. The cursor can also be moved by pressing on left and right arrows of the keyboard, jumping from line to line of the waveform. Keys “a” and “s” will move the cursor to the left and right respectively in smaller steps (a tenth of the waveform resolution).

Delta Time cursor

Delta Time type:

Shows on the waveform the main cursor and delta timelines around it, like the spectrum sidebands. Once selected clicking on the spectrum will add the center frequency cursor. The center cursor can be moved using the left and right arrows of the keyboard, or “a” and “s” keys for smaller steps.

Once the cursor is on the correct point clicking again on the graph will set this point as the central reference, which will be identified with a red vertical line, and will add the *Delta Time* cursor and its harmonics.

The *Delta Time* cursor can also be moved using the left and right arrows of the keyboard, which will also move the corresponding harmonic lines.

13.8.5 Runout Compensation

When a proximity probe is being used to monitor the gap observed between the bearing and the shaft of a machine, the result is not only a function of the dynamic movement of the shaft, but there is also an effect caused by the irregularities of the shaft surface. The "measured gap" resulting from shaft irregularities is called runout, and includes:

- Mechanical defects: lack of roundness, missing dents, eccentricity, and flat surfaces.
- Electrical effects: Non-uniform electrical properties of the material's shaft surface observed, such as residual magnetism and non-uniform shaft material.

All these effects can be eliminated and corrected by applying a technique known as Runout Compensation, which basically consists of subtracting a Reference signal from the measured signal when the machine is in operation.

Runout compensation is available for both the Waveform and Orbit widgets.

Obviously, demagnetizing, jacketed, machining and/or polishing the shaft surface can minimize the causes of runout, but it is time consuming and not always physically possible or practical. In such a situation it is more cost effective to simply subtract the recorded slow running runout from the actual vibration. This is possible because the runout never changes, regardless of the speed of the machine. Since the runout compensation is a static value, it does not influence the dynamic response of the measurement.

The Reference is usually measured and recorded during slow roll to minimize the unbalanced effects of rotation (i.e. no dynamic movement of the shaft), so only the combined mechanical and electrical runout is seen.

The Vigilant dashboard allows selecting any stored signal to be used as a Reference to apply runout compensation. Any stored signal that appears in the widget timeline can be selected, with the only condition that it contains a complete machine rotation cycle: that is, that there have been at least two equal tachometer flanks.

To be able to perform runout compensation it is necessary that the waveforms of the moving machine are comparable with the waveform of the slow roll signal. To be able to subtract the two signals it is necessary to use the synchronous view explained in the next section.

13.8.6 Synchronous View

Comparing different waveforms from a machine in a variable speed regime is often much more difficult than comparing the spectra. The waveforms cannot be overlapped, since by changing the speed of the machine and keeping the sampling rate constant, there will be a different number of samples for each cycle of the machine.

The Waveform and Orbit widgets have several display options that allow solving this.

The Synchronous View changes the display to show a resampled version of the signals, so that there is always the same number of samples for each machine cycle. The X-axis is no longer displayed in time units, but in machine cycles. The sections of the original waveforms that do not correspond to a complete machine cycle are cut out.

Synchronous Average views also do the same, but they also apply an averaging operation to the waveforms that helps to greatly reduce the effects of unwanted noise in the measurement.

When the time domain of a machine's vibration signal is averaged, the resulting signal gradually builds up the portions of the signal that are synchronized with the tachometer, and other parts of the signal, such as noise and any other components, such as other rotating parts of the machine, etc., are attenuated. Synchronous averaging is useful for waveform analysis especially in the case of gear drives.

The synchronous averaging functionality of the Vigilant is limited, as it only allows averaging the waveform cycles contained in the waveform that has been recorded in a single capture.

The synchronous views require the Order Tracking module to be activated (Optional software features).

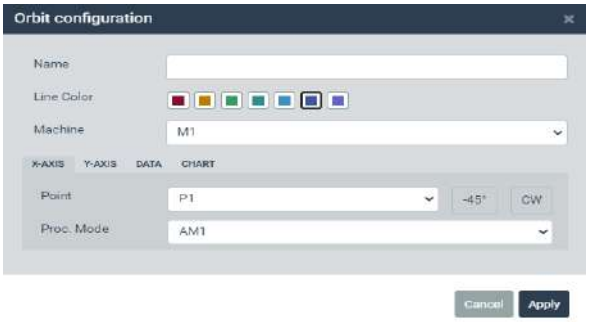
13.9 Orbit

This *Widget* displays the orbit graph calculated from two waveform measurements (Optional software features). Typically, two proximity probes mounted orthogonally are used to acquire the signals for this plot. The widget displays the orbit as well as two time base plots (waveforms), that display the dynamic vibration amplitude information coming from the same sensors as the orbit.

The most common use for orbit plots is to monitor turbomachinery with fluid film bearings. Orbit widget requires a pulse tachometer to determine the velocity of the machine and identify the rotating cycles in the waveforms.

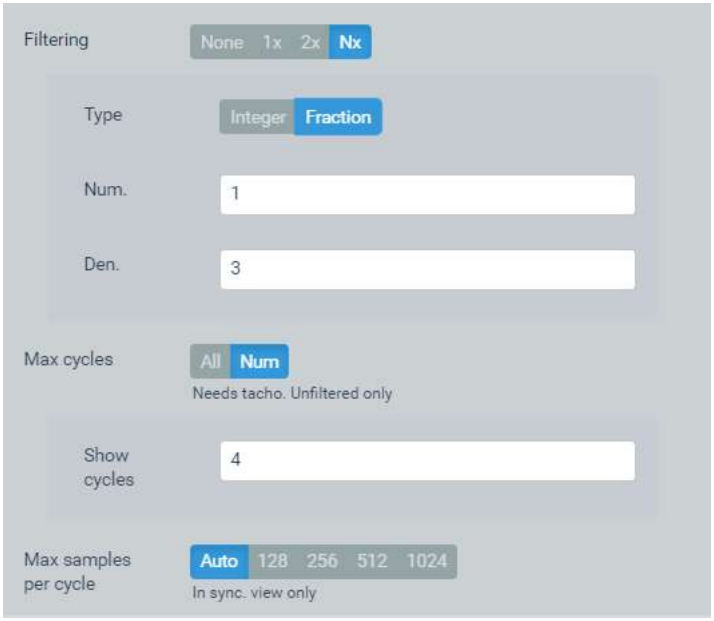
13.9.1 Configuration

The following picture shows its configuration settings. Once the *Widget* is selected click on the shortcut key “c” or the button to show its configuration form.



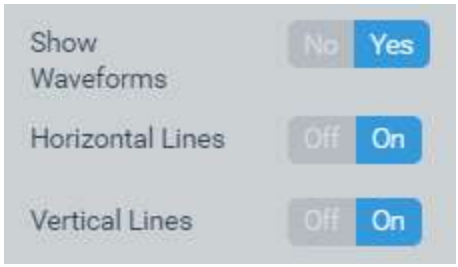
Field	Description
Name	Defines the name to the *Widget*. It will be shown at the upper bar of the *Widget*.
Line Color	Selects the color of the orbit line.
Machine	Selects the machine of the waveform from the pull-down list.
X-AXIS	
Point	Selects from the pull-down list the dynamic point of the waveform that will be used for the X-Axis in the orbit. Angle assignment and turning sense are indicated.
Proc. Mode	Selects the *Processing mode* of the waveform from the pull-down list.
Y-AXIS	
Point	Selects from the pull-down list the dynamic point of the waveform that will be used for the Y-Axis in the orbit. Angle assignment and turning sense are indicated.
Proc. Mode	Selects the *Processing mode* of the waveform from the pull-down list.

When using Orbits, it is highly advisable to define Components assigned to each couple of points that will be used for the orbits, so that the system will be able to check the correct angles assignments.



Field	Description
Filtering	Apply a filtering composition to the waveforms to extract the main rotational components of the waveforms. A signal reference with any harmonic or sub-harmonic value may be applied to calculate the

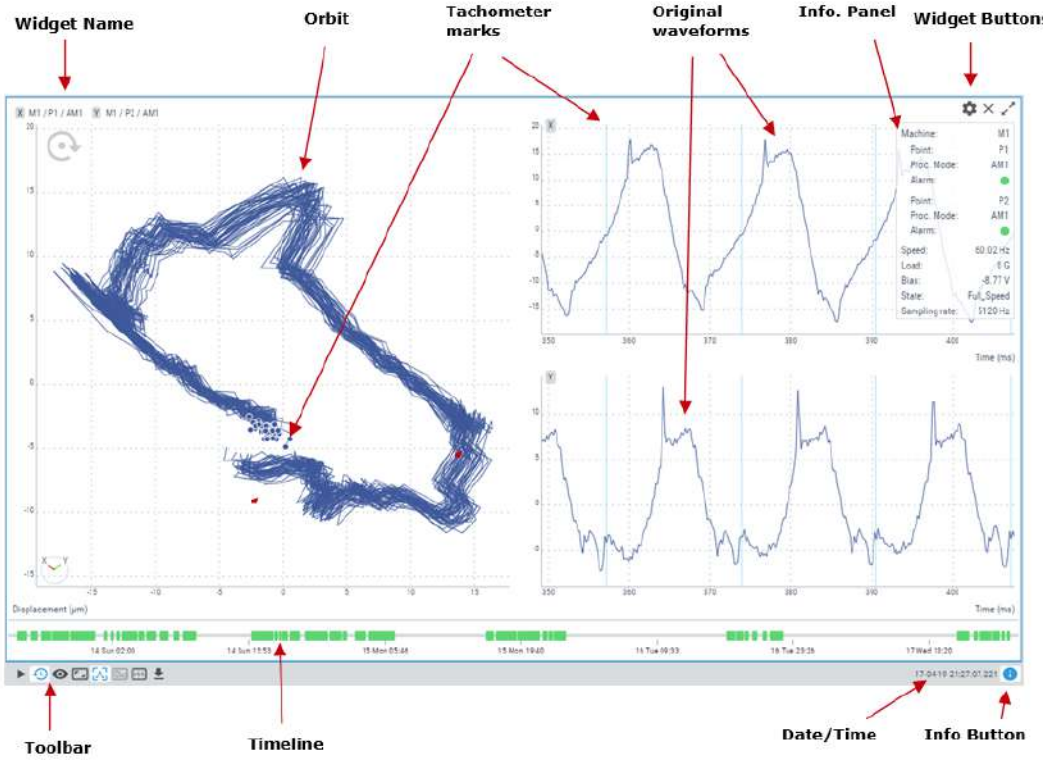
	filtered signal. Sub-harmonic values are indicated by introducing a fraction in the form (only *rational* numbers are valid).
Max cycles	Select a maximum number of rotating cycles to be displayed in the interface.
Max samples per cycle	Selects the maximum number of sample points to show per machine rotating cycle (in between two tachometer edges) when some type of Synchronous View is selected.



Field	Description
Show waveforms	Shows on the Widget the waveforms from which the orbit is calculated.
Horizontal Lines	Shows or hides horizontal grid lines on the *Widget*.
Vertical Lines	Shows or hides vertical grid lines on the *Widget*.

13.9.2 Display

The following picture shows the Orbit *Widget* and its components.



Symbol	Description
	The *Play/Pause* button will make the values of the waveform to be updated automatically with the latest measurement performed by the *Vigilant*. The *Play* state will last for a few minutes and will go back to *Pause* mode after a while, in order not to waste data bandwidth.
	Shows the *Timeline* of the waveform measurements. The *Timeline* presents in a graphical mode the array of waveforms stored on this point for the selected *Processing mode*. The waveforms are ordered by its date/time on the *Timeline* and are represented as a vertical bar. The color of the bar represents the machine alarm status at that date. Clicking on any of these bars will update the plot with the waveform for that date. See Timeline for more information.
	Timeline *Filter* button hides the marks in the timeline that do not match the selected Machine State or Alarm status. Those records will be displayed more diffused in the timeline and it will not be possible to select them.
	Restores the zoom to its normal condition, removing the effect of any previous zoom done on the plot.
	Sets the current cursor as a single cursor type.
	Runout compensation. Requires Order Tracking (Optional software features). Depending on whether a runout Reference signal has already been selected or not, this button may enable several different actions: • Set as reference: Select the current position in the timeline to be used as runout reference. • Remove reference: Disables the signal previously selected to act as a reference. • Go to reference: Moves in the timeline to select the position currently selected to be the runout compensation reference. • Activate/Deactivate: Enables or disables runout compensation. See previous section for a detailed explanation about Runout Compensation.
	Synchronous view. Requires Order Tracking (Optional software features). Enables several options for waveform representation: • Original: Shows the original (non-synchronous) waveforms. X-axis will be represented in time units. • Sync. View: Shows a resampled version of the waveforms, so that each rotation cycle has the same amount of points. The X-axis will be shown in cycles. • Sync. Average: Shows waveforms composed of the average value of all the cycles in the original waveforms (they are resampled to calculate the average). The displayed waveforms will have all cycles to be identical. • Sync. Average (1 cycle): This option is like the previous one, but only shows one revolution cycle. The cycles of the original synchronous waveforms are shown in the background, to allow seeing the effect of the average operation. See previous sections for a detailed explanation about Synchronous View.

	Exports the orbit values to CSV format and creates and downloads it into a local file.
	Shows/hides orbit information box. This box shows the sampling rate of the waveforms.

13.9.3 Zoom

Use the mouse wheel to zoom in and out on the graph. The *Widget* will zoom around the cursor position is located on the plot, for both X and Y directions.

After zooming-in use drag and drop with your mouse to move the plot left and right.

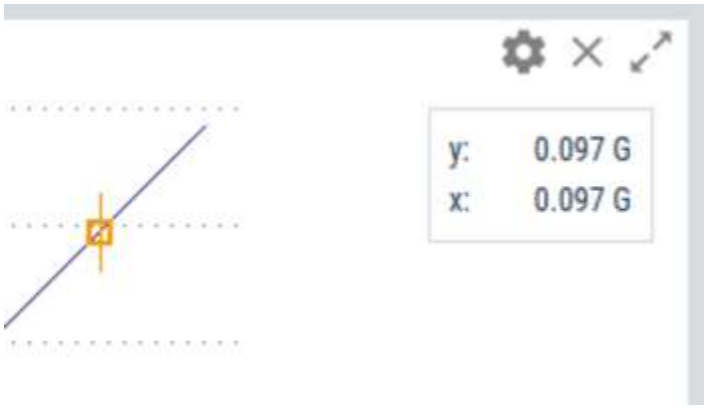
Click on the *Reset zoom* button:

to restore the plot to its normal scaling, removing the effect of any previous zoom done on the plot.

13.9.4 Single cursor

After selecting the *Single* cursor icon:

from the toolbox, clicking on the graph will add a *Single* type cursor to orbit. This will show a pop-up window at the top right side of the *Widget* with the X and Y values of the orbit.



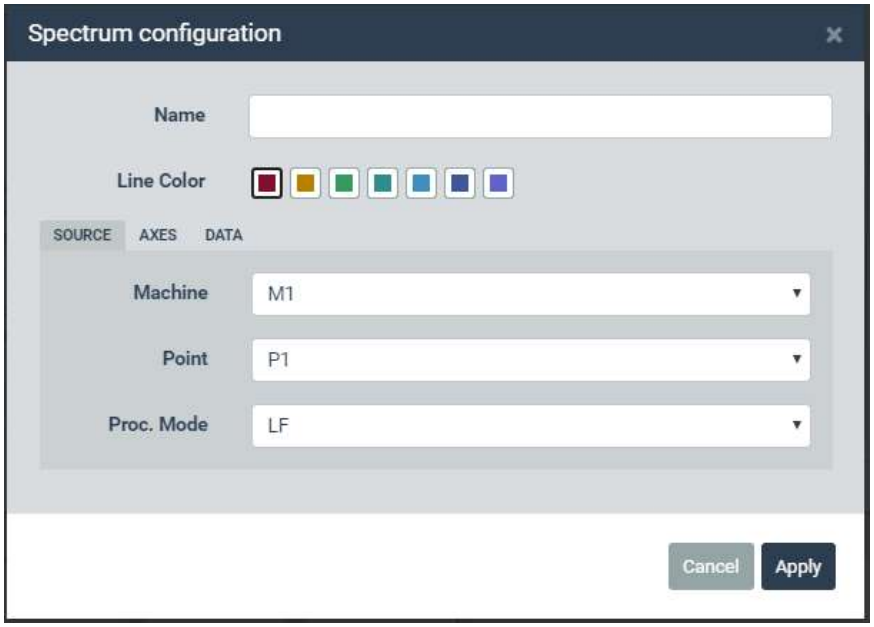
Once the cursor is created clicking on the graph again will move the cursor into the corresponding point of the orbit. The cursor can also be moved by pressing on left and right arrows of the keyboard, jumping from point to point of the orbit. Keys “a” and “s” will move the cursor to the left and right respectively in smaller steps (a tenth of the distance between points).

13.10 Spectrum

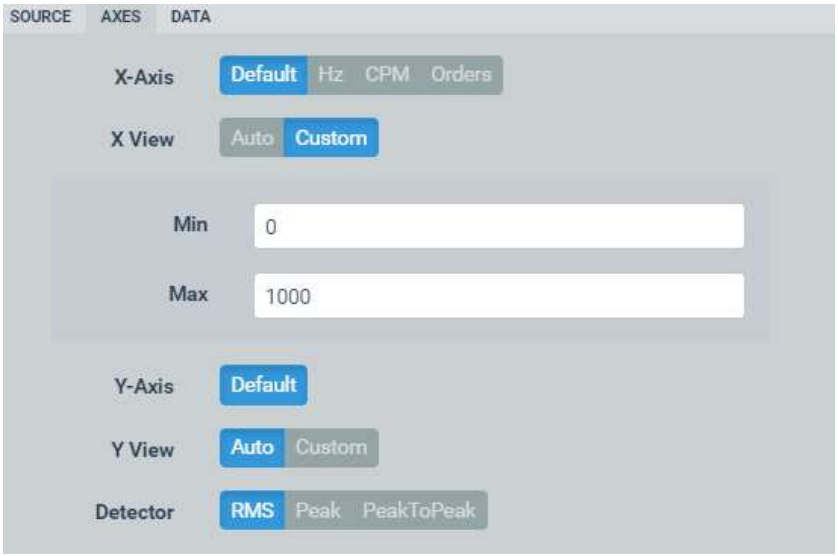
This *Widget* displays the spectrum measurement of a dynamic point (Optional software features).

13.10.1 Configuration

The following picture shows its configuration settings. Once the *Widget* is selected click on the shortcut key “c” or the button in order to show its configuration form.



Field	Description
Name	Defines the name to the *Widget*. It will be shown at the upper bar of the *Widget*.
Color	Selects the color of the spectrum line.
Machine	Selects the machine of the spectrum from the pull-down list.
Point	Selects the dynamic point of the spectrum from the pull-down list.
Proc. Mode	Selects the *Processing mode* of the spectrum from the pull-down list.

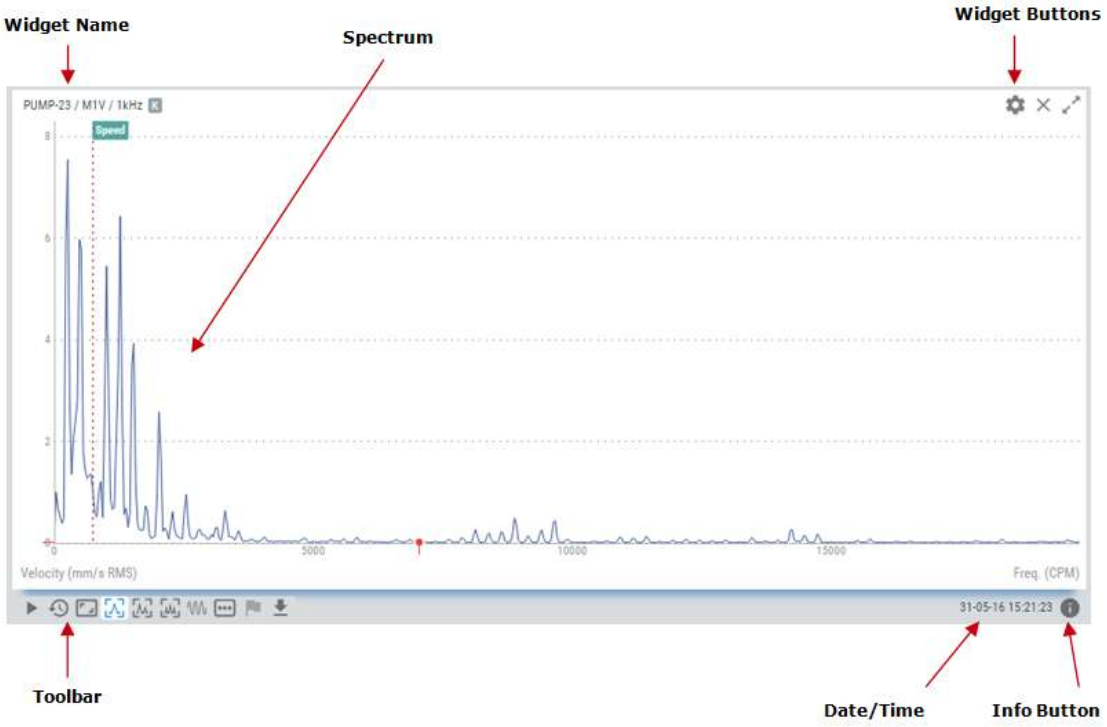


Field	Description
X-Axis	Sets the frequency units of the spectrum. Select between *Default, CPM, Hz* or *Orders*. *Default* will use the units defined on the *User Preferences*.
X View	Sets the maximum and minimum values visible in the X axis. Note that clicking on the *Reset zoom* button with this option enabled will reset it to the values set in this form.
Y-Axis	Shows the property of the Y axis. For vibration sensors this field selects between *Default, Acceleration, Velocity* or *Displacement*. *Default* will set the property to the one defined on the *Machine-Point-Processing Mode* in the *main Configuration*.
Y View	Sets the maximum and minimum values visible in the Y axis. Note that clicking on the *Reset zoom* button with this option enabled resets it to the values set in this form.
Detector	Selects the detector to be applied to the spectrum amplitude (RMS, Peak, Peak-Peak).

Field	Description
Speed	Configure the widget to use the *Machine speed* depending on the configuration, or to use a custom user setting. This affects how the cursors behave.
Harmonics	Sets the number of harmonics the *Harmonic* and *Side Band* cursor will show.
Horizontal Lines	Shows or hides horizontal grid lines on the *Widget*.
Vertical Lines	Shows or hides vertical grid lines on the *Widget*.

13.10.2 Display

The following picture shows the spectrum *Widget* and its components.



Symbol	Description
▶	The *Play/Pause* button will make the values of the spectrum to be updated automatically with the latest measurement performed by the *Vigilant*. The *Play* state will last for a few minutes and will go back to *Pause* mode after a while, in order not to waste data bandwidth.
■	*Pause* button will freeze the current spectrum, so the plot will not be updated with new measurements.
	Shows the *Timeline* of the spectrum measurements. The *Timeline* presents in a graphical mode the array of spectra stored on this point for the selected *Processing mode*. The spectra are ordered by its date/time on the *Timeline* and are represented as a vertical bar. The color of the bar represents the machine alarm status at that date. Clicking on any of these bars will update the plot with the spectrum for that date. See Timeline more information.
	Timeline Filter button will hide the marks in the timeline that do not match the selected Machine State or Alarm status. Those records will be displayed more diffused in the timeline and it will not be possible to select them.
	Restores the zoom to its normal condition, removing the effect of any previous zoom done on the plot.
	Sets the current cursor as a single cursor type.
	Sets the current cursor as a harmonic type cursor. This will show the main frequency selected and the number of harmonics defined on the configuration of the *Widget*.

	Sets the current cursor as a side band type cursor. This will show a center frequency and sidebands around it, each of them with the number of harmonics defined on the configuration of the *Widget*.
	Shows the waveform measured along with the spectrum, as defined in the configuration of the corresponding *Processing Mode*.
	Selects the *Processing mode* the *Widget* will show the spectrum from.
	Shows the list of *Fault Frequencies* defined for the corresponding dynamic point. Selecting one of them will show on the spectrum plot the *Fault Frequency* as a dotted red line, along with the harmonics defined on its configuration.
	Exports the spectrum values to CSV format and creates and downloads it into a local file.
	Shows/hides spectrum information box. This box shows the following information associated with the measurement: machine, dynamic point, processing mode, machine speed and load, sensor bias voltage, machine state and alarm condition, maximum and minimum frequency of the spectrum.

13.10.3 Zoom

Use the mouse wheel to zoom in and out horizontally on the spectrum plot. The *Widget* will zoom the spectrum around the frequency aligned vertically with the mouse location. After zooming-in use drag and drop with your mouse to move the plot left and right.

To make a zoom on vertical direction, locate the mouse over the Y axis and use the mouse wheel. The spectrum plot will vertically zoom in and out.

Click on the *Reset zoom* button to restore the plot to its normal scaling, removing the effect of any previous zoom done on the plot.

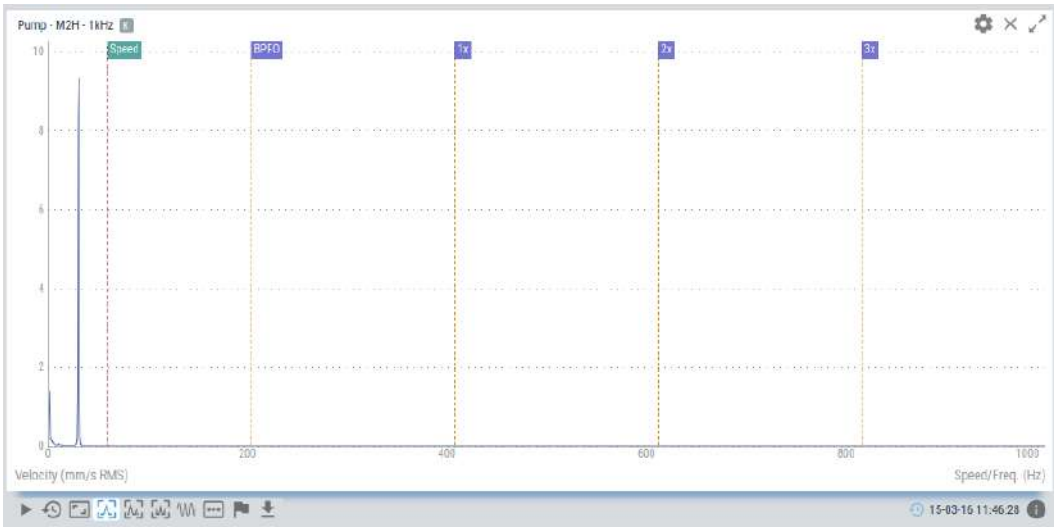
13.10.4 Fault Frequencies

This option shows on the spectrum plot the fault frequencies assigned to the measurement point. Fault frequencies are those related to different failure modes on the machine (gear mesh, ball bearing, RPM harmonics, belts, etc.). These frequencies are defined on the configuration of the system and can be assigned to the different dynamic points.

By clicking on the icon:

the Widget will show the list of *Fault Frequencies*.

By selecting one of them the corresponding *Fault Frequency* will be represented on the spectrum plot as a dotted vertical line, along with its harmonics. The number of harmonic lines is defined on the configuration of the *Fault Frequency*.



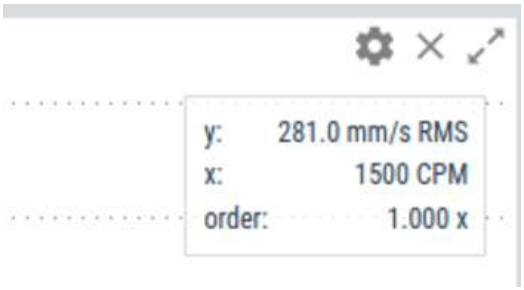
13.10.5 Cursors

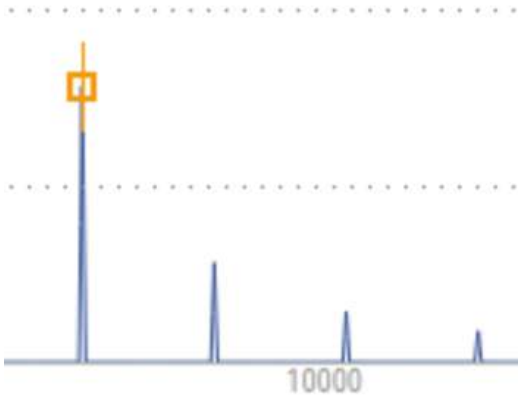
Cursors allow the user to mark any frequency of the spectrum. The *Widget* provides 3 different type of cursors: *Single, Harmonic* and *Side Band*.

Single cursor

After selecting the *Single* cursor icon:

, clicking on the graph will add a *Single* type cursor to spectrum. This will show a pop-up window at the top right side of the *Widget* with the amplitude and frequency values of the spectrum line where the cursor is located.





Harmonic cursor

Once the cursor:

is created, clicking on the graph again will move the cursor into the line of the spectrum vertically aligned with the mouse click position. The cursor can also be moved by pressing on left and right arrows of the keyboard, jumping from line to line of the spectrum. Keys “a” and “s” will move the cursor to the left and right respectively in smaller steps (a tenth of the spectrum resolution).

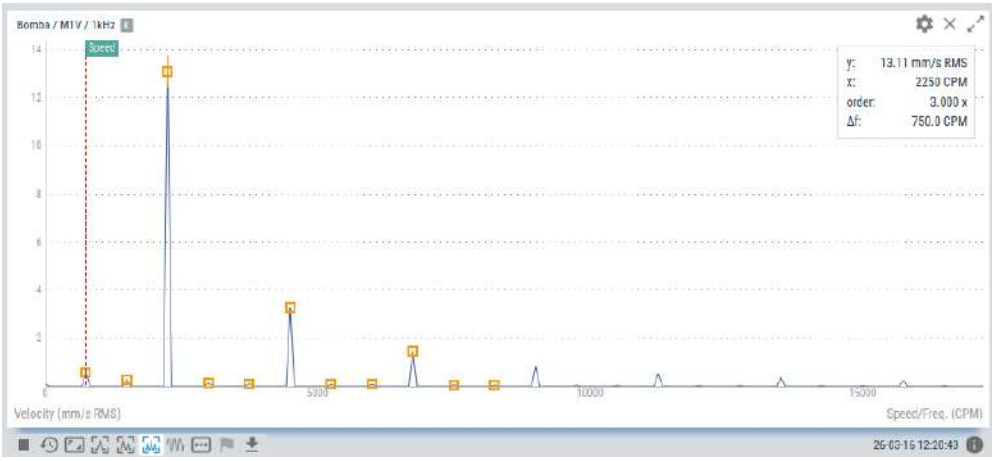
Harmonic type will show on the spectrum the main frequency selected and the number of harmonics defined on the configuration of the *Widget*.

The main cursor is identified by a vertical line crossing the cursor itself.

Side band cursor

The *side band* cursor will show on the spectrum a center frequency and sidebands around it, each of them with the number of harmonics defined on the configuration of the *Widget*. Once selected clicking on the spectrum will add the center frequency cursor. The center cursor can be moved using the left and right arrows of the keyboard, or “a” and “s” keys for smaller steps.

Once the cursor is on the correct frequency peak clicking again on the graph will set this frequency as the central one, which will be identified with a red vertical line, and add the side band cursor and its harmonics.



Side band cursor can also be moved using the left and right arrows of the keyboard, which will also move the corresponding side bands harmonics.

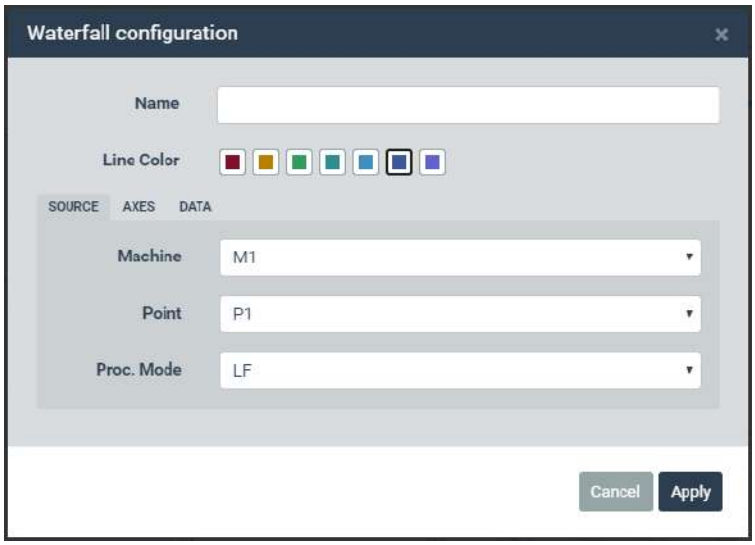
13.11 Waterfall

This *Widget* displays three-dimensional plot of a group of spectra, all of them in the same graph, allowing to compare the different measurements and giving information about the evolution of the signal throughout time (Optional software features).

A waterfall graph consists of a series of spectra acquired at consecutive times. The X-axis displays the frequency or order of each point in the spectra. The Z-axis displays the value of the signal. The Z-axis displays the time at which the signal was acquired.

13.11.1 Configuration

The following picture shows its configuration settings. Once the *Widget* is selected click on the shortcut key “c” or the button in order to show the configuration form.



Field	Description
Name	Defines the name of the *Widget*. It will be shown at the upper bar of the *Widget*.
Line Color	Selects the color of the waterfall lines.
Machine	Selects the machine of the spectra from the pull-down list.
Point	Selects from the pull-down list the dynamic point of the spectra.
Proc. Mode	Selects the *Processing mode* of the spectra from the pull-down list.

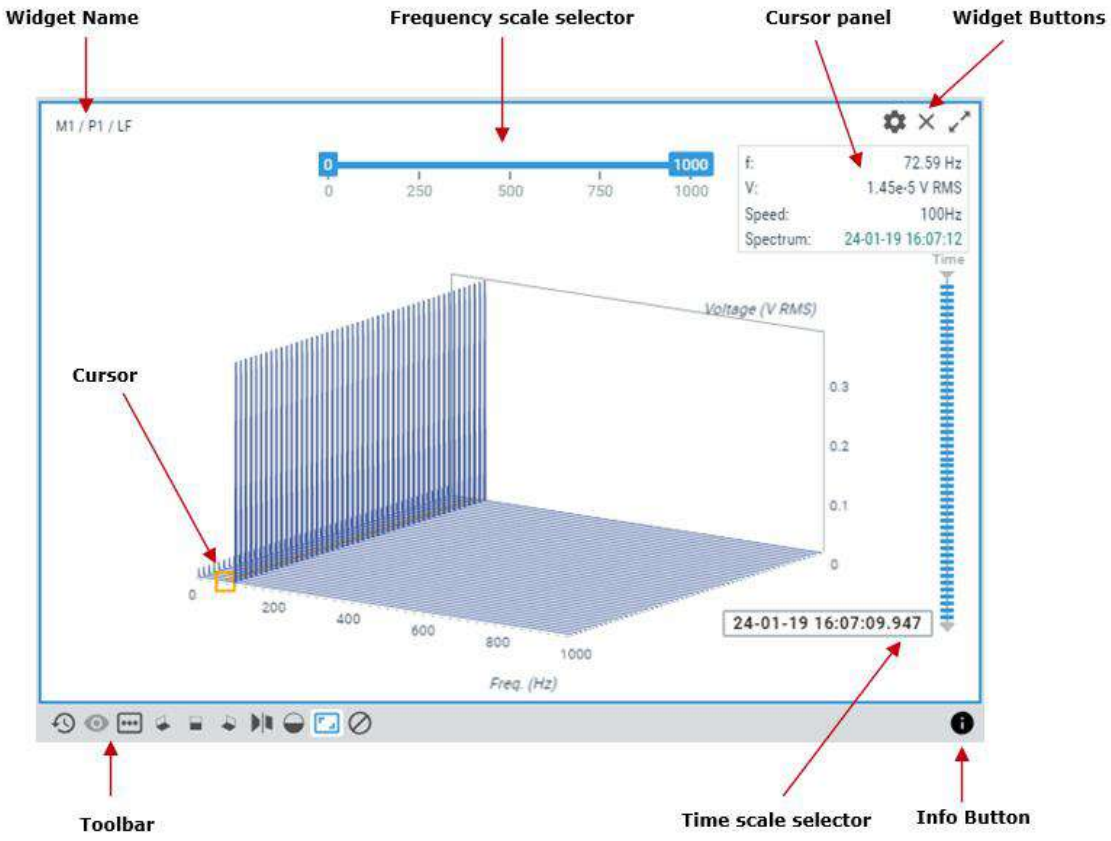
Field	Description
X-Axis	Sets the frequency units for the spectra. Select between *Default, Hz, CPM* or *Orders*. *Default* will use the units defined on the *User Preferences*.
Y-Axis	Shows the property of the Y axis. For vibration sensors this this field will select between *Default, Acceleration, Velocity or Displacement*. *Default* will set the property to the one defined on the *Machine-Point-Processing Mode* in the *main Configuration*.
Detector	Selects the detector to be applied to the spectra amplitudes (RMS, Peak, Peak-Peak).

Field	Description
Speed	Configure the widget to use the *Machine speed* depending on the configuration, or to use a custom user setting. This affects how the cursors behave.
Number of spectra	Maximum number of spectra to represent in Z-axis of the widget.

Bins	The spectra represented in this widget are limited in the number of bins. The higher the number, the more time Dashboard will need to load the widget. This does not affect parameters and other calculations defined in *Configuration*.

13.11.2 Display

The following picture shows the *Waterfall Widget* and its components.



Symbol	Description
	Shows the Timeline of the spectra measurements. The *Timeline* presents in a graphical mode the array of spectra stored on this point for the selected *Processing mode*. The spectra are ordered by its date/time on the *Timeline* and are represented as vertical bars. The color of the bar represents the machine alarm status at that date. The selector above the bars allows configuring the range of dates from which the set of spectra will be chosen.
	Timeline *Filter* button hides the marks in the timeline that do not match the selected Machine State or Alarm status. Those records will be displayed more diffused in the timeline and it will not be possible to select them.
	A quick link to select from which *Processing mode* the *Widget* will be showing the spectra.

	Select standard rotation views.
	Toggle perspective/orthographic view.
	Toggle filled/transparent paths for the spectra (the area below the spectrum becomes opaque)
	Restores the zoom to its normal condition, removing the effect of any previous zoom done on the plot.
	Remove selection button. Hides the cursor and the spectra selection marks.
	Shows/hides the waterfall information box. This box shows the machine, point and processing mode of the spectra.

13.11.3 Frequency scale selector

Use the frequency scale selector to amplify different portions of the graph or certain frequencies.

With the help of the mouse, move the controls in each side of the selector, and select the maximum and minimum frequencies that will be plotted in the chart.

13.11.4 Time scale selector

The time scale selector allows selecting and moving the cursor to individual spectra more easily and directly than using the keyboard. The selector also gives information about the dates at which the spectra were taken.

The active spectrum will change its fill color, and an information panel will be displayed in the top right corner of the widget, indicating the *speed* of the machine, recorded for that spectrum, and a link to open another Widget with that spectrum.

This tool will not be shown if there is not enough screen resolution available to draw all the elements. The minimum resolution depends on the number of spectra to be shown. Note that without a proper size this widget will not be useful.

13.11.5 Cursors

Cursors in the *Waterfall* are handled mainly by Keyboard Shortcuts.

Use the *left* and *right* arrows from the keyboard to display the cursors and move through the frequency domain selecting the points in the active spectrum.

Select the active spectrum by using the *up* and *down* arrows from the keyboard, or also using the *Time scale selector*, explained above.

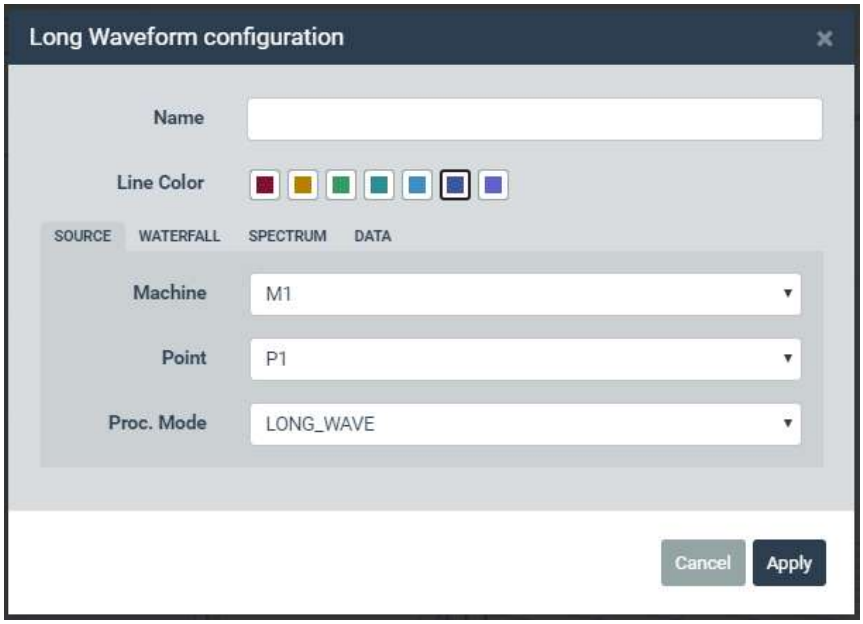
Once the cursor is created, a cursor panel will be displayed up in the right of the widget, indicating the frequency and amplitude of the bin, the *speed* of the machine at the moment of that capture, and a link to open another Widget to show the selected spectrum.

13.12 Long Waveform

This *Widget* displays a long waveform capture, using an envelope view instead of the full waveform (Optional software features). Different analysis tools allow decomposing this long duration signal, extracting spectra, parameters, etc.

13.12.1 Configuration

The following picture shows its configuration settings. Once the *Widget* is selected click on the shortcut key "c" or the button in order to show its configuration form.



Field	Description
Name	Defines the name of the *Widget*. It will be shown at the upper bar of the *Widget*.
Line Color	Selects the color of the long waveform lines.
Machine	Selects the machine from the pull-down list.
Point	Selects from the pull-down list the dynamic point.
Proc. Mode	Selects the *Processing mode* of the long waveform from the pull-down list.

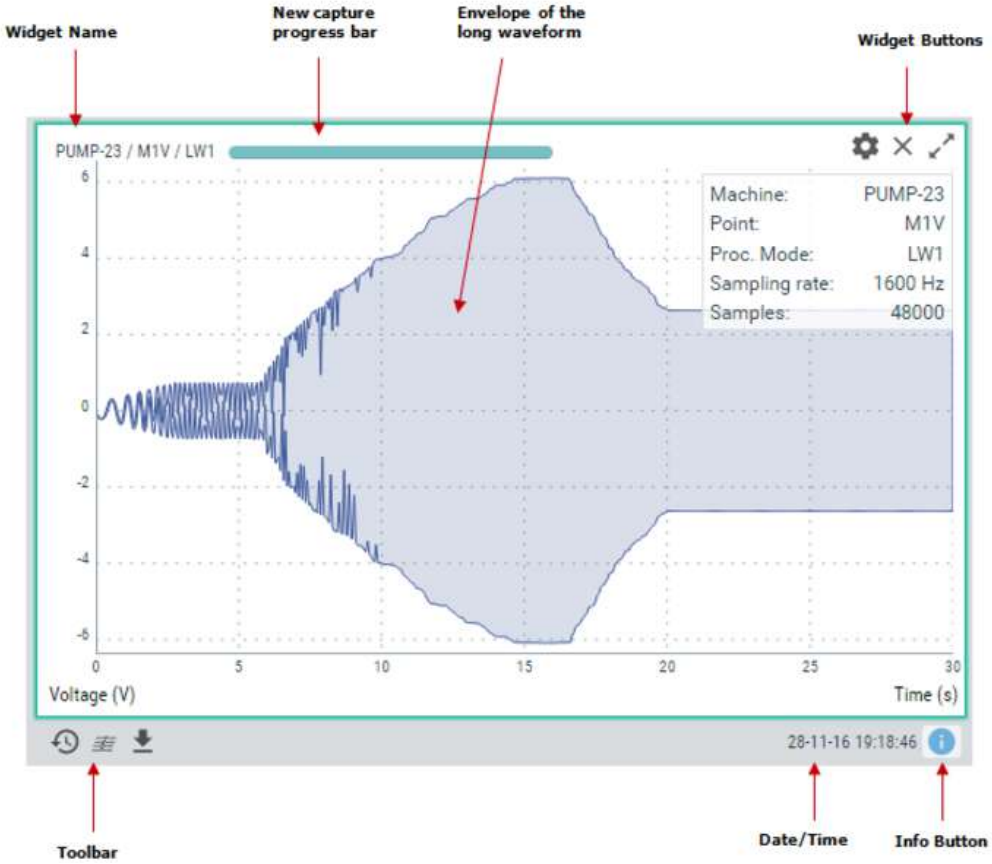
Field	Description
Window	Select type of window to calculate the spectra: • Rectangular. • Hann. • Hamming. • Blackman.
Integrate	Sets up if the data has to be integrated once or twice. Acceleration integrates to velocity, and this to displacement.
Min. Freq.	Sets the minimum frequency calculated for the spectrum. The maximum is set by the sampling frequency of the signal.
Number of spectra	Sets the default number of spectra displayed in the waterfall.
Bins	Sets the number of bins to be displayed in spectra: 100/200/400/800

Field	Description
Window	Select type of window to calculate the spectra: • Rectangular. • Hann. • Hamming. • Blackman.
Integrate	Sets up if the data has to be integrated once or twice. Acceleration integrates to velocity, and this to displacement.
Min. Freq.	Sets the minimum frequency calculated for the spectrum. The maximum is set by the sampling frequency of the signal.
Bins	Sets the number of bins to be displayed in spectra: 100/200/400/800
Averages	Sets the number of averages to calculate the spectrum (1-8)
Overlap	Sets the percentage of overlapping between waveform cuts used to calculate the spectrum.

Field	Description
Show RMS	Shows or hides the trend of the RMS value along the waveform
Horizontal Lines	Shows or hides horizontal grid lines on the *Widget*.
Vertical Lines	Shows or hides vertical grid lines on the *Widget*.

13.12.2 Display

The following picture shows the Long-Waveform *Widget* and its components.



Symbol	Description
	Timeline: select which waveform will be displayed from storage.
	Display the waterfall's spectrum calculated from the long waveform. It calculates several spectra from portions of the waveform, according to the settings, and shows them in a waterfall.

	Exports the long waveform to a WAV file and downloads it to a local file.
	Shows/hides information boxes. This box shows the sampling rate and number of samples in the waveform.

13.12.3 Single cursor

The long waveform widget allows two cursor options, automatically selected with the mouse movements applied over the widget.

By making a single mouse click on the signal, the system will select a certain point from it, from which it will be possible to extract a spectrum diagram according to the configuration applied to the widget. The cursor panel will display information about the selected point:

- t: position in time of the cursor.
- V1 / V2: maximum and minimum amplitude values of the envelope at that moment.
- rms / p / pp: values of the magnitude parameters of the wave, also in that specific point.
- Spectrum: direct link to a pop-up window, in which a spectrum widget will be calculated and shown accordingly to the configuration of the long waveform widget.

By clicking and dragging with the mouse over the plot a different type of cursor will appear, which will allow us selecting a specific area of the waveform. In this case, the cursor box will display the following information:

- t0 / t1: start and end time values for the selected signal area.
- Waterfall: direct link to a pop-up widget with a waterfall plot of the area selected by the cursor, calculated accordingly to the settings applied in the long waveform widget.

Do not confuse access to waterfall available from the cursor with the button available at the bottom of the widget. The first one will show the waterfall of a portion of the signal, while the button will always calculate the waterfall of the complete signal.

13.13 Phase Diagram

Phase Diagram, also called Bode and Polar plots, display *peak-phase* parameters in different representations.

The Bode and Polar representations are combined in the same widget, which can be used to describe the locus of a rotational speed vector signal during speed changes.

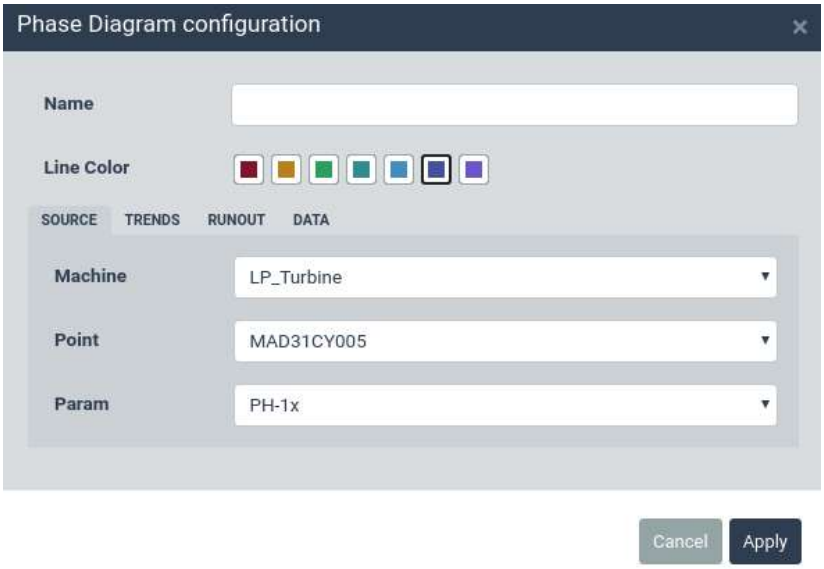
This is typically used for transient (non-stationary signals) analysis, in both run-up and run-down tests of the machines (Optional software features).

The Bode plot displays in two graphs the values of Peak and Phase as a function of the rotational speed. The graphs can also be configured to be displayed as a function of time (time in X-axis). Bode plots can help identifying the resonance speed of a rotor or examining the rotor dynamics on an order basis.

The Polar plot (also called Nyquist) displays the same data as the Bode, but in polar coordinates, which enables seeing phase changes in the range from 0 to 360 degrees. The Polar plot uses the information about the sensor mounting angles to display the data adjusted to the actual angles defined in the machine. Data coming from orthogonally mounted sensors can be compared using a couple of polar plots.

13.13.1 Configuration

The following picture shows the configuration settings of the *Phase Diagram* widget. Once the *Widget* is selected click on the shortcut key “c” or the button in order to show its configuration form.



Field	Description
Name	Defines the name of the *Widget*. It will be shown at the upper bar of the *Widget*.
Line Color	Selects the color of the phase diagram lines.
Machine	Selects the machine from the pull-down list.
Point	Selects from the pull-down list the dynamic point.
Param	Select a *Peak/Phase* parameter to be displayed, in case there was more than one for this point

Field	Description
Peak View	Sets the maximum and minimum values visible in the Y axis. Note that clicking on the Reset zoom button with this option enabled reset it to the values set in this form.

Peak Detector	Selects the detector to be applied to the peak amplitudes (RMS, Peak, Peak-Peak)
Phase View	Configure how the angles are displayed in the phase view of the Bode plot.
X Axis	Configure to order the points in the X-axis using the timestamp or the speed of the machine (real Bode view).

Runout is measured and recorded during slow roll to minimize the unbalance effects of rotation (i.e. no dynamic shaft movement).

Field	Description
Magnitude (runout)	Magnitude value to compensate for the runout position of the shaft.
Angle (runout)	Angular value to compensate for runout position of the shaft.

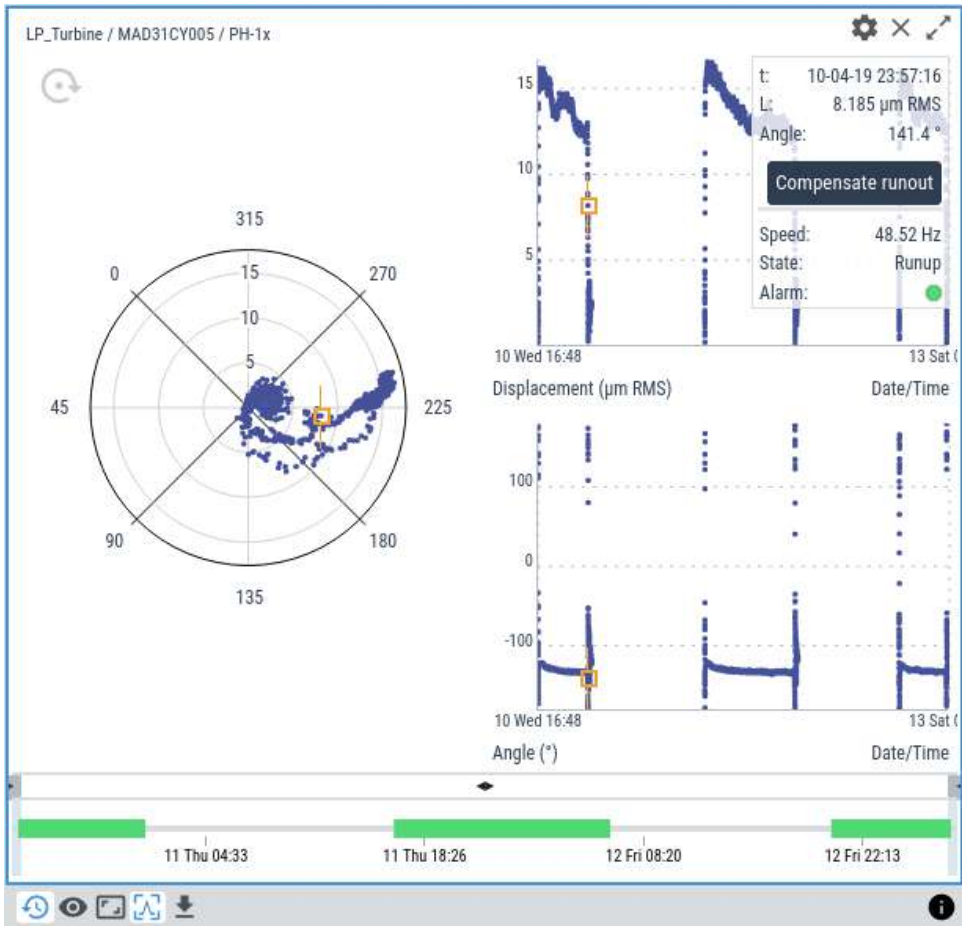
Runout reference may be set directly from the display mode using the link available in the cursor window.

Field	Description
Display	Use (or not) lines to connect the points in between.
Layout	Show Bode, Polar, or both Plots
Horizontal Lines	Shows or hides horizontal grid lines on the *Widget*.

Vertical Lines	Shows or hides vertical grid lines on the *Widget*.

13.13.2 Display

The following picture shows the phase plots *Widget* and its components.



Symbol	Description
	Timeline: select which part of the storage will be used as source data for the phase plots.
	Phase D. filter behaves similar as the filter in Trends. The button allows selecting which machine state and alarm status to show, and the rest of the points get hidden. Note that the points' alarm status is calculated when the data was stored and may not match with actual settings.
	Restores the zoom to its normal condition, removing the effect of any previous zoom done on the plot.
	Sets the current cursor as a single cursor type.
	Exports the Phase Plot values to CSV format and creates and downloads it into a local file.

	Shows/hides mimic information boxes. This box shows the following information associated with the machine: machine name, speed, load, state and alarm condition.

13.13.3 Single cursor

The *Single* cursor is selected by default in this widget.

Clicking on any point of the graphs, this will show a pop-up window at the top right side of the *Widget* with the following information:

- t: timestamp of the capture.
- L: Peak value of the parameter.
- Angle: Phase value of the parameter.
- (Compensate runout): Sets runout reference at this capture.
- Speed: Speed of the machine at that capture.
- State: State of the machine at that capture
- Alarm: Alarm state of the machine at that capture.

Once the cursor is created clicking on the graph again will move the cursor into the corresponding point of the graph. The cursor can also be moved by pressing on left and right arrows of the keyboard, jumping from point to point of the orbit.

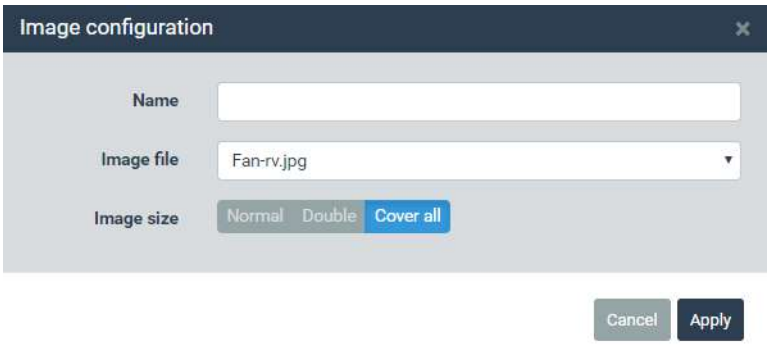
13.14 Image

This *Widget* displays an image defined by the user but, unlike the Mimic, it does not require to be linked to any Machine or other element.

It may be useful to add custom information to the *Dashboard*.

13.14.1 Configuration

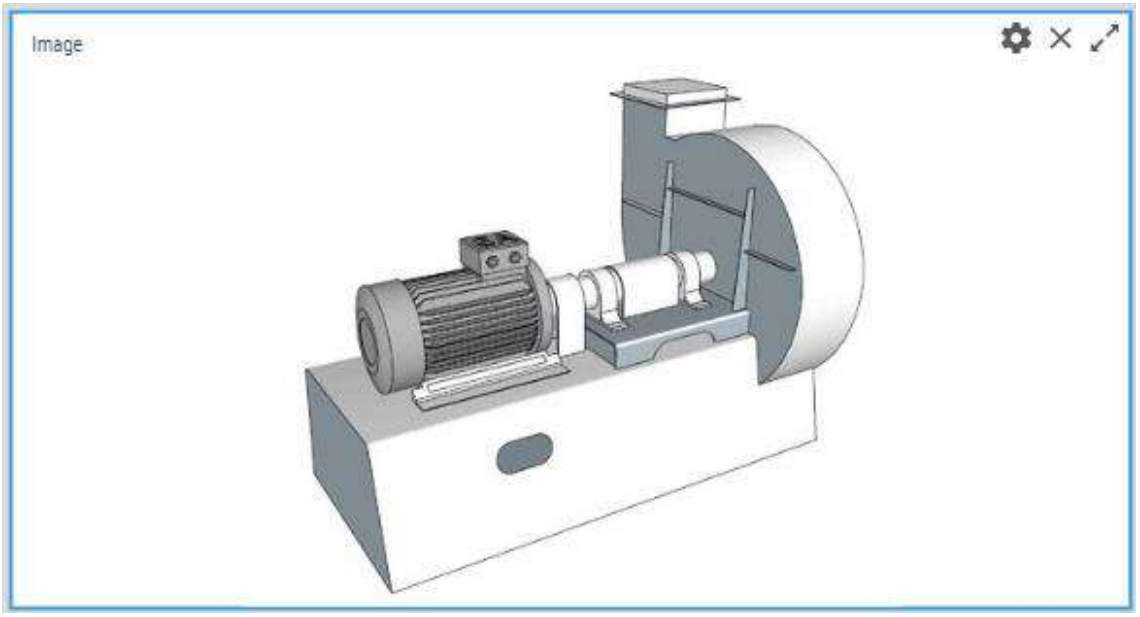
The following picture shows its configuration settings. Once the *Widget* is selected click on the shortcut key “c” or the button in order to show its configuration form.



Field	Description
Name	Defines the name to the *Widget*. It will be shown at its upper bar.
Image size	Sets the way the image fits on the space of the *Widget*: *Normal* shows the image at its normal resolution, *Double* increase 2 times the size of the image, *Cover all* fits the image file to the total space available on the *Widget*.

13.14.2 Display

The following picture shows the *Image Widget* and its components.



The Image widget has no tools, options, or cursors.

13.15 Shaft Centerline

The *Shaft Centerline* plot is designed to show changes in the average radial position of the shaft (Optional software features).

When a rotor system with hydrodynamic bearings changes speed or load, the stiffness and damping characteristics of the bearings are also modified. As a result, changes in the average radial position of the shaft will also be observed.

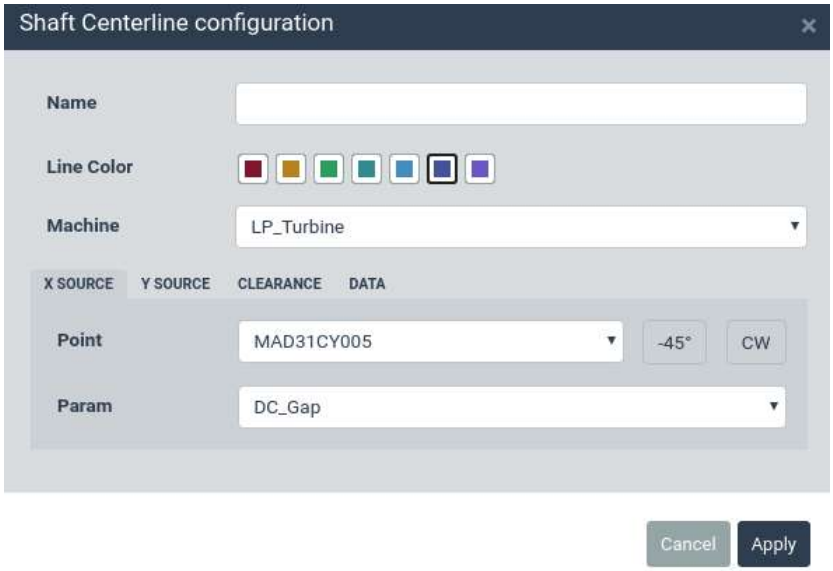
Primary and secondary machinery malfunctions such as misalignment, fluid-induced instability, and rubs, to name a few, can produce significant changes in the rotor's radial position within the bearings or seals.

These changes in radial shaft position can be directly observed via the *Shaft CenterLine* plot.

To draw this graph, two displacement measures, normally collected by means of proximity probes, are needed as sources. As in the case of the Orbit graph, the two points must be placed orthogonally, in order to reconstruct the position of the shaft in two dimensions.

13.15.1 Configuration

The following picture shows the configuration settings of the *Shaft Centerline* widget. Once the *Widget* is selected click on the shortcut key "c" or the button in order to show its configuration form.



Field	Description
Name	Defines the name of the *Widget*. It will be shown at the upper bar of the *Widget*.
Line Color	Selects the color of the shaft centerline plots.
Machine	Selects the machine from the pull-down list.
Point	Selects from the pull-down list the dynamic point. Angle assignment and turning sense are indicated.
Param	Selects the parameter to be used to create the plot. Only *mean* type parameters are valid for creating this plot.

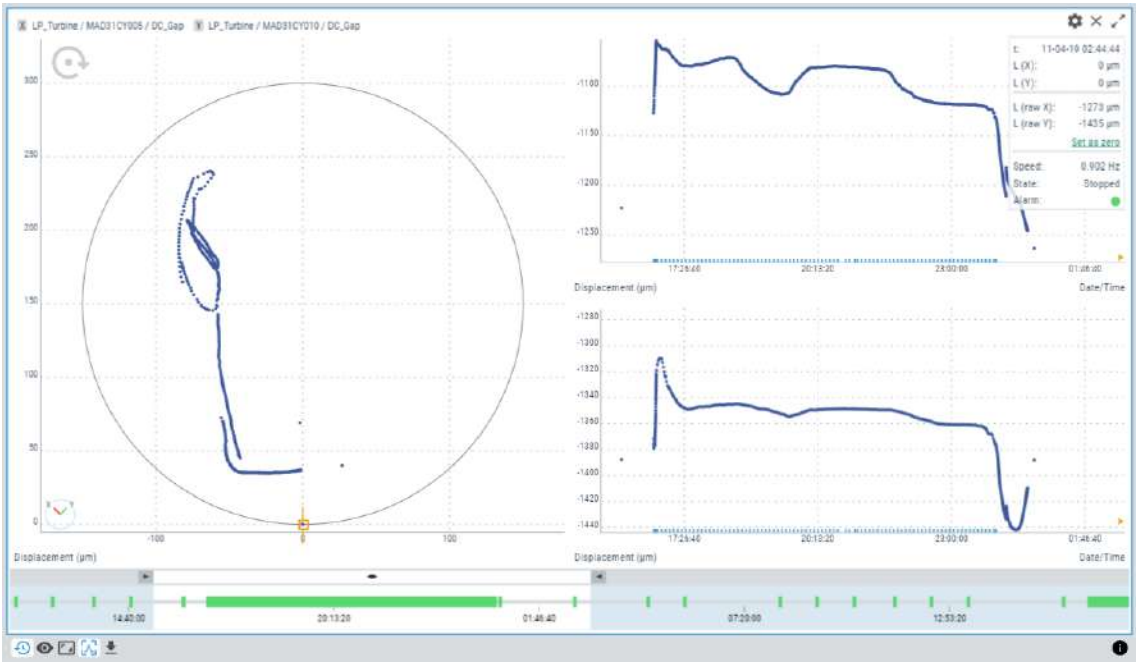
Only *Points* with *Mean* type parameters, and using a **displacement unit**, are valid for creating *Shaft Centerline Plots*.

Field	Description
Horizontal (clearance)	Sets the maximum horizontal clearance that the axis is supposed to have into the shaft area. Indicates the theoretical maximum displacement in X axis and sets the width of the shaft drawing.
Vertical (clearance)	Sets the maximum vertical clearance that the axis is supposed to have into the shaft area. Indicates the theoretical maximum displacement in Y axis and sets the height of the shaft drawing.
X zero	Sets the position of the axis in allegedly rest mode (when speed is zero or close to zero).
Y zero	Sets the position of the axis in allegedly rest mode (when speed is zero or close to zero).

Field	Description
Draw Clearance	Draw a circle (or ellipse) representing maximum shaft clearance.
Show Trends	Display two plots on the right of the widget showing trends.
Display	Use (or not) lines to connect the points in between.
Horizontal Lines	Shows or hides horizontal grid lines on the *Widget*.
Vertical Lines	Shows or hides vertical grid lines on the *Widget*.

13.15.2 Display

The following picture shows the Shaft CenterLine plot *Widget* and its components.



Symbol	Description
	Timeline: select which part of the storage will be used as source data for the shaft centerline plot.
	SCL filter behaves similar as the filter in Trends. The button allows selecting which machine state and alarm status to show, and the rest of the points will get hidden. Note that the alarm status of the points was calculated when the data was being stored and may not match with actual settings.
	Restores the zoom to its normal condition, removing the effect of any previous zoom done on the plot.
	Sets the current cursor as a single cursor type.
	Exports the SCL Plot values to CSV format and creates and downloads it into a local file.
	Shows/hides SCL information box. This box shows the following information associated to the machine: machine name, points names, and parameters names.

13.15.3 Single cursor

The *Single* cursor is selected by default in this widget.

Clicking on any point of the graphs (either the main SCL plot or the trends), this will launch a notification box at the top right side of the *Widget* with the following information:

- t: timestamp of the point.
- L(X): Corrected horizontal position of the shaft center, after applying angular correction and subtracting Zero origins.
- L(Y): Corrected horizontal position of the shaft center, after applying angular correction and subtracting Zero origins.

- L (raw X): Horizontal position of the shaft center. Raw data, without clearance compensation.
- L (raw X): Vertical position of the shaft center. Raw data, without clearance compensation.
- “Set as zero”: Sets the selected point as the origin of coordinates, so that its position is used to calculate corrected positions.
- Speed: Speed of the machine at the selected point.
- State: State of the machine at the selected point.
- Alarm: Overall alarm state of the machine at the selected point.

Once the cursor is created clicking on the graph again will move the cursor into the corresponding point of the graph. The cursor can also be moved by pressing on left and right arrows of the keyboard, jumping from point to point of the orbit.

14 Maintenance

14.1 Relevant aspects

The *Vigilant* does NOT require any consumable material for its normal operation.

With use, problems can be detected, after some time, with the following elements:

- **Permanent storage.** The *Vigilant* uses an internal micro-SD memory card for permanent storage of the measurement data. The device comes by default with a flash memory card with a total capacity of 4Gb. Although **Vigilant** is using industrial range SD cards with pSLC technology for this feature, and that minimizes the risk of data loss or corruption, the flash technologies used in micro-SD cards are subject to failure, and thus incidents with the SD storage are in the long term inevitable. Read carefully following chapters about Micro-SD card maintenance to learn how to handle it.
- **Accuracy of measurements.** If after a time of obtaining the equipment, it is detected that the measurement is not as accurate as expected, it may be necessary to refine the calibration. If this occurs, please contact your equipment provider.

14.2 Periodic inspections

The system requires periodic inspections that might be performed by a trained user. These inspections should include the following points:

- Log. During operation, the system performs a self-checking, creating a log with all the errors it finds. Periodic checking of the error log messages should be performed.
- LEDs. Inspect the proper operation of the different LEDs.
- Temperature. Check for abnormal temperature on the unit.
- Odor. Check no abnormal odor is present.
- Mechanical defects. Inspects the unit as having not present mechanical defects.
- Noise. Check for abnormal noises.
- Dirt. Clean with a dry cloth any dirt present on the unit.
- Cooling. Make sure the cooling system of the cabinet works properly.
- Communication. Check communications between the different components.
- Connections. Ensure all cable connections are properly tight to the terminal, and that the correspondent connector is well inserted in its socket. Ensure the Ethernet cable is well inserted into its RJ45 female connector.
- Attachment. Ensure the Vigilant is correctly attached to the mounting panel and does not move or have an excessive looseness.
- DIN rail. In case or DIN rail attachment ensures no oxidation, corrosion or dirt is present on both parts of the DIN rail assembly.
- Time configuration. Check for the correct time and date of the equipment.

14.3 Reboot

The *Reboot* function allows to restart the *Vigilant* quickly in case of error. To reboot the unit, follow these steps:

- Carefully insert a thin object (like a paper clip) into the hole located next to the power connector.
- Press and release the button located inside the hole.
- Wait until the unit is initialized.

14.4 Rescue mode

If the button located in the hole next to the power connector is pressed while the *Vigilant* is starting up, the unit will enter the **rescue mode**.

Follow these steps to enter the **rescue mode**:

- Power off the *Vigilant*, if it is running, and wait until all LEDs are switched off.
- Carefully insert a thin object into the hole located next to the power connector and apply a slight pressure.
- Power on the *Vigilant* while holding the button down and wait until the status LED starts blinking red/orange. Then, release the button.

While in rescue mode, the same button can be used to execute several maintenance actions. The numbered LEDs will allow you to select which action to execute.
Press and release quickly the button to change from one LED to another.

- Press and hold the button for two seconds or more to execute the selected action.

Actions in rescue mode:

LED	Action
1	Reboot
2	Reboot
3	Reboot
4	Delete the main configuration (inputs, sensors, machines...)
5	Delete all the users except “admin”. Restore admin’s password and preferences
6	Restore the system configuration (network, date, services...)
7	Delete all stored data (trends, spectra, waveforms...)
8	Delete **all configurations** and restore the *Vigilant* to its factory state

After an action is selected, the corresponding LED will turn yellow while the action is executed. When the process finishes, the LED will turn green again. Some actions could take up to one minute. After that, you can execute another action or reboot the system.

If an error occurs while executing an action, the corresponding LED will turn red.

14.5 Micro-SD card maintenance

The *Vigilant* uses an internal micro-SD memory card for permanent storage of the measurement data. The device comes by default with a flash memory card with a total capacity of 4Gb. Although **Vigilant** is using industrial range SD cards with pSLC technology for this feature, and that minimizes the risk of data loss or corruption, such data losses are ultimately unavoidable. The flash technologies used in micro-SD cards are subject to failure, and for several reasons it is possible that some sectors of the card may become unreadable, or they cannot be written again, or they have other problems.

Since software version 0.7.0 this type of sporadic failures do not cause a general malfunction of the system, as the system is now to operate without flash memory, allows performing maintenance operations on it (for example, a formatting), or even replace the SD card if necessary.

The *Vigilant* allows three possibilities for permanent data storage:

- Use the internal micro-SD card for storage (default option).
- Storage disabled, by selecting this option from the Storage menu. Timeline function will be disabled in all the widgets, and the Trends widget will not work at all.
- Use temporary data storage. The data will be written only in the RAM memory and thus it will get lost as soon as the system is rebooted.

Temporary data storage option is activated automatically if any error is detected on the SD card during the system start-up.

If the system detects any type of anomaly in the reading or writing on the card, this event will be notified to the user by means of the Exception indicator in the navigation bar.

In the Storage menu, in System, it is possible to configure the equipment to work without storage, as well as to format the SD card in case it is not being used.

Using the Rescue mode at the start-up of the system it is also possible to perform some operations with the card, such as formatting it.

Otherwise, please contact **Vigilant** if you need to replace the SD card of your system or if you are not sure about its integrity. In following chapters, it is explained how to perform a Micro-SD card replacement .

14.6 Replacement of internal components

Since hardware version 1.3, the *Vigilant* has a removable cover on its back, from where you can access the inside of the equipment to proceed with the replacement operations of some elements that may have a limited useful life or may need to be replaced after a certain number of hours of use.

These elements are the following:

- Internal battery (for secondary power).
- Fan.
- Micro-SD card.

The following sections explain the replacement procedures for each of these elements.

This procedure refers exclusively to equipment with a hardware version equal or later than v1.3. That version was released to the public in July 2019. If your device is older than that, or you are not sure about it, please contact **Vigilant** to know how to handle the possible replacements.

14.6.1 Access to the rear compartment

The first step to replace any of the indicated elements is to access the rear compartment of the *Vigilant*.

- Disconnect your equipment from external power supplies and remove any wiring.
- Place the instrument on a horizontal surface that is clean and free of any possible element that could disturb your work.
- Verify that you have enough space to carry out the work.

To manipulate the instrument and access its interior it is recommended to use antistatic elements, such as an antistatic mat and bracelet.

To remove the screws and access the compartment you will need to use a screwdriver of the type PZ1 (Pozidriv). For the handling of the cables inside the compartment it is recommended to use a small flat screwdriver.

The first step to access the compartment is to remove the DIN rail clamp, using a screwdriver type PZ1, as shown in the following photo:

Once the DIN rail clamp is removed, remove the four screws at the corners of the back cover, as seen in the following photo:

Once the screws are removed, the back cover of the equipment may be carefully lifted. When removing the lid, you can see the internal compartment of the *Vigilant*:

14.6.2 Battery replacement

The Vigilant units carry an internal Lithium-Ion battery, which is used as an auxiliary power supply, which allows the clean shutdown of the operating system when the main power has been disconnected, allowing time to save the temporary data and index the bases of data.

Battery replacement is a safe procedure, safe from electrical hazards.

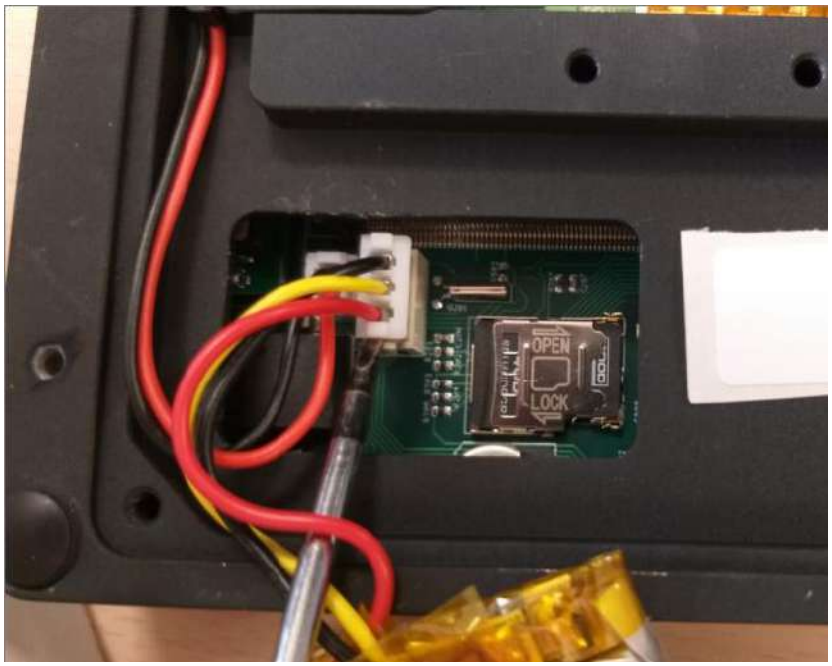
The battery cannot be replaced by any other model. Use only and exclusively batteries supplied by the equipment manufacturer.

The main body of the battery is simply embedded in the hole in the compartment. Remove the main body with your fingers or use a help tool if necessary. We recommend using a plastic tool such as those supplied to use with mobile phones. If you use a steel screwdriver, you may leave marks or aesthetically damage the equipment case.

The most delicate part of battery replacement is electrical disconnection. Be very careful when removing the connector and help yourself with the right tool. In no case pull the cables directly.

Note that the battery connector is polarized and only enters a certain position.

Be careful not to tangle the wires.



14.6.3 Fan replacement

The *Vigilant* units have a brushless fan unit that gets activated when the temperature inside the device exceeds 50 degrees Celsius. The fan helps control and stabilize the temperature of the system.

The fan replacement must only be carried out in exceptional cases in case a general fault of the installed unit has been determined. The manufacturer will supply the necessary replacement unit.

The fan replacement must only be carried out in exceptional cases in case a general fault of the installed unit has been determined. The manufacturer will supply the necessary replacement unit.

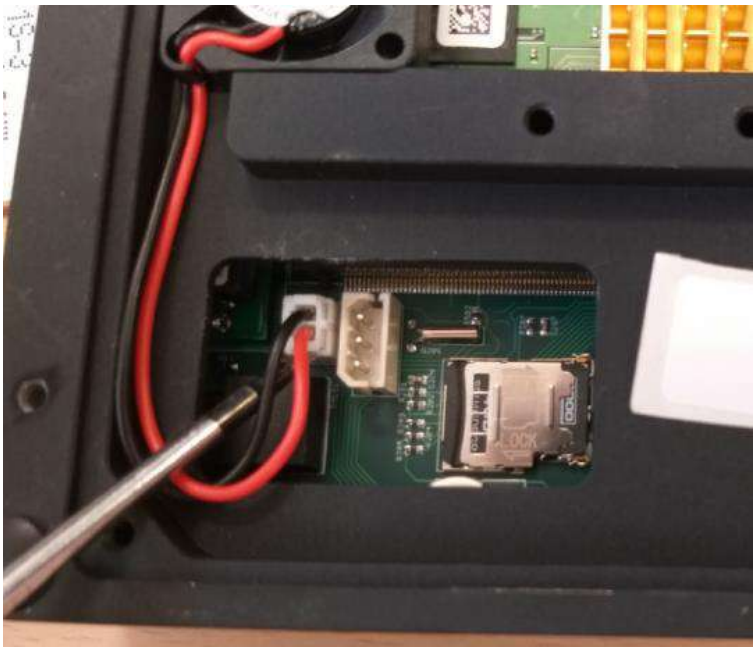
The fan used in the *Vigilant* has a life expectancy of more than 5 years working continuously at maximum power. Its replacement is an exceptional procedure and must be carried out with great care.

The procedure is remarkably like the one with the battery. Simply remove the main body of the fan with your fingers or with the help of a plastic tool that does not damage the equipment housing.

Remove the cable connector carefully, with the help of a tool, and never pull directly from the cables.

The connector is polarized and thus can only be inserted in one direction.

It is necessary to first remove the battery to have necessary space to remove the fan cables.



14.6.4 Micro-SD card replacement

The *Vigilant* unit has an internal micro-SD card where all trend data, spectra, waveforms, etc. are permanently stored. The data is collected during normal operating measurements of the equipment. Other data such as measurement settings, system and users are also stored in the card.

Although the system has several hardware and software features intended to preserve the integrity of the storage system, storage units based on flash technology are fragile by nature. They all have relatively high failure rates.

Although most of the times faults affect unimportant blocks of data, eventually the main database of the system may get damaged, or even the boot partition of the card may get corrupted. In such events, it may become necessary or convenient to replace the micro-SD card.

Vigilant instruments are supplied with 4GB cards of industrial range (pSLC) formatted in FAT32. Although the system is supposed to be compatible with almost any microSD card format, it is recommended to contact **Vigilant** so that it can provide you with a suitable replacement for your card in case you need to change it.

In case the system detects an incorrect type of card or without the appropriate format, the device will start up with the storage deactivated. From the system menu or from the Recovery mode it is possible to carry out the initial formatting in principle of any micro SD card.

To access the microSD card, you must first remove the battery from the computer. Once the battery is removed, the card's connection tray is in the accessible hole below it.

The tray shows two marks where you have to slide the cover of the same, one to open the compartment, and in the other direction to close it. You can slide this cover with the help of a screwdriver.

Once the compartment is opened, the card can be pulled up with the help of tweezers.

Card removal is a delicate procedure and for which a certain manual skill is required. Do not try to do it if you are not sure of the steps to follow and to have the right material.

14.7 Troubleshooting

The following table shows solutions for possible trouble with this device:

Symptom	Possible Cause	Description
No communication	The unit is off	Turn *Vigilant* on by applying power to it.

	Cabling	Ethernet port led's should be blinking in yellow. Otherwise check cable connections.
	Network configuration	Check network configuration. IP address and mask should be in the same range in both the *Vigilant* and the computer.
	Processor failure	Restart the unit.
The information is not displayed correctly	Bad functioning of the browser	Update the browser to the latest version. If this does not correct the problem, try a different web browser. The system is optimized to work with Chrome.
Incorrect value of the signals	Wrong wiring sensors	Check input LEDs (see Indicators). Check sensor wiring. Check *Vigilant* configuration.
Login website is not displayed	There are several sessions open	Delete browsing history in your web browser. Log out using the user menu in the top bar.
Power led is red	Wrong power supply	Check for the power supply, as specified in Power supply.
	Firmware failure	Load new firmware to the unit. See Upgrading the firmware.
	Hardware failure	Contact customer support.

15 Basic Operations

15.1 Starting Up the Unit

Connect the unit to the power supply as described in Power supply. Once the unit is powered, it will start up. The *Vigilant* has a start-up period of several seconds. This time can vary from 10 to 15 seconds.

The power led is used to indicate the status of the *Vigilant* during the start-up. During start-up, the status indicator will be turned on with a solid red color. After the start-up period the indicator turns into solid green, meaning the device start-up is completed successfully.

In case the power led keeps on red color that means the system presents a problem.
See Troubleshooting.

15.2 Powering off the unit

Switch off the power supply or remove the power connector to shut down the system.
The *Vigilant* includes a battery that will make the system to shut down cleanly.

When the *Vigilant* detects a loss in the power supply it automatically initiates its shutdown. After it is down if power supply comes back the unit will start up again. In case the power supply comes back during the shutting down the process will continue until it is down, remaining in this condition for 1 minute. After that period, the unit will start up again.

15.3 Upgrading the firmware

This option is available in *System* interface, in the Upgrade firmware form:

If the unit has the *Offline upgrade* module activated (Optional software features), the firmware may be updated by selecting a file in your network location. Otherwise, you will need direct connection to the Internet to execute the upgrade. The *Vigilant* must have access to the Internet and have necessary Network Ports open.

Online firmware upgrades require the *Vigilant* unit to have direct access to the Internet, with a good enough connection. It is therefore recommended to consider this requirement when defining the project and take actions for an easy way to connect the system to the Internet. It is also recommended when

support by **Vigilant** is required. Required Network Ports must also be open.

Follow these steps in order to check for new versions and upgrading the firmware of the *Vigilant*:

1) Upgrade from server: Click on *Check for new FW on server*. If a new firmware version is available, click on *Upgrade* to begin with the installation.
2) Offline upgrade: After selecting a file from your computer or your local network, the system will check if it is a valid firmware file, and if its version is newer than the one currently active in the device. If it is valid, the installation will begin.
3) In order not to damage the unit it is particularly important to follow the indications. The process of updating can take up to several minutes.
4) The unit will be automatically restarted after upgrading the firmware.

It is strongly recommended not to interrupt the uploading and installation process of the firmware. This process can take several minutes, so the unit must not be reset or turned off.

It is strongly recommended not to interrupt the uploading and installation process of the firmware. This process can take several minutes, so the unit must not be reset or turned off.

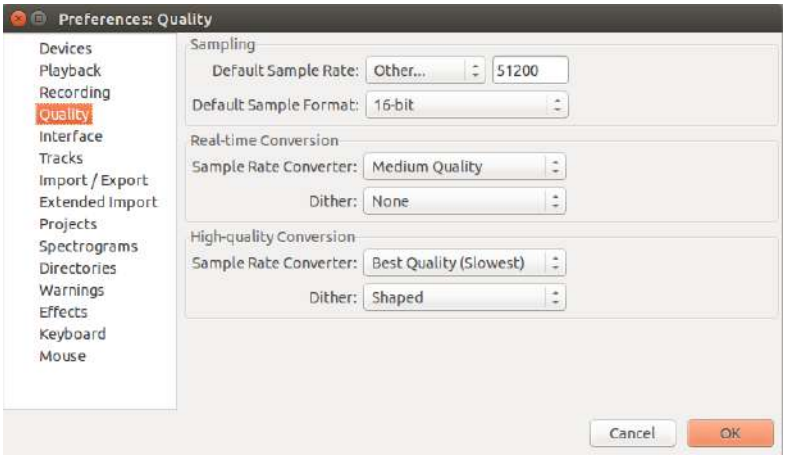
It is strongly recommended to delete the cache of the web navigator after system upgrade. Some navigators will not load some parts of the interface, but they will use the stored interface instead, and this could lead to some troubles with the system.

1. Appendix A

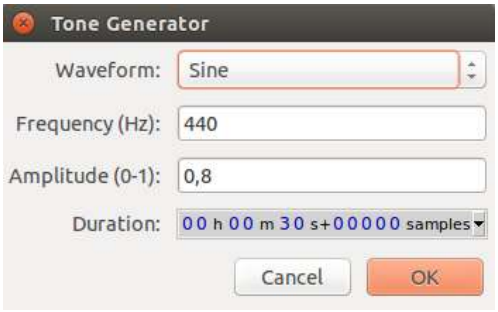
1.1 Creating simulation files

Simulation files are raw (header-less) binary files with 16-bit signed integer samples recorded at 51200 Hz. You can create new simulation files using an audio editor.

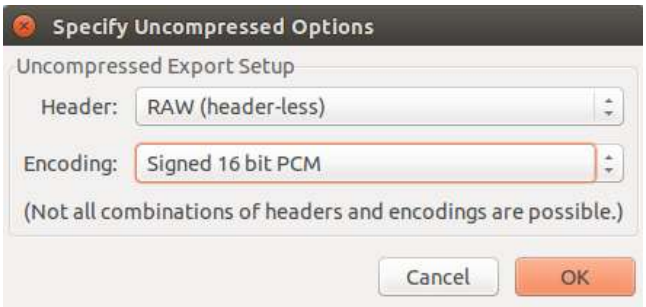
In the following instructions we will make a 440 Hz sine tone using the free audio editing software Audacity. Adjust default sample rate and sample format: **Edit > Preferences > Quality**. Set the default sample rate to **51200 Hz** and sample format to **16-bit.**



Create a 440 Hz, 30 seconds long sine tone: **Generate > Tone**.



Export file as raw file (header-less) 16-bit signed integer samples: **File > Export > Other uncompressed files**. Set header to **RAW** and encoding to **signed 16-bit PCM**.



2. Appendix B

1.2 Optional software features

Vigilant has a wide variety of optional software modules and utilities that allow the customization of the system to meet any particular requirement.

There are available three predefined configurations: Supervisor, Diagnostic, Turbomachinery. The system may also be adapted to any specific needs, upon request, so customers only pay for the functions to be used.

Code	Feature	Supervisor	Diagnostic	Turbomachinery	Description
ET	Extend Processing Blocks		X	X	Extend to 24 simultaneous processing blocks
WV	Waveform Widget		X	X	Displays the original dynamic sensor data
SP	Spectrum Widget		X	X	Displays the FFT data transformation
DM	Demodulation		X	X	Technique for detecting HF bearing failures
OB	Orbits & SCL widgets			X	Enables Shaft Centerline and Orbit widgets
AC	Advanced Capture			X	Allow advanced event-based storage strategies
LW	Long Waveforms			X	Capture and storage of long duration waveforms
PH	Phase Tools			X	Calculation and display of phase displacements
SW	Spectrum Waterfall			X	Shows multiple spectra in a 3-D plot
MB	Modbus Master	O	O	O	Allows using ModBus for external readings
OP	OPC UA Client	O	O	O	Allows using OPC for external readings
EM	Custom email server	O	O	O	Allows using customized email servers

FO	Offline firmware upgrade	O	O	O	Upgrade firmware using a local file

Options marked with an “O” may be activated for any of the predefined configurations.

3. Appendix C

1.3 Network Ports

1.3.1 Incoming connections

Port	Service	Description
TCP 80	HTTP	Web server
TCP 443	HTTPS	Web server (SSL support)
TCP 21	FTP	FTP server for data backup
TCP 873	RSYNC	Rysnc server for data backup
TCP 502	MODBUS TCP	Modbus TCP slave
TCP 22	SSH	Reserved for remote support and maintenance

1.3.2 Outgoing connections

Port	Service	Destination	Description
UDP 123	NTP	Configurable by the user	Automatic system clock synchronization
TCP 502	MODBUS TCP	Configurable by the user	MODBUS TCP master
TCP 443	HTTPS	feeds.bevigilant.io	Firmware updates
TCP 465	SMTP	mail.bevigilant.io	Allows sending notification emails to users (optional)

4. Appendix D

1.4 Keyboard Shortcuts

Key	Action
General	
escape	Close modal window (one level).
h	Show this panel.
l	Show alarm log.
o	Open or close the sidebar.
Desktop	
ctrl + d	Add a new desktop.
d	Select the next desktop (in cycle).
e	Enter layout editor.
shift + d	Select previous desktop (in cycle).
shift + tab	Focus previous widget (in cycle).
tab	Focus next widget (in cycle).
Layout Editor	
escape	Exit layout editor.
r	Move the desktop tab to the right.
shift + r	Move the desktop tab to the left.
Forms	
arrowdown	Move form select list down.
arrowup	Move form select list up.
enter	Accept form.
escape	Cancel form.
shift + tab	Focus on the previous form element.
space	Toggle checkbox or select option.
tab	Focus on the next form element.
Any Widget	
c	Open widget configuration.
delete	Delete widget.
i	Open or close widget info panel.
Space	Maximize or minimize widget.

Spectrum	
arrowleft*	Move active cursor one sample left.
arrowright*	Move active cursor one sample right.
Arrowup	Find an approximated peak with respect to the cursor.
Enter	Start or stop data streaming.
f*	Move active cursor 1/10 sample left.
g*	Move active cursor 1/10 sample right.
j*	Move active timeline cursor one event left.
k*	Move active timeline cursor one event right.
N	Change to the next cursor (in cycle).
P	Change to next processing mode (in cycle).
shift + arrowleft*	Move all cursors one sample left.
shift + arrowright*	Move all cursors one sample right.
shift + f*	Move all cursors 1/10 sample left.
shift + g*	Move all cursors 1/10 sample right.
t x	Open or close timeline. Exit cursor mode.
w	Show waveform.
z	Reset zoom.
Waveform	
arrowleft*	Move active cursor one sample left.
arrowright*	Move active cursor one sample right.
enter	Start or stop data streaming.
f*	Move active cursor 1/10 sample left.
g*	Move active cursor 1/10 sample right.
j*	Move active timeline cursor one event left.
k*	Move active timeline cursor one event right.
n	Change to the next cursor (in cycle).
p	Change to next processing mode (in cycle).
s	Show spectrum.
shift + arrowleft*	Move all cursors one sample left.
shift + arrowright*	Move all cursors one sample right.
shift + f*	Move all cursors 1/10 sample left.

shift + g*	Move all cursors 1/10 sample right.
t x	Open or close timeline. Exit cursor mode.
z	Reset zoom.
Parameters	
enter	Start or stop data streaming.
j*	Move active timeline cursor one event left.
k*	Move active timeline cursor one event right.
t	Open or close timeline.
Trend	
arrowdown	Change focus to the next source (in cycle).
arrowleft*	Move active cursor one sample left.
arrowright*	Move active cursor one sample right.
Arrowup	Change focus to previous source (in cycle).
shift + arrowleft*	Move all cursors one sample left.
shift + arrowright*	Move all cursors one sample right.
Z	Reset zoom.
Orbit	
arrowleft*	Move active cursor one sample left.
arrowright*	Move active cursor one sample right.
Enter	Start or stop data streaming.
j*	Move active timeline cursor one event left.
k*	Move active timeline cursor one event right.
T	Open or close timeline.
Z	Reset zoom.
Phase Diagram	
arrowleft*	Move active cursor one sample left.
arrowright*	Move active cursor one sample right.
t	Open or close timeline.
z	Reset zoom.
Long Waveform	
j*	Move active timeline cursor one event left.
k*	Move active timeline cursor one event right.

t	Open or close timeline.
Waterfall	
Arrowd own	Move down one layer.
arrowleft*	Move active cursor one sample left.
arrowright*	Move active cursor one sample right.
arrowup	Move up one layer.
P	Change to next processing mode (in cycle).
S	Show spectrum.
T	Open or close timeline.
Shaft Centerline	
arrowleft*	Move active cursor one sample left.
arrowright*	Move active cursor one sample right.
x	Exit cursor mode.
z	Reset zoom.

(*) Holding the key repeats the shortcut.

4			
3	CGI 2021/05/12	Updated version + layout	
2	CMA 2021/04/26	Updated version/Product certifications	
1	CGI	Original version	CMA
Ver.	**Editor**	**Nature of modification**	**Verified**