TWave T8 User Manual

Release 2.0

TWave S.L.

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CHAPTER

ONE

INTRODUCTION

Note to customer

This manual contains the information about how to install and use your *TWave T8* unit. Read carefully and understand this manual before using this product. Following the instructions will help reduce damages or malfunctions of the system, avoiding downtime and maintenance costs. Keep a copy of this manual available for consultation at all locations users might need, and in a readable condition.

When using this product it is necessary to be knowledgeable about not only the information in this manual but also about any instrumentation that is connected to it. Also general information about safety is required 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 *TWave T8* module is combined with other instrumentation and then resold or transferred as part of an assembly, be sure that this manual is given to the end user.

When disposing this product follow the local laws and regulations.

In no event will **TWave** be responsible or liable for errors, omissions or inconsistencies that may be contained in this manual, or for indirect or consequential damages, 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 and does not represent a commitment on part of **TWave**. 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. Due to the many variables and requirements associated with any particular installation, **TWave** cannot assume responsibility or liability for actual use based on the examples and diagrams.

Symbols used

Paragraph styles used to highlight texts of special interest:

> **Warning:** This label identifies information intended to draw attention about potential sources of danger for personnel, the environment, the system or the machinery.

Danger: This label identifies information that provides important advice to be followed for the successful understanding and application of the product.

CHAPTER

TWO

SUPPORT AND CONTACT DETAILS

Sales and support contact

Address:

TWave
C/Secundino Roces Riera 1, 2 P5
Parque empresarial de Asipo
33428, Llanera, Asturias
Spain

Telephone: +34 984 839 720

Email: info@twave.io

Web page: http://www.twave.io

Installation assistance

If you experience a problem with a *TWave T8* unit please review the information contained in this manual. You can also contact our Customer Support for initial help in getting your *TWave T8* unit up and running by calling to this number: **+34 984 839 720**.

TWave provides technical information on the web to assist you in using our products. Visit our web page http://www.twave.io to download technical manuals and other documents.

CHAPTER

THREE

STANDARDS

The *TWave T8* has been design and tested to meet the following directives and standards.

EMC

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

- *IEC EN 61000-6-1:2007 EMC.* Electromagnetic Equipment for Measurement, Control and Laboratory Use – Industrial EMC Requirements.
- *IEC EN 61000-6-3:2007/A1:2012 EMC.* Emission Standard for Industrial Environments.
- *IEC EN 55022:2010.* Information technology equipment– Radio disturbance characteristics.
- *IEC EN 61000-4-2/3/4/5/6.* EMC Standards.

Electrical security

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

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

CHAPTER

FOUR

SAFETY INFORMATION

General

The *TWave T8* monitoring system was designed to meet the safety regulations. However its safety can be at risk if the equipment is installed or used by untrained personnel, used in an improper manner or not inspected and maintained.

Warning: Installation, operation and maintenance of the system should only be undertaken by specialist personnel, and in accordance with the safety and accident prevention regulations.

Warning: Repairs of the system should only be undertaken by **TWave**, or by personnel authorized by **TWave**

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

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 **TWave** for assistance.

Warning: Be sure that main power is off, and will stay off until the end of the installation work. Check that the equipment is voltage free by using a voltage tester. Installation should always be carried out with the equipment isolated from the power supply or any electrical power source.

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

Danger: Check that all materials to be installed are compliance with EU directives or international regulation with respect to 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 properly installed and connected. Wiring should follow these requirements:

- Use 17 to 22 AWG copper conductors (AWG 20 recommended) for wiring the equipment. For ground terminal a AWG 17 size conductor is recommended.
- 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 ferrules must be used for stranded conductors.
- Soldering the conductor is forbidden.

Environment and enclosure

The *TWave T8* modules are supplied as "open type" devices, meaning it should be installed in an enclosure suitable for the environment conditions that might be present, and to prevent any damage to personnel.

Danger: 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 over-voltage Category II applications, at altitudes up to 2000 meters.

See *Specifications* for environment specifications applied for the equipment.

ATEX

The equipment was not designed for being installed in potentially explosive atmospheres.

Danger: 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 environments.

Power supply and grounding

Power requirements for the equipment are given at the specifications described on *Specifications* Be sure the installation meets the specifications before powering the equipment.

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

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

Danger: Before installing the equipment calculate the total power required for all the *TWave T8* 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 the equipment on.

The equipment must be connected 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 properly connected to that ground terminal. Additionally the equipment makes a chassis ground connection through the DIN rail, which in turn must be connected to ground.

Danger: Make sure DIN rail with good conductive properties is used. Steel DIN rails are recommended. 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 that can result in improper chassis grounding.

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

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

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

Transportation 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.

Warning: Protect the equipment against humidity during its transportation and storage, even when original packing is used.

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

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

CHAPTER

FIVE

SYSTEM DESCRIPTION

Introduction

TWave T8 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.

TWave T8 is a smart solution for protection, condition monitoring and failure mode identification of critical machinery. It can work as a standalone system, as it does not required 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.

TWave T8 is a small size and low consumption hardware device. It integrates a web server that provides an interface for users through a web browser (Cloud Monitoring), without having to install any software. With that web interface the user can both configure and access all data being measured in the unit, along with all the type 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 long periods of time. 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 Internet, so its measurements can be accessed from any part of the world using a computer or device connected to Internet and a web browser.
- It is not required to pay for software licenses to access the data.
- Access is not limited to a number of computers or devices.
- Obsolescence is avoided by applying automatic updates.
- It is very intuitive, which accelerates the learning curve and allows user to access all of the functionality from start.
- The initial investment is reduced by simplifying the monitoring system.

The system includes 8 analog inputs with simultaneous high-frequency sampling. T8-L version adds 4 additional low-frequency sampling analog inputs.

Additional inputs or outputs can be added using an Expansion Module. Default version adds 4 low-frequency analog inputs and 4 relay outputs. The ports of the expansion modules may be fully customized on customer request.

TWave T8 also includes bidirectional communication via Modbus-TCP protocol for its integration with external systems.

CHAPTER

SIX

DESIGN

External appearance

In the front and back sides of the *TWave T8* several pluggable terminal blocks allow connecting wires both for sensor signals and power supply.

TWave T8 also has a RJ45 jack port on the left part of the front of the case, for Ethernet communications (100Base-TX). Next to the RJ45 port there is an USB connector (A-type), in order to plug a slave device (not implemented yet) .

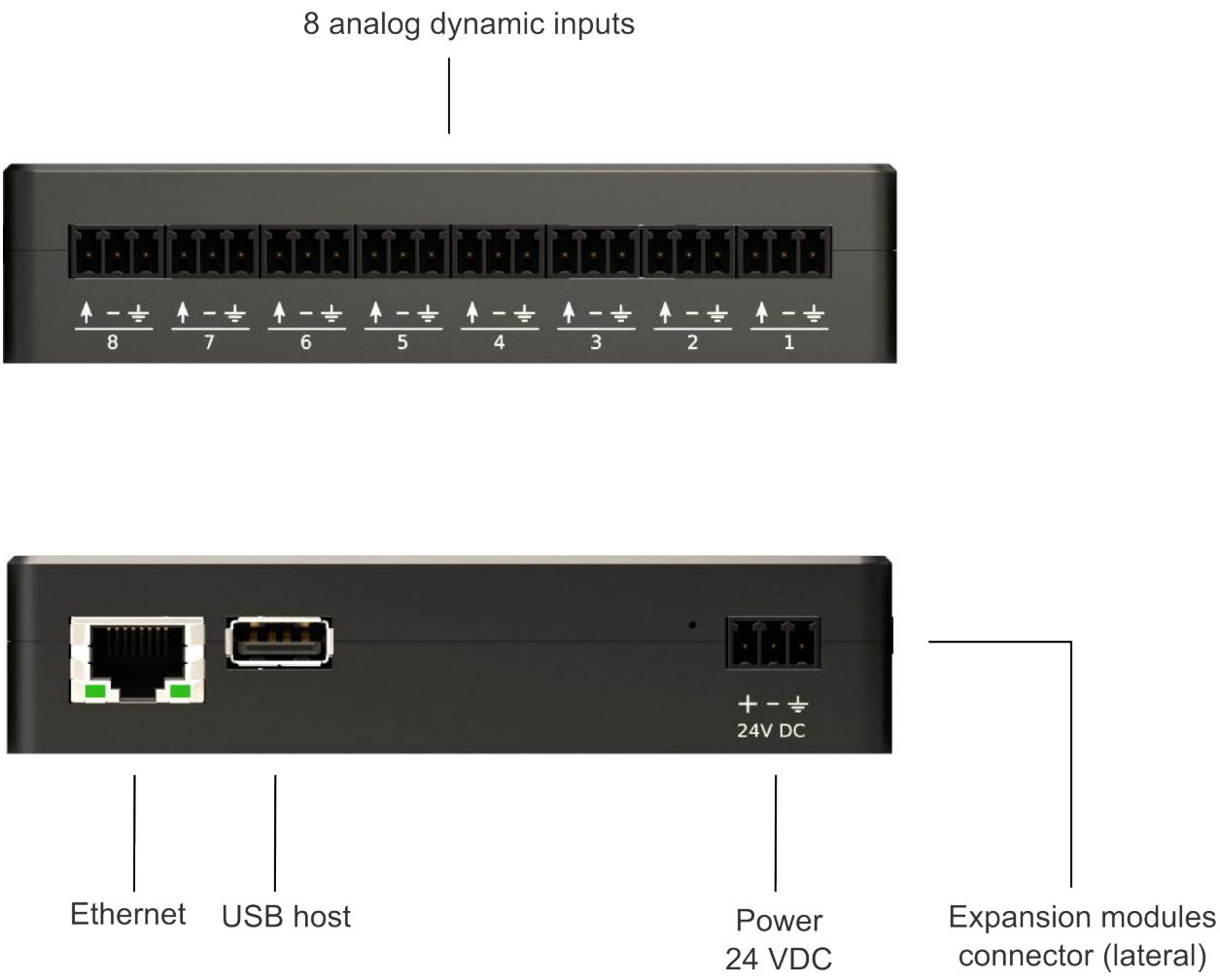
On the right side of the case of the case of the Compact (M) version *TWave T8* there is a multipole connector, that can be used to plug expansion hardware modules. This connector is not present in the Large (L) version of the device.

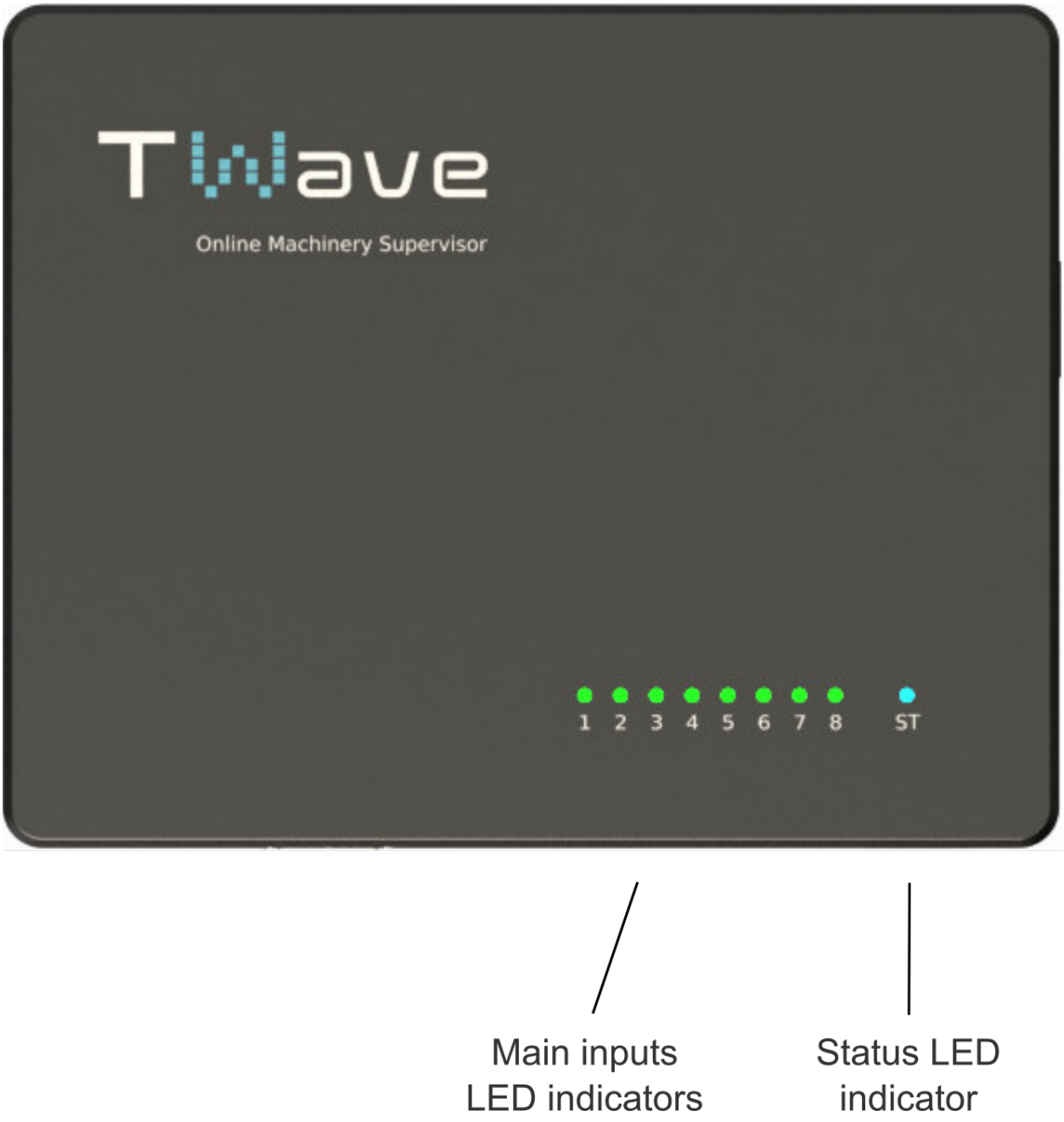
On the top of the instrument, several LED indicators give some information about the state of the device and the signals that it is reading.

The following chapters contain some images with more detailed information about the *TWave T8*, its hardware variants and expansion modules.

Compact model

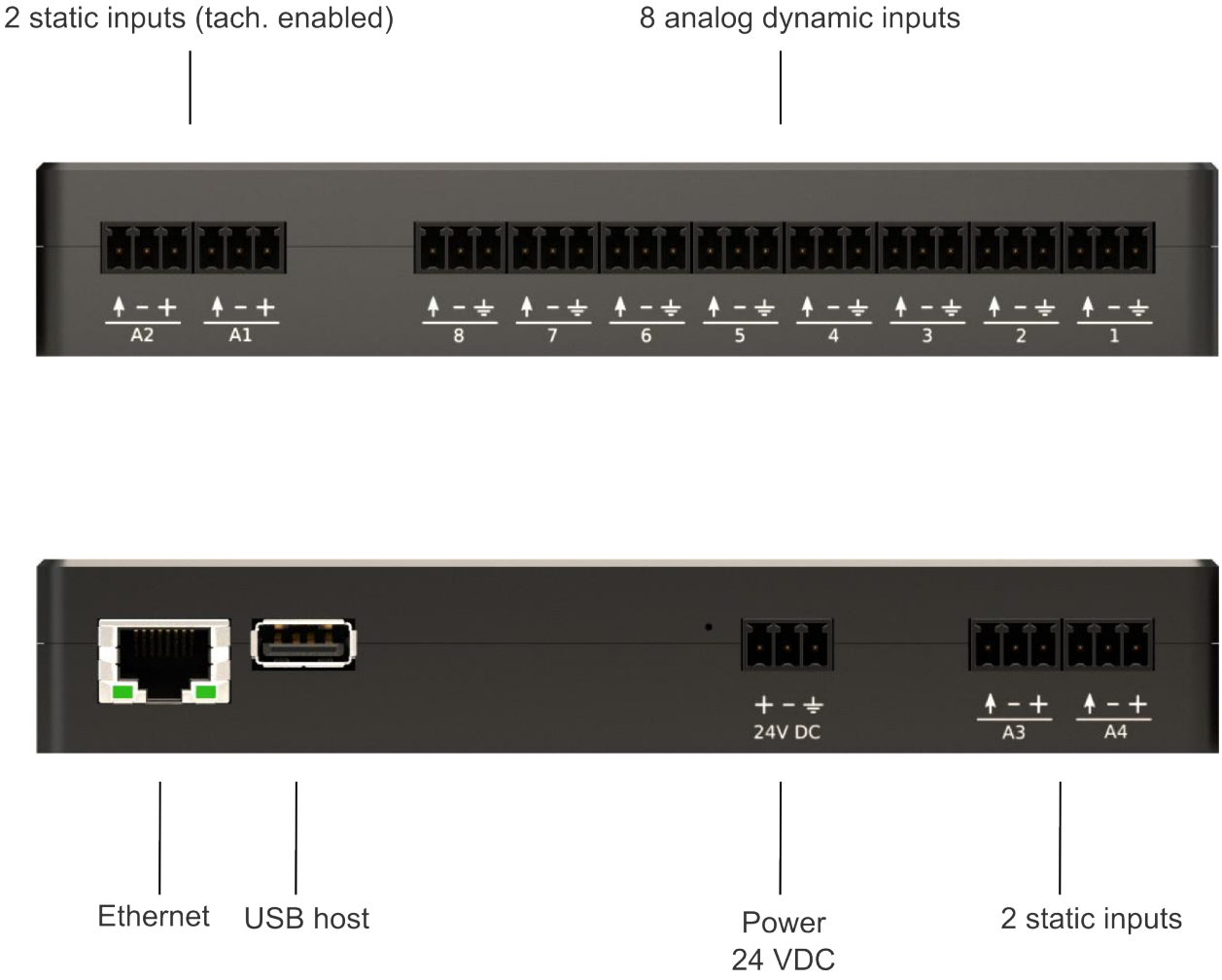
The Compact or -M version of the *TWave T8* has only 8 high-speed inputs (main inputs), and no auxiliary input. However, it has a multipole port on one of the laterals for plugging Expansion Modules, so that the hardware capabilities can be augmented if needed.

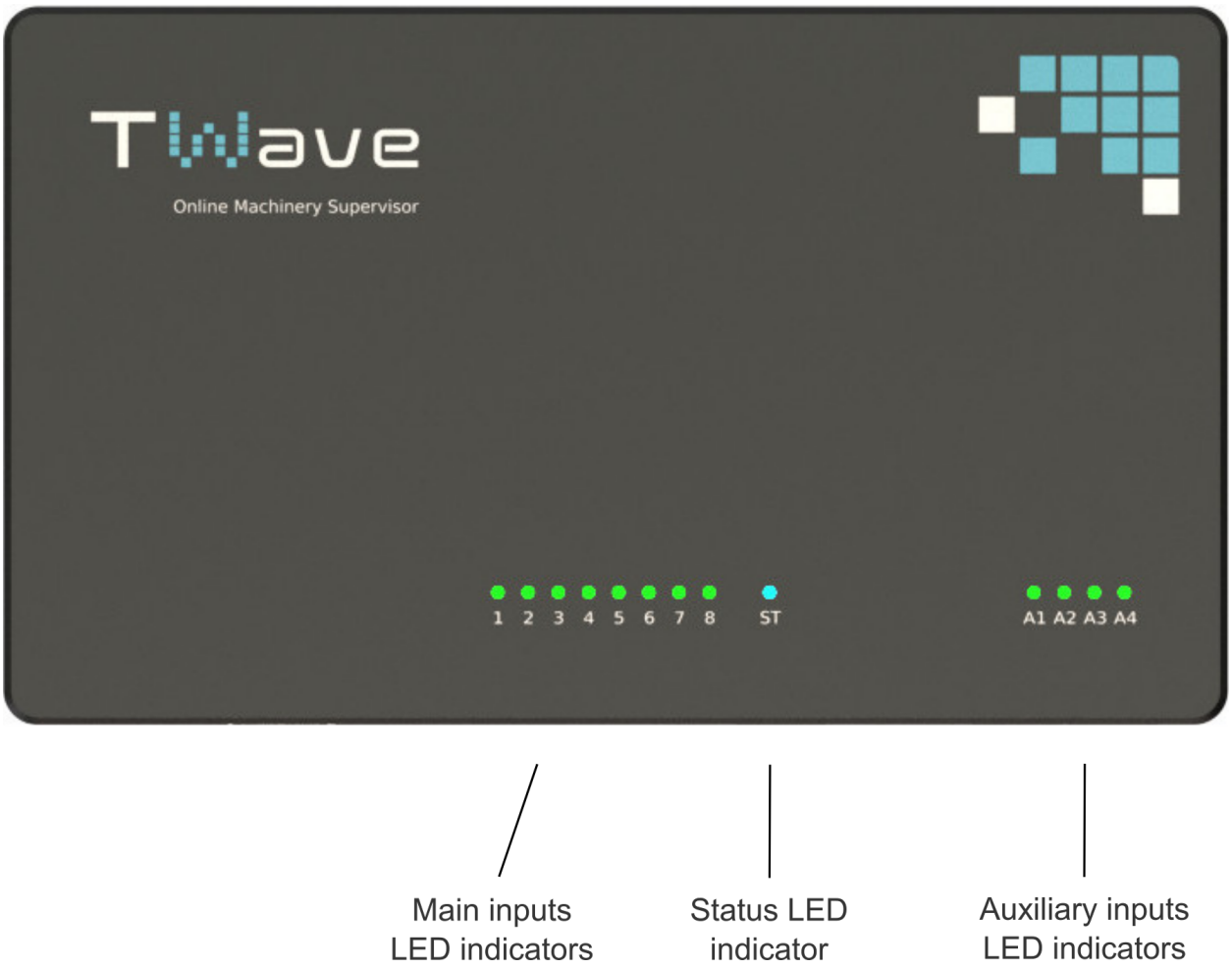

8 analog dynamic inputs
8
7
6
5
4
3
2
1
24V DC
Ethernet
USB host
Power
24 VDC
Expansion modules
connector (lateral)



Large model

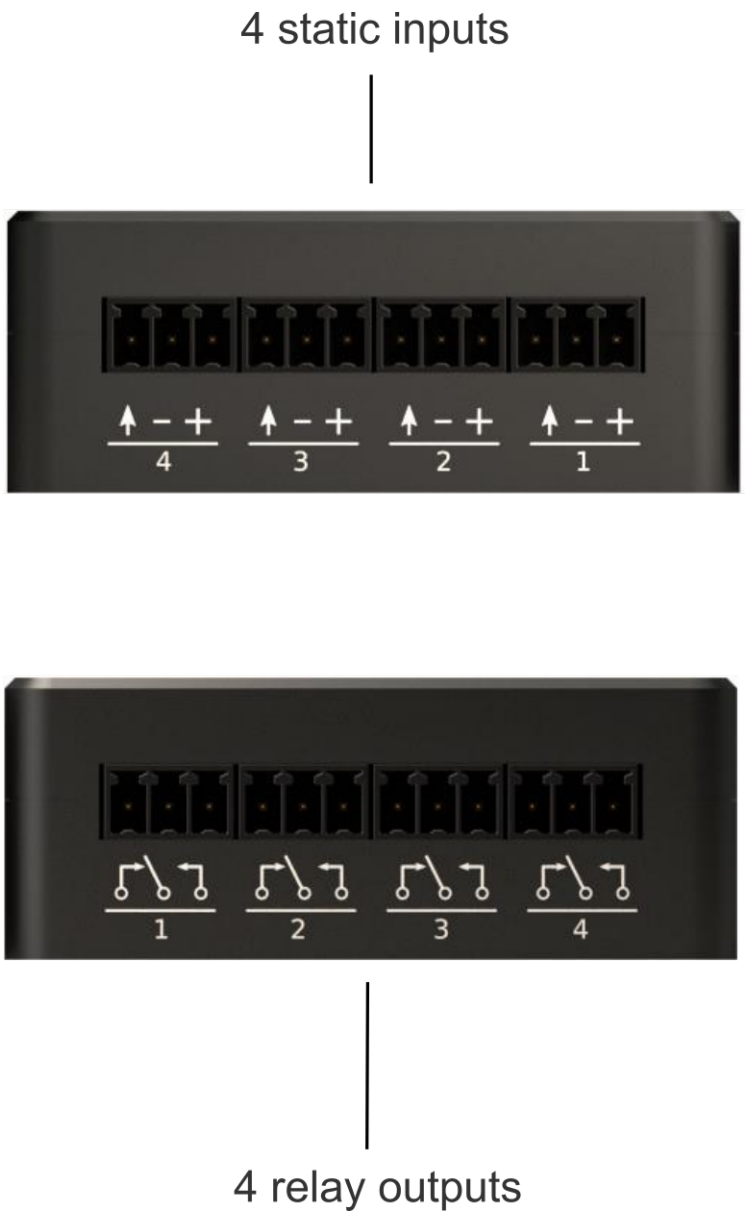
The Large or -L version of the *TWave T8* has 8 main inputs (high-speed) and 4 additional auxiliary inputs, for static analog sensors or tachometers. However it does not have expansion port to expand the hardware any more.

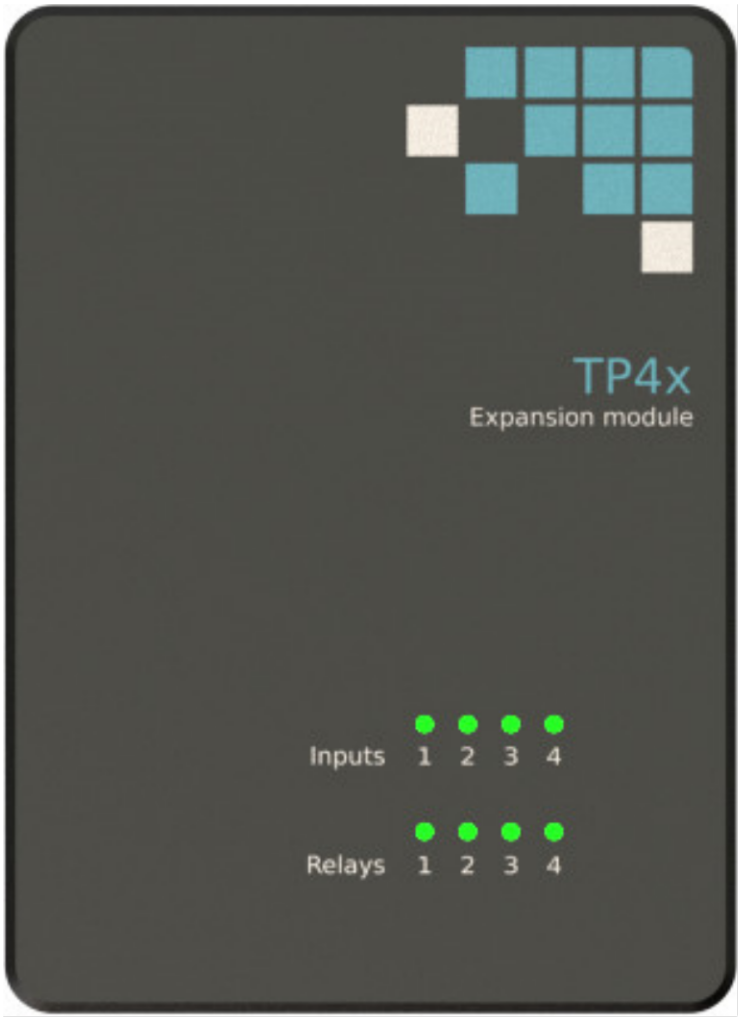

2 static inputs (tach. enabled)
8 analog dynamic inputs
A2
A1
8
7
6
5
4
3
2
1
24V DC
A3
A4
Ethernet
USB host
Power
24 VDC
2 static inputs



Expansion module

Hardware features of the Compact version of *TWave T8* may be improved by using hardware Expansion Modules. As shown in the figure, standard design of the Module includes 4 auxiliary inputs (for static signals and tachometers) and 4 relay outputs:


4 static inputs
4
3
2
1
1
2
3
4
4 relay outputs



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 on in rescue mode.
Ethernet connector	Yellow or green	Link/Activity
Input ports (Any type)	Green	Channel is measuring and no alarm is detected for all the measurements done on the channel.
	Orange	Channel is measuring and at least one of the measurements of the channel is in warning or alert condition .
	Red	Channel is measuring and at least one of the measurements of the channel is in alarm or fault condition.
	Off	The input channel is either disabled, or if enabled, it is processing the sampling data.
Output ports (Any type)	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).

CHAPTER

SEVEN

SPECIFICATIONS

TWave T8-M

The following table shows the specifications for the compact version of the *TWave T8* device:

High Speed Inputs	
Number of high speed inputs	8
HS Inputs sampling rate	512 to 102400 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

Signal Processing	
Spectral lines (bins)	100, 200, 400, 800, 1600, 3200, 6400, 12800
Time waveform samples	128 up to 8192
Window types	Hann, Hamming, Blackman, Rectangular
Processing modes	Waveform, Spectrum&Waveform, Demodulation, Long Waveform
Filter types	Butterworth, Bessel, Chevyshev
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	8x Red/Green LEDs
Network communication	IEEE1588 Ethernet Gigabit
Power Supply	20-26 Vdc, 24 Vdc nominal
Power consumption	<7 W

Mechanical features	
Mounting	Standard 35 mm DIN rail
Size	119x95x27 mm
Weight	0.35 Kg
Temperature range	-30 to +65 ºC
Humidity	95% RH
EMI/EMC EMI/EMC EMI/EMC	EN55022:2011/AC:2012, EN61000-4-2:2010, EN61000-4-3:2007 /A2:2011, EN61000-4-4:2005/A1:2010/CORR:2010, EN61000-4-5:2007/CORR:2010, EN61000-4-6:2009
Electrical security	UNE-EN 60950:2007

TWave T8-L

The following table shows the specifications for the large version of the *TWave T8* device:

High Speed Inputs	
Number of high speed inputs	8
HS Inputs sampling rate	512 to 102400 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 8192
Window types	Hann, Hamming, Blackman, Rectangular
Processing modes	Waveform, Spectrum&Waveform, Demodulation, Long Waveform
Filter types	Butterworth, Bessel, Chevyshev
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 Gigabit
Power Supply	20-26 Vdc, 24 Vdc nominal
Power consumption	<7 W

Mechanical Features	
Mounting	Standard 35 mm DIN rail
Size	162.2x95x27 mm
Weight	0.42 Kg
Temperature range	-30 to +65 ºC
Humidity	95% RH
EMI/EMC EMI/EMC EMI/EMC	EN55022:2011/AC:2012, EN61000-4-2:2010, EN61000-4-3:2007 /A2:2011, EN61000-4-4:2005/A1:2010/CORR:2010, EN61000-4-5:2007/CORR:2010, EN61000-4-6:2009
Electrical security	UNE-EN 60950:2007

CHAPTER

EIGHT

INSTALLATION

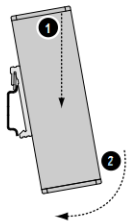
Mechanical assembly

The *TWave T8* system was not designed as an "enclosed type". This means that it would normally require to be installed into an external enclosure prepared for the environmental conditions of the application site.

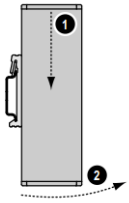
The equipment includes an accessory to be mounted on standard DIN rail (35 mm rail). Using the accessory installed at the back of the casing, the equipment can be arranged on a DIN rail fastened to the mounting panel of the enclosure.

On the picture below it can be seen the back side of the *TWave T8*, where this DIN rail accessory is shown:

The following table describes the steps for assembling or removing the *TWave T8* from the DIN rail.



To fasten the *TWave T8* 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 *TWave T8* press firmly on top and pull the lower end away from the DIN rail.

Warning: The *TWave T8* includes a forced ventilation system that regulates its temperature. However in order to guarantee its correct cooling the temperature within the enclosure must be kept within the allowable limits (see *Specifications*. Heating caused by all components within the enclosure must be taken into account, installing a forced ventilation system in the enclosure if required.

Warning: Allow some free space around the air input grid and ventilator output. equipment to ensure its correct cooling. To improve its cooling remove any insulation material that might be around or close to the unit and ensure the free circulation of air around the unit.

Warning: Outdoors 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 *TWave T8* unit from any external heat source that could cause high temperatures.

Danger: It is responsibility of the assembler to ensure the environmental conditions described at the specifications of the unit.

CHAPTER

NINE

ELECTRICAL INSTALLATION

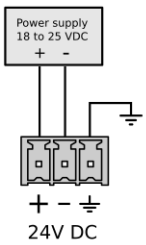
Connectors

Connections for I/O channels and power supply are achieved by using pluggable screw terminal blocks. In both cases the *TWave T8* 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).

Power supply

The *TWave T8* must be powered with a nominal 24 VDC power supply. The voltage can vary from 18 to 25 VDC, as described in the specifications (see *Specifications*.



The maximum power consumption is around 7W (300mA under 24 VDC).

The *TWave T8* case, DIN clip and chassis ground terminals are connected together (more information in next section: *Ground connection*.

Danger: In order to power the equipment a CE certified power supply (or equivalent) is required. The power supply must have a ground reference, and must be connected to the ground of the installation.

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

Warning: A switch or circuit-breaker must be included in the installation. It must be suitably located and easily reached.

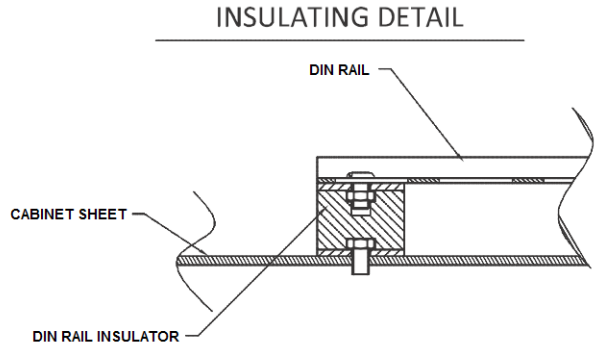
Ground connection

All the connectors for the main analog inputs of the *TWave T8*, and also the power input connector, have a terminal for chassis ground connection. All those terminals are connected in between, and in turn they are also connected both to the *TWave T8* case and the DIN rail clip.

Danger: 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 a safe operation of the system and minimize noise interferences.

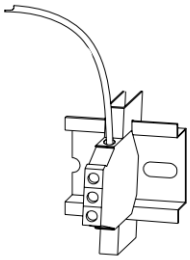
Some installations, in order to avoid noise problems, may require a ground connection for sensors and instrumentation separated from the safety ground, which is typically connected to the cabinet casing. In such cases the *TWave T8* must be connected to the instrumentation ground, and it must be ensured that the DIN rail where the *TWave T8* is supported is isolated from the safety ground.

In the following graph it is shown an example of how the DIN rail can be isolated from the cabinet.



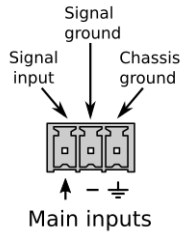
Danger: It is recommended to connect to the instrumentation ground both the *TWave T8* ground terminal and the DIN rail where the *TWave T8* is supported.

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).



Main inputs

The main inputs or *high speed inputs* of the *TWave T8* share the following configuration:

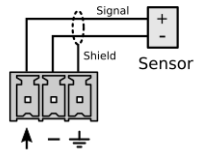


These inputs admit voltage signals in the range of +-24 V (24 Vpp in AC mode), and have been designed to accommodate fast signals coming from sensors like accelerometers, tachometers or displacement probes. Of course, they can also be used to read slower signals like temperature probes or others.

As it is shown in the image, all the main 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.

Danger: The signal terminal of the main inputs *TWave T8* is connected to a current source of about 5.5 mA, that can be activated for powering ICP/IEPE transducers, like many accelerometers.

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

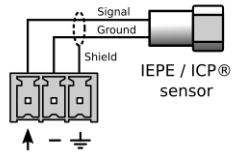


This scheme is valid for any kind of sensor with external power supply and voltage output (either analog or digital).

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

ICP/IEPE transducer

The system is able to power ICP/IEPE accelerometers and velocimeters connected to the main inputs, so that they can be connected just as shown below:



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

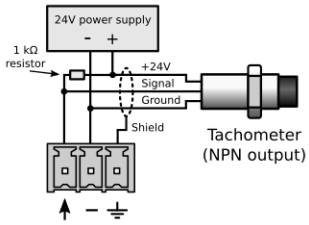
Danger: In order to avoid noise in the signals a shielded cable is recommended, as shown above. Ensure this shield is grounded. In order to avoid loops and noise make sure just one of the sides of the cable is connected to ground. Typically grounding is done in the cabinet side.

Periodic Pulse Signal (Tachometer)

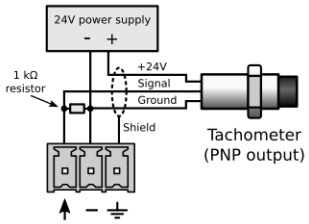
Main inputs may also be configured for detecting the speed from a periodic pulse signal. The pulse detection of the signal is based on a trigger voltage (threshold) and a hysteresis value defined by the user.

Tachometers are used mainly to detect the speed of a rotating machine. Typically, tachometers are based on proximity sensors. Most commonly 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 a NPN output type, the normal connection between the sensor and the main inputs would be something like this:



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

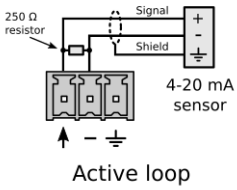


In order to avoid noise in the signal, a shielded cable is recommended. The shield must be grounded at one side of the cable (typically at the cabinet side).

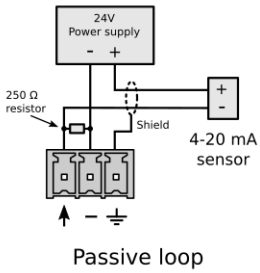
4-20 mA Signal

Dynamic inputs can be configured to measure 4-20 mA current loop signals. This kind of current loops 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.

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 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 *TWave T8* do not have the possibility of powering the sensors sensors in that way, thus an external power source must be added in between the sensor and the *TWave T8*:



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

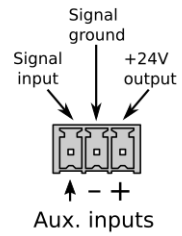
Digital Inputs

Main inputs can be configured as a digital inputs. This means the channel will measure a value of 1 (true) or 0 (false) depending on the DC voltage of the signal. A hysteresis is applied around this value. Both DC voltage and hysteresis can be configured by the user.

As an example if 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 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.

Auxiliary inputs

The connectors for the auxiliary analog inputs, available both in the Large version of the *TWave T8* and in the Expansion Module, have the following configuration:

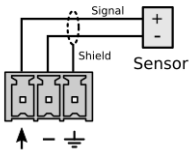


The auxiliary inputs admit voltage signals in the range of +-24 V, and have been designed to read analog signals at slow rates.

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).

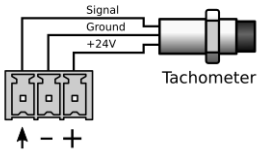
In the following sections there will be shown the typical connection between different kind of sensors and the auxiliary inputs:

Periodic Pulse Signal (Tachometer)

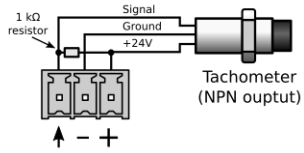
Some of the auxiliary inputs may also be configured for detecting the speed from a periodic pulse signal. The pulse detection of the signal is based on a trigger voltage (threshold) and a hysteresis value defined by the user.

Tachometers are used mainly to detect the speed of a rotating machine. Typically, tachometers are based on proximity sensors. Most commonly 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.

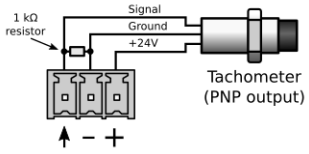
The connection between the auxiliary inputs and a tachometer with analog or digital inputs would look like this:



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



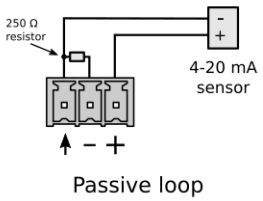
In case the sensor has a PNP output, the connection would look like this:



4-20 mA Signal

Dynamic inputs can be configured to measure 4-20 mA current loop signals. This kind of current loops 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.

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:



Passive loop

Digital Inputs

Auxiliary inputs can be configured as a digital inputs. This means the channel will measure a value of 1 (true) or 0 (false) depending on the DC voltage of the signal. A hysteresis is applied around this value. Both DC voltage and hysteresis can be configured by the user.

As an example if 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 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.

Other I/O ports

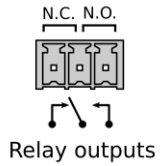
The number of peripheral ports of the *TWave T8* can be expanded by using the Expansion Modules. This option is only available for the compact version (M) of *TWave T8*.

The Expansion Modules add 8 additional I/O ports to the device. Standard model of the Expansion Module add 4 auxiliary inputs and 4 relay outputs, but on demand the Modules may be designed with other port configurations (thermocouple or Pt100 inputs, digital outputs, etc.):

Relay outputs

Standard Expansion Modules for *TWave T8* include 4 power relay outputs. The relays are compatible with any signal up to 5 A at 250 Vac.

The terminals of the relay output connectors are common, NC (normally closed terminal) and NO (normally open terminal), like it is shown in the following picture:



Relay outputs

RTD inputs

Customized Expansion Modules for *TWave T8* may include RTD input channels. RTDs are temperature sensors.

Thanks to their higher accuracy and repeatability, they are slowly replacing thermocouples in industrial applications below 600 °C. They are usually produced of a pure material, that changes its resistivity with temperature. Most common model is Pt100, which is a Platinum sensor with a nominal 100-Ohm resistance at 25 °C.

The RTD input channels include a 3-wire configuration, in order to minimize ambient noise on the readings. Terminals are labeled “+”, “R” and “-”, where the actual reading of the sensor output is performed on the reference “R” terminal.

CHAPTER

TEN

USER INTERFACE

This section describes the user interface of the *TWave T8* Machinery Supervisor*.

Introduction

TWave T8 comes with an embedded web-based user interface that can be accessed from any operating system, including tablets and smart phones.

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:

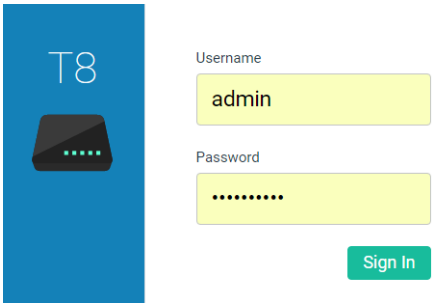
- *System*. Provides information about the status of the *TWave T8*, and allows the user to configure its general settings.
- *Configuration*. Configures the different monitoring components of the *TWave T8* (inputs, sensors, processing modes, parameters, measuring points, alarms, etc.).
- *Dashboard*. This interface shows the data measured by the *TWave T8* unit.
- *Manual*. Shows the manual of the *TWave T8*.

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

Access

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

- Connect the *TWave T8* to your device or network using an Ethernet cable.
- Find out the IP address of the unit. By default the *TWave T8* is supplied with this 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 *TWave T8* unit on the web address.
- The browser will show the login box.



- Enter the user name and password and click on "Sign in". The *TWave T8* has a predefined user called *admin*. The password of *admin* is unique for every *TWave T8* unit. Please refer to the Quickstart document provided in the original package of the unit.

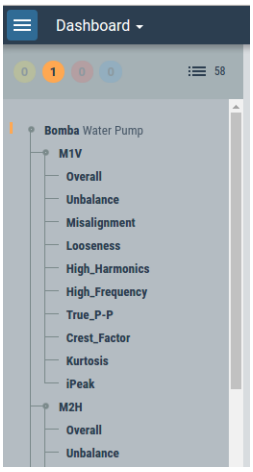
Toolbar

The following picture shows the toolbar of the User Interface and its components. It appears at the upper part of the web page and will be shared by the different modules of the interface.

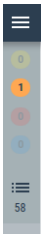
Show tree

On the left of the toolbar this button:

will show or hide the tree structure of the configuration. When the configuration tree is visible the alarm toolbar will be located above the configuration tree, in horizontal.

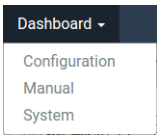


When the configuration tree is hidden the alarm toolbar is located on the left, in vertical direction.



Application selection

The toolbar shows the name of the active application interface in the middle. Clicking on it will show the list of modules of the user interface.



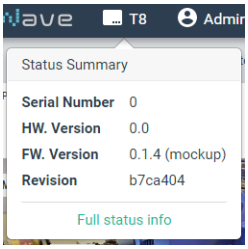
Selecting an item of the list will change the interface into the correspondent application.

Note: the Dashboard application will be shown by default when accessing the system.

Device info

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, and hardware and firmware version). Clicking on Full status info will show the status page of the system configuration (See *Status*).

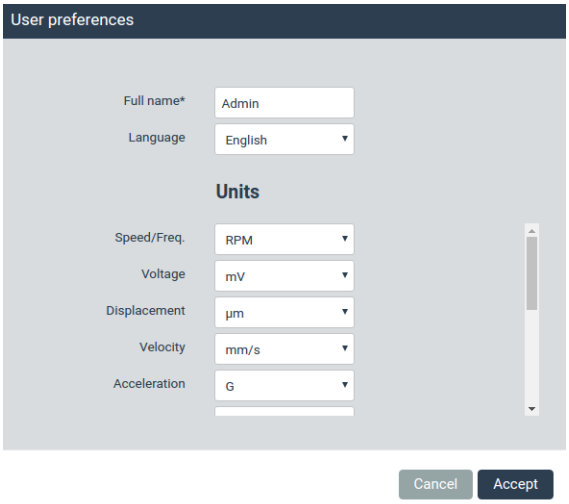


User

On the far right the toolbar shows the name of the logged user. Clicking on it will show the following options:

- Preferences
- Logout

Preferences will show the user settings. The following form will appear.



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 units the user will use for each property. The form presents the properties and units defined in the configuration of the *TWave T8*. See section *Units* in order to add any magnitude or unit to the system.

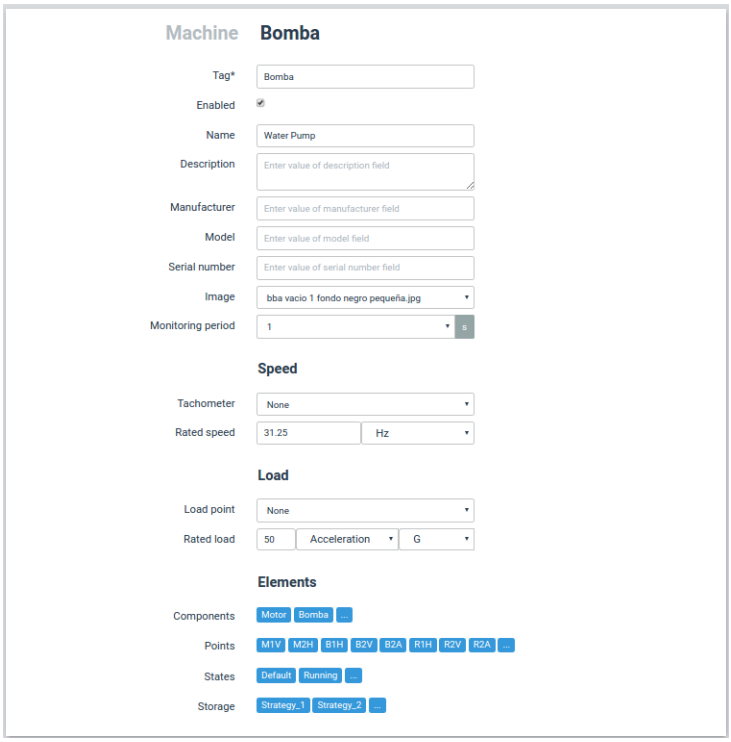
Selecting *Logout* will exit the user interface and will show the initial login dialog box.

Basic interface elements

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

Forms

Forms contain different fields where the user can introduce information, either by writing free text or by selecting a value from a pull-down list. These fields are most of the time classified into sections, for an easier understanding and organization of the different options available. The following picture shows an example of a form.



Those fields inside a box and with a white background indicate they can be edited. 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 they are required to be filled in. Otherwise the changes on the form will not be accepted.

After changing the fields of 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.

Danger: 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 *TWave T8* until the Apply button from the tool bar is used.

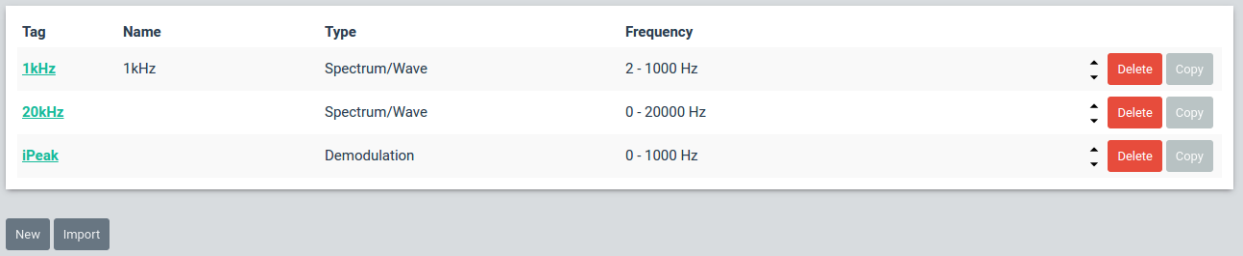
In some cases the field provides a help text. This appears when it is left blank and shows an example or a tip about how to introduce the information correctly.

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.

List

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



By clicking on any particular item of the list this will be edited. On the right end or at the bottom of the list the interface will show some buttons which provide some edit options (Move up, Move down, Delete, Copy, New, Import, etc). These options are described on the following table.

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 a dynamic point can be copied from the list of points of a different machine into the current one. A pop-up window will appear in order to select the point to be 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.

CHAPTER

ELEVEN

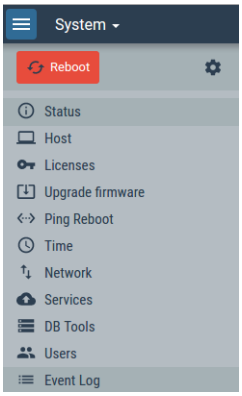
SYSTEM SETTINGS

Introduction

The System Settings interface provides information about the status of the *TWave T8*, and allows the user to configure some of its properties.

Toolbar

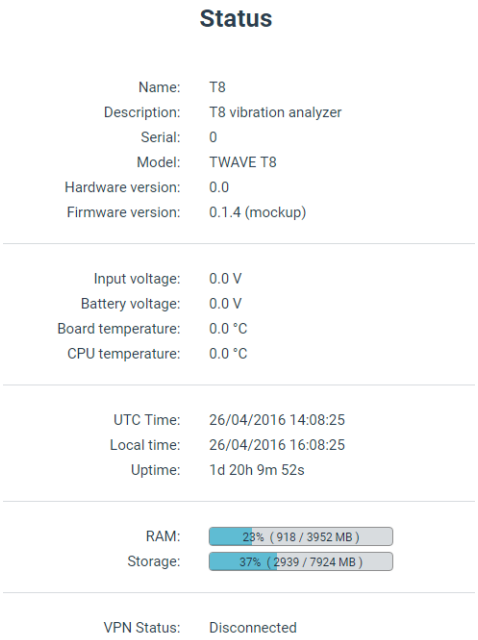
The interface shows a vertical toolbar on the left, which allows the user to access the different options.



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 *TWave T8* settings and import and export system and user configurations.
Status	Shows the status and general information of the units.
Host	Defines the name of the unit, description and its host name.
Licenses	Shows a list with all the different modules of the *TWave T8* and informs if they are enabled in the unit or not.
Upgrade firmware	Shows the firmware version and checks if a new firmware is available.
Ping reboot	Enables and configures the Ping_reboot service. This service makes the unit to check its connection with a server via Ethernet using the ping command. In case the communication fails after several retries the unit will be rebooted automatically.
Time	Sets the date and time of the unit and activates and configures its NTP client.
Network	Configures the network interface.
Services	Enables and configures these services: Rsync, FTP and VPN.
DB Tools	Provides information about the data blocks or records stored in the unit for each machine, and allows to remove them within a time range. It also allows to rebuild the database from the data blocks or records stored.
Users	Allows the administration of the users within the system.
Event Log	Shows the events occurring in the system.

Status

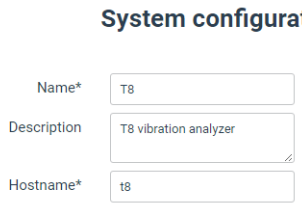
This option shows the status of the *TWave T8* unit and provides additional general information.



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 *TWave T8* 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.
Input Voltage	Shows the 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 mother board.
CPU Temperature	Shows the current temperature of the main processor (CPU).
UCT 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 *TWave T8* unit was turned on.
RAM	Shows the percentage of RAM memory the *TWave T8* unit is currently using.
Storage	Shows the percentage of storage capacity being used.
VPN status	Shows the VPN status.

Host

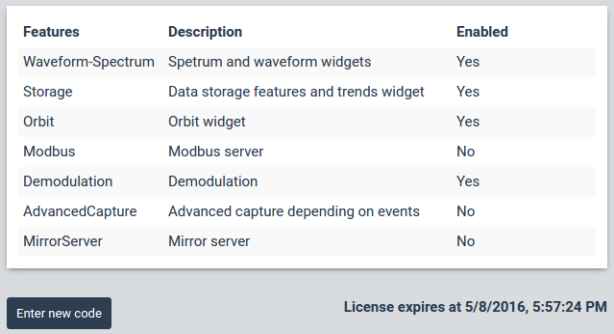
Defines the name and description and hostname of the *TWave T8* unit. The user can change them in order to correctly identify the unit.



Label	Configuration tool
Name	This field allows the user to define a name for the *TWave T8* unit. It is recommended to use a unique name when several units are used.
Description	Sets a user-defined description of the unit.
Hostname	Name that identifies the unit in the network. Use a unique name within your network.

Licenses

Shows a list with all the different modules or features of the *TWave T8* and informs if they are enabled in the unit or not. In case of a demo or a renting unit the form also shows the expiration date of the license.



Once the license has expired the system will stop displaying the Dashboard interface. The button Enter new code allows the user to extend the expiration date of the license, or to register it in case of purchasing, by introducing the code received from **TWave**.

Upgrade firmware

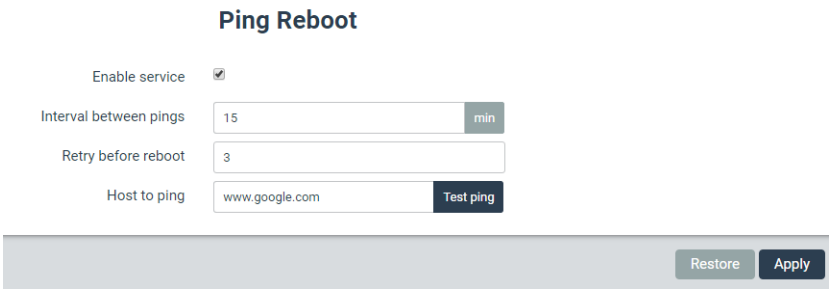
This form shows the current firmware version of the *TWave T8* unit. Its button Check for new updates verifies if there is a new version of the firmware available. It requires that the *TWave T8* unit has access to Internet.

In case the firmware is not up to date, an upgrade will be possible by clicking on the button Upgrade firmware. Clicking on this button will download and install all the files required for upgrading the firmware. Onces the process is finished the system will ask to reboot the unit.

Danger: The *TWave T8* system can only be upgraded using an Internet 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 Internet. It is also recommended when support by **TWave** is required.

Ping reboot

This service checks the connection of the *TWave T8* with a server via Ethernet using the ping command. In case the communication fails after several retries the unit will be rebooted automatically.



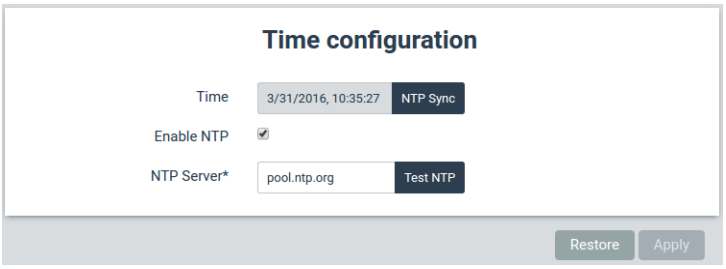
Label	Configuration tool
Enable service	Enables/disables the ping reboot service.
Interval between pings	Sets the time between the ping checks. It defines the number of minutes that will elapse between the different communication checkings with the server.
Retries before reboot	Sets how many times the unit will check for the communication.
Host to ping	Sets the server the *TWave T8* unit will try to connect to using the ping command.
Test ping	Makes a manual test. This option tries to ping the server defined on the *Host to ping* field.

As an example the settings shown in the picture above will try to ping the server www.google.com every 15 minutes. In case it cannot contact the server, it will try 3 times. If all of them fails, that means after 45 minutes, the *TWave T8* unit will be rebooted.

Time

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

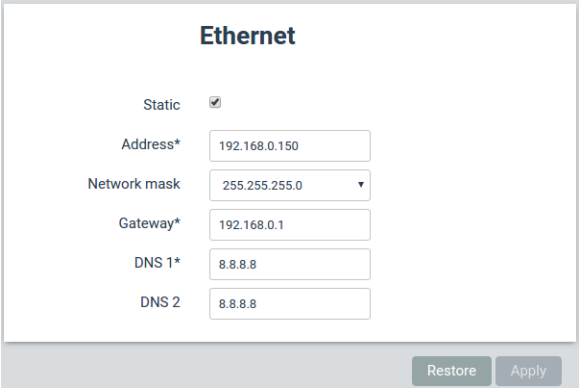
The system may be configured to keep in time by synchronizing with a NTP Server. Network Time Protocol (NTP) is a networking protocol for clock synchronization between computer systems over packet-switched, variable-latency data networks.



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. It is shown when the *Enable NTP* checkbox is unmarked.

Network

This section allows the user to configure the Ethernet interface of the *TWave T8* unit.



Field	Description
Static	Allows the user to configure the static IP address of the *TWave T8*. If not checked the *TWave T8* unit will try to get its IP through DHCP protocol.
Address	Configures the IP address of the unit.
Network Mask	Sets the network mask.
Gateway	Sets the network gateway.
DNS1	Defines the primary DNS address.
DNS2	Defines the secondary DNS address.

Services

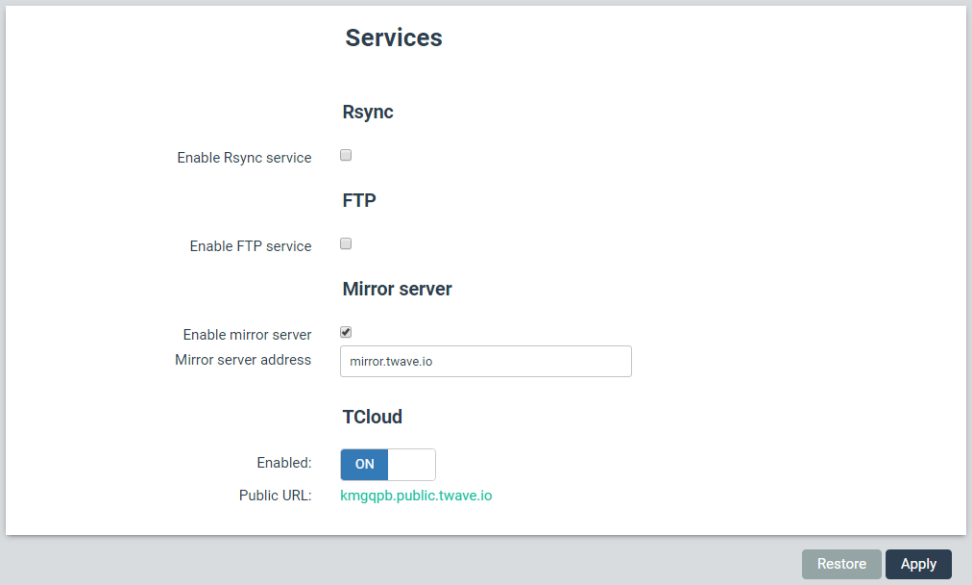
The *TWave T8* provides 4 types of services: *Rsync*, *FTP*, *TMirror* and *TCloud*. This section allows configuring them.

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 *TWave T8* unit works as an *Rsync* server, so it is required a *Rsync* client in your computer in order to use this service. See https://en.wikipedia.org/wiki/Rsync for more information. The *TWave T8* unit does provide this backup service for the folders where all the data and configuration files are stored.

The *FTP* service provides a way for both uploading and downloading files into or from the *TWave T8* unit. Like the *Rsync* service the *TWave T8* unit works as a *FTP* server, so it is required a *FTP* client in your computer in order to use this service. The *TWave T8* shares through *FTP* the folders where all the data and configuration files are stored.

Both the *TMirror* and the *TCloud* tools connect the *TWave T8* to the **TWave** cloud in order to use the different services this network can provide. The *TCloud* enables the possibility of accessing the device directly from an Internet address, which is indicated in this page.

The *TMirror* adds the feature that a remote server is continuously making backup copies continuously of the content of the device storage, so the monitoring data will keep always available as long as the service is enabled. This feature is very useful for equipments connected by 3G links or having bad Internet access.



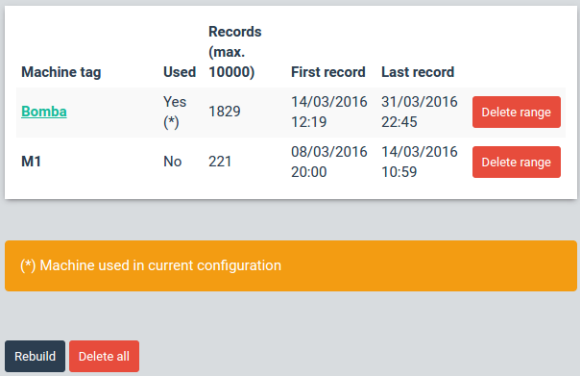
Field	Description
Enable Rsync service	Enables the Rsync service. When checked the form shows the fields *Rsync* user and *Rsync* password.
Rsync user	Sets the user name to be used by the Rsync client to use the service.
Rsync password	Sets the password to be introduced in the Rsync client to use the service.
Enable FTP service	Enables the FTP service. When checked the form shows the fields *FTP* user and *FTP* password.
FTP user	Sets the user name to be used by the FTP client to use the service.
FTP password	Sets the password to be introduced in the FTP client to use the service.
Mirror server	Select On or Off in order to enable or to disable the connection the **TWave** mirror server.
Mirror server address	Select manually the address of the mirror server assigned to store the backup data.
TCloud	Select On or Off in order to enable to disable the connection to the **TWave** cloud.

DB tools

The *TWave T8* stores the data in its internal flash memory using different files. Each of these files includes a set of machine measurements taken at a particular time, and are referred to as *Captures*.

The system also includes a *Redis* database located in RAM memory. This database contains the trends for each parameter and other information (timeline data, FIFOS, etc.) which is related to the files where all the data is stored for each *Capture*. The system updates this database when new measurements are stored. It also makes a periodic automatic backup into the flash memory, and just before shutting down or powering off the system. This enables to quickly restore the database into RAM memory when restarting the unit.

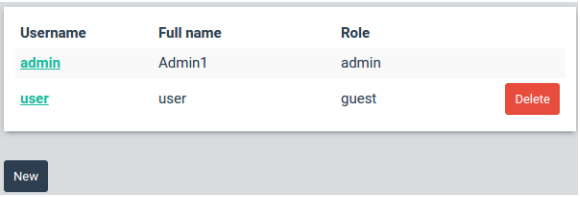
This section provides information about the records stored in the unit for each machine and allows to remove them within a time range. It also provides the option to rebuild the database from the *Captures* stored in the flash memory. This is required when the Redis database is suspected to be corrupted or when the user copies new *Capture* files from a machine backup using *Rsync* or *FTP* services.



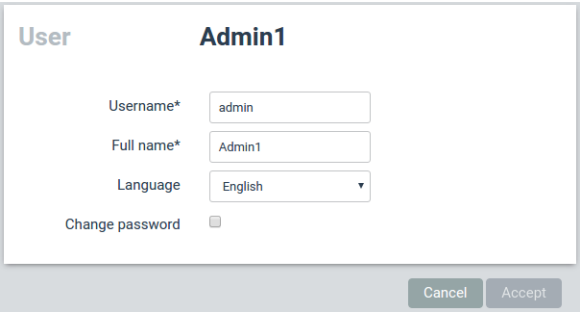
Field	Description
Machine tag	Shows the list of machines configured on the *TWave T8* unit.
Used	Informs if the machine is being monitored by the *TWave T8* unit.
Records	Shows the number of records or *Captures* stored on the internal memory for each machine.
First record	Date and time of the first *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 memory from the *Captures* stored in the flash memory.
Delete all	Deletes all the *Captures* stored on the internal flash memory for all the machines.

Users

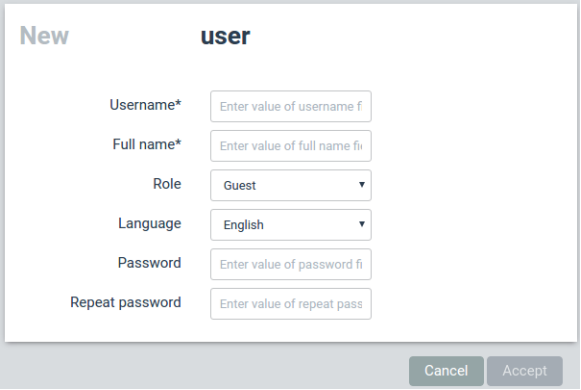
This form shows a list of the users currently defined on the *TWave T8* unit.



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 *TWave T8* 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 also 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 accessing 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.

Danger: Only users with Administrator role will be able to change the user options.

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

Simulation files

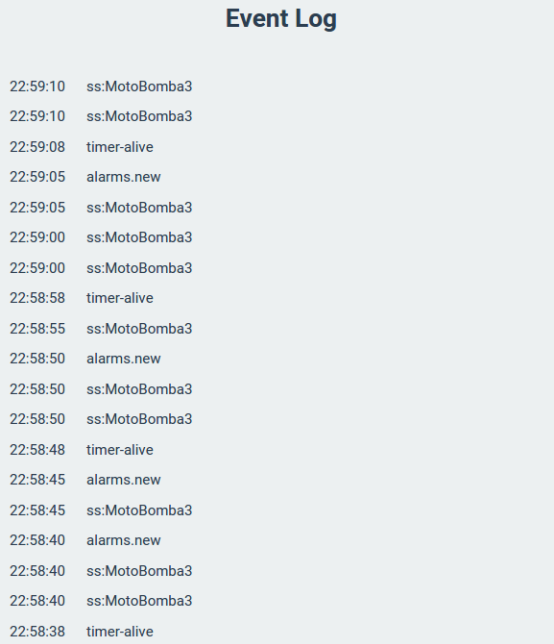
In this area you will be able to manage the simulation files loaded into the system.

Please refer to the *Appendix A* if you want to generate your own simulation files.

Event Log

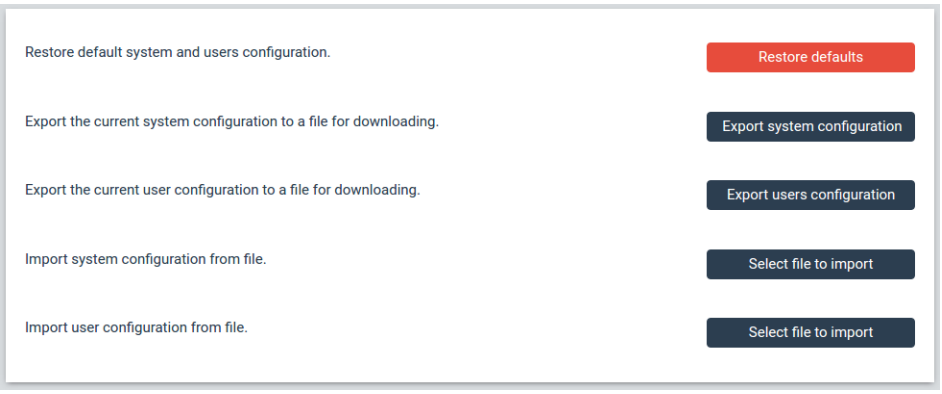
This menu shows the events occurring in the system. This option is useful to know the activity of the unit (captures, storage, event triggers, errors, alive heartbeat, alarms, etc.).

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.



System maintenance

This option allows the user to restore the default settings of the *TWave T8* units, and import and export user and system configuration files.



Field	Description
Restore defaults	Restores the *TWave T8* configuration defaults: • Network configuration • Deletes all users except **admin**, restoring its default password and preferences.
Export system configuration	Exports into a file called *system.db* all the configuration options contained in the *System* interface.
Export users configuration	Exports into a file called users.db the information related to each user: name, full name, role, language, passwords, preferences and desktop layouts.
Select file to import (system)	Imports into the *TWave T8* unit the *system.db* file containing all the configuration options of the *System* interface.
Select file to import (user)	Imports into the *TWave T8* unit the *user.db* file containing all the information related to each user.

CHAPTER

TWELVE

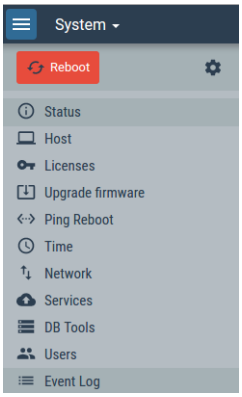
CONFIGURATION

Introduction

This section shows how to configure the monitoring options of the *TWave T8* units, 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 included in the system for a correct monitoring configuration.

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, and lists the *Machines* defined in the unit.



Option	Description
Apply	This button applies the changes made in the configuration database to the *TWave T8* 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 resources available in the device.
Inputs	Configures the dynamic inputs (channels) of the *TWave T8* 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 *TWave T8* as client in the network, asking other devices for the values of their registers (*Optional software features*).
Modbus slave	Sets properties to configure the *TWave T8* as server in the network, allowing other devices to read different parameter values.
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 *TWave T8*. The Toolbar shows the list of machines defined on the unit, which give access to their particular configuration components (see *Machines*).

Processing blocks

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

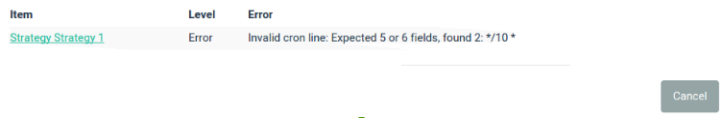
Each input of the *TWave T8* unit can be linked to a measurement *Point*. If the Point is *Dynamic* type, it can have different *Processing Modes*, so that the data coming from the sensor is analyzed simultaneously in different ways (e.g. high and low frequencies, different filter settings, applying demodulation, etc.).

> **Warning:** 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 32 processing blocks (*Optional software features*).

User can add more Points and more 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.

Apply button

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

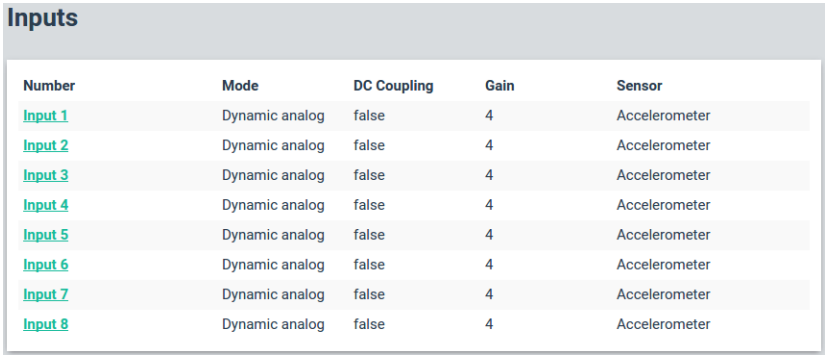


If no errors are found, the system will ask for confirmation to apply the configuration. Clicking on the *Apply configuration* button will apply the configuration into the *TWave T8*, which will start monitoring with the new configuration options, changing the label of the Apply button into “applied”.

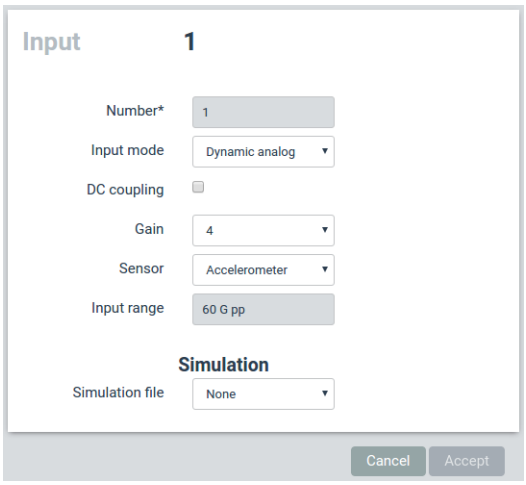
Danger: All changes made on the configuration interface will be stored on the configuration database. However they will not be applied into the *TWave T8* until the configuration errors are checked and the Apply configuration button is clicked.

Inputs

This section configures the input channels of the *TWave T8* device. By clicking on this menu option the interface shows the list of inputs.



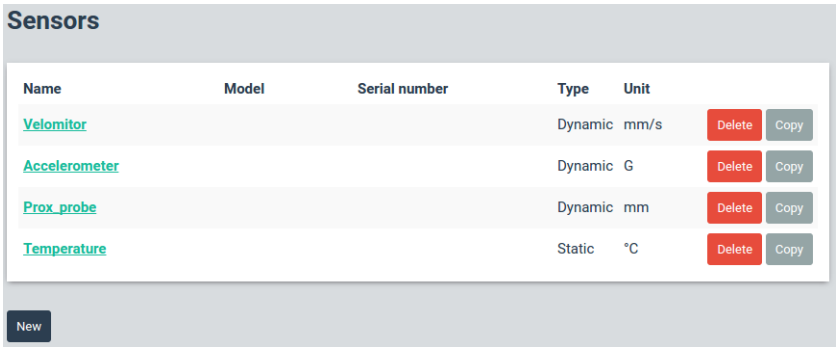
Click on one of the items in order to configure the corresponding input.



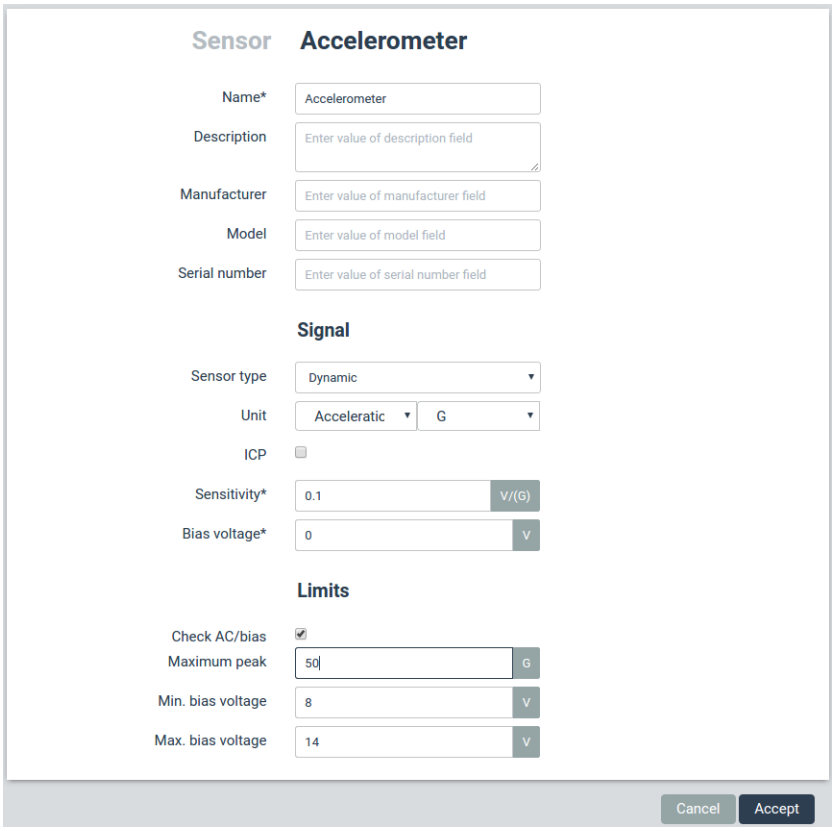
Option	Description
Number	Shows the input channel that will be configured.
Input Type	Defines the type of input that will be configured for this channel: • *Dynamic analog*. • *Static analog*. • *Pulse train*: this type is configured for pulse signals. Measures the frequency of the pulses in Hz. The trigger level and hysteresis can be set up by the user. See Dynamic channels • *Digital*: 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. Both values can be set by the user. See Digital inputs
DC Coupling	By marking this check-box 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 be applied to the signal of the input. This option modifies the range, or maximum amplitude the input will be able to measure, taking into account the maximum voltage for the channels is $\pm$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.
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 type.
Hysteresis	Sets a hysteresis around the threshold voltage that triggers the pulse detection. As an example an hysteresis of 0.1V and a threshold of 1V will make the system to 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.
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.

Sensors

This section configures the sensors that will be connected to the *TWave T8* 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 in order to configure the corresponding sensor.



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.

Signal

Field	Description
Sensor Type	Defines if the sensor provides a static or dynamic signal.
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 (see *Units*).
Sensitivity	Sets the sensitivity of the sensor in volts per engineering units, as defined in the previous field.
ICP	Defines if the sensor requires or not IEPE/ICP powering.
Bias voltage	Value in volts of the signal offset provided by the sensor.
AC detector	Defines the detector type (if any) associated to the value measured for the static signal (RMS, Peak, Peak-Peak or none). Applies only to *Static* sensors type.

Limits

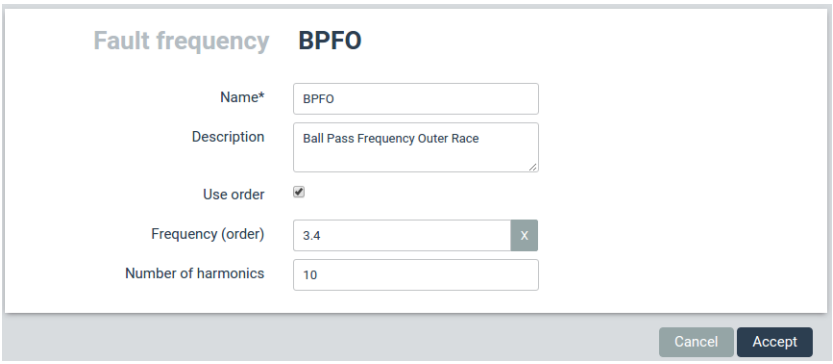
Field	Description
Check AC/bias	This checkbox defines if both the DC and AC components of the the signal must be validated by the system (applies only for dynamic sensors type).
Minimum	Defines the minimum value allowed for the signal provided by the sensors.
Maximum	Defines the maximum value allowed 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.

Fault Frequencies

Fault frequencies are objects that represent a frequency associated to a particular type of fault or condition of the machine. These objects can be assigned to dynamic points, so they can be shown 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.

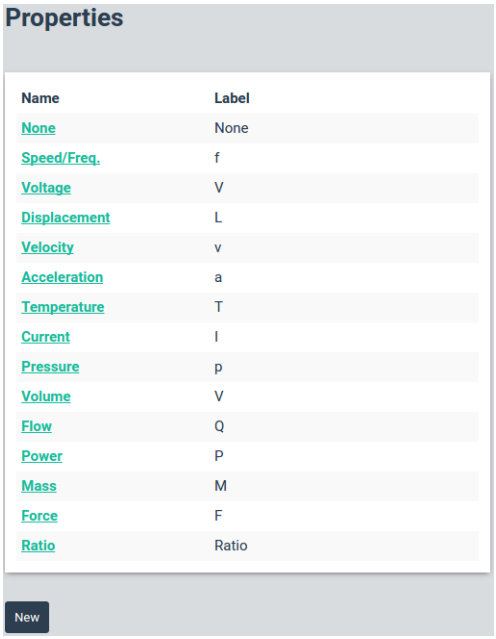
Click on one of the list items in order to configure the corresponding fault frequency or in the New button to add a new one.



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 if the *Use Order* checkbox is selected or not. Order units are based on the RPM of the point. On 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.
Nº of harmonics	Sets the number of harmonic lines to show on the spectrum.

Units

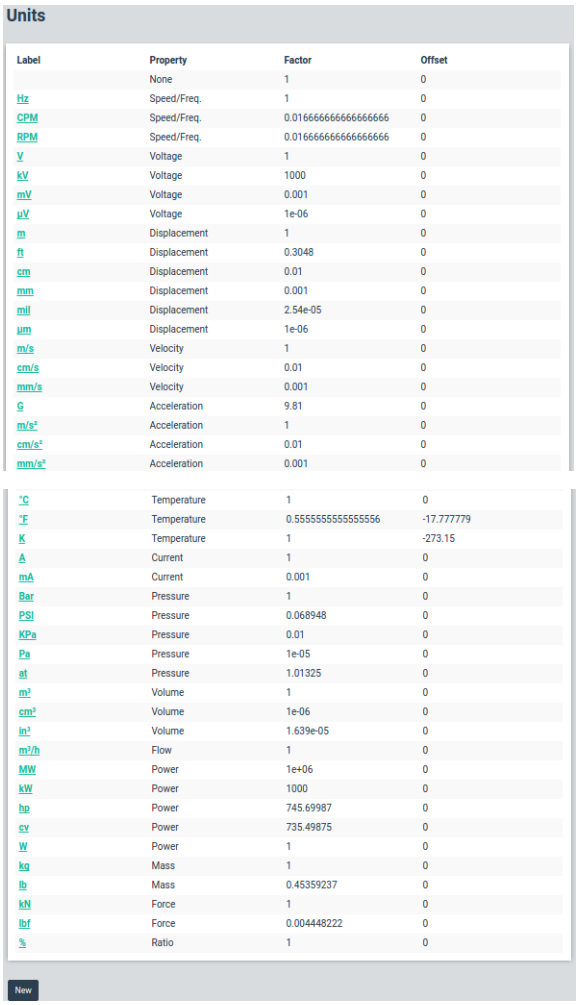
This option defines the *Properties* and *Units* that will be available on the system. By default the *TWave T8* comes with the following predefined magnitudes/properties and units.



Properties

Name	Label
None	None
Speed/Freq.	f
Voltage	V
Displacement	L
Velocity	v
Acceleration	a
Temperature	T
Current	I
Pressure	p
Volume	V
Flow	Q
Power	P
Mass	M
Force	F
Ratio	Ratio

New



Units

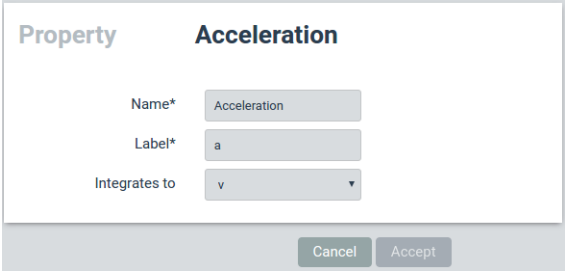
Label	Property	Factor	Offset
	None	1	0
Hz	Speed/Freq.	1	0
CPM	Speed/Freq.	0.016666666666666666	0
RPM	Speed/Freq.	0.016666666666666666	0
V	Voltage	1	0
kV	Voltage	1000	0
mV	Voltage	0.001	0
µV	Voltage	1e-06	0
m	Displacement	1	0
ft	Displacement	0.3048	0
cm	Displacement	0.01	0
mm	Displacement	0.001	0
mil	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	0.5555555555555556	-17.777779
K	Temperature	1	-273.15
A	Current	1	0
mA	Current	0.001	0
Bar	Pressure	1	0
PSI	Pressure	0.068948	0
KPa	Pressure	0.01	0
Pa	Pressure	1e-05	0
at	Pressure	1.01325	0
m³	Volume	1	0
cm³	Volume	1e-06	0
in³	Volume	1.639e-05	0
m³/h	Flow	1	0
MW	Power	1e+06	0
kW	Power	1000	0
hp	Power	745.69987	0
cv	Power	735.49875	0
W	Power	1	0
kg	Mass	1	0
lb	Mass	0.45359237	0
kN	Force	1	0
lbf	Force	0.004448222	0
%	Ratio	1	0

New

These predefined *Properties* and *Units* are read only, and cannot be deleted or edited (except *dB reference* field of the *Units*). However the user is able to add new units for any of the properties, by pressing on the *New* button. Those one

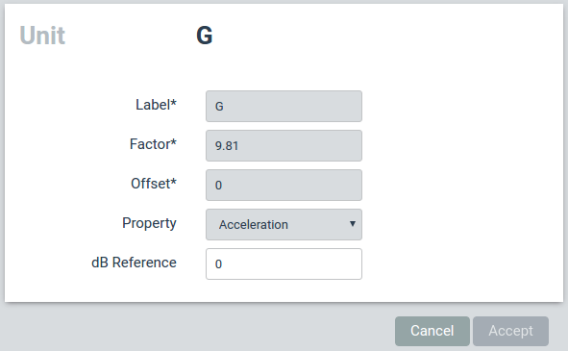
created by the user will be able to be deleted by pressing on the *Delete* button.

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



Option	Description
Name	Identifies unequivocally the *Technique*. It can contain numbers, upper and lower characters. Special characters or blank spaces are not allowed.
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*.

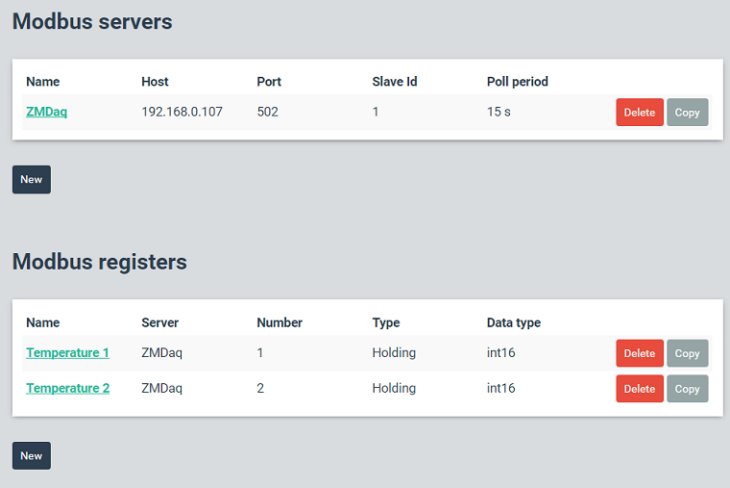


Option	Description
Label	Text that identifies unequivocally the *Unit* within the system It can contain numbers, upper and lower characters. Special characters or blank spaces are not allowed.
Factor	Sets the factor that will be applied to the measurement to convert its units into the Unit being configured.
Offset	Defines the offset that will be 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.
Property	Property associated to the *Unit*.
dB Reference	Sets the reference value for the dB calculation.

Modbus master

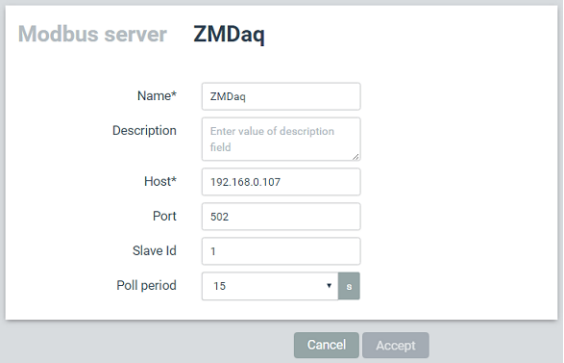
The Modbus Master module allows connecting to external instruments such as sensors or PLCs to read values and use them for the machine supervision (*Optional software features*).

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 *TWave T8*.



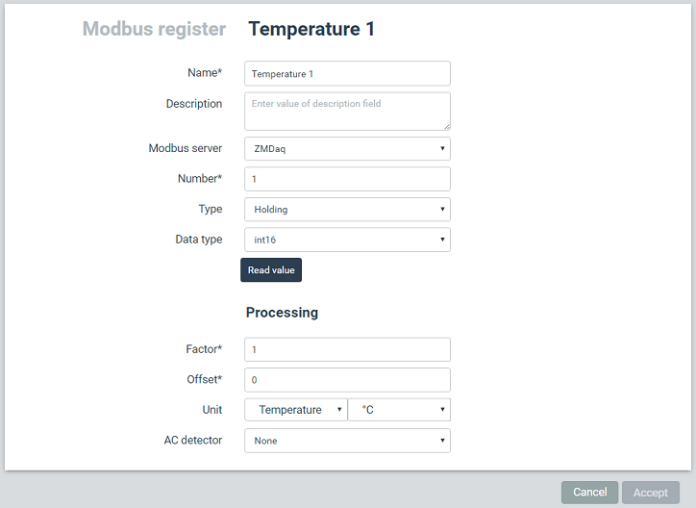
The menu includes two separate forms that allow the configuration of external data sources.

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



Option	Description
Name	Identifies unequivocally the *Server*. 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 is 502.
Slave Id	Number of slave 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.

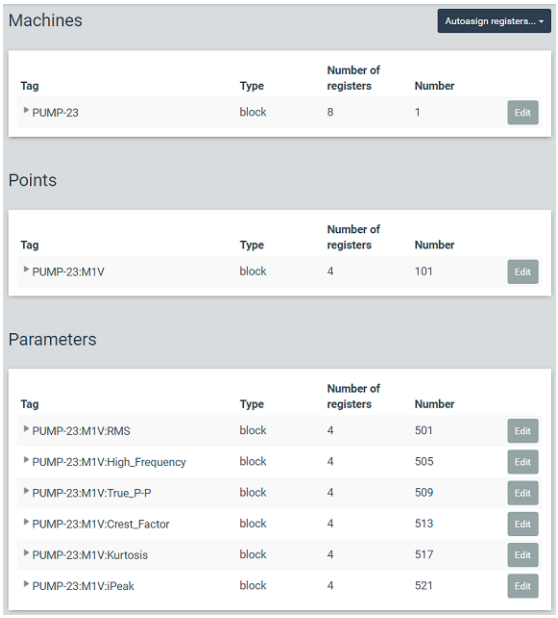
A second form shows fields to define the specific Modbus *registers* that are available to read in the previously defined servers:



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	Indicate which *Modbus server* this register is related to.
Number	Indicates the Modbus address or number of register
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
Read value	Execute 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	Select the magnitude and unit to be used with the data of the Modbus register.
AC detector	Select AC Detector (RMS, peak, p-p) for the previously defined unit, in case it was necessary.

Modbus slave

This option configures the *TWave T8* device as a Modbus servers, allowing external systems the access to any internal parameter value.



The menu includes three forms that allow setting up Modbus register numbers to any element of the interface:

- Machines
- Points
- Parameters

New elements may be automatically added to the list, using the *Autoasign 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 be accessed in the *Modbus register*. The tags corresponding with elements with subelements (blocks) can be expanded to see those blocks
Type	Indicates what kind of data it is: block (a group of different elements accesible in different registers), Int16, float, etc.
Number of registers	Amount of Modbus holding registers occupied by this element, including different sub-elements.
Number	Number of register

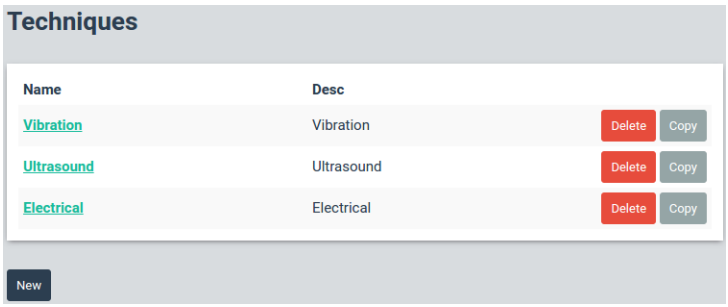
The different elements in the forms have different subelements. The register number indicates the initial address where this element can be read, but each of them have different subelements that are found at different Modbus registers. Moreover, some values include long data format types, that do not match with standard Modbus Int16 holding registers, so they are stored using more than one register. The addresses and format type for all the Modbus field are well indicated in the forms.

Machines	Points	Parameters
speed	vbias	value
load	alarm	alarm
state	error	error
alarm		
error		

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 particular 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.

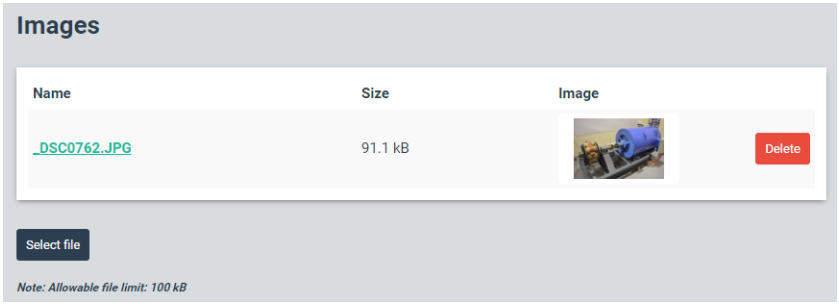


Option	Description
Name	Text that identifies unequivocally the *Property* within the system. It can contain numbers, upper and lower characters. Special characters or blank spaces are not allowed.
Description	This field allows the user to include a description of the *Technique*.

Images

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

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



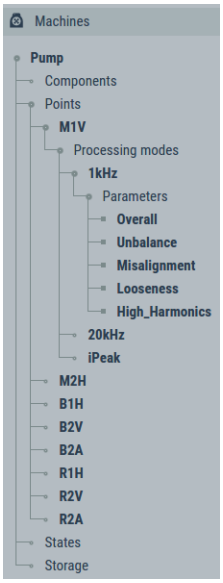
The button *Select File* will ask the user to select an image file to add to the list. Clicking on the Delete button will remove the image from list. Press on the name in order to view the image in large format.

Machines

Machines are the main objects for setting the monitoring configuration in the *TWave T8* unit. They are composed of different basic objects: *Components, Points, States and Storage strategies*. The configuration of all these basic objects within the machine defines the monitoring behavior of the unit.

Points, in turn, contain the objects *Processing Modes*. These objects define the different type 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 type of components and its hierarchy for a machine called Pump.



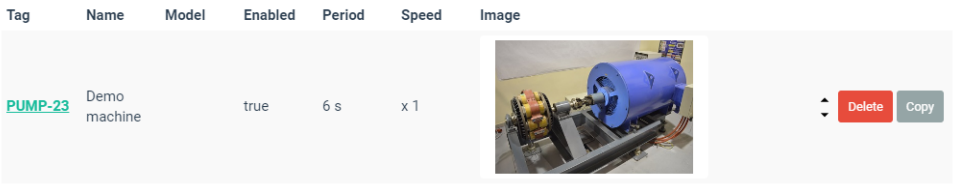
Those items of the tree in bold represent the objects the machine is composed of, while those not in bold represent the type of components.

By clicking on the items related to the type of components of the machine the interface will show on the right the list of objects defined of that particular type. By clicking on the components itself the interface will show its configuration form.

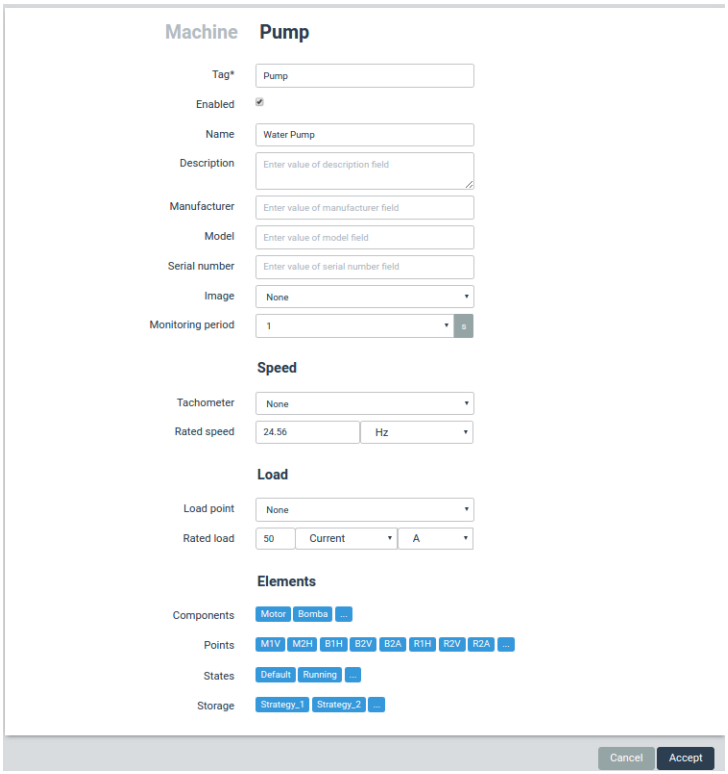
The following table describes the different objects that define the configuration of the machines.

Objects	Description
Components	Define the parts of the machine (ex. motor and pump). Points can be assigned to a particular machine component. This is only informative, and do not affect to the machine monitoring.
Points	Measuring locations on the machine. Points are associated to a particular sensor and input channel on the *TWave T8* unit. There are 3 types of points: • *Dynamic*: Those associated to a dynamic input. • *Static*: Those associated to a static o digital input. • *Tachometer*: Those associated to a Pulse train input. The data source of static and tachometer points can be a physical input of the *TWave T8* unit or a digital Modbus address.
States	Define the different machine conditions or states that the *TWave T8* unit will take into account. They allow the user to define different *Storage strategies* and apply different alarm limits for the measurements depending on these machine states.
Strategies	These objects define when and what measurements the *TWave T8* will store on 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 *TWave T8* (filtering, enveloping, rectification, etc.), and defines the properties of the spectrum and waveform that will be measured (sampling frequency, window type, resolution, averages, nº 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 "new" button in order to create a new machine from scratch.



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. First character must be alphanumeric. Maximum length is 25 characters.
Enable	Activates the monitoring of the machine. Disabling this option will cause the *TWave T8* unit to ignore the machine on its monitoring activity.
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*.
Monitoring 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 pre-buffering capabilities of the *TWave T8* units.

Speed

Field	Description
Tachometer	Sets the tachometer point that will be used to measure the speed of the machine.
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 a the speed of the machine is defined from a tacho measurement.

Load

Field	Description
Load point	Sets the static point that will be 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.

Elements

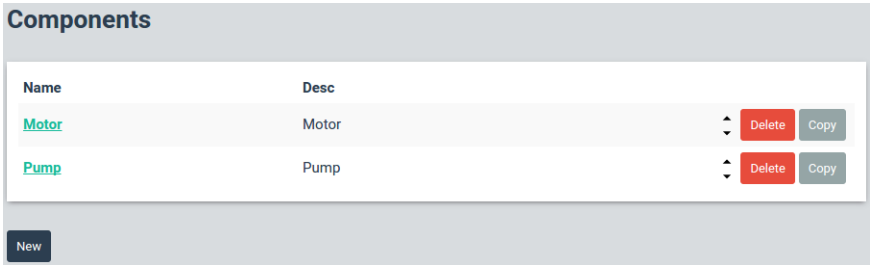
Field	Description
Components	Shows all the *Components* objects type the machine is composed of. Clicking on one of them will access to its configuration form.
Points	Shows all the *Points* defined on the machine. Clicking on one of them will access to its configuration form.
States	Shows all the *States* defined on the machine. Clicking on one of them will access to its configuration form.
Storage	Shows all the *Storage Strategies* defined on the machine. Clicking on one of them will access to 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.

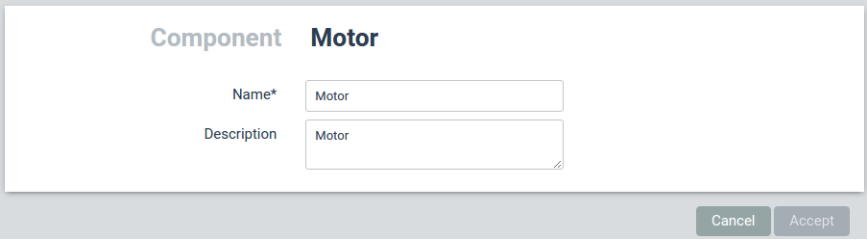
Components

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*.

Points

Points are the objects where all the measurements the *TWave T8* unit will perform for the machine will be associated to. They are linked to a particular 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 *TWave T8* 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 *TWave T8* allows defining formulas operating with different parameters and data sources, to build complex data correlations.

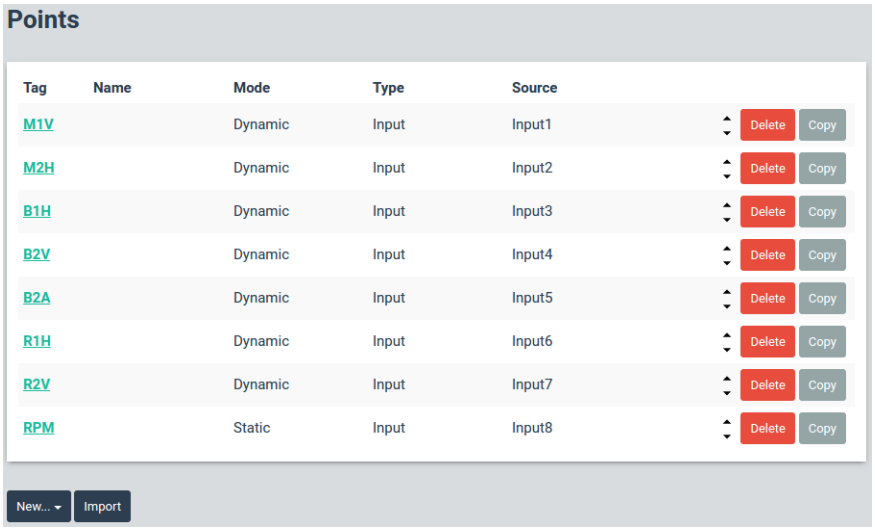
The points may also be classified in three different modes, in function of the nature of their data and how it will be shown in the Dashboard:

- *Dynamic points*: Those associated to a dynamic input, so that spectral analysis could be applied to them.
- *Static points*: Static points are associated to 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.
- *Tachometer points*: Tachometer are special points because their value can be used to define the speed of the machine, which is a relevant parameter of the system. Tachometer points may be linked to any input (static analog or pulse train types), to a Modbus point, and also calculated from a formula.

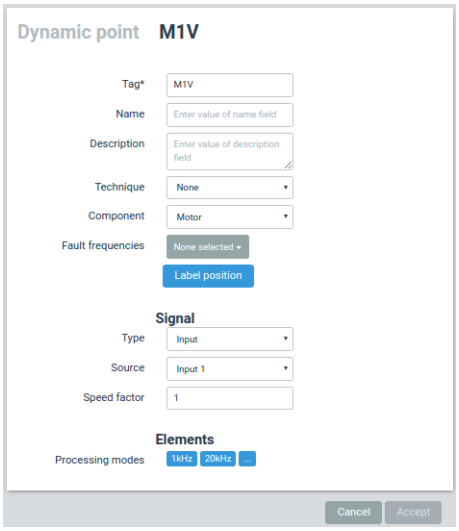
Danger: To define a *tachometer* to be used as the speed reference for the machine, you must first create and configure a point of type tachometer and then, in the Machine menu, set it up as the speed source for the machine.

Danger: Only in the case that the tachometer is defined with a pulse train input, will phase calculations and diagrams be available for the machine (tachometer edge detections).

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.



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.
Label position	Defines the location the point will take on the picture associated to the machine. It will be shown in the *Mimic Widget*. Clicking on the button the picture will appear on a pop-up window. Select with the mouse the point location and click on the accept button to save it.
Angle position	For a dynamic point, this sets the angle at what the sensor is connected. Note that 0º 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.

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

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 *TWave T8* 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 to 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 to the measurement read from a static or tachometer input.

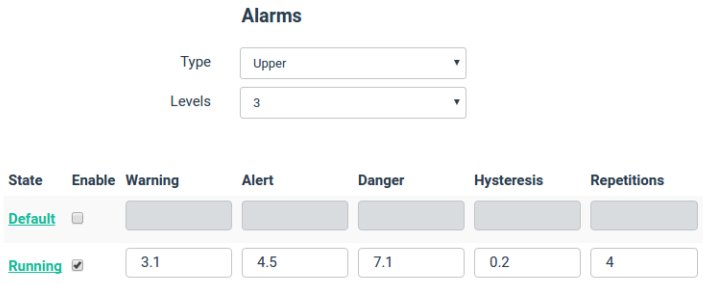
Elements

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

Alarms

Field	Description
Type	Defines the type of alarms that will be associated to 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 particular state.
Warning	Sets the *Warning* alarm level for the particular state. It only shows up when the number of levels are set to
Alert	Sets the *Alert* alarm level for the particular state.
Danger	Sets the *Danger* alarm level for the particular state.
Hysteresis	Sets the amount of hysteresis around the alarm limit. The value entered is an absolute value. This value us 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 reaches the alarm level. A repetition value of 1 means that the the alarm level.

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 in order 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.



Processing modes

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

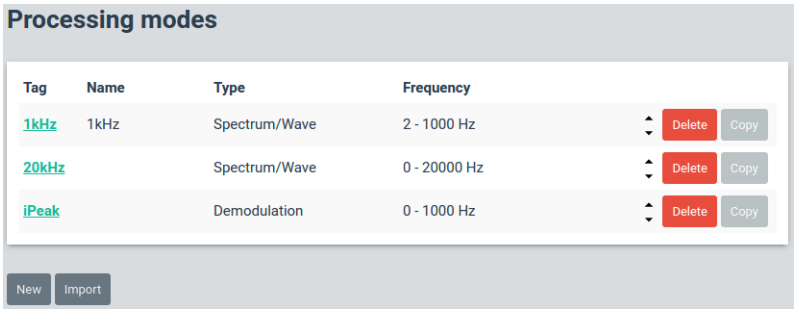
The *Processing Modes* define the properties of the spectra or waveforms that will be extracted from that point, and which parameters will be calculated from them. One single Dynamic Point can have multiple *Processing Modes*, e.g. with different sample frequency and other different parameters.

> **Warning:** All the signals in the *TWave T8* are always sampled at the same time, despite coming from different points or Processing Modes with different sampling frequency.

The Processing Modes perform all the processing of the information coming from the inputs in real-time. This activity needs a lot of CPU resources. To measure this, 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 leas one *Processing block*.

> **Danger:** *Processing Blocks* are a limited resource. Different versions of the *TWave T8* may have a different number of them available (e.g. 16 or 32 total blocks).

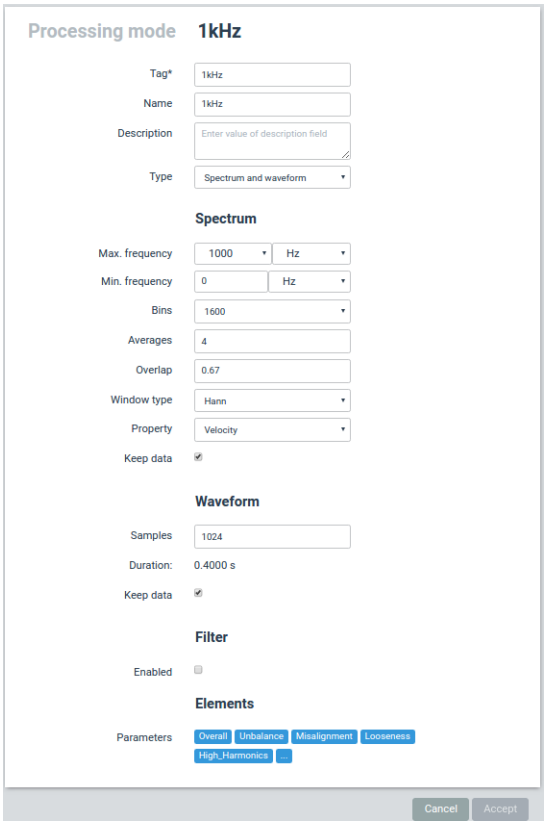
Clicking on the menu option will show the list of Processing Modes.



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 a spectrum.
- *Spectrum and waveform*: measures both a waveform and a spectrum.
- *Demodulation*: measures both a waveform and a spectrum using the **demodulation** technique, which is useful e.g. to detect ball-bearing failures at high frequencies (*Optional software features*).
- *Long Waveform*: captures and stores a long duration waveform. This is not done on every monitoring period, only when there is any storage strategy configured to save it on disk (*Optional software features*).

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 most forms:



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.

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*.
Keep Data	Keeps or discards the waveform measure after calculating all the parameters associated to the *Processing mode*.

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 %.
Window Type	Selects the type of window for the signal processing. The options are *Rectangular, Hanning, Hamming* and *Blackman*. By default this window is set to *Hanning*.
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*.

Filter

Field	Description
Enable	Sets if the filter is activated.
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.

Elements

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

Long-Waveform

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

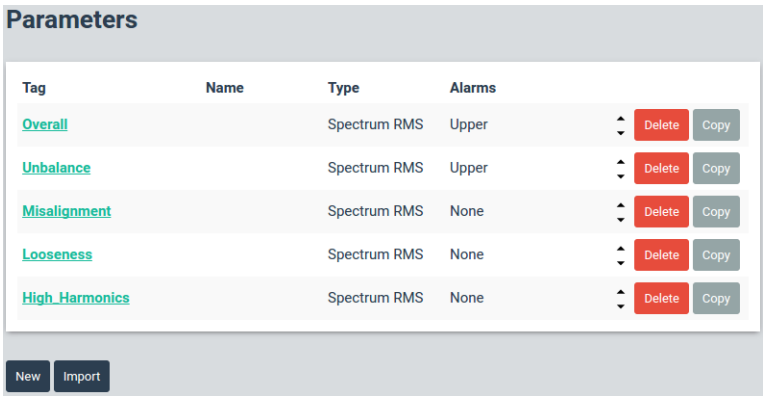
Field	Description
Sample rate	Defines frequency of the sampling rate that the system will use.
Maximum duration	Defines the maximum time duration of the waveform, in seconds. Note that this duration may not be achieved if a stop condition is detected before. See storage strategies for more info. *Maximum 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 *TWave T8*. *Maximum prebuffering duration is 30 seconds.*

Parameters

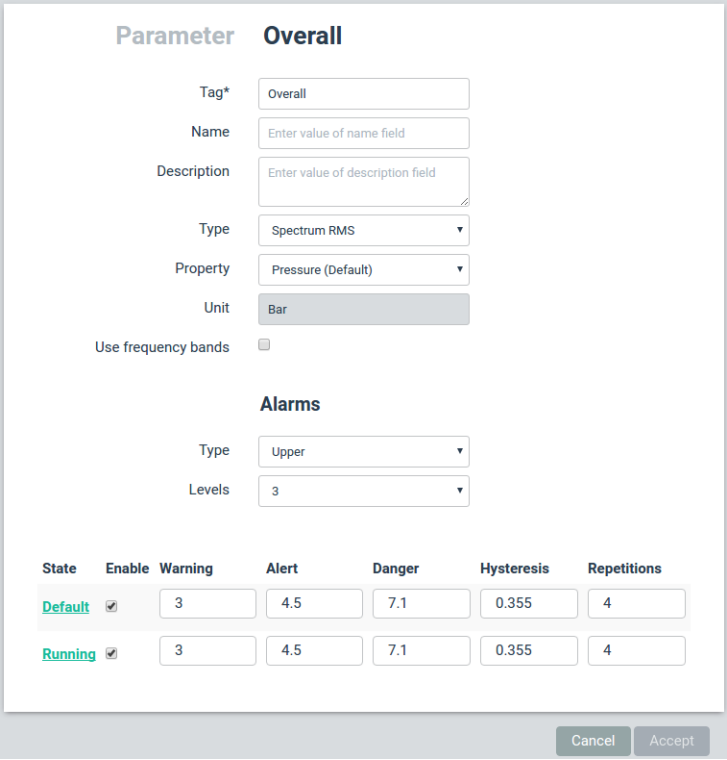
The *Parameters* define the scalar values that will be measured in each *Processing Mode*. These parameters are calculated from the spectrum or from the waveform taken in the corresponding *Processing Mode* using different algorithm types or data processing.

Warning: 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.



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*. • *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*.

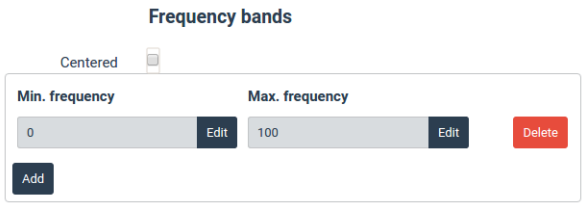
Parameter types

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

Parameter	Description
Mean	Calculates the DC component of the signal. It is the average value of the samples.
Wave RMS	Measures the RMS value from the waveform. The RMS is also known as the quadratic mean, and it is a magnitude of the power or strength of the signal.
True Peak	In AC mode, it is the maximum absolute value of the waveform; if the signal has a DC component, the peak amplitude is the maximum absolute value of the difference from the mean.
True Peak-Peak	It is the change between peak (highest amplitude value) and trough (lowest amplitude value, which can be negative) waveform.
Spectrum RMS	Measures a RMS value from the spectrum. It could either be calculated from the whole frequency content of the spectrum or just from a band. See parameter field *Use frequency bands*.
Calculated Peak	Calculates the theoretical peak value from the spectrum RMS value.
Calculated Peak-Peak	**Calculates the theoretical peak-to-peak value of the signal from** the spectrum RMS value.
Crest factor	Calculates ratio between peak value to the RMS value of a waveform (e.g. 1.4142 for a sine wave). It is a measure of how extreme the peaks are (the more peaks the higher crest factor).
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 that has a real part or module module (the Peak) and an argument (the phase). Indicates the deviation in time between two signals (a point and the tacho). In order to be able to do the calculations, the parameter needs a *minimum tachometer frequency* to be met, proportional to the sampling frequency of the *Processing Mode*. Also, the parameter can be calculated for the main tachometer frequency, but also for any higher order (up to the 4th order moment).loptl
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).

Frequency Bands

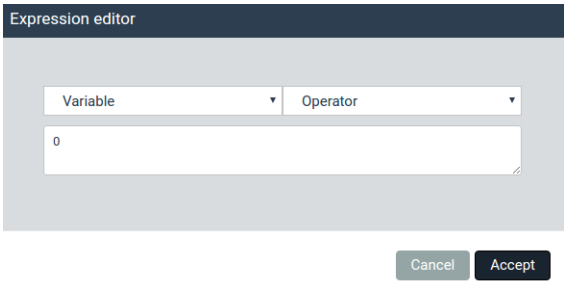
Certain parameters calculated from the spectrum graph allow defining *frequency bands* for their calculation. This option means that the value will not be computed from all the frequencies in the spectrum, but just from someones in particular.



Field	Description
Use frequency bands	Enables the definition of a frequency band when *Spectrum RMS* is selected as the parameter type. It will make the interface to how up the fields to define the band of the spectrum from which the RMS will be calculated.
Centered	This check box defines whether or not the frequency band will be defined using a centered frequency plus a band width.
Min. Frequency	Sets the minimum frequency of the spectrum. 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 spectrum. 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.
Center Frequency	Sets the center frequency of the band to be defined. This field appears only if *Centered* check box is marked.
Width	Sets the width of the band to be defined. This field appears only if *Centered* check box is marked.

Minimum and maximum frequency range for the calculations can be defined as a fixed value or by using an expression. Both fields can be changed by clicking on the Edit button. The *Expression editor* will appear, allowing the user to introduce any value o expression.

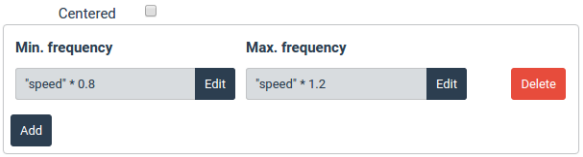
> **Danger:** The units of the value introduced or the output of the expression are Hz.



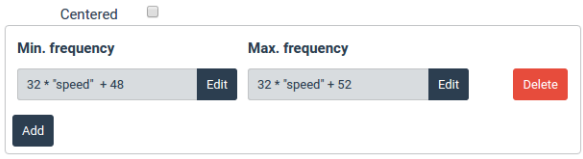
This formula editor helps the user by providing the list of variables and operators available on the system. Selecting one of them from the corresponding pull-down list the editor will automatically insert the variable or operator into the expression. The system checks automatically if the syntaxes of the expression is correct. If not it shows an *Invalid Expression* message.

> **Danger:** These expressions make possible defining the frequency band as a function of the speed of the machine, for example.

The image below shows such a case, where the minimum and maximum frequencies are defined as 0.8 and 1.2 times the machine speed, so that this band always includes the 1xRPM peak, even if the machine speed changes.

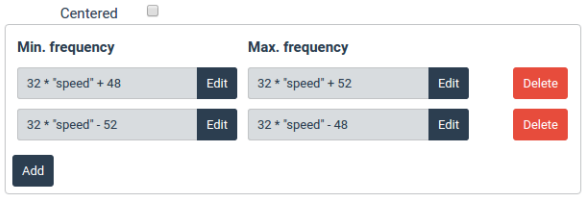


On the other hand it is also possible to follow an energy band around a sideband peak of the RPM or harmonic, as shown below.



This band will follow a narrow energy band around the 32th harmonic of the machine speed plus 50 Hz.

On the other hand the system allows to add several of these bands by clicking on the *Add* button. In the example below the left band around 50 Hz is added to the resulted RMS value.



By clicking on the *Delete* button the corresponding band will be removed.

The system also allows to define the band using a center frequency and a band width around as shown below. The center frequency can be defined using the *Expression editor*.

Alarms

The parameters allow defining different alarm values that will be associated to 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 particular state.
Warning	Sets the *Warning* alarm level for the particular state. It only shows up when the number of levels are set to 4.
Alert	Sets the *Alert* alarm level for the particular state.
Danger	Sets the *Danger* alarm level for the particular state.
Hysteresis	Sets the amount of hysteresis around the alarm limit. The value entered is an absolute value. This value us 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 reaches the alarm level. A repetition value of 1 means that the the alarm level.

Alarm IDs

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 expression, you will need to use the following constants:

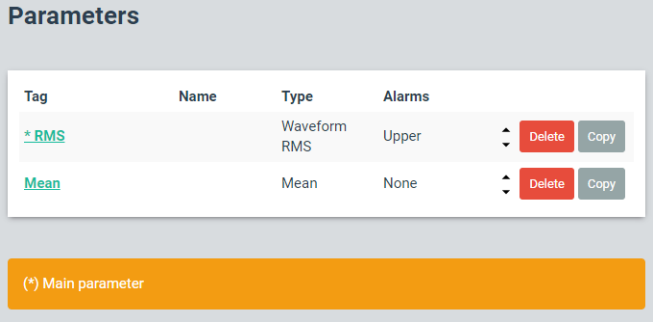
ID	Alarm level
0	No alarm
1	Warning
2	Alert
3	Danger

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.

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

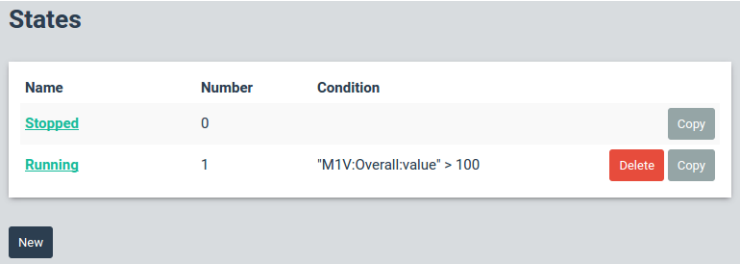
This means that this parameter is the one going to be displayed by default in many *Dashboard* widgets. Users can configure which parameter is going to be by modifying the list orders in the *Parameters* and *Processing Modes* menus.



States

The *States* are objects included in the machine configuration that define the different machine conditions the *TWave T8* will take into account. 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.

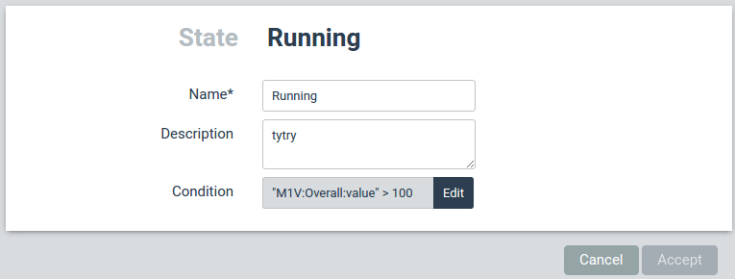


Danger: The first State of the list is the default one and it is created automatically for each machine. Its name can be changed but it cannot be removed, and does not have any expression associated with it. The machine will be set into this State if the expressions of all the other States are not true.

Danger: The expressions are evaluated following the order of the machine State list. If one of the expressions is true the rest of the State expressions will not be evaluated. So that the machine will take the State whose expression comes true first.

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.

The following picture shows the configuration form.

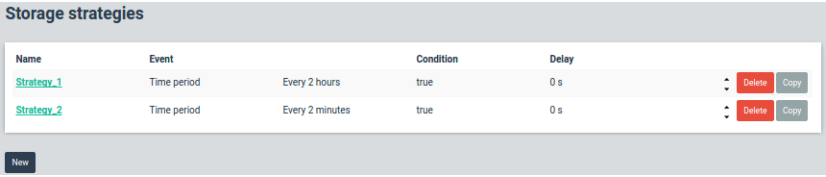


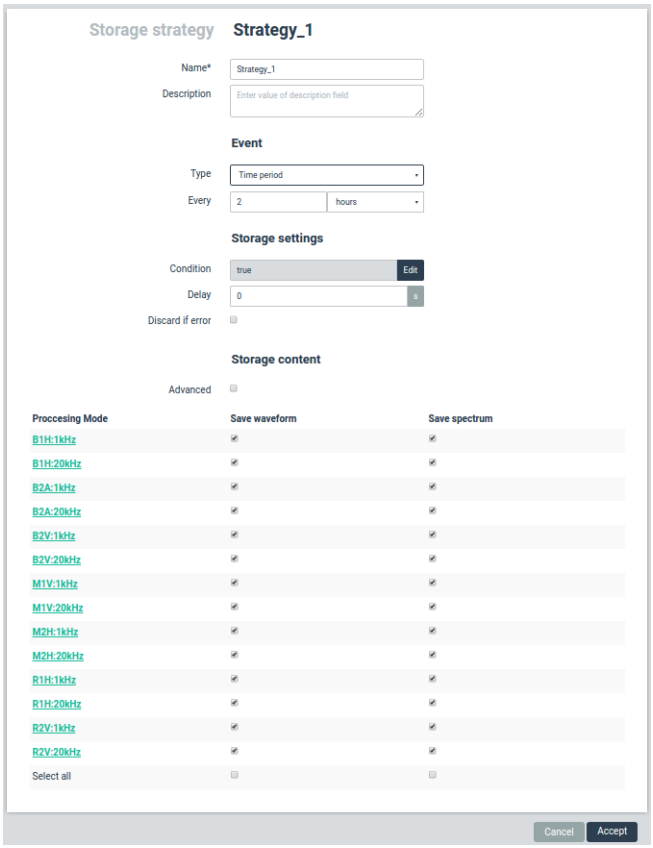
Field	Description
Tag	Text that identifies unequivocally the *State*. Only ASCII alphanumeric characters are allowed, including ".", "-", and "_". Any other special characters or blank spaces are not allowed. First character must be alphanumeric. Maximum length is 25 characters.
Description	Allows the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

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.





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*

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 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 the 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)

Storage settings

Field	Description
Condition	Defines an expression that must be true in order to store the data when the storage event is triggered. Click on the *Edit* button in order to introduce the expression using the following 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.
Delay	Sets the amount of time to be wait between the event and when the data is actually written.
Discard if	Specifies, using a logic expression, which conditions should be met to discard the capture data, avoiding its storage.

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 an expression introduced by the user.
Save Waveform	Sets whether or not 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 or not 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.

Danger: 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 required a new measurement to be performed).

CHAPTER

THIRTEEN

DASHBOARD

Introduction

The *Dashboard* allows the user to display the data measured and/or stored on the *TWave T8* unit. It also shows the historical or currently active alarms present on the system.

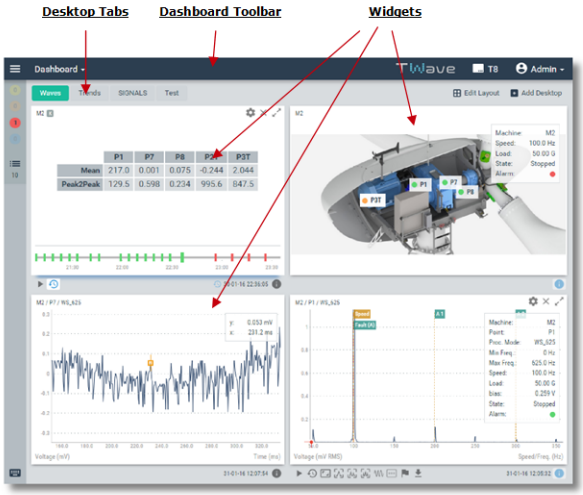
The *Dashboard* displays the data on windows called *Widgets*. The area where these *Widgets* are located is called Desktop. Each *Dashboard* can contain up to 20 different *Desktops*. The layout of each *Desktop* defines the number of *Widgets*, their size and location.

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

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

Dashboard Layout

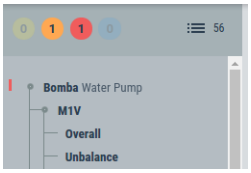
The following picture shows an example of *Dashboard* and its different components.



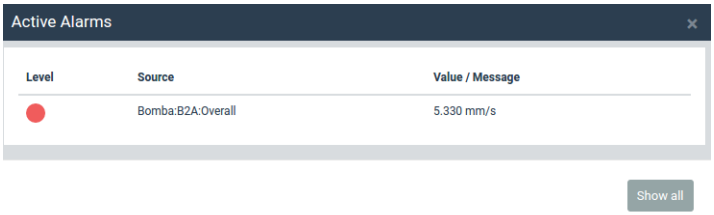
Alarm Toolbar

The *Alarm Toolbar* shows the number of alarms currently active on 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, and above the database tree.

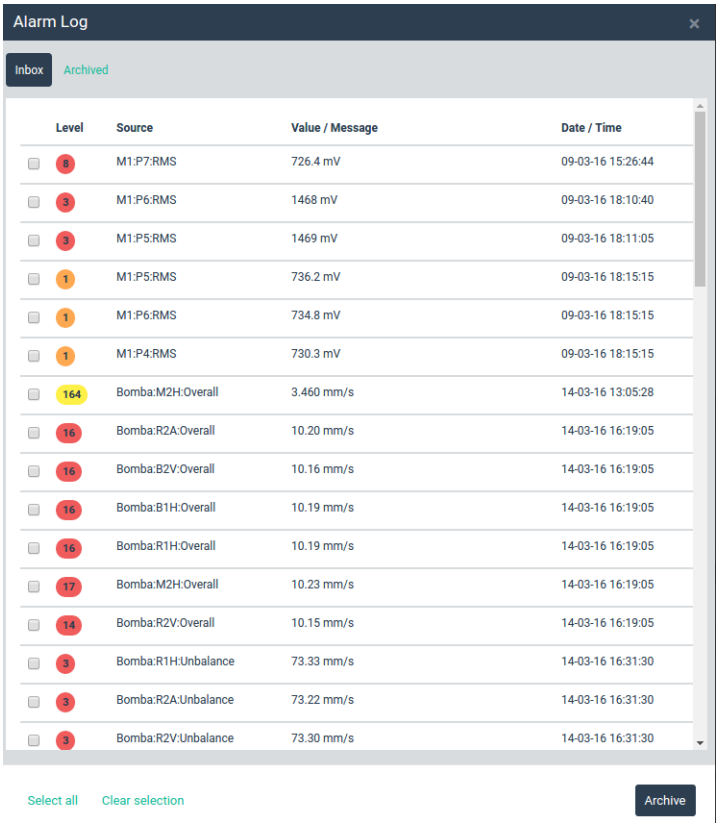


The active alarms are represented with a colored circle for each type (Warning, Alert and Danger). The number inside the circle represents the amount of alarms currently active for each type in the system. Clicking on the corresponding button a pop-up window will show the list of alarms of that type currently active.



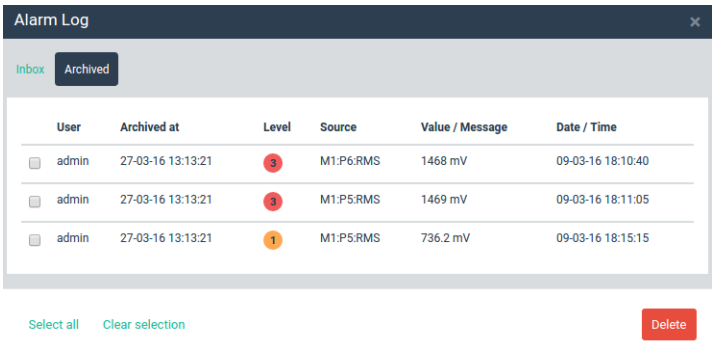
Clicking on the *Show all* button the list will present all the alarms, of any type, currently active on the system. Below the active alarm circles the Toolbar shows a button with the number of historical alarms not acknowledged (79 in the example below).

Clicking on this button will show the list of non-acknowledged alarms.



The number of the field “Level” represents how many times the measurement changed into the corresponding alarm condition. As an example the number 164 for the parameter “Bomba:M2H:Overall” of the picture above means that this parameter changed from normal into warning alarm condition 164 times. The Date/Time field informs about the first time the parameter went into warning alarm.

By selecting the items of the list and clicking on “Archive” the corresponding alarms will be acknowledged, removing them from the list. The “Archived” tab will show those historical alarms already acknowledged, as shown below.

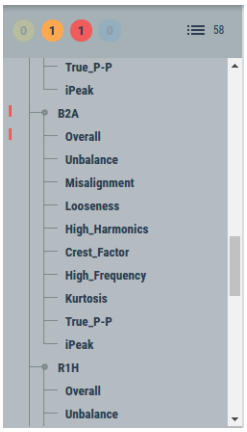


The historical alarm log will show the date the alarm was acknowledged and the user who did it, along with the other information about the alarm. By selecting these list items and clicking on “Delete” the corresponding alarms will be removed from the system.

Database tree

The database tree is shown or hidden by clicking on the following button of the Dashboard Toolbar.

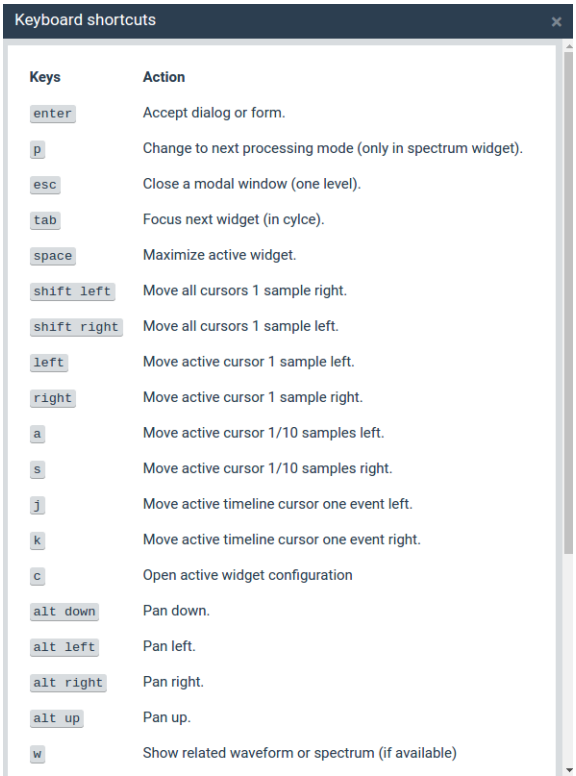
The database tree presents the structure of the database, as defined in the configuration, showing the machines, measuring points and parameters. If any of the *Parameters* are in alarm a vertical mark on the left of the tree will identify it with the corresponding color, as shown in the example below:



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 graphs will have the normal functionality of the *Trend or Spectrum widgets*. Pressing ESC will close these windows.

At the bottom of the Configuration Tree the interface will show the following button.

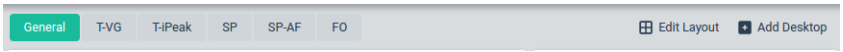
Clicking on it will show a pop-up window with all the key shortcuts available for the different *Widgets*.



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*.



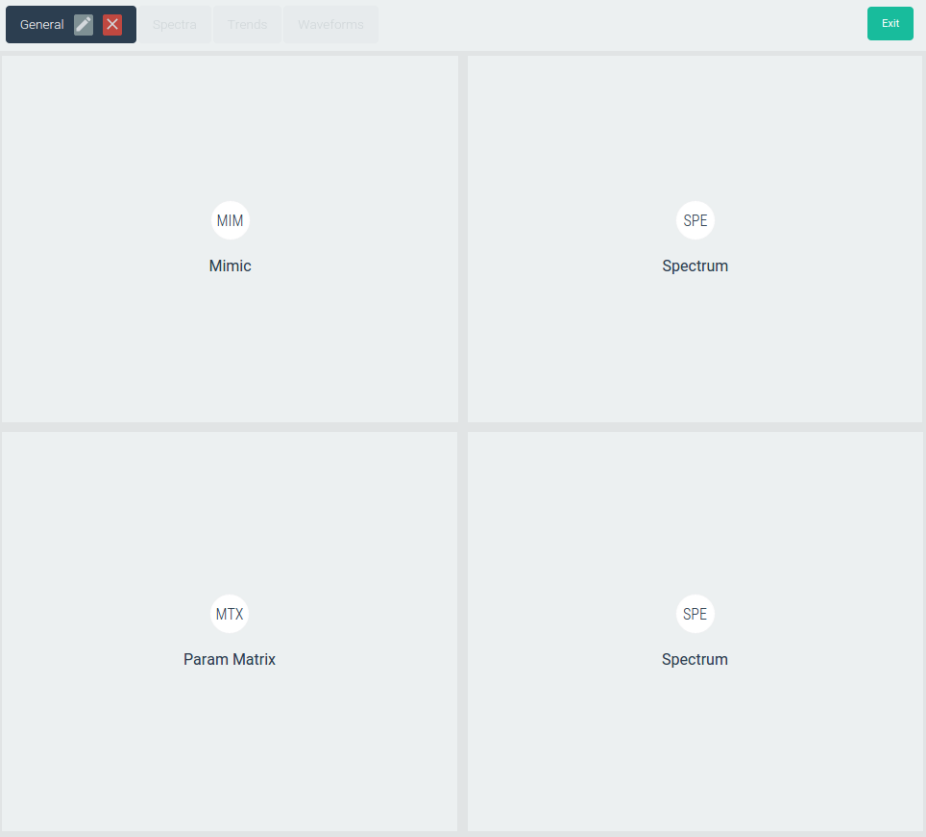
On the example below the *Dashboard* is composed of 4 *Desktops* called General, Spectra, Trend and Waveform, and shows the layout and *Widgets* of the one called Spectra.

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*.

Edit Desktop Layout

The layout of the *Desktop* can be changed by the user. The changes made will only affect to 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 to change the name, or click on *Cancel* button otherwise.
Delete Desktop	Deletes the Desktop. A pop/up window will appear in order to confirm the actions. Click the *Accept* button to delete the *Desktop*, or cancel otherwise.
Vertical Split	Splits the *Widget* vertically in 2 equal parts.
Horizontal Split	Splits the *Widget* horizontally in 2 equal parts.
←	Merges 2 *Widgets* horizontally into a single one.
→	Merges 2 *Widgets* horizontally into a single one.
↑	Merges 2 *Widgets* vertically into a single one.
↓	Merges 2 *Widgets* vertically into a single one.
Exit	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 in order to be split into 2 parts.

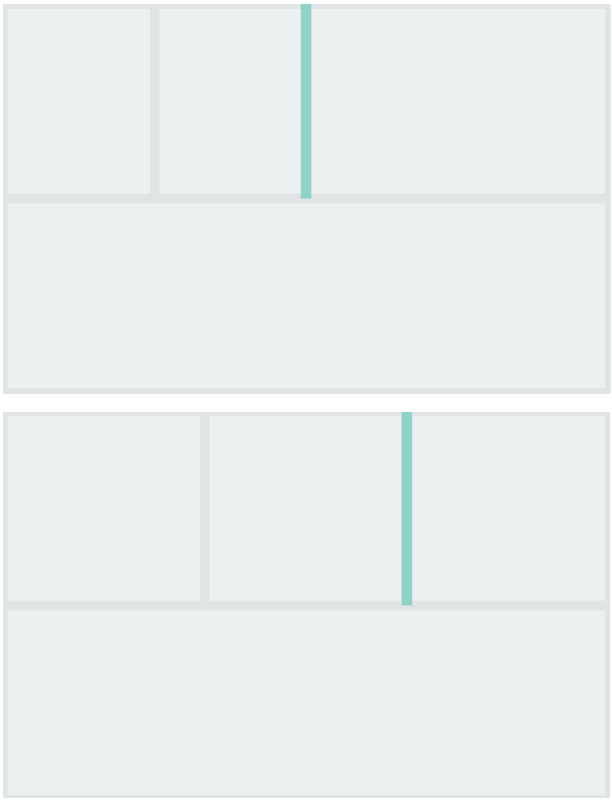
Split Widgets

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*, in order to create the number of *Widgets* and layout required by the user.

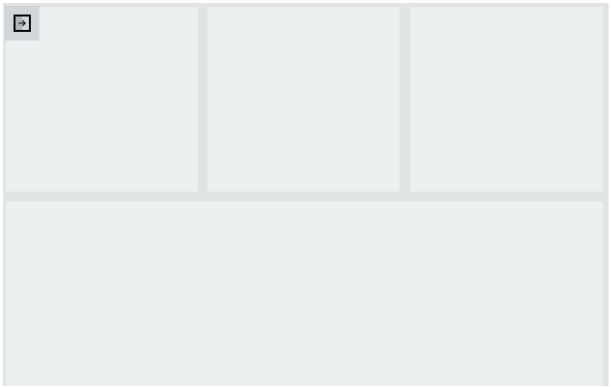
The split buttons will divide the *Widget* into 2 equal ones. The size of each one can be changed though by using the vertical and horizontal division lines.

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.



Merge Widgets

These changes can be reversed by using the *Merge* buttons. These buttons joins 2 *Widgets* back into a single one. Both *Widgets* must have been divided previously and should not have further changes in order for this option to be available. The following images show an example.



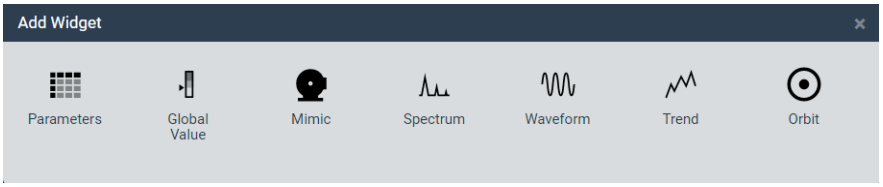
Clicking on the *Merge Horizontal* button will join both *Widgets* into a single one, as shown below.

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

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.

Click on an empty one. A window like this will appear, showing the different type of *Widgets* available.



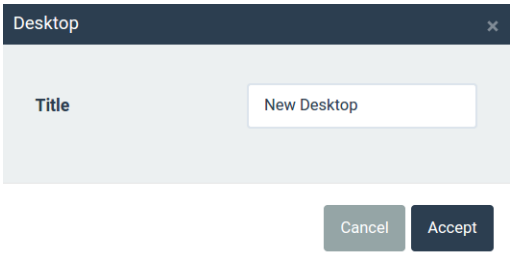
Select the corresponding type of *Widget* that will be assigned to the corresponding window (spectrum on the example

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*).

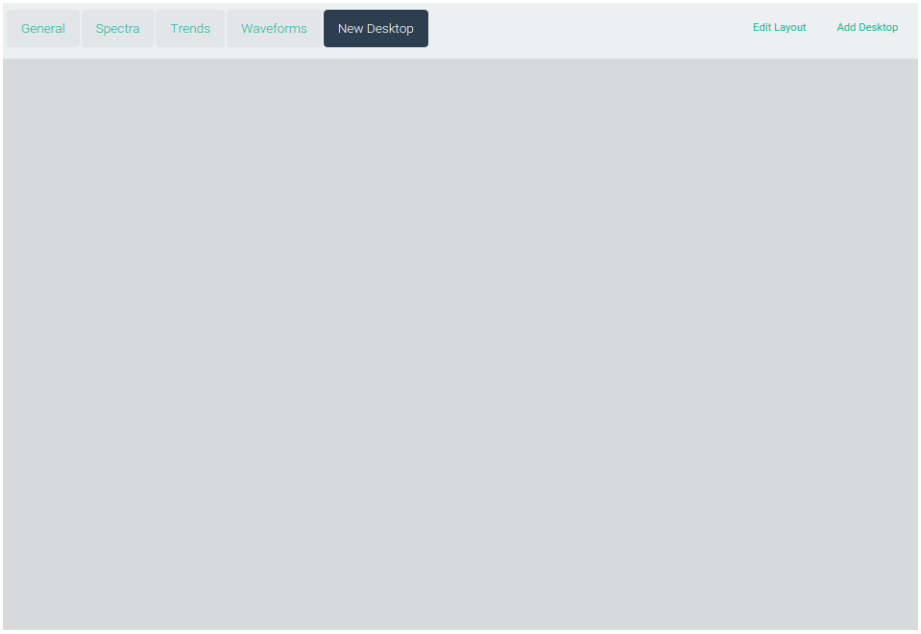
Add Desktop

The button Add Desktop of the Toolbar will add 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.



Widgets

This Chapter describes the different type of *Widgets*. It shows how to work with them and its configuration options.

The following table shows the different type of *Widgets* the user can currently create on the *TWave T8* units.

Widget type	Description
Spectrum	Displays the spectrum of a particular measurement point.
Wave-form	Displays the waveform of a particular measurement point.
Trend	Presents the trend of a measurement.
Global Value	Displays the value of a parameter.
Parame-ters	Presents all the parameters measured for each point in a matrix format.
Mimic	Shows a mimic of the machine. Over the mimic the widget will show the measuring points of the machine, and their alarm status.

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:

Sym-bol	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.

Timeline

The *Timeline* is a graphical tool that allows the user to access quickly to the measurements stored on the database of the *TWave T8* module. It is included on the following Widgets: *Spectrum, Waveform, Parameters* and *Orbit*.

Clicking on this button:

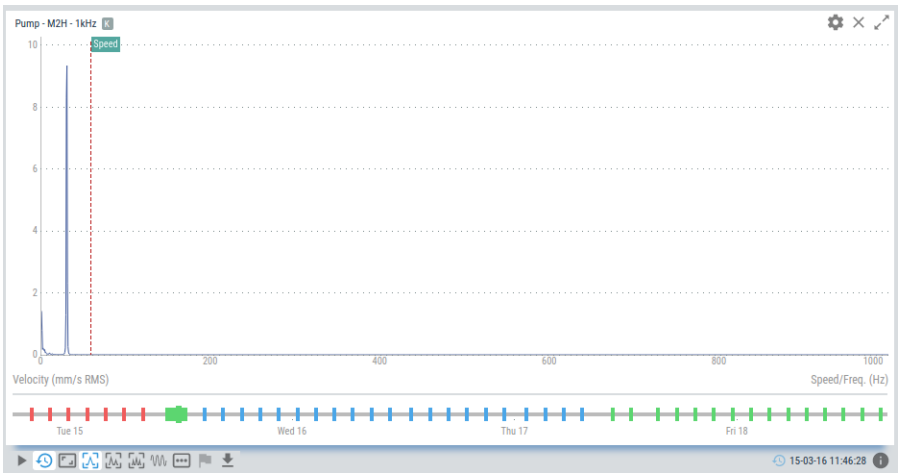
the *Widget* will show up the *Timeline* at the bottom part of the *Widget*.

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.

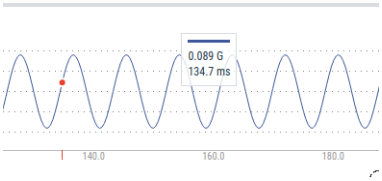
By clicking on one of the bars the *Widget* will show the measurement corresponding to that date/time.

The following picture shows the *Timeline* on the *Spectrum Widget*.

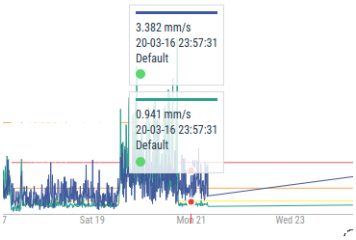


Dynamic cursor

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.

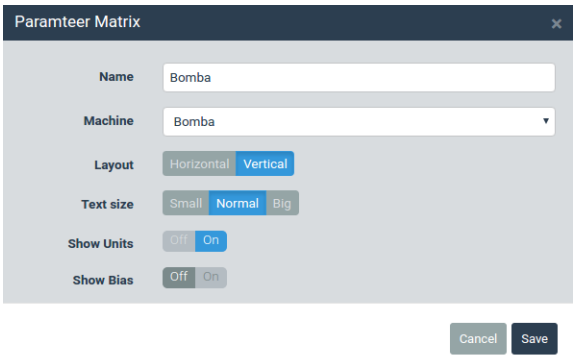


Parameter Matrix

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.

Configuration

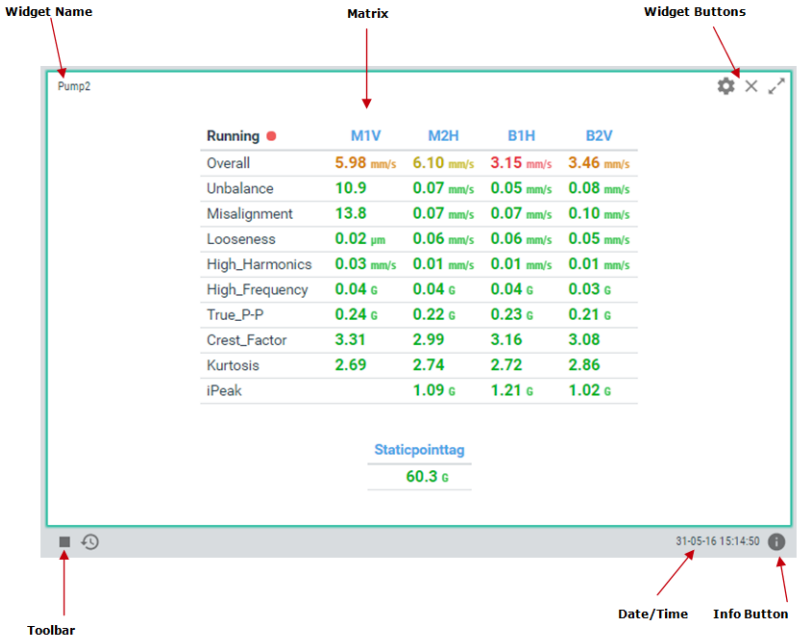
The following picture shows its configuration settings, which may be accessed through the shortcut key “c” or the button in the right corner.



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 parameter 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 3 size options: Small, Normal, Big
Show units	Shows or hides the units and detector 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.

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 *TWave T8*.
■	*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.
	Shows/hides the parameter matrix information box. This box shows the following information associated to the matrix: machine name, speed, load, state and alarm condition of the machine at the time selected.

Cell Colors

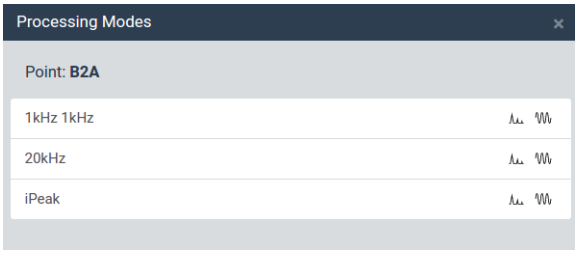
The background colors of the cells will be in yellow, orange or red in case the corresponding parameter reaches the alarm condition *Warning, Alert* or *Danger* respectively. In case the parameter goes above the validation range defined on the configuration of the measurement the cell background will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

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.

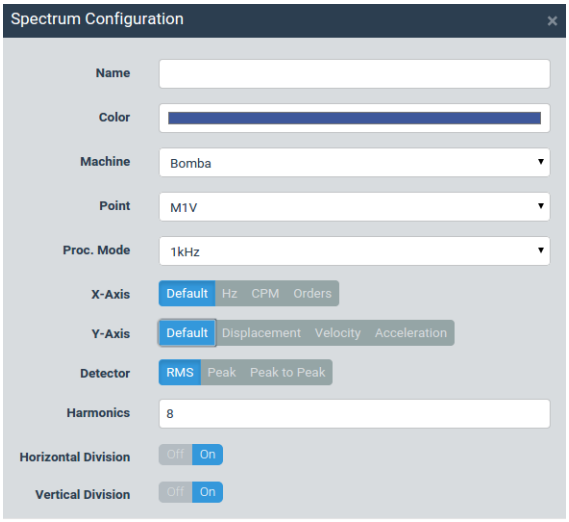
Selecting one of the *Processing modes* a window will show up with the corresponding spectrum measurement. This spectrum window will have the same functionality as the normal spectrum *Widget*. For instance, the associated waveform could be visualized by clicking on the corresponding icon from the window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

Spectrum

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

Configuration

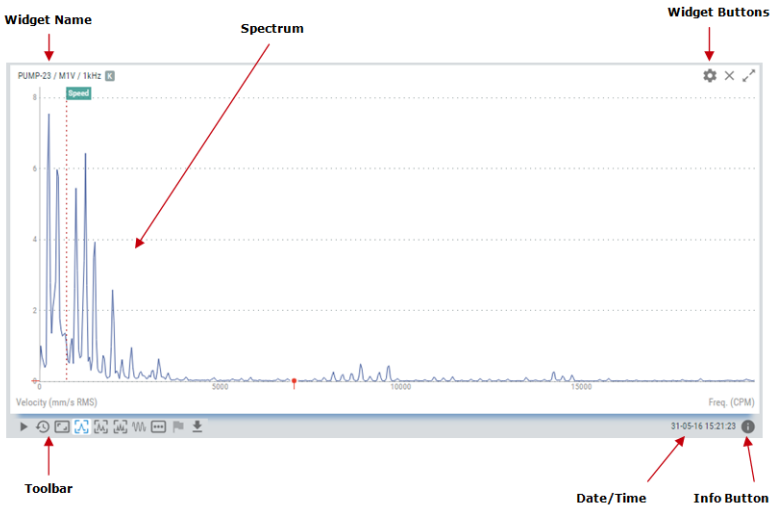
The following picture shows its configuration settings. Once the *Widget* is selected click on the shortcut key "c" or the button in order to show its configuration form.



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.
X Axis	Sets the frequency units of the spectrum. Select between *Default, CPM, Hz* or *Order*. *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 spectrum amplitude (RMS, Peak, Peak-Peak).
Harmonics	Sets the number of harmonics the *Harmonic* and *Side Band* cursor will show.
Horizontal Division	Shows or hides horizontal grid lines on the *Widget*.
Vertical Division	Shows or hides vertical grid lines on the *Widget*.

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 *TWave T8*.
■	*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 particular date. See *Timeline* for more information.
	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 to 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.

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.

In order 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 .

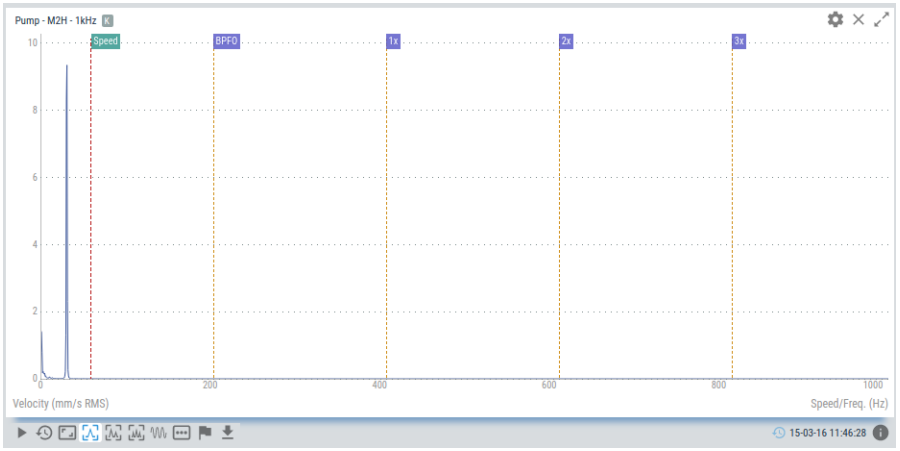
Fault Frequencies

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 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 particular *Fault Frequency*.



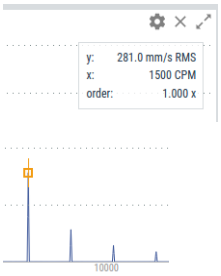
Cursors

Cursors allow the user to mark any frequency of the spectrum. The *Widget* provides 3 different type of cursors: *Single, Harmonic* and *Side Band*. The cursor type can be selected using the the following icons.

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.

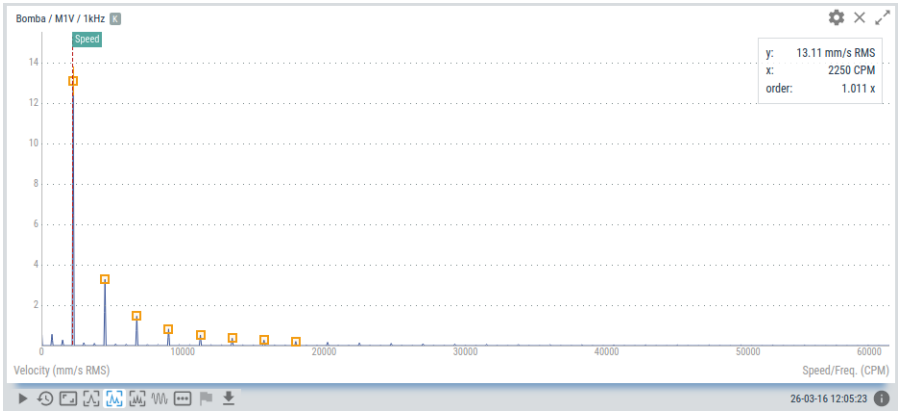


Harmonic cursor

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*.

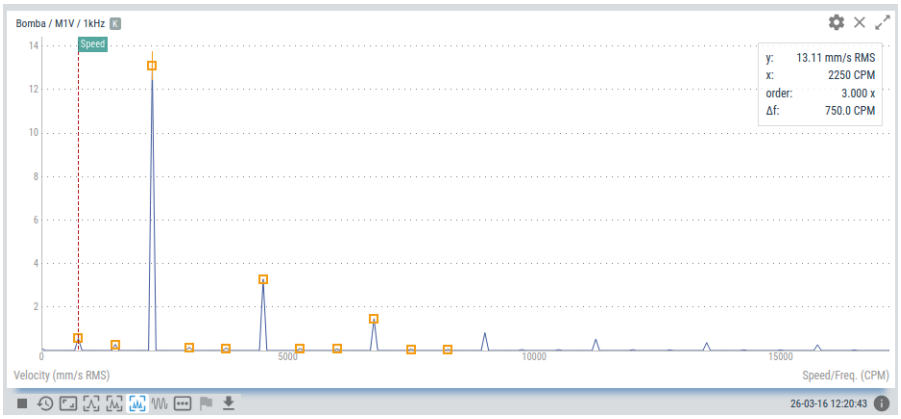


The main cursor is identified by a vertical line crossing the cursor itself.

Side band cursor cursor

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.



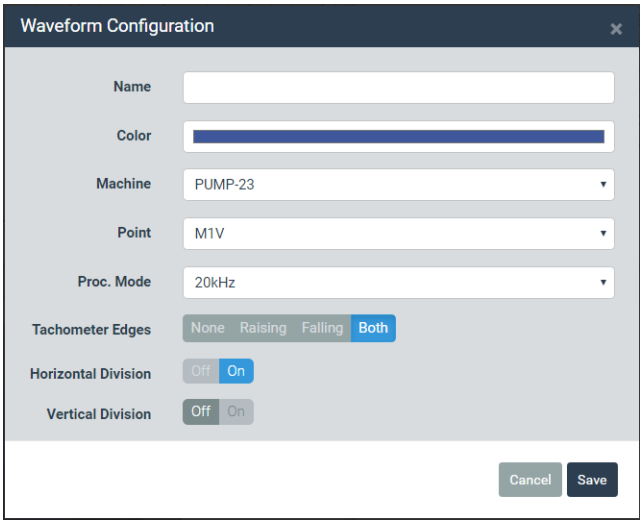
Side band cursor can also be moved using the left and right arrows of the keyboard, which will also move the corresponding side bands harmonics.

Waveform

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

Configuration

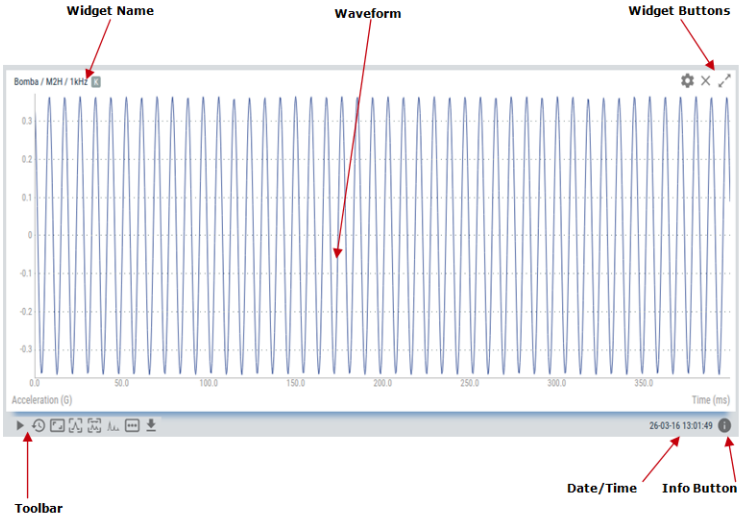
The following picture shows its configuration settings. Once the *Widget* is selected click on the shortcut key “c” or the button in order to show its configuration form.



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 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.
Tachometer 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 Division	Shows or hides horizontal grid lines on the *Widget*.
Vertical Division	Shows or hides vertical grid lines on the *Widget*.

Display

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



Sym-bol	Description
▶	The *Play/Pause* button will make the values of the waveform to be updated automatically with the latest measurement performed by the *TWave T8*.
■	*Pause* button will freeze the current waveform, so the plot will not be updated with new measurements.
	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 particular date. See *Timeline* for more information.
	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 time lines around it. This cursor type is similar to 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.
	Exports the waveform values to CSV format, and creates and downloads it into a local file.
	Shows/hides waveform information box. This box shows the following information associated to 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.

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 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.

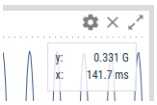
Cursors

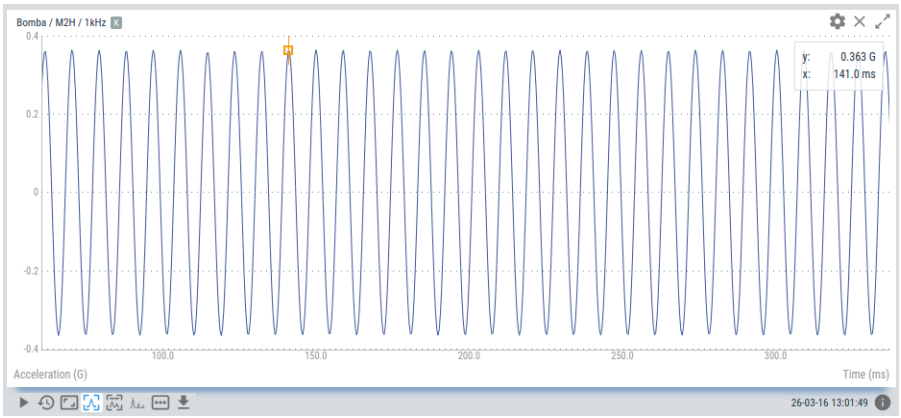
Cursors allow the user to mark any point of the waveform. The *Widget* provides 2 different type of cursors: *Single*, and *Delta Time*. The cursor type can be selected using the the following icons.

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.



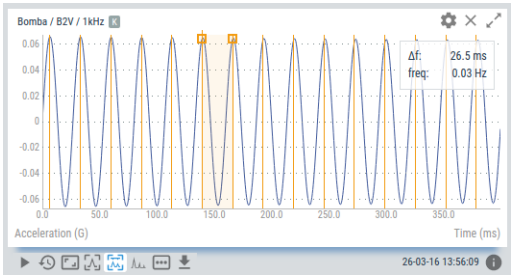


Once the cursor is created clicking on the graph again will move the cursor into the line of the waveform point aligned with the mouse click position. The cursor can also be moved by pressing on left and right arrows of the keyboard, jumping from line to line of the waveform. Keys “a” and “s” will move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

Delta Time cursor

Delta Time type:

will show on the waveform the main cursor and delta time lines around it, similar to 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.



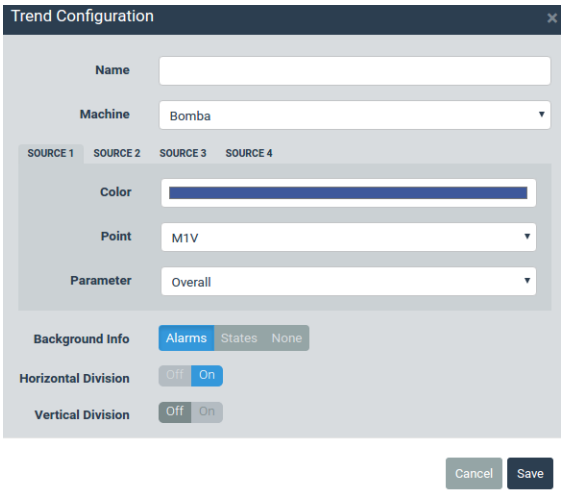
The *Delta Time* cursor can also be moved using the left and right arrows of the keyboard, which will also move the corresponding harmonic lines.

Trends

This *Widget* displays the trend of one or several parameters (*Optional software features*).

Configuration

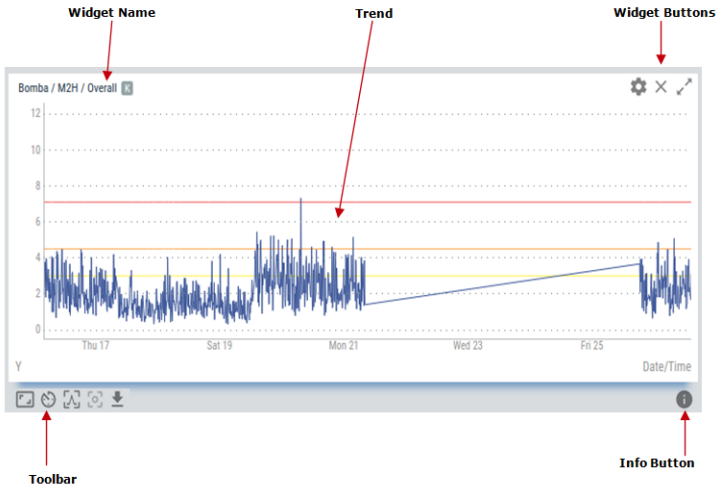
The following picture shows its configuration settings. Once the *Widget* is selected click on the shortcut key “c” or the button in order to show its configuration form.



Field	Description
Name	Defines the name to the *Widget*. It will be shown at its upper bar.
Machine	Selects the machine of the measurements to be shown from the pull-down list.
Source	From these tabs up to 4 data source or measurements can be selected to be plotted on the *Widget*.
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.
Parameter	Selects the parameter or measurement to be plotted for that source from the pull-down list.
Background info	Selects whether or not to show the alarm levels or machine state on the plot.
Horizontal Division	Shows or hides horizontal grid lines on the *Widget*.
Vertical Division	Shows or hides vertical grid lines on the *Widget*.

Display

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



Sym-bol	Description
	Restores the zoom to its normal condition, removing the effect of any previous zoom done on the plot.
	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*.
	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. This will 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 to each trend: machine, point and parameter, along with the color line for each of them.

Zoom

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

In order to make a zoom on 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 in order to zoom in and out keeping that reference still.

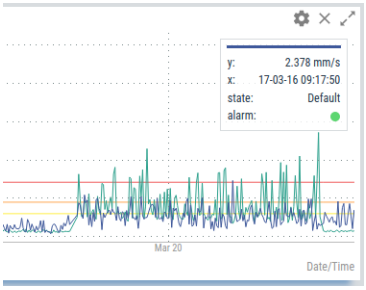
Click on the *Reset zoom* button:

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

Single cursor

After selecting the *Single* cursor icon:

, clicking on the graph will add a *Single* type cursor to the trend plot. This will show a pop-up window at the top right side of the *Widget* with the amplitude and time values. It will also show the state and alarm condition of the machine at that time.



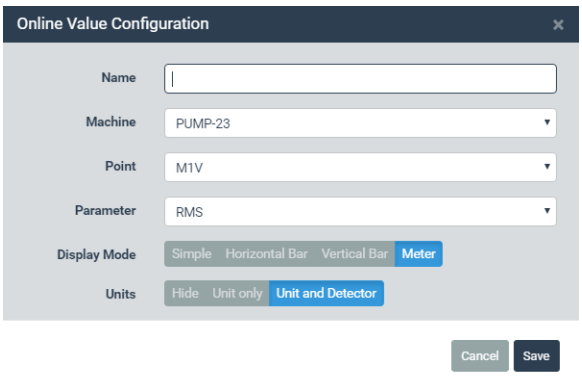
Once the cursor is created clicking on the graph again will move the cursor into that point of the trend vertically aligned with the mouse click position. The cursor can also be moved by pressing on left and right arrows of the keyboard, jumping from line to line of the spectrum. Keys “a” and “s” will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

Online Value

This *Widget* displays the online value of a particular parameter measure on a dynamic input of the *TWave T8*.

Configuration

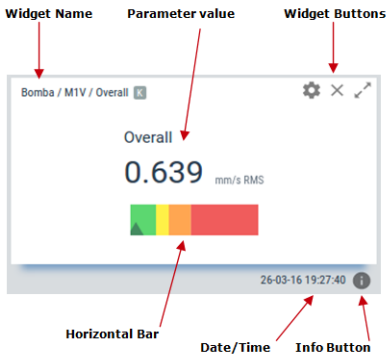
The following picture shows its configuration settings. Once the *Widget* is selected click on the shortcut key "c" or the button in order to show its configuration form.



Field	Description
Name	Defines the name to the *Widget*. It will be shown at its upper bar.
Machine	Selects 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.
Parameter	Selects the parameter or measurement to be plotted for that source from the pull-down list.
Display mode	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 detector (e.g. RMS) for the parameter.

Display

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



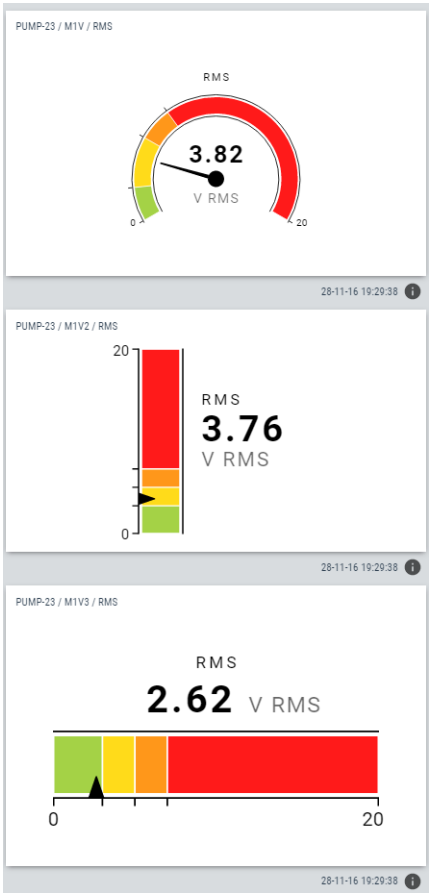
Sym-bol	Description
ⓘ	Shows/hides global value information box. This box shows the following information associated to the measurement: machine name and speed.

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 an detector, and a small color circle with the alarm status for the given value. 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 is the value from the different alarm levels.

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



Access to trends chart

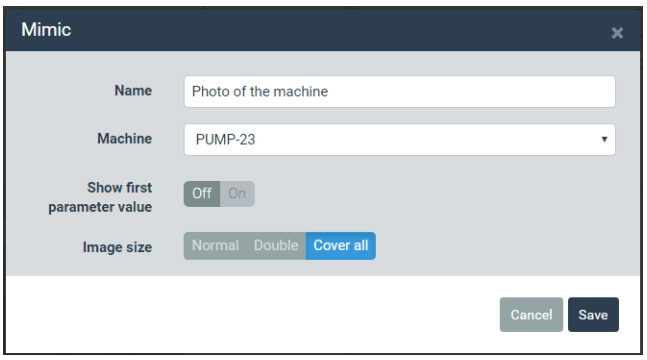
By clicking on the measurement value the interface will present a window with the trend of the parameter. The graph will have all the options as the trend *Widget*. This window can be closed by selecting the corresponding button of the window or by pressing the ESC key.

Mimic

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

Configuration

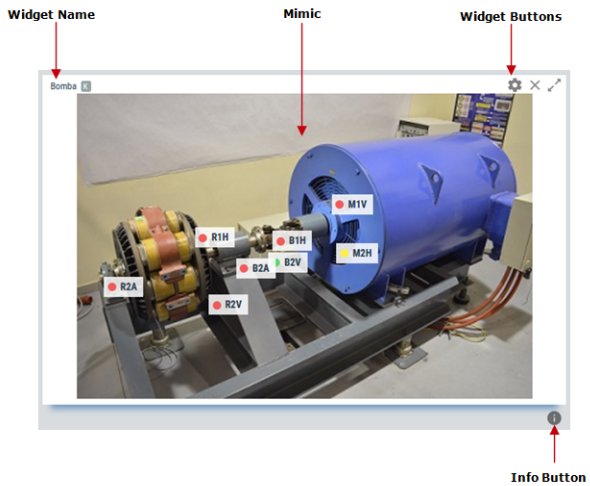
The following picture shows its configuration settings. Once the *Widget* is selected click on the shortcut key “c” or the button in order to show its configuration form.



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 will fit on the space of the *Widget*: *Normal* will show 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*.

Display

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



Sym-bol	Description
ℹ	Shows/hides mimic information box. This box shows the following information associated to the machine: machine name, speed, load, state and alarm condition.

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.

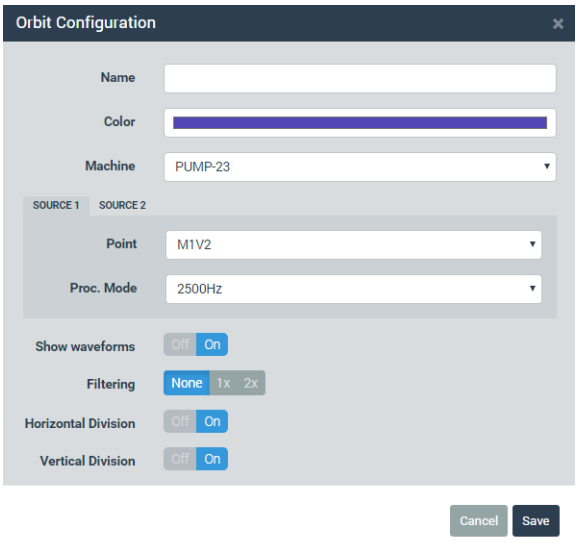
Orbit

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 timebase 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.

Configuration

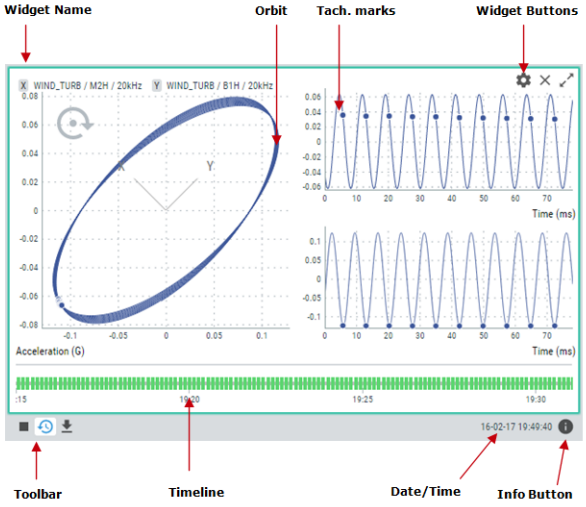
The following picture shows its configuration settings. Once the *Widget* is selected click on the shortcut key "c" or the button in order to show its configuration form.



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 orbit line.
Machine	Selects the machine of the waveform from the pull-down list.
Source 1,2	On these tabs it is defined the two waveforms source or points from which the orbit is calculated.
Point	Selects from the pull-down list the dynamic point of the waveform.
Proc. Mode	Selects the *Processing mode* of the waveform from the pull-down list.
Show waveforms	Shows on the Widget the waveforms from which the orbit is calculated.
Filtering	Apply 1x or 2x filtering to the waveforms to extract the main rotational components of the waveforms.
Horizontal Division	Shows or hides horizontal grid lines on the *Widget*.
Vertical Division	Shows or hides vertical grid lines on the *Widget*.

Display

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



Sym-bol	Description
▶	The *Play/Pause* button will make the orbit graph to be updated automatically with the latest waveform measurements performed by the *TWave T8*.
■	*Pause* button will freeze the current waveform, so the graph will not be updated with new measurements.
	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 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.

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.

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.

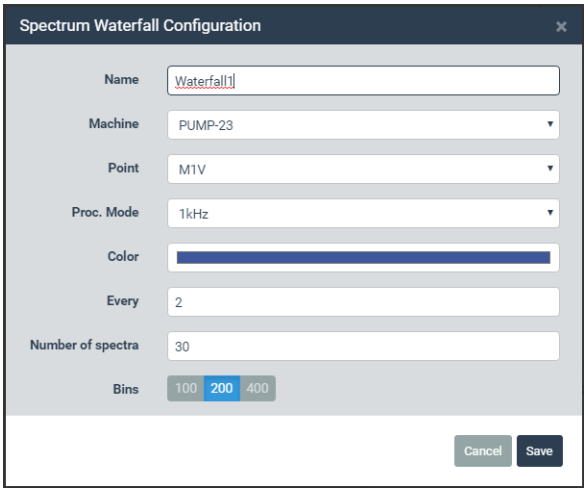
Once the cursor is created clicking on the graph again will move the cursor into the corresponding point of the orbit. The cursor can also be moved by pressing on left and right arrows of the keyboard, jumping from point to point of the orbit. Keys “a” and “s” will move the cursor to the left and right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

Waterfall

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

Configuration

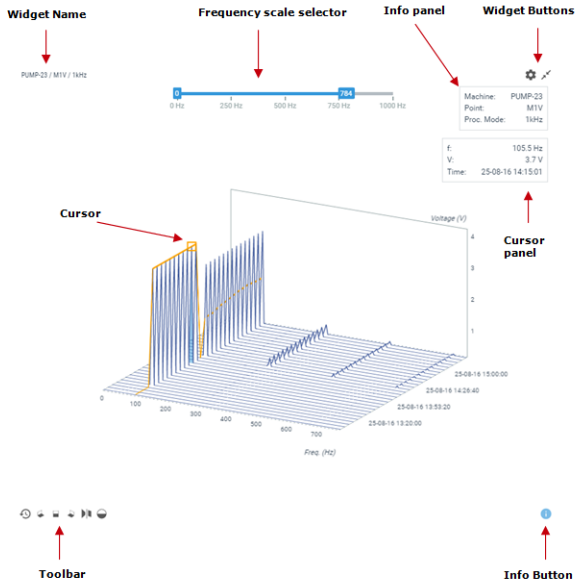
The following picture shows its configuration settings. Once the *Widget* is selected click on the shortcut key “c” or the button in order to show its configuration form.



Field	Description
Name	Defines the name of the *Widget*. It will be shown at the upper bar of the *Widget*.
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.
Color	Selects the color of the waterfall lines.
Every	The widget will represent one spectra of *every X* of available spectra the list of stored signals.
Number of spectra	Number of spectra to represent in the widget.
Bins	The spectra represented in this widget are limited in the number of bins. The higher the number, the more time the more time the Dashboard will take to load the widget.

Display

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



Symbol	Description
	Timeline: select which spectra from the stored will be displayed
	Select standard rotation views.
	Toggle perspective/orthographic view.
	Toggle filled/transparent paths for the spectra (the area below the spectrum becomes opaque)
	Shows/hides waterfall information box. This box shows the machine, point and processing mode of the spectra.

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.

Events timeline

Clicking on the first button of the toolbar, the Widget will display the Events 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.

By clicking on one of the bars the Widget will show the spectrum corresponding to that date/time in the first position on the waterfall, and plot a waterfall with the number of spectra older than this one according to the values of *every* and *number of spectra* options in the Widget configuration. The spectra that are being represented are marked with wider bars in the Timeline.

Cursors

Cursor allow the user to mark the point for a specific frequency in the spectra of the waterfall.

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

Select the active spectrum by using the up and down arrows from the keyboard. The active spectrum will change its fill color and also the shape of its line (making it thicker).

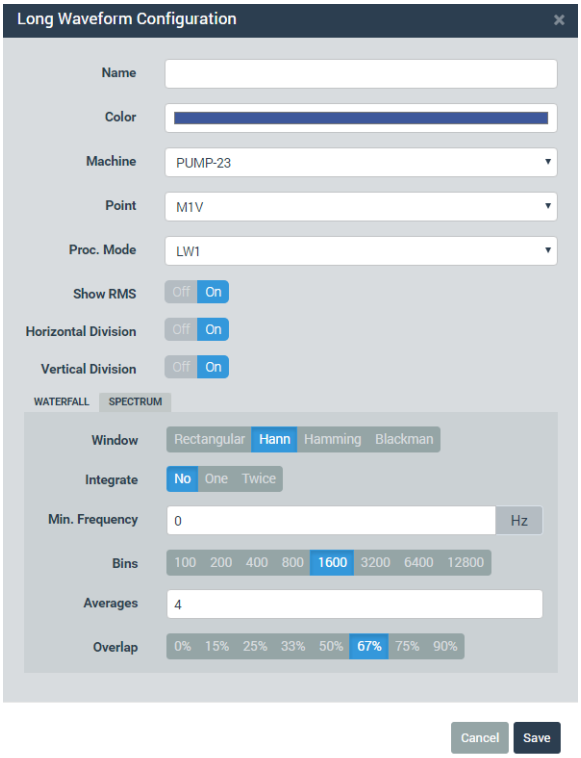
Once the cursor is created, a info panel will be displayed in the widget, indicating the frequency and amplitude of the bin, and also the time and date corresponding with the active spectrum.

LongWaveform

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.

Configuration

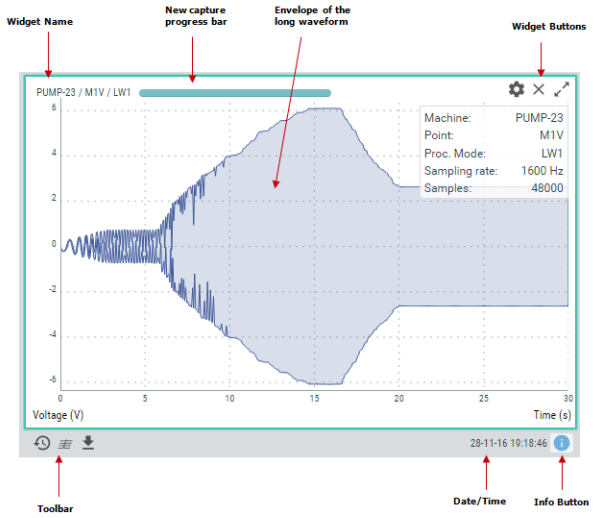
The following picture shows its configuration settings. Once the *Widget* is selected click on the shortcut key “c” or the button in order to show its configuration form.


Long Waveform Configuration
Name
Color
Machine
PUMP-23
Point
M1V
Proc. Mode
LW1
Show RMS
Off
On
Horizontal Division
Off
On
Vertical Division
Off
On
WATERFALL
SPECTRUM
Window
Rectangular
Hann
Hamming
Blackman
Integrate
No
One
Twice
Min. Frequency
0
Hz
Bins
100
200
400
800
1600
3200
6400
12800
Averages
4
Overlap
0%
15%
25%
33%
50%
67%
75%
90%
Cancel
Save

Field	Description
Name	Defines the name of the *Widget*. It will be shown at the upper bar of the *Widget*.
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.
Show RMS	Shows or hides the trend of the RMS value along the waveform
Horizontal Division	Shows or hides horizontal grid lines on the *Widget*.
Vertical Division	Shows or hides vertical grid lines on the *Widget*.
Waterfall	
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. Frequency	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
Spectrum	
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. Frequency	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.

Display

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



Sym-bol	Description
	Timeline: select which waveform will be displayed from storage.
	Display spectrum waterfall calculated from the long waveform. It calculates several spectra from portions of the waveform, according to 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 box. This box shows the sampling rate and number of samples in the waveform.

Phase Plots

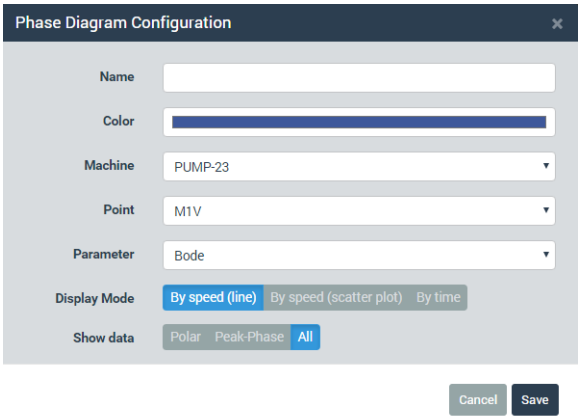
Phase plots, also called Bode and Polar plots, display *peak-phase* parameters in different representations (*Optional software features*). The Bode and Polar representations are combined in the same widget, which can be used to describe the locus of a rotational speed vector signal during speed changes. This is typically used for transient (non-stationary signals) analysis, in both run-up and run-down tests of the machines.

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.

Configuration

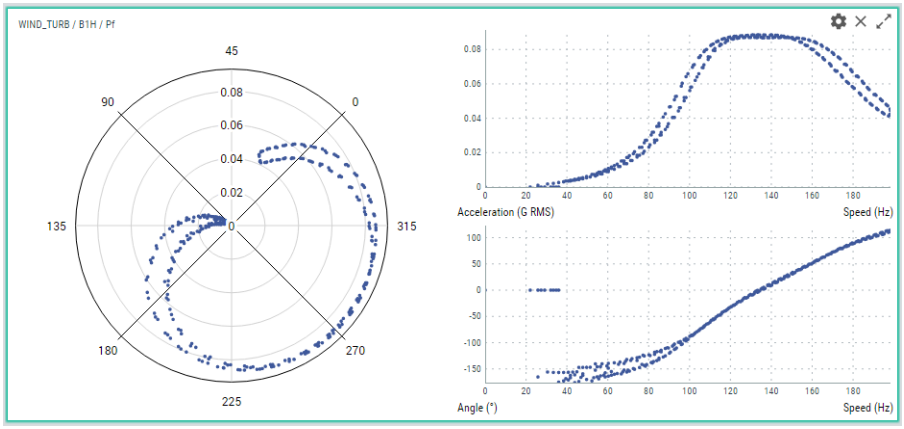
The following picture shows the configuration settings of the Phase plots widget. Once the *Widget* is selected click on the shortcut key “c” or the button in order to show its configuration form.



Field	Description
Name	Defines the name of the *Widget*. It will be shown at the upper bar of the *Widget*.
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.
Parameter	Select a *Peak/Phase* parameter to be displayed, in case there was more than one for this point
Display Mode	Select the X-axis for the Bode and how the points are drawn: • By speed (line) • By speed (scatter plot) • By time (line)
Show data	Show Bode, Polar, or both Plots

Display

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



CHAPTER

FOURTEEN

MAINTENANCE

General

The *TWave T8* does not require consumable material for its normal operation. On the other hand, it does not contain any component that is subject to be replaced by the user, apart from the connectors.

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.
- *Odour*. Check no abnormal odour is present.
- *Mechanical defects*. Inspect the unit has 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 *TWave T8* is correctly attached to the mounting panel, and does not move or have an excessive looseness.
- *DIN rail*. In case or DIN rail attachment ensure not 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.

Reboot

The *Reboot* function allows to restart the *TWave T8* quickly in case of error. To reboot the unit follow these steps:

- Insert carefully 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.

Rescue mode

If the button located in the hole next to the power connector is pressed while the *TWave T8* is starting up, the unit will enter the **rescue mode**.

Follow this steps to enter the **rescue mode**:

1. Power off the *TWave T8*, if it is running, and wait until all LEDs are switched off.
2. Insert carefully a thin object into the hole located next to the power connector and apply a slight pressure.
3. Power on the *TWave T8* while holding the button down and wait until the status LED changes to red.

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 during more than two seconds 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 its 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 *TWave T8* 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.

Troubleshooting

The following table shows solutions for possible trouble with this device:

Symptom	Possible Cause	Description
No communication	The unit is off	Turn *TWave T8* on by applying power to it.
	Cabling	Ethernet port leds 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 *TWave T8* and the computer.
	Processor failure	Restart the unit.
The information is not displayed correctly	Bad web 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 *TWave T8* 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	Reload the firmware into the unit. See *Upgrade firmware*.
	Hardware failure	Contact customer support.

CHAPTER

FIFTEEN

BASIC OPERATIONS

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 *TWave T8* has a start-up period of several seconds. This time period can vary from 10 to 15 seconds.

The power led is used to indicate the status of the *TWave T8* 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*.

Powering off the unit

Switch off the power supply or remove the power connector in order to shut down the system. The *TWave T8* includes a battery that will make the system to shut down in a clean way.

When the *TWave T8* detects a loss in the power supply it initiates automatically 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 is down, remaining in this condition for 1 minute. After that period the unit will start up again.

Upgrading the firmware

Follow these steps in order to check for new firmware versions and upgrading the firmware of the *TWave T8*. The *TWave T8* must have access to the Internet.

1. Click *Check for new updates*.
2. If a new firmware version is available, click *Upgrade* to install it.
3. In order not to damage the unit it is very important to follow the indications.

> **Warning:** 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.

4. The unit will be automatically restarted after upgrading the firmware.

Warning: 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.

CHAPTER

SIXTEEN

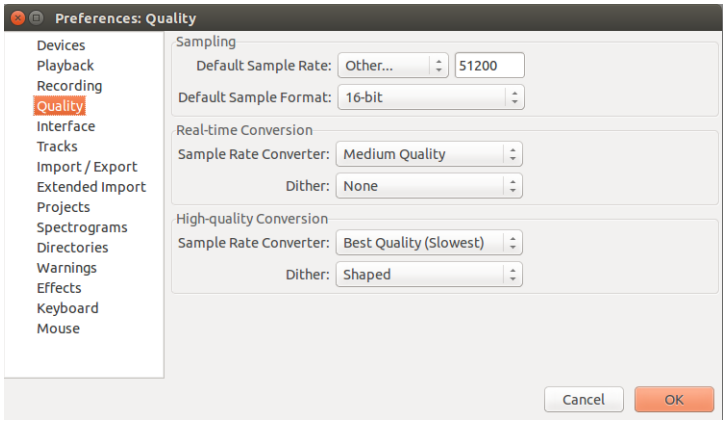
APPENDIX A

Creating simulation files

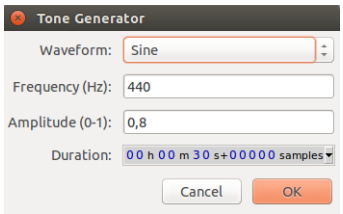
Simulation files are raw (header-less) binary files with 16-bit signed integer samples recorded at 51200 Hz. You can create new simulation files using an audio editor.

In the following instructions we will make a 440 Hz sine tone using the free audio editing software Audacity:

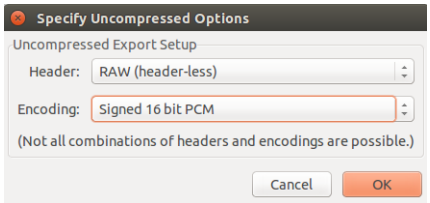
1. Adjust default sample rate and sample format: **Edit > Preferences > Quality**. Set the default sample rate to **51200 Hz** and sample format to **16-bit**.



2. Create a 440 Hz, 30 seconds long sine tone: **Generate > Tone**.



3. 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**.



CHAPTER

SEVENTEEN

APPENDIX B

Optional software features

TWave T8 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	Super-visor	Diag-nostic	Turboma-chinery	Description
SM	Simultaneous Capture	X	X	X	Simultaneous sampling on all dynamic channels
PB	Prebuffering	X	X	X	Real-time monitoring regardless sampling time
OV	Online Value Widget	X	X	X	Bar or meter display for showing parameters
PM	Parameter Matrix Widget	X	X	X	Shows all the parameters in a single view
MM	Mimic Widget	X	X	X	Displays the machine image and its points
WV	Waveform Widget		X	X	Displays the original dynamic sensor data
SP	Spectrum Widget		X	X	Displays the FFT data transformation
DS	Data Storage		X	X	Controls the storage of parameters and graphs
TR	Trends Widget		X	X	Displays the value of parameters across time
DM	Demodulation		X	X	Technique for detecting HF bearing failures
ET	Extend Processing Blocks			X	Extends the processing capability to 32PB
OB	Orbit Widget			X	Combines 2 waveforms in a single chart
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	O	O	O	Allows reading values from external devices
HF	High Frequency	O	O	O	Enables HF data acquisition and heterodyning (not implemented yet)
WF	WiFi	O	O	O	Configure and use Wifi dongles via USB port (not implemented yet)

Options marked with an "O" may be activated for any of the predefined configurations.

CHAPTER

EIGHTEEN

APPENDIX C

Network ports

The user interface requires that the network between the *TWave T8* and the computer or device has this Ethernet TCP-IP ports open for all the system functions to work properly.

The following table presents these ports and describe it function.

Port	Service	Description
TCP-80	HTTP	Enables to access the user interface.
TCP-21	FTP	Allows the FTP communication.
TCP-22	SSH	Allows SSH communication. Reserve for the Support Team for remote maintenance of the system.
TCP-873	RSYNC	Enables the automatic backup system through the network.
TCP-502	MODBUS TCP/IP	Enables the modbus TCP-IP data communication.