User manual

SKF @ptitude Observer

User Manual Part No. 32170900-EN
Revision U – September 2020
Observer 12.2

WARNING! Read this manual before using the product. Failure to follow the instructions and safety precautions in this manual can result in serious injury, damage to the product or incorrect readings. Keep this manual in a safe location for future reference.

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Product Support – Contact Information

Your start point on SKF.com should be the Condition Monitoring Systems page. From there select Support and Training to access a range of resources including:

- Product Support Plans
- Product manuals
- Product downloads

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1
Introduction

@ptitude Observer is a core platform in a family of reliability software applications that work together as SKF @ptitude Monitoring Suite. It is for data management and analysis of measurement data for condition monitoring, internationally acknowledged for its versatility, performance and user friendliness.

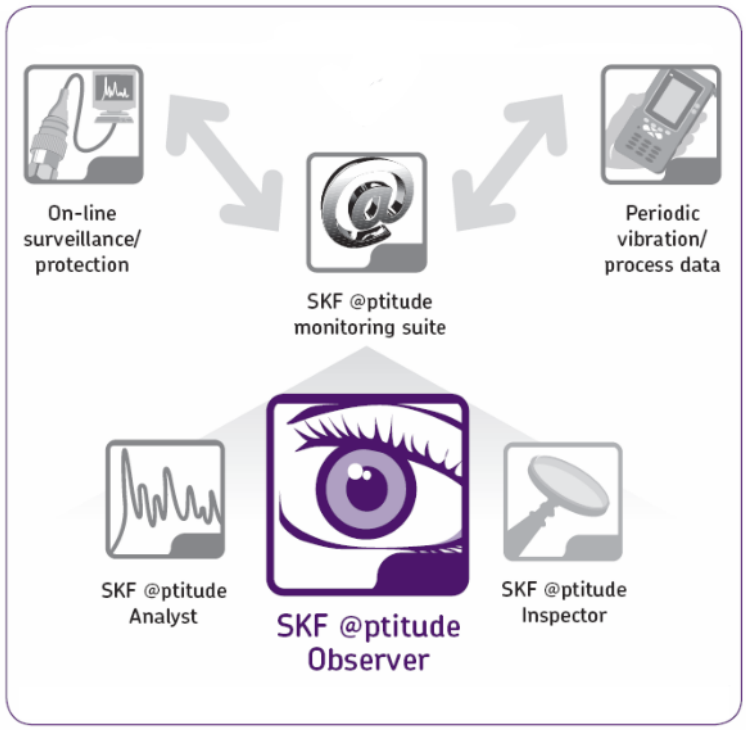


Figure 1 - 1
SKF @ptitude Monitoring Suite

@ptitude Observer is Microsoft Windows® -based and supports most of the Windows based systems.

Whilst this manual describes full features and functionality be aware that specific content may be reliant upon an appropriate software licence and access by an administrator level user.

Data Acquisition Device Support

This version of @ptitude Observer supports the following data acquisition devices (DADs):

- MasCon16
- MasCon16R
- IMx-1 System
- IMx-8/IMx-8Plus
- IMx-16/IMx-16Plus
- IMx-Rail
- IMx-B
- IMx-C
- IMx-P
- IMx-R
- IMx-S
- IMx-T
- IMx-W, WindCon
- Microlog CMVA series
- Microlog CMXA 50
- Microlog AX
- Microlog GX
- RB06

Note that:

- the last @ptitude Observer version supporting the IMx-M was 10.2
- the last @ptitude Observer version supporting MasCon48 and MasCon48P was 12.0

@ptitude Observer Logical Architecture

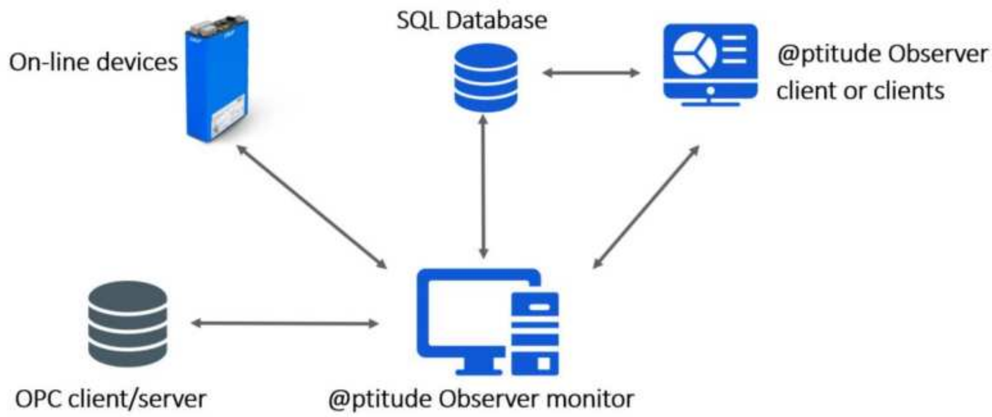


Figure 1 - 2
SKF @ptitude Observer Logical Architecture

IMx/MasCon devices are linked to a network which is connected via a modem or LAN to an @ptitude Observer Monitor connected to an SQL database. The @ptitude Observer Monitor can in turn be connected to a LAN network, for example. Several @ptitude Observer clients may be linked to this network. @ptitude Observer can also be installed on the same computer as the @ptitude Observer Monitor service.

Through a general interface such as OPC, it is possible to link the @ptitude Observer Monitor to an existing control or processing system. The @ptitude Observer Monitor, @ptitude Observer clients and the database can be separated physically from each other provided that they are on the same network where ODBC (open database connectivity) calls can travel freely.

The operator interface (@ptitude Observer client software) is predominantly based on graphical communication. Operator input like mechanical machine characteristics are also set up graphically and all disturbance frequencies are obtained automatically. The system also has tools for machine diagnostics.

Communication Possibilities

As the standard TCP/IP interface allows many different types of media to be used, such as twisted pair cable, fibre optics, wireless LAN, mobile data networks, etc. the communication possibilities are almost unlimited.

The system can work in either its own separate network or within an existing factory network. The internet can also be a link between IMx/MasCon devices and the @ptitude Observer Monitor as well as between the @ptitude Observer Monitor and @ptitude Observer clients.

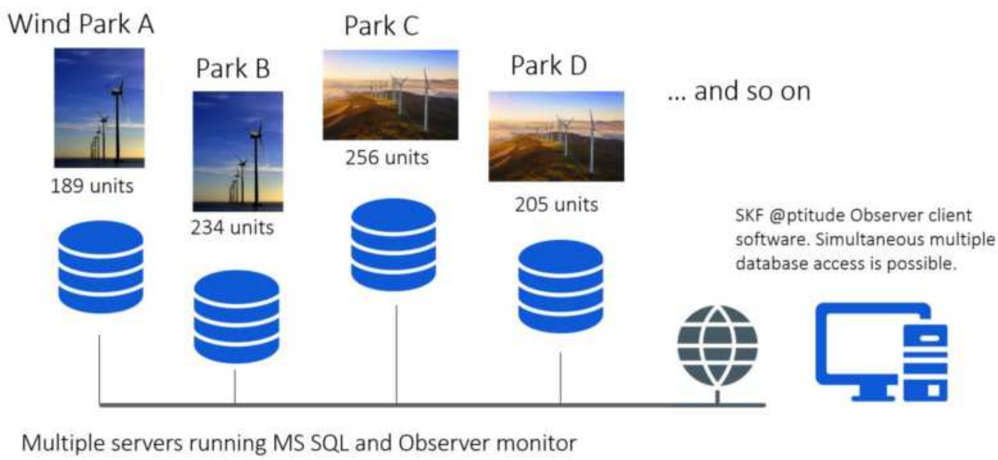


Figure 1 - 3
SKF @ptitude Observer Communication Possibilities – example

With @ptitude Observer Monitor and an Internet connection, it is possible to set up @ptitude Observer clients anywhere in the world.

Network Connectivity Requirements

- Each IMx/MasCon device needs a TCP/IP compatible communication path to @ptitude Observer Monitor.
- The following connection technologies are some of the examples that can be used:
  - Fibre optics
  - Pair copper wire (<1 Km)
  - ADSL (asymmetric digital subscriber line)
  - DSL (digital subscriber line)
  - Internet
  - 128K ISDN (integrated services digital network) dial-up connection
  - GPRS (general packet radio services)
  - Standard Ethernet network
- Several types of IMx device have extended network capabilities with features such as Wi-Fi and mobile network connectivity, built in.

Important - An on-line condition monitoring system like IMx/MasCon together with @ptitude Observer can be successfully operated only on an installed and tested network infrastructure. Even though the IMx/MasCon devices and @ptitude Observer Monitor are equipped with several fault tolerant routines and procedures, they can ultimately only be as reliable and effective as the network to which they are connected.

Connecting an SKF Microlog Analyzer

The components and drivers that can be used to facilitate connecting an SKF Microlog Analyzer to @ptitude Observer software depends on the Microlog model and the operating system used on the computer that the Microlog will interface to.

The key component is Windows Mobile Device Center (WMDC):

- WMDC is required for Windows 7 (32- or 64-bit) and Windows 10, 32-bit.
- WMDC is required for the Microlog CMXA 70 or legacy devices.
- For systems with a mix of Microlog models that includes the CMXA 70 or legacy devices use WMDC and ensure that the PC Comms settings in any CMXA 75 and CMXA 80 devices are set to *WMDC*.

WMDC is not officially supported on Windows 10 so for those users on the 64-bit version of that operating system and having only Microlog CMXA 75 and/or CMXA-80 devices, it is recommended to install the SKF Sync driver:

- This installs a Rapi.dll driver that eliminates the need for WMDC.
- Microlog device firmware will need to be version 4.06 or above.

Note that for this to work properly on a computer where WMDC has previously been used, a complete uninstall of WMDC is required. For help on removing WMDC, contact TSG.

2
Technical Specification

Hardware Connectivity

IMx is a series of on-line monitoring systems with dynamic/static inputs, digital inputs and digital outputs with simultaneous measurement on all channels up to 40 kHz. The available number of inputs, outputs and the physical form varies depending on the type of the data acquisition device.

An SKF Enlight Collect IMx-1 system consists of IMx-1 wireless sensors, gateways and a mobile application (SKF Enlight Collect Manager App) which provides the opportunity for a completely wireless architecture at the machinery being monitored. For more information on these different system components and how they integrate with @ptitude Observer, refer also to the ***SKF Enlight Collect IMx-1 System user manual***, Part Number 15V-090-00087-100. That manual describes the @ptitude Observer configuration details required for interfacing to an IMx-1 system and the way the different system components interact.

MasCon16 is an on-line monitoring system with 16 dynamic/static inputs, 2 digital inputs, 4 digital outputs.

SKF Microlog Analyzer is a portable data collector for single or multi-channel measurements.

Data Processing

- On-line data acquisition from IMx/MasCon (Ethernet, TCP/IP).
- On-line process data through OPC (object linking and embedding for process control).
- As measurement data from SKF Enlight Collect IMx-1 or other on-line systems is received and processed by instances of SKF @ptitude Monitor, the Monitor Service Viewer will register events associated with this activity. Note that data that is time stamped earlier than 3 years before the current date will be rejected. In the viewer/log, the description field will include the invalid date that caused the data to be ‘trashed’ and the event Type will be set as Error.
- The format used to store measurement values in both IMx devices and @ptitude Observer is designed to cope with a wide range of values. When processing very large values however some difference between the input value and the value stored or returned may be noticed due to the internal conversion that takes place. This can best be illustrated by an example:

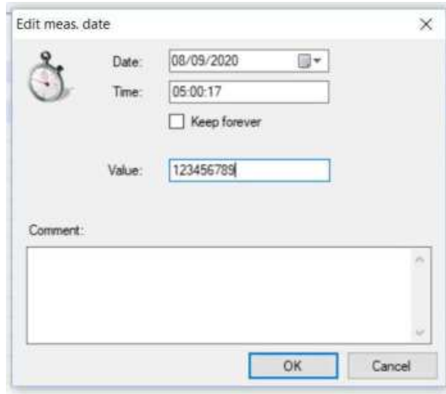


Figure 2 - 1
Enter a very large number for the measurement value

After entering the very large measurement value, the Meas. Date window shows the value now in scientific notation and with some precision lost:

Measurements

Date/Time	Keep forever	Value [Bar]	Buffer
08/09/2020 05:00:17	No	1.234568E+08	Normal
08/09/2020 04:59:58	No	1000000	Normal
08/09/2020 04:59:50	No	100000	Normal
03/09/2020 08:14:02	No	11	Normal
01/09/2020 04:10:22	No	12	Normal
01/08/2020 04:09:58	No	10	Normal

Figure 2 - 2
The stored value as shown in the Meas. date window

The Trend list confirms the converted/stored value is different to the original input value as it reflects that loss of precision:

Meas. point	Date/Time	Speed	Process	Digital	E.U.	Overall
Software Process point	08/09/2020 05:00:17	0	0	0	Bar	123456800
Software Process point	08/09/2020 04:59:58	0	0	0	Bar	1000000
Software Process point	08/09/2020 04:59:50	0	0	0	Bar	100000
Software Process point	03/09/2020 08:14:02	0	0	0	Bar	11
Software Process point	01/09/2020 04:10:22	0	0	0	Bar	12
Software Process point	01/08/2020 04:09:58	0	0	0	Bar	10

Figure 2 - 3
The stored value as shown in the Trend list window

Configuration Features

- **Data Acquisition Device Configuration** for each DAD in the system. Typically for an IMx device, every configurable aspect of its functionality can be set in @ptitude Observer or using the On-line Device Configurator tool. This includes hardware configurations aspects such as sensor power and interface configuration for protocols such as Modbus.

- **Measurement points**. A variety of measurement point types can be configured. These include:

  Dynamic Measurement Points

  Trend Measurement Points

  IMx-1 sensor and measurement cluster

  Note that certain measurement point types are device dependent, for example: they may be IMx-1 specific, be supported by IMx or Microlog but not both, or may operate only at an @ptitude Observer, software level.

Analysis Features

FFT (Fast Fourier Transform) analysis is the classic way of analysing vibration data where the vibration signal is shown as a function of frequency. Frequency ranges up to 40 kHz and resolutions up to 6 400 lines can be used.

Time waveform analysis can identify problems that might not be detected by FFT analysis. Statistical and similar assessments can be applied, including crest factor, Kurtosis and skewness. Advanced analysis can be performed using the capture capabilities of the IMx including event capture for continuous pre- and post-event, data capture.

DPE (Digital Peak Enveloping) analysis is an excellent method to detect small impulses such as bearing defect in a noisy environment.

Order tracking analysis is an efficient way to analyse machines with variable speed. It measures the speed of the shaft every revolution and adjusts the sampling rate to keep the same number of samples per revolution regardless of shaft speed.

Run-up/Coast down occurs when a machine is started or stopped. At such occurrences the system can be configured to store transient data according to the user defined conditions, like speed variations, set for the actual measurement group. During transients, separate alarm conditions can be applied.

Machine parts is a graphical tool that defines the machine's mechanical arrangement to support defect frequency calculation as well as machine diagnostics. The whole drive chain can be set up graphically using drag and drop from a machine component toolbox.

Bearing library stores geometrical data from approximately 30 000 different bearings from several different manufacturers. It is used for automatic defect frequency calculation.

Machine diagnostics expert system uses a rule based diagnostic system for automatic frequency analysis which gives clear text messages regarding fault type.

Balancing is the on-line balancing of machines suitable for turbines with up to 15 planes, 5 states and a maximum of 40 simultaneous measurement points.

User Interfaces

Beneath the toolbar area are normally two windows. To the left, the tree view window holds, across a number of tabs, the different types of views by which the user can navigate the system. The main types of user interface found in the tree view window are named:

Hierarchy

System

Workspace

Diagram

If the @ptitude Observer licence includes SKF Rail Track Monitoring and the application is *Metro*, then users will also make use of a further view named 'RailMo'.

From the Show menu, the tree view window can be enabled or disabled, and a particular tab can be given the focus. When the tree view window is active this can also be achieved by simply clicking on the required tab.

To the right, if the tree view is active, the 'main window' typically displays the DASHBOARD and any diagrams being viewed. If the @ptitude Observer licence includes an SKF Enlight Collect IMx-1 system, then this area is also where the Enlight Collect IMx-1 System view will be displayed.

Controls for handling multiple displays within this window area are handled from the 'Window' menu: for example, cascade, give a particular display the focus, etc.

Graphic Displays

The many Graphic Displays available in @ptitude Observer facilitate machinery data analysis and diagnostics. They include plots in the time and frequency domains, some in circular formats that provide immediate visualisation of both amplitude and phase data and others that use colour to visualise energy content and identify areas of concern.

SKF Rail Track Monitoring in *Metro* mode, has its own special displays to aid the analysis of track condition. These are based on data from IMx-Rail devices that has been matched to specific rail sections before being processed.

Alarm

There are a variety of alarm features such as level alarm, trend alarm, vector alarm, diagnostics alarm and circle alarm. Upon alarm, notifications can be automatically sent to designated user(s) by e-mail or SMS (short message service).

- **Speed dependent alarm conditions** can be up to 15 primary alarms for each measurement point. These alarms can be at a fixed frequency, fixed frequency range, speed dependent frequency or speed dependent frequency range.
- **Speed or load dependent alarm level** can be fixed or set as a function of shaft speed or any DC measurement point for each alarm level. For each alarm condition, there are two alarm levels for vibration measurement points and four alarm levels for DC measurement points.

- **Class dependent alarms** (for Dynamic and Dynamic Envelope points only) can be enabled as alarms dependent on the two Multiple Gating Point operating classes. This disables other alarms. Refer to Enable class dependent alarms for details.
- **Alarm group** is used to collect correlated data from associated measurement points (the alarm group members), when an alarm occurs. Normally when an alarm is raised only the measurement data from that measurement point is saved in the database. If an alarm group member generates an alarm, data from all the measurement points in that alarm group will be saved, refer Alarm Group.

Report

PDF-based and Word reports containing alarm lists, notes, manual conclusions, trend data, diagnosis reports and condition monitoring statistics can be produced. Refer to File > Report.

System Integrity

- System alarms via e-mail or SMS messages.
- User defined system privileges and preferences for each individual user.
- Database backup and management functionality.
- Automatic hardware serial number verification.
- Error logs.
- Tracking of TCP/IP communication package errors.
- Hardware sequence number tracking.
- Missing data alarm.

3
Getting Started

It is recommended that the steps explained in the SKF @ptitude Observer Installation manual, part number 32170700, are followed. As mentioned there, when starting @ptitude Observer for the first time:

Select a language at the "Select language" screen.

If this copy of @ptitude Observer has not yet been registered, the "Unregistered version of Observer" screen will appear, for the necessary action to be taken.

Clicking the **Enter license key** button the **License Key** screen appears for the license key to be entered. Alternatively, the session can be continued by clicking the **Continue unregistered** button. However, there will be further prompts from time to time throughout the session until the product is registered.

Note that once a language has been selected and the license key entered, this user will not be required to enter them again and @ptitude Observer will directly prompt the user to select a database to be connected.

Database Connection

To run @ptitude Observer, a database must be connected. If no database has been configured or more than one database is configured but without a default choice being set, then the Connections dialog will automatically show when the @ptitude Observer session is started. This dialog allows the user to select from a list of existing database connections or, using **Add**, to create a new connection. This dialog can also be accessed from within @ptitude Observer whenever the database connections need to be managed: File > Manage databases.

For information on this dialog and the various fields that need to be configured for a connection, refer to Manage Databases.

Logon

For user authentication, @ptitude Observer supports the use of both Observer internal and Active Directory (AD) group, methods.

- In Enlight Collect IMx-1 systems, for users to be able to log in through the SKF Enlight Collect Manager app they must be using @ptitude Observer internal user and not Active Directory group, authentication.

@ptitude Observer internal user authentication

A default user (User name/Password: “admin”/”admin”) can be used to start the system. However, it is strongly recommended to create individual user accounts for those who have access to the system. It is necessary to have individual user accounts and rights, so that configuration changes can be tracked. For further guidance, refer to the **Security roles** and **Users** sections in the Database menu.

Figure 3 - 1
Observer Logon for internal, user authentication method

The system will remember the user name and the password if the **Remember me** checkbox is marked.

Note: for an @ptitude Observer login, the **User name** entry is not case sensitive.

Change Language Feature

There is the option to change the language of the application before it starts. After entering **User name** and **Password**, select the desired language from the **Language** list and then click **OK**. The Observer application will initialize in the selected language.

- The language can be changed only upon starting up. When ending a session or logging off without exiting, the **Language** list is disabled.

Figure 3 - 2
Language Selection Capability

Using Log off then Logon to switch user type

Users authenticated by @ptitude Observer can switch user type without exiting the application: for example, if logged on in a restricted rights role and then there is a need to make a change requiring administrator privileges.

To do this, log out by going to **File** > **Log off.** There will be a prompt to confirm the log off. Click **Yes**.

Figure 3 - 3
Log off confirmation

Once logged off, the **Logon** dialog opens automatically. Log on as a different type of user, such as Admin, to perform the required tasks.

Users with 'Machine Operator Level 1' security role only have access to the process overview and therefore can't use the method described above. For these users, a log off is included in the process overview context menu, refer Log off.

User authentication using Active Directory groups

When @ptitude Observer is used within a managed IT environment an @ptitude Observer administrator can set Active Directory (AD) authentication as the primary authentication method to allow users to open and use @ptitude Observer without explicitly logging on within the application.

Prerequisites and behaviour

All users who will have access to @ptitude Observer (and for whom AD authentication is to be used) must be part of at least one AD group. An @ptitude Observer internally authenticated administrator level user is needed to complete the @ptitude Observer configuration needed for AD authentication.

When the @ptitude Observer configuration has been completed, all members of that AD group will potentially have access to @ptitude Observer at a specific security role. Note that:

- Although a user may be included in multiple AD groups only a single @ptitude Observer role, the highest ranked role, will apply.
- Similarly, if a user belongs to an AD group that is mapped to multiple @ptitude Observer roles then again only the highest ranked role applies.
- An AD authenticated user cannot 'Log off' the @ptitude Observer application and so cannot use @ptitude Observer authenticated user credentials.
- If AD authentication is in place and the authentication fails for the current user, @ptitude Observer will revert to the internal user authentication method and the Logon dialog, will display.
- In Enlight Collect IMx-1 systems, for users to be able to log in through the SKF Enlight Collect Manager app they must be using @ptitude Observer internal user and not Active Directory group, authentication.

Configuring @ptitude Observer for AD authentication

An @ptitude Observer administrator can set Active Directory (AD) authentication as the primary authentication method from the Security roles dialog:

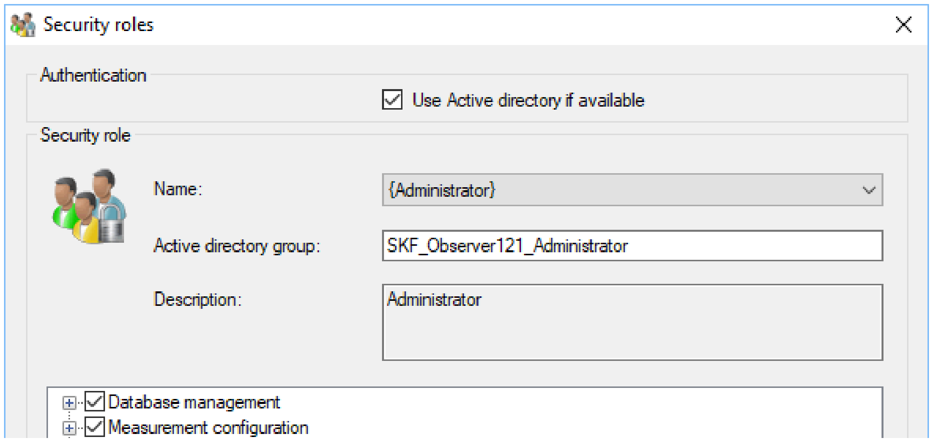


Figure 3 - 4
Security Roles Dialog

Authentication: enable so as to use Active directory if available. Note that this is a global setting and applies to all security roles not just the role selected in the lower drop-down.

Active directory group: @ptitude Observer will propose a default naming based on the software version and the role. Differently named defaults will therefore be available for all predefined roles within the release. Note that if custom roles exist these will be available in the security role drop-down, but no default AD group naming will be offered. Edit the entries as required so that group names indicated here match their respective AD group names.

The changes require an @ptitude Observer restart to take effect but when @ptitude Observer opens with AD authentication enabled it will retrieve the user's domain name for example 'domain\username' and then work through the security roles in order. The first positive match where a query to the AD confirms that domain name exists in a mapped AD group is the security role with which @ptitude Observer will open for the user.

DASHBOARD

After a successful logon, the "DASHBOARD" screen will provide Notifications, News Feed and Message Center interfaces.

Refer to Dashboard under Show in Menu Items section.

4
System Configuration

This chapter describes the configuration of @ptitude Observer, how to get the analysis work started quickly and how @ptitude Observer works as a condition monitoring system.

The configuration of @ptitude Observer is usually performed when the system is installed, however changes can be easily made.

Prior to analysing measurement data, @ptitude Observer must be configured for the particular plant and its machinery. It is important that all machine parts as well as measurement points are located at the correct positions.

Guidance for System Installations

Regular backup of the database is normal practice. Backup intervals and methods are governed by the specific needs of each installation. It is a best practice to create a full backup before any major upgrade of @ptitude Observer.

Databases with many attached IMx devices will grow rapidly. For a new database, it is advised to initially utilise less than 75% of the maximum capacity to allow for future expansion.

The number of IMx devices within a database can be capped by careful choice of the extent of systems included within it. For example, separate databases can be used for different geographical locations, operational processes or company organisational structures.

Recommended System Configurations

To get a system up and running properly the following system configurations should be covered.

- **Build a hierarchy view** by creating necessary plants, areas and machines to organise the condition monitoring systems.
- **Define hardware devices** such as input boards, sensors, signal characteristics, etc. for each device and channel.
- **Define machine parts** by defining the drive line for each machine. All shafts, bearings, gear wheels, drive belts, impellers along with other machine parts, are connected to a drive line. Based on these inputs the system can calculate all defect frequencies within the whole machine.
- **Set up measurement points and alarms** to get the data into the system. For on-line systems, multiple measurement points can be defined per channel, if needed.
- **Build a process overview** for an on-line condition monitoring system which can support viewing data, live as it comes into the system. IMx/MasCon devices typically measure and send data faster than other on-line data acquisition devices. @ptitude Observer enables the creation of user defined displays with measurement points and links to other displays overlaid on graphic pictures like drawings, digital photos, etc.

Building a Hierarchy View

The hierarchy view aims to achieve a logical grouping of all the measurements and to illustrate their relationship to one another.

The hierarchy view has available the following hierarchical levels:

- Database
- Node
- Machine
- Sub machine
- Enlight Collect IMx-1 Sensor and IMx-1 measurement 'clusters'
- Meas. point

Event, run cycle and scheduled, capture groups also display in the hierarchy view and can be added by right clicking on the relevant machine. Each IMx can have only one such capture group, which will display before the other points in the machine's hierarchy. Measurement points are added directly to the group by right clicking on it. Event capture, run cycle capture and scheduled capture are three specific types of measurement group, refer to **Measurement Groups** for further information on the different types and their uses.

Quick Information

If this type of notification is enabled in user preferences, it is possible to hover the mouse over any item in the hierarchy view tree to display additional information about the node, machine, sub-machine, sensor or measurement point. In addition to some basic information, the latching status of the node is shown, as well as the status of the last reading. (The latching status is the summarized status which is shown in the hierarchy.)

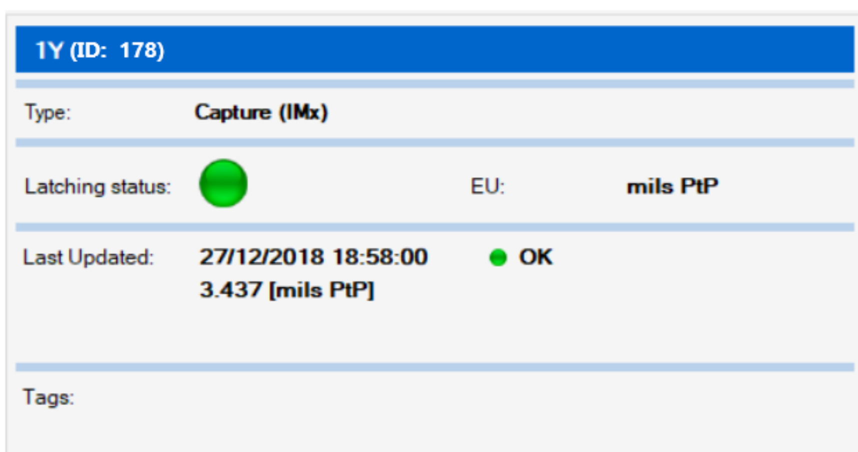


Figure 4 - 1
Example of Quick Information on Mouse Over

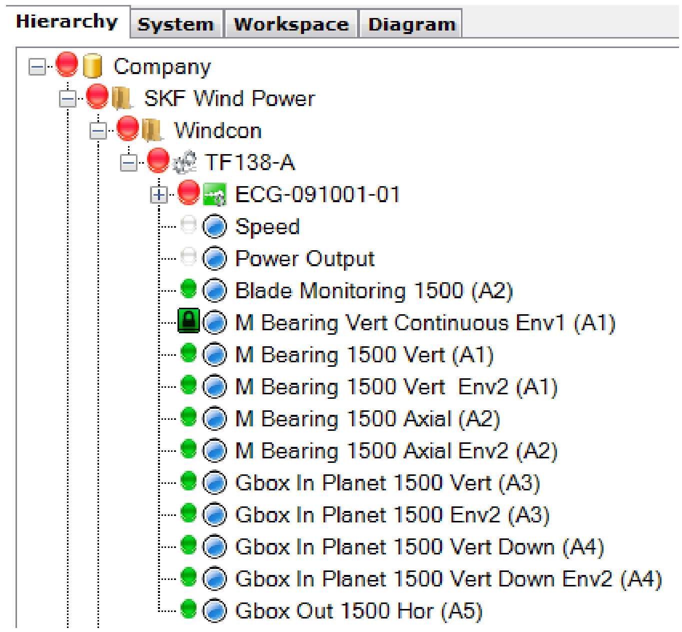


Figure 4 - 2
Example of the Hierarchy View

Database

Database is the logical top level of the hierarchy view with nodes, machines, sub machines, measurement points, machine parts and machine properties underneath.

The main database gets added to the hierarchy view as a top level when a database is selected from the list of registered database connection on local computer via Connections interface under Manage databases in File menu item.

External databases can be added to the hierarchy view as a top level via Add external database interface in File menu item.

Node

A **Node** is a hierarchical element that can be used to describe the layout or organisation so as to provide a logical grouping of machines. The number of nodes is unlimited and nodes can be created within other nodes but not within or below the **Machine** level. There the **Sub machine** is used.

To create a Node:

- First select a node or a database in which a node is to be added in the hierarchy view.
- Click on the right mouse button, select **Add**, then **Node**.
- On the properties screen, enter the name of the node and its description.

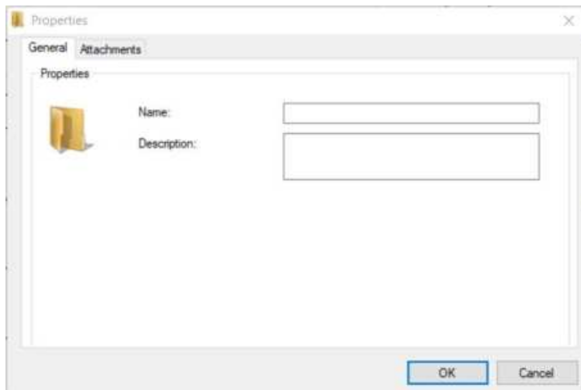


Figure 4 - 3
Create a Node

Attachments tab is a way to add and manage attachments for the node. Although accessible when creating the node, it can only be used when later editing the created node. Similar functionality exists also for the **Machine** and **Sub machine** levels.

Machine

Machine is located in a particular node, for example, Fan 2, Pump 3a, etc.

To create a Machine:

There are different ways to create a machine.

1. First select a node or a database in which a machine is to be added.
2. Click on the right mouse button, select **Add**, then **Machine**.

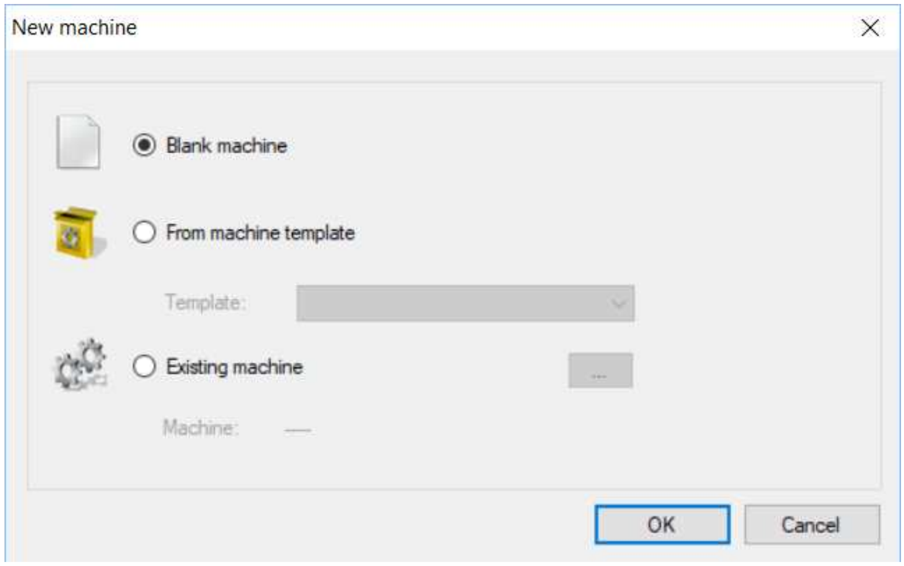


Figure 4 - 4
Create a Machine

- Creating a machine from scratch.
  - Select **Blank machine**, then click **Ok**.
  - Enter the machine properties in General and Extended Information screens. Refer to Machine Properties in System Configuration.
- Creating a machine from a template.
  - Select **From machine template**.
  - Choose a **Template** from the drop-down list: templates already created from existing machines are stored in the template library and will be shown in this list.
  - Click **Ok** to launch the Machine Copy Wizard to help with the process of copying a machine to a new location. Refer to Machine Copy Wizard in System Configuration.
- Creating a machine by copying an existing machine.
  - Select **Existing machine**.
  - Click the ellipses button and then select a machine from the displayed hierarchy view.
  - Follow the instructions in the Machine Copy Wizard section in System Configuration.

Sub Machine

A sub machine is a sub section of a machine.

To create a sub machine:

- First, select a machine in which a sub machine is to be added in the hierarchy view.
- Click on the right mouse button, select **Add**, then **Sub machine**.

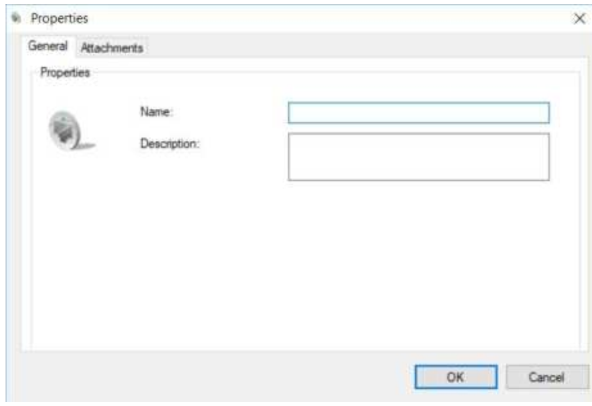


Figure 4 - 5
Create a Sub Machine

- On the properties screen, enter the **Name** of the sub machine and its **Description**.

Enlight Collect IMx-1 Sensor

An IMx-1 sensor node is always added to a sub-machine, refer IMx-1 Sensor. When adding an IMx-1 sensor to a sub-machine in the hierarchy, an IMx-1 sensor node along with a four-measurement cluster is created.

Measurement Point

Measurement point is a measurement that should be captured on a machine. Here a type of sensor, position of sensor, resolution, frequency range, etc. are specified. Note that for measurements reliant on IMx and Direct Modbus devices, these need to be created and configured first:

- IMx/MasCon
- Direct Modbus devices

Creating Measurement Points

Refer to Setting up Measurement Points and Alarms in System Configuration and for additional information specific to certain point types, the relevant manual chapters:

- Direct Modbus Points
- Measurement Group - Measurement points

Managing IMx/MasCon Devices and Channels

This section shows how to set up and edit IMx/MasCon devices and their corresponding channel layouts for the selected database. Note that the process for adding and maintaining an IMx-1 system is described separately, refer Adding SKF Enlight Collect Gateways and IMx-1 sensors.

Devices and then channels must be created before they can be assigned with measurement points.

The number of channels available is dependent on the device type and model, refer to the literature specific to a particular product for details.

- An IMx device typically has 8 or 16 dynamic/analogue channels and 2, 4 or 8 digital channels (dependent on the specific IMx model).
- Each WindCon or MasCon16 device has 16 channels of the vibration/analogue type and 2 channels of the speed/digital type.

To get to IMx/MasCon devices screen:

- First, click **On-line** on the toolbar.
- Select **IMx/MasCon devices**.

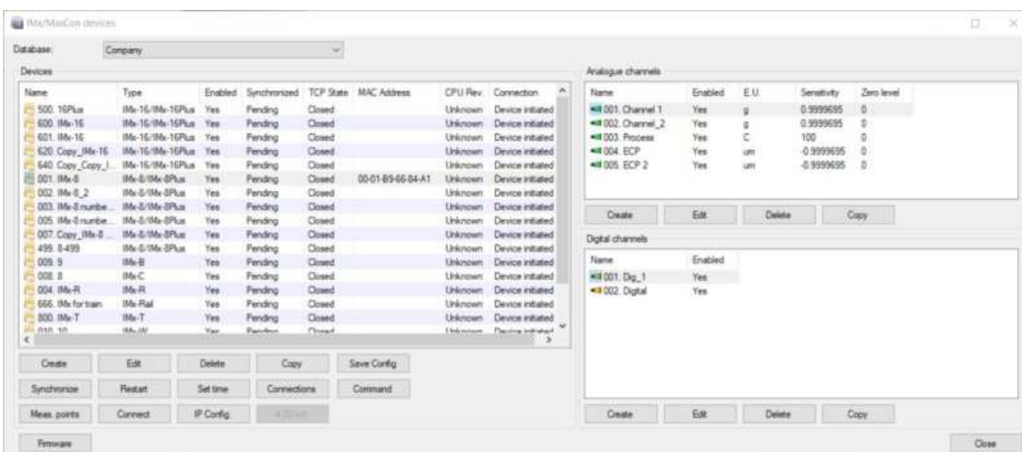


Figure 4 - 6
Example of IMx/MasCon Devices Screen

- Select a database.

The IMx/MasCon devices dialog contains a number of control buttons for the **Devices**, **Analogue channels** and **Digital channels** windows that after creating a device or channel, can be used to manage or further configure it. These latter controls usually require a device or channel to be selected in the window before pressing the appropriate button.

Create

Click the **Create** button below the **Devices** table to create a new device for the selected database. On the **New device** dialog, select the **Type** of device to be created. A screen for creating the new device appears.

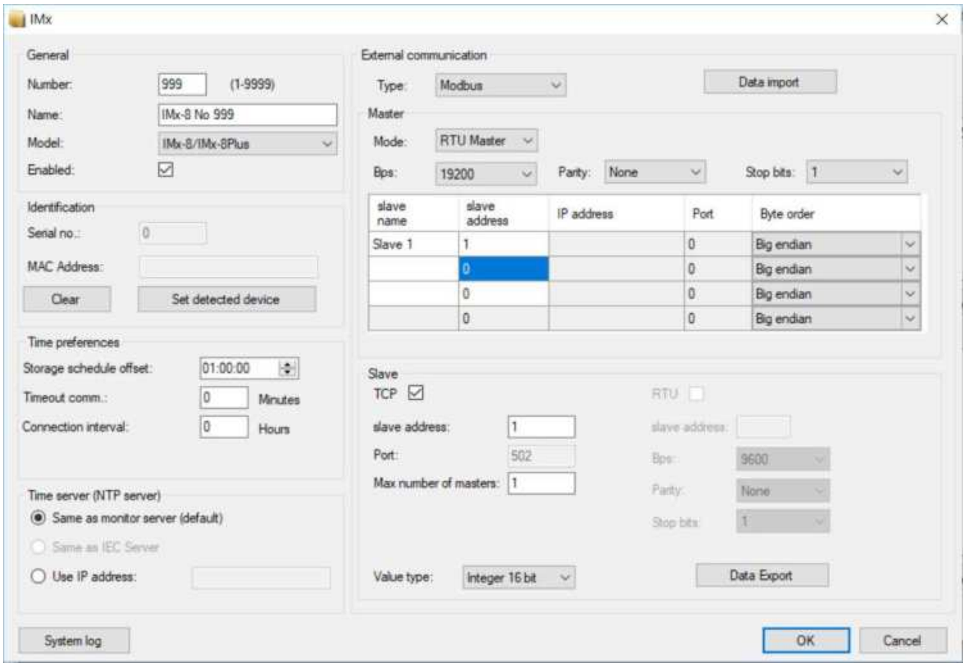


Figure 4 - 7
Example of Create IMx Screen

The following attributes are available for creating a device. Note that different attributes are available depending on the device **Model** selected.

Number is a unique number for the device. IMx devices may have a unit ID number from 1 to 9 999. Mascon16 devices may have a device ID from 1 to 255.

Name is a free text name that can be used to identify the device.

Model can be selected from the drop-down, for example: IMx-8/IMx-8Plus (one joint entry for the IMx-8 and IMx-8Plus and similarly another for the IMx-16 and IMx-16Plus).

Enabled (ticked) is the normal status of a newly created device. This control can be used to disable the device if desired. A device might be disabled if it is not yet physically in place or a connection to it is not currently available.

Serial no. (available for IMx/MasCon16 only) is a read only field that displays the serial number that this device had and should continue to have. This is used to enforce data integrity.

When a device is set up it will get the serial number "0".

When a device connects for the first time, the serial number of that device will be stored automatically in the database.

The next time any device connects with the specific device number the device is challenged for a serial number match. If serial numbers mismatch the device is not allowed to connect to the monitor service and a system alarm will be generated to the user.

If the device is replaced or the CPU board of the device is replaced, it is necessary that the serial number is reset by clicking the Clear button.

MAC Address displays the MAC address reported by the device and then stored in Observer. With firmware v5.907 or later, the IMx model and memory size of the device are also detected automatically when the device connects to Monitor and Observer. The memory size detected dictates the CPU Rev that is shown in the main IMx/MasCon devices dialog.

- The CPU Rev is stored/displayed as "Higher than v1.48" if the SDRAM-size is 64 MB and "Lower than v1.48" if the SDRAM-size is 32 MB. When Monitor generates a configuration, it checks if the configuration needs the newer "Higher than v1.48" CPU type. If there is a mismatch; a system alarm will be sent to Observer informing the user of this and a popup with the text "Invalid Device Configuration" will be displayed in Observer.

When an IMx device connects to Monitor and Observer, Monitor compares its MAC address and model to what is configured in Observer. If there is a mismatch, a system alarm in Observer informs the user. The alarm contains the MAC address or Model that the device sent. The connection is closed when there is mismatch of the MAC address or Model.

Clear – click the **Clear** button to clear both the stored serial number and the MAC address of the unit in Observer. The **Clear** button also clears any association with any device that has been assigned through the **Set detected device** function.

Set detected device – is a way to create a new device in the Observer database based on the detected device or to "transfer" the identity of a detected device to an already configured device that exists in Observer.

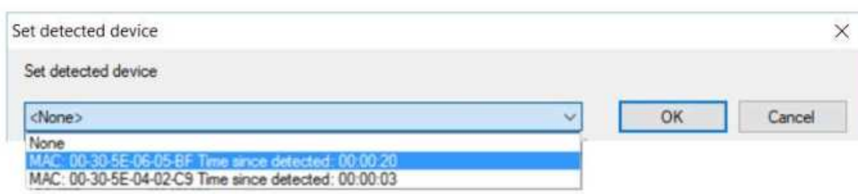


Figure 4 - 8
Example of Set Detected Device List

Be aware that the drop-down list contains only devices that meet all the following criteria:

- are detected in the last two hours
- are in stand-alone mode or set as server initiated
- are *not* already assigned to a device
- are *not* in maintenance mode
- are in the same network sub-net
- are broadcasting their MAC address if connected by Wi-Fi

When assigning an existing identity to a new/different physical device, the 'detected device' selected, must always be the same type of IMx as the existing identity to which it is being associated. After the configuration is complete, it will always be Monitor that initiates the transfer process, not the IMx.

The **Connection** column on the IMx/MasCon devices screen indicates whether the connection to the device is Device initiated (the default) or Server initiated (initiated by Monitor).

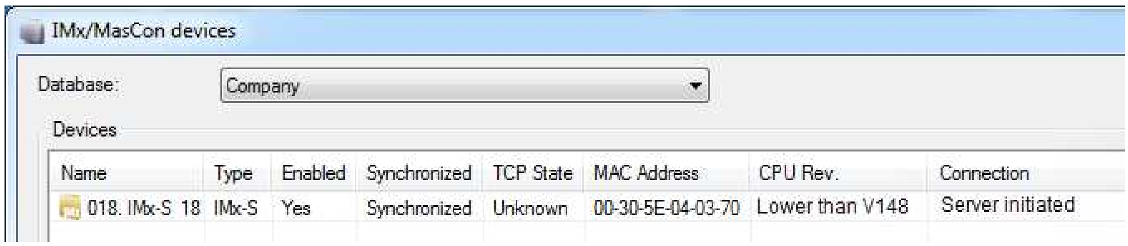


Figure 4 - 9
Example of the **Connection** Column

Storage schedule offset is a parameter that is used in conjunction with **Connection interval** just to spread the workload of the monitor service and server in the @ptitude Observer environment, when using multiple devices that are not permanently connected to the monitor service. The setting acts as a time offset for when the device should connect to the monitor service and upload all the collected data which has been stored on the device. Using this setting, the workload of the monitor service and server can be spread out over a 24-hour period instead of all the devices connecting and uploading their data at the same time. Note that this setting affects neither the actual time of the measurements nor the reported time of the measurements. This setting has no effect unless the **Connection interval** parameter is also set, see below.

Timeout comm. (communication) is an interval of time in minutes used to generate a system alarm if there was no communication between the device and the @ptitude Observer Monitor for that interval of time.

Connection interval sets a minimum interval of time between successive connections of the device to @ptitude Observer Monitor. For example, setting 24 (hours) specifies a connection to the monitor service, only once per day. In conjunction with **Storage schedule offset**, it can be useful to control processing workload and traffic on the network and monitor computer. It is used, for example when using ISDN (integrated services digital network) routers.

External communication is available for IMx and to a more limited extent MasCon16 devices. It is used to configure the functionality of the selected external communication type on the device.

Type can be *None*, *Modbus, GPS(GPS50M), MVB*, *TSI* or *IEC61850 MMS*. Note that the available types vary depending on the model of the selected device.

- *Modbus* supports connections between the IMx and multiple other Modbus devices including the possibility of simultaneous RTU and TCP, master and slave usage. See **Modbus Communication** and following sub-sections for typical scenarios and the restrictions that apply.

- *GPS(GPS50M)*, implements a fixed Modbus RTU Master configuration for communication with the SKF supplied GPS receiver module. Note that selecting this option implements a dedicated Modbus configuration to import that data, which does not support other or multiple devices, see **Configuring External Channels**.

For Modbus: (**Master**) **Mode** can be set as either *TCP Master* or *RTU Master*.

For Modbus RTU:

Bps defines the speed of the Modbus bus.

Parity provides Modbus data validation which can be set to *No Parity*, *Odd Parity* or *Even Parity*.

Stop bits defines the number of stop bits in use for Modbus. It can be *1* or *2*.

Slave Name is a name given to help identify the Modbus slave device.

Slave Address is a Modbus slave address with which the (IMx) Modbus master communicates.

IP address specifies the IP address of the desired target device.

Port is the standard port for the Modbus TCP/IP protocol.

Byte order specifies the byte arrangement of the slave data being read.

Data Import accesses **Configuring External Channels**

Slave: **TCP** and/or **RTU** support

Slave address here, is the address of this IMx, as a slave device.

Bps, Parity and **Stop bits**, for the Modbus RTU link (when used)

Max number of masters is the number of external Modbus TCP master devices which will access this IMx.

Value type is either Integer 16 bit or Float 32 bits.

Data export accesses **Configuring Modbus Export**

Parameter is application specific and is required only for MVB and TSI types.

Time server (NTP server) configures the Time server (NTP server) for an IMx device. NTP stands for Network Time Protocol, which is an Internet protocol used to synchronize computer clocks to a specified time service. (See Figure 4-7.)

Same as monitor server (default) uses the NTP Server parameters specified in the network configuration file downloaded through the serial interface. See **time synchronization thresholds** for details about setting up threshold alarms.

Same as IEC Server If this option is selected, the IEC server to be used, must be identified. In the External communication section, select the **Type** as **IEC61850 MMS**. Next, check **Client Enabled**. Enter the **Server address**, which is the IP address of the IEC Server.

Use IP address enables the IMx device's NTP IP address to use the same NTP service as the machines, turbines, etc. it is monitoring.
For example, IMx A is monitoring Machine 1. Machine 1 is an NTP client of an external NTP service. By setting the NTP server address of IMx A to point to the

same NTP service as Machine 1, the timestamps from Machine 1 and IMx A will be aligned. See **time synchronization thresholds** for details about setting up threshold alarms.

System log is a record containing all the historical configuration changes made to the device.

Edit TSI Config is available for IMx-R devices only. It configures the IMx-R TSI part and MVB. For more information, refer to the "IMx-R User Manual", part number 32179900.

Modbus Communication

Subject to certain restrictions, an IMx supports multiple Modbus instances, including simultaneous RTU and TCP use and support for multiple slave devices:

Table 4-1.
Allowable Modbus combinations.

	TCP Master	RTU Master
TCP Slave	Supported	Supported
RTU Slave	Supported	Not supported
TCP Slave + RTU Slave	Supported	Not supported

Only one instance can use **Master Mode:**

- If *RTU Master* is selected, then *RTU Slave* is unavailable
- If *TCP Master* or *None* is selected the IMx can be a *TCP* and/or an *RTU* slave

The IMx can be a **TCP** or **RTU Master** to multiple slave devices and a **TCP** slave to multiple masters:

- The total number of Modbus connections is limited to 4
    - ‘Modbus Connections’ is the sum of all slaves (to which the IMx is a master) and masters to which the IMx is a slave (TCP and RTU)

GPS(GPS50M) represents a special Modbus configuration where the IMx is an RTU master to a single specific (GPS receiver) module, with slave address, 1. In that case no multi-use of the Modbus RTU communications is allowed.

The examples in the following sections will illustrate typical usage.

For more information about Modbus communication, refer also to the application note: "*General Modbus Protocol Considerations for IMx Devices*" (document part number CM3226) and to: "*Modbus for SKF IMx and @ptitude Observer*" (user manual part number 15V-090-00051-100).

Configuring Modbus Master Communication

When **Type** *Modbus* is selected, and the **Mode** is *RTU Master*, the **Bps**, **Parity** and **Stop bits** fields are available. Select the same serial port parameters (Bps, Parity, Stop bits) as for the generic Modbus slave to ensure communication between master and slave.

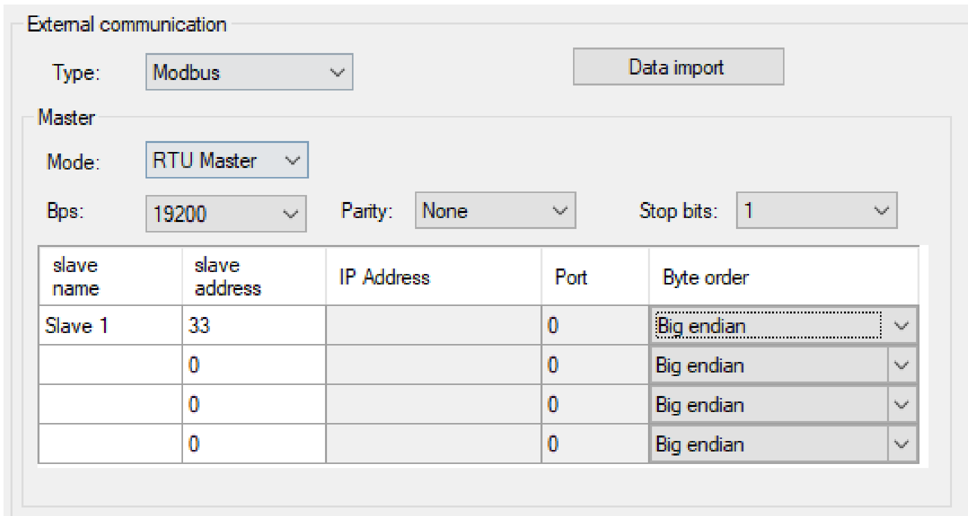


Figure 4 - 10
Example of IMx with Modbus Communication Mode RTU Master

When **Type** *Modbus* is selected, and the **Mode** is *TCP Master*, the **TCP/IP address** and **Port** fields are available. Enter the **TCP/IP address** of the desired target device. **Port** number defaults to 502.

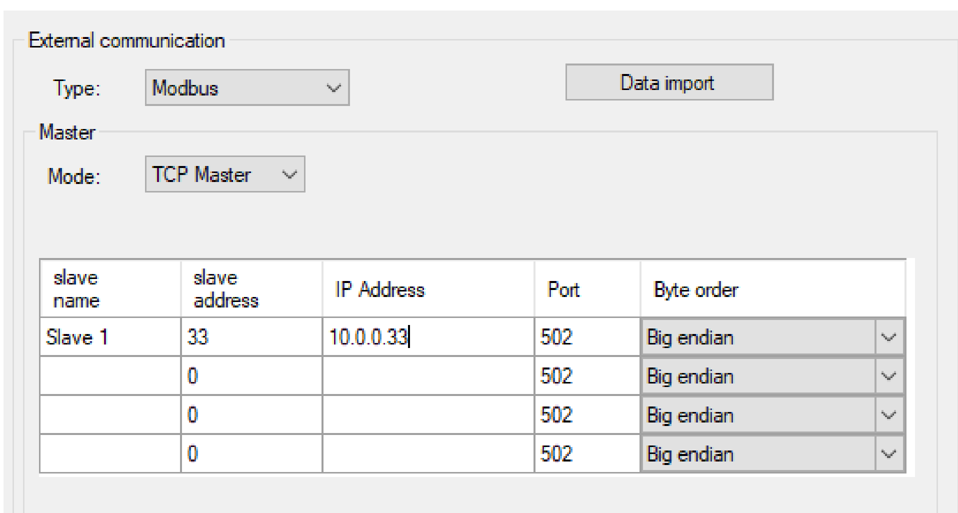


Figure 4 - 11
Example of IMx with Modbus Communication Mode TCP Master

Master devices retrieve data from slave devices (and in the IMx this data is written to 32 virtual channels, see [Configuring External Channels](#)). The Modbus **Byte order** setting is a per slave setting that specifies how the slave data is organised and how to read the bytes in the client unit (IMx).

Big endian format stores the most significant byte first at the lowest storage address.

Big endian word swap takes the big endian format and swaps the word order of two consecutive registers.

Little endian format stores the least significant byte first.

Little endian word swap takes the little endian format and swaps the word order of two consecutive registers.

➢ Since the required word swap depends on the size of the numbers stored in the file (two 2-byte integers require a different swap than one 4-byte integer), the file format must be known to perform endianness conversion.

For more information, refer to the application note: *"General Modbus Protocol Considerations for IMx Devices"* (document part number CM3226).

Up to four slaves can be associated with the IMx master and a table row is available for specific settings for each. The available rows (maximum number of slave devices supported) in any particular situation is affected (reduced) by the number of instances where the IMx is also configured as a slave to a Modbus master.

A right click context menu provides for removing a slave entry and for copying slave settings to an empty/available table row:

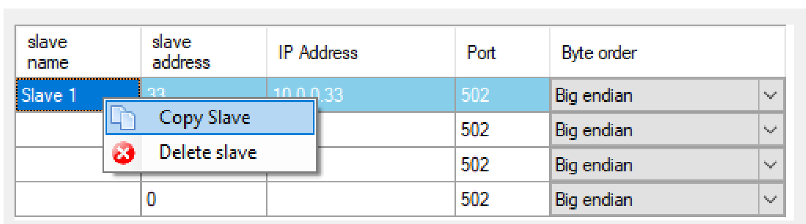


Figure 4 - 12
Context menu for copying and deleting slave devices

Note that all slaves should have unique **Slave Address** entries.

Warning messages will be given under the following circumstances:

- Attempting to select *RTU Master* when *RTU* slave mode is already enabled
    - Not allowed
- Changing the **Mode** from *TCP Master* to *RTU Master*
    - Allowed, but results in loss of TCP configuration information

Configuring Modbus Slave Communication

Subject to the choice of master mode and the number of slaves which should be addressed, there is also the possibility to configure the IMx as a slave device:

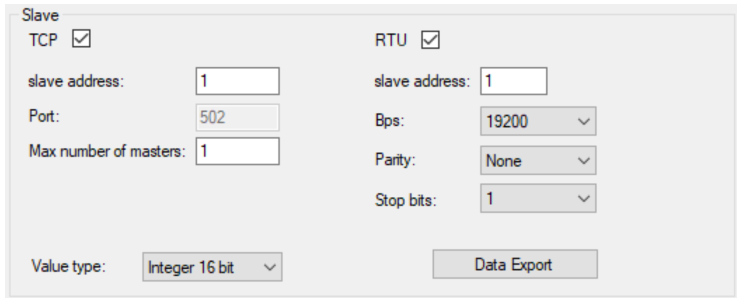


Figure 4 - 13
Example of IMx configured as Modbus Slave

A slave device typically makes data available to external Modbus master devices, see **Configuring Modbus Export**.

Slave devices can usually also import data, **Configuring External Channels**, but this is not allowed if, in another Modbus instance, the IMx is also a Modbus master.

When *RTU* is selected, the **Slave address**, **Bps**, **Parity** and **Stop bits** fields are available. Select the same serial port parameters (Bps, Parity, Stop bits) as for the generic Modbus master to ensure communication between master and slave.

When *TCP* is selected, the **Port** number is read only and only the **Slave address** and **Max number of masters** fields are available.

Max number of masters: The IMx can be a TCP slave to multiple Modbus master devices. Set here the maximum number of master devices to accept, noting that the range is 1 to 4*

*4 is only allowed where no other Modbus connections are in use. Each connection (as a TCP or RTU Modbus slave to one master device and as a TCP or RTU Master to one slave device), counts towards the total allowance of 4 connections.

The **Value type** selection and **Data Export** button configure up to 128 registers of measurement data, for export to a Modbus master. This data and its configuration is common to all connections to external master devices, they all have the same data available to them.

The **Value type** setting specifies how the IMx presents the values, either as *Integer 16 bit* or *Float 32 bit*.

When *Float 32 bit* is selected, the following apply:

- Only odd register numbers are used in the Modbus export dialog.
- A maximum of four speed channels are allowed, depending on the IMx model.
- The 32-bit floating point value is output in Big Endian Word Swap format.
- A sensor fault or source point out of range will return a NaN (Not a Number).

When *Integer 16 bit* is selected, the following apply:

- Both odd and even register numbers are used in the Modbus export dialog.

- The dialog then includes a Full scale configuration setting that scales the measurement value to a 16-bit signed integer.
- Full scale must be a positive number greater than 0.
- The register data range for a vibration point (overall level) is 0 to +32767, corresponding to 0 to Full scale.
- The register data range for a process point is -32767 to +32767, corresponding to -Full scale to Full scale.
- A value clipped by the conversion will limit at the register data range, -32767 or +32767.
- The register value -32768 is reserved for sensor fault indication.

Configuring Modbus Export

Click the **Data Export** button to open the Modbus export dialog.

The configuration window assigns a measurement point to a Modbus input register. A multi-channel point uses one Modbus register for each channel.

➢ All IMx point types are supported except Running hours, Counter and Gear inspector measurement points.

Note that the population of the Modbus export dialog after a database upgrade will have the following exclusions:

- Multi-channel measurement points are excluded from the Modbus export dialog. To export the measurements, select the points again from the **Point name** drop-down list.
- In measurement points with decimals in the measurement range the **Full Scale** is rounded up to the greater integer.

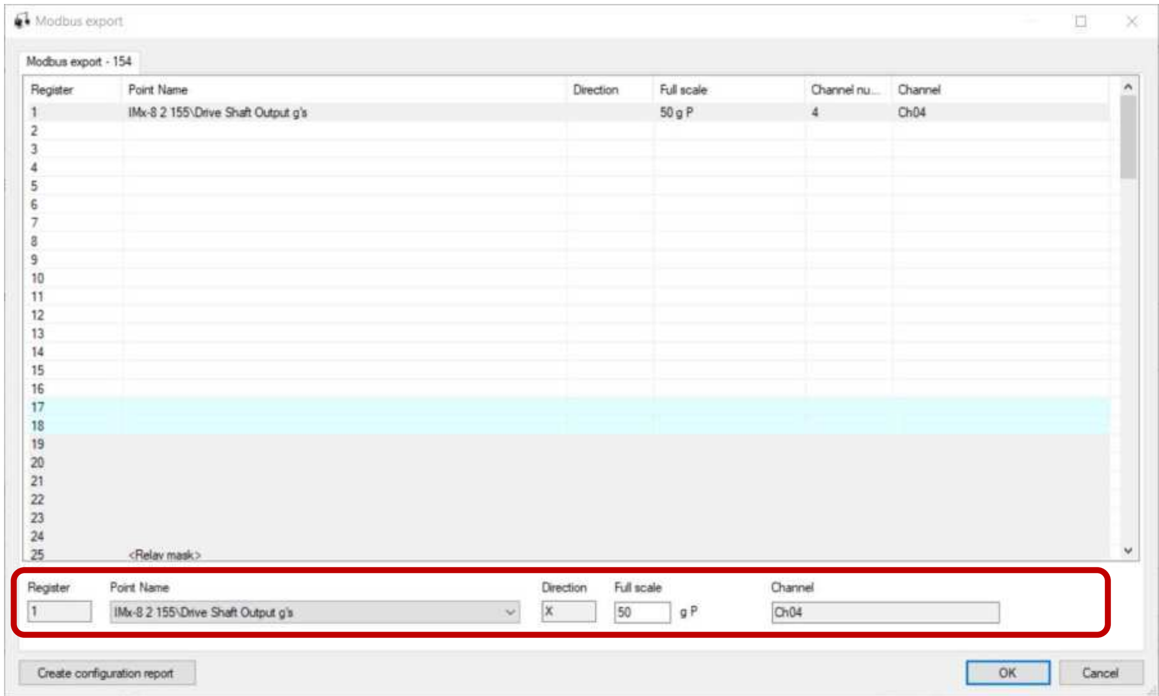


Figure 4 - 14
Example of Modbus Export Dialog

Use the fields at the bottom, below the Modbus Register list, to enter data and select the **Point Name**. The Modbus export selections can include some or all of the measured points from the analogue and digital channels of an IMx device; the speed measurements from the digital channels; the relay mask, warning mask, alarm mask, heartbeat, system information status, digital input status and System diagnostic status.

Modbus registers 1-16, 31-128 are freely configurable.

Modbus registers 17-24 are reserved for speed points.

Modbus registers 25-30 are reserved for the output of relay mask, warning mask, alarm mask, heartbeat, system information, digital input status and System diagnostic status.

- As stated above, when *Float 32 bit* is chosen as the **Value type**, only odd register numbers are used in the **Modbus export** dialog and a maximum of four speed channels are allowed, depending on the IMx model.

The **Create configuration report** button, at the lower left of the dialog, saves the information currently visible in the Modbus configuration table for documentation purposes. Click **Create configuration report** to save a file in CSV format, the report provides a record of how the registers have been configured on a device.

Configuring IEC External Communication

When @ptitude Observer has the license module “IEC 61850” installed, the option of configuring External communication as IEC 61850 MMS is enabled.

The following IMx models allow the External Communication **Type** to be **IEC61850 MMS**: IMx-W, IMx-C, IMx-S, IMx-T, IMx-B, IMx-8/IMx-8Plus and IMx-16/IMx-16Plus.

- IEC 61850 is a standard for the design of electrical substation automation. IEC 61850 is a part of the International Electrotechnical Commission's (IEC) Technical Committee 57 (TC57) reference architecture for electric power systems.

Attempting to select IEC61850 MMS as the Type without having the appropriate device model or license key, will cause a message to display stating: To use this feature an extension of your license key is required.

When IEC61850 MMS is enabled, the additional **External communication** settings must be configured.

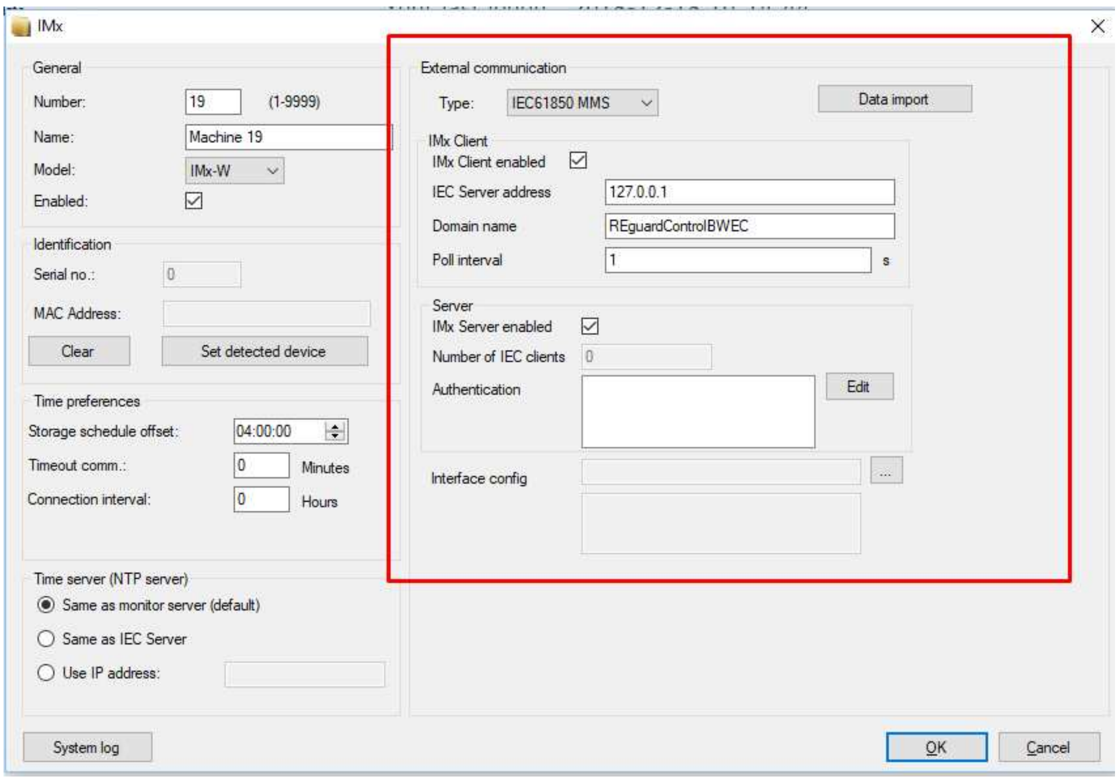


Figure 4 - 15
Example of Create IMx Screen with IEC61850 MMS Enabled

- Set up the IMx to communicate as a **Client**, requesting data from the IEC controller server:
  - Select (check) the **IMx Client enabled** checkbox to enable the IMx to communicate with the applicable IEC controller as a client.
  - Enter the IEC controller IP address in the **IEC Server address** text box.
  - Enter the IEC controller **Domain name**.
  - Enter the frequency, in seconds, with which the IMx will ask for data from the IEC controller in the **Poll interval** text box.
- Set up the IMx to communicate as a **Server**, providing data to the IEC controller server:

- Select (check) the **IMx Server enabled** checkbox to enable the IMx to communicate with the applicable IEC controller as a server.
- Enter the number of clients (up to three) that will connect to the IMx in the **Number of IEC clients** text box.
- Click the **Edit** button next to the **Authentication** text box to access a **Password list** dialog, where it is possible to add and manage up to three usernames and passwords for access to the applicable clients.

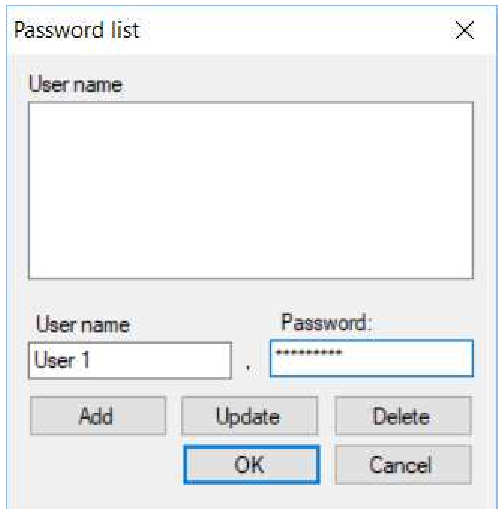


Figure 4 - 16
Example of Password List Dialog

- Click the browse (ellipsis) button next to the **Interface config** text box to locate and attach the appropriate parameters (.iec) file. This special file contains coded parameters that the IMx will require to successfully read and understand data from the server.

Once the IEC is configured, continue with configuration of the appropriate external channels.

> ➢ The appropriate license key is required to make any change to the IEC external communication configuration. If the IMx device is already configured for IEC external communication but there is not an appropriate license key, the external communication fields will be read only.

Configuring External Channels

External channels are IMx channels based on externally sourced data. The external channel setup window applies to all types of IMx devices and all types of external communication, so the layout differs depending on what device is used and how external communication is configured.

Modbus - Supports 32 external channels. Where the IMx is a Modbus master; this supports data from multiple slaves but no access to these registers is available to connections where the IMx is also a Modbus slave. Makes no distinction between analogue/digital (do not use the same external channel in both types because they cannot be configured differently).

GPS(GPS50M) – A specific configuration supporting the external GPS module available from SKF.

IEC61850 - Supports 32 external analogue channels.

IMx-R and RB06 TSI - Supports both analogue and digital at the same time: 32 analogue and 4 digital channels.

To access the Modbus external communication channels dialog, click the **Data Import** button.

The first example below, shows the external communication channels of an IMx device setup as a Modbus master.

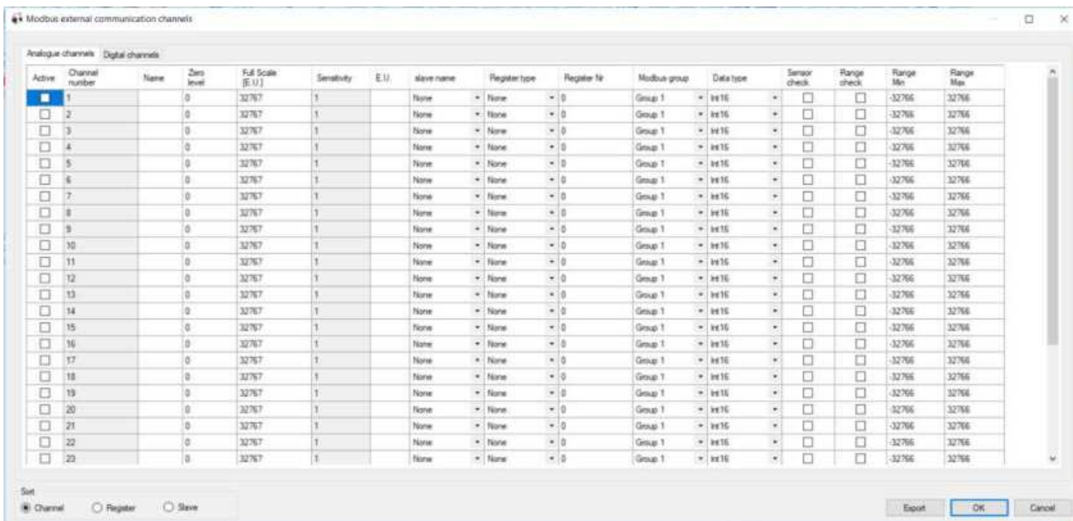


Figure 4 - 17
External Channels with Modbus Master Setup

The Modbus configuration dialog has three sorting buttons, one for sorting by **Channel** number another for sorting by **Register** type and number and one for sorting by **Slave name**. The **Slave name** column has a drop-down control to allow the selection of any of the configured external slave devices.

In addition to **OK** and **Cancel** buttons, **Export** exports the configuration to a CSV file format.

When setting **Full Scale**, the sensitivity of the channel is calculated from range value and full scale value.

Maximum of (abs[Range min], abs[Range max])/full scale.

In the **Data Type** column, configure Modbus to read *int16*, *int32*, *Uint16*, *Uint32* or *Float*.

- If the data type *Float* is selected, the Full Scale cell becomes read only and a sensitivity value is entered instead.

When **Sensor check** or **Range check** are not enabled with a checkmark, the **Range Min** and **Range Max** are ignored.

Modbus Group can be applied to the Modbus registers. These groups are used to optimise the data transfer and avoid unreadable registers. Up to three groups per slave, each with a maximum span of 125 registers are supported. Make sure to select a different Modbus group if this register range is exceeded, if there are unreadable registers to avoid or if the register type changes. For example:

Ch1	> Holding	> Reg Nr. 101 => Group 1
Ch13	> Holding	> Reg Nr. 201 => Group 1
Ch26	> Holding	> Reg Nr. 409 => Group 2
Ch27	> Input	> Reg Nr. 150 => Group 3

- A group cannot contain both holding and input register types.

In the Analogue channels tab, the channels that are configured as digital have a grey background and cannot be edited. Similarly, in Digital channels tab, the channels that are configured as analogue have a grey background and cannot be edited.

When one row is selected, right click with the mouse to open a context menu. The menu option **Clear row** resets the selected row to its default settings and marks the channels as not modified.

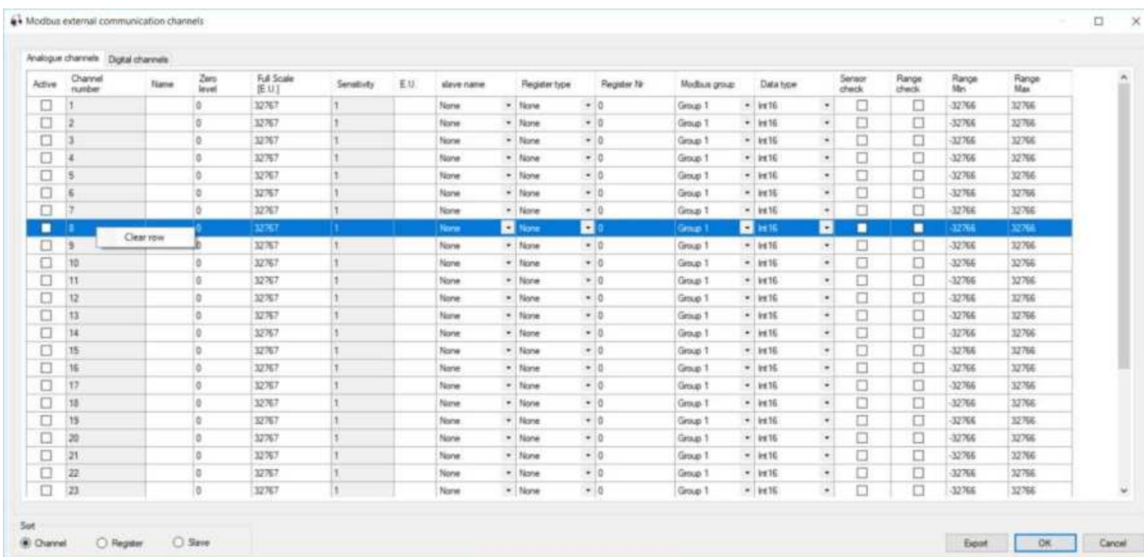


Figure 4 - 18
Clear Row Option in the Context Menu

The second example below shows the external communication channels of an IMx device set up as a Modbus slave.

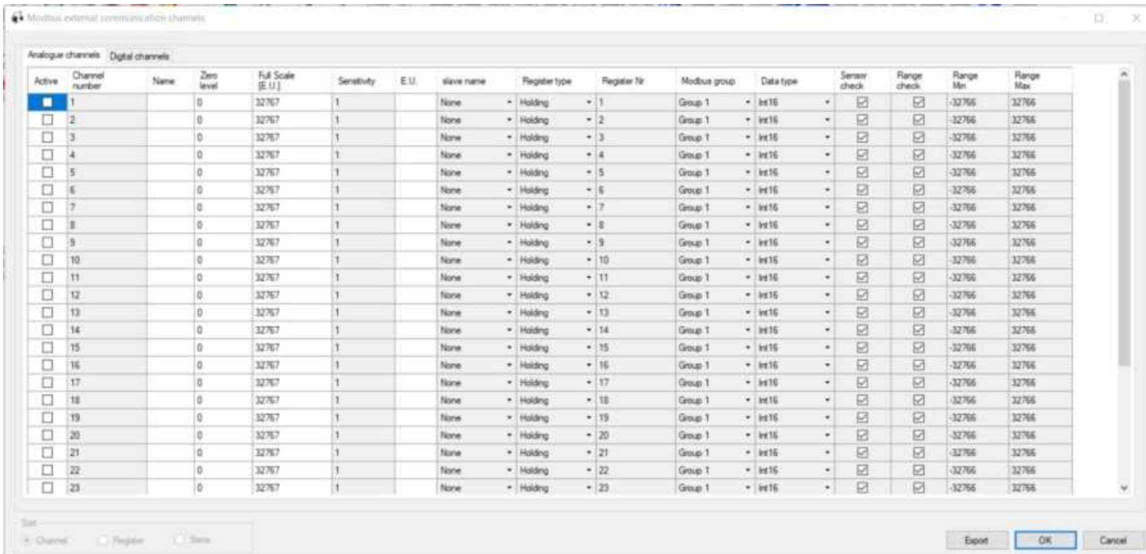


Figure 4 - 19
External Channels with Modbus Slave Setup

When Modbus is enabled in slave mode additional fields, those shown with a grey background, are not editable.

Note that external communication channels are not available to an IMx in slave mode, if it is also configured as a Modbus master device (sole use of these 32 channels by the connection in master mode).

Also, be aware that it is not allowed to write to IMx registers when the IMx is a slave to multiple masters.

The next example below shows the external communication channels of an IMx device set up to communicate with a *GPS(GPS50M)*, slave.

Figure 4 - 20
External Channels when external communication **Type** is *GPS(GPS50M)*

This is a fixed/standard configuration for retrieving GPS position data from the device. When switching from **Type** *Modbus* to *GPS(GPS50M)* a warning message will be displayed because any existing Modbus configuration will be lost.

The example below shows the channels when external communication **Type** is set to IEC61850.

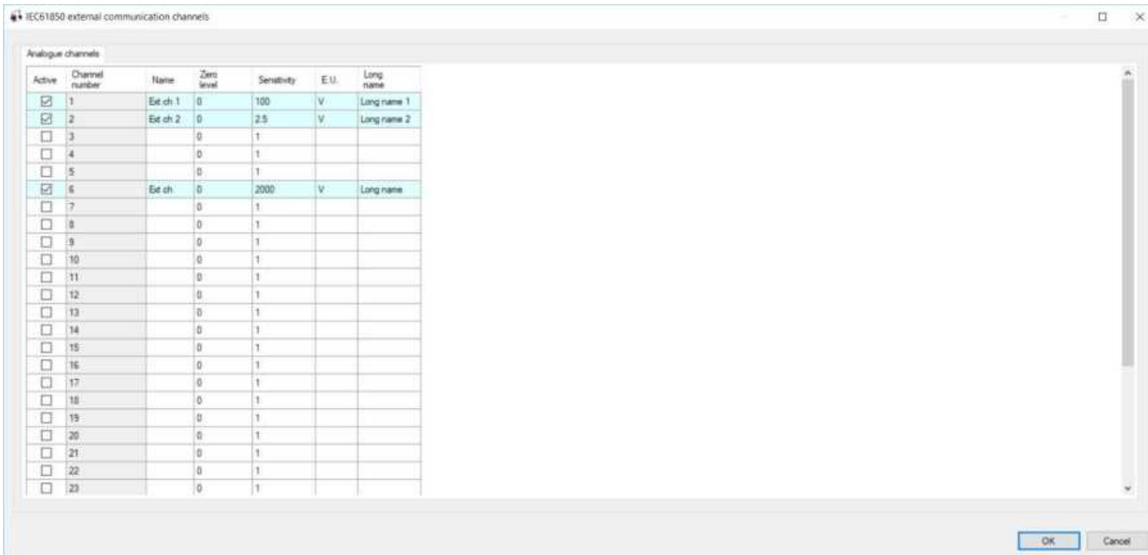


Figure 4 - 21
External Channels with IEC Setup

When external communication is set to IEC61850, the column **Long name** is visible. Use this column to configure the name of the IEC data that should be read.

Edit

Edit function allows the settings of an existing device within the selected database, to be changed. The definitions of attributes are the same as in Create though the **Number** and **Model** fields cannot now be edited.

The following attribute is available only for Edit function:

Convert to IMx converts an existing MaxCon16 to an IMx device.

- After the conversion, the device type cannot be reverted.
- When converting to an IMx-8/IMx-8Plus only channels 1 to 8 can be converted and, if applicable, the user will be prompted to delete or disconnect points using channels 9 to 16.

Delete

The **Delete** function deletes an existing device. Normally, before a device can be deleted, all the attached measurement points and device channels must be deleted first. Holding down the CTRL key however, changes the button from **Delete** to **Force delete** which will delete a device, even if it has existing channels configured.

Copy

Copy function allows all the settings of an existing device to be copied to a new device. Note, a unique device number for the new device must be selected from the list of system generated numbers.

Save Config

Save Config allows the measurement configuration settings of an existing device to be saved as a plain, readable text file to a location of the user's choosing. The information is broken down into logical sections such as Global parameters or by channel etc. and each of these sections has an 'END' entry to delimit and mark its extent.

Synchronize

Synchronize function sends a newly generated, complete setup file from the local database where setup changes are stored, to the remote device such as an IMx/MasCon16. The transmission is sent by the @ptitude Observer Monitor service. If this fails because of an error or timeout, then the IMx/MasCon device will be indicated as not synchronized**.** Not synchronized means that the system is yet to download the newer setup to the device.

After clicking **Synchronize**, Monitor generates a configuration and it checks whether the configuration needs the newer CPU type. If so; a system alarm is sent to Observer and Observer, then displays a communication error stating "Invalid Device Configuration".

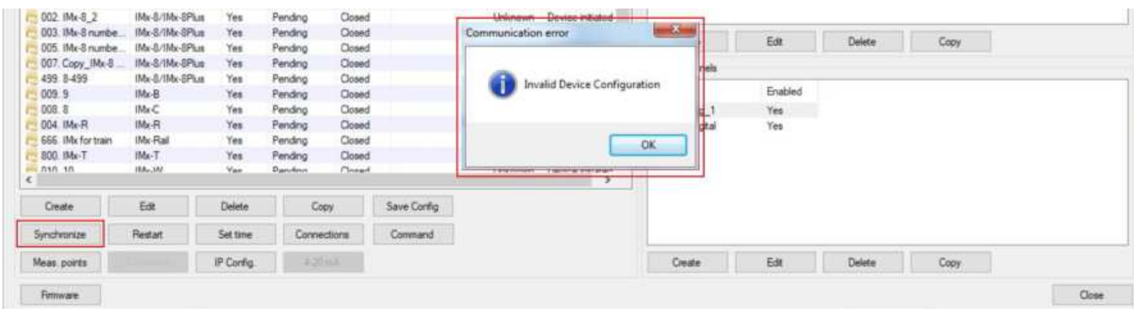


Figure 4 - 22
Communication Error Displayed When CPU Type is Incorrect

Restart

Restart function forces the device to perform a self-diagnostics boot-up stage and reinitialize all the channels and setup information.

Set Time

Set time function sets up a time on an IMx/MasCon16 device of the selected database and adjusts any incorrect date and time. Since IMx/MasCon16 devices do not use local computer time, this function is the way to synchronize devices' time to that of the computer from where the function was initiated.

Connections

Connections function produces a log of connection histories of the device. The log can be used to solve intermittent connection problems for an IMx/MasCon device.

There are different types of messages:

- **Error**: indicates that a communication error exists. It can be that the communication between the device and the @ptitude Observer Monitor is not stable or is unreliable.

- **Unknown**: indicates that the @ptitude Observer Monitor service has been closed unexpectedly, for example because of a loss of power to the @ptitude Observer Monitor.
- **Monitor restart**: indicates that the @ptitude Observer Monitor service has been closed normally.
- **Normal***:* indicates that the IMx/MasCon device has been restarted normally.

Measurement Points

The Measurement points function provides a list of all measurement points available on the selected device and allows their enabled status to be set. This is an especially useful function for portable systems: to be able to change the status of measurement points using the same channels.

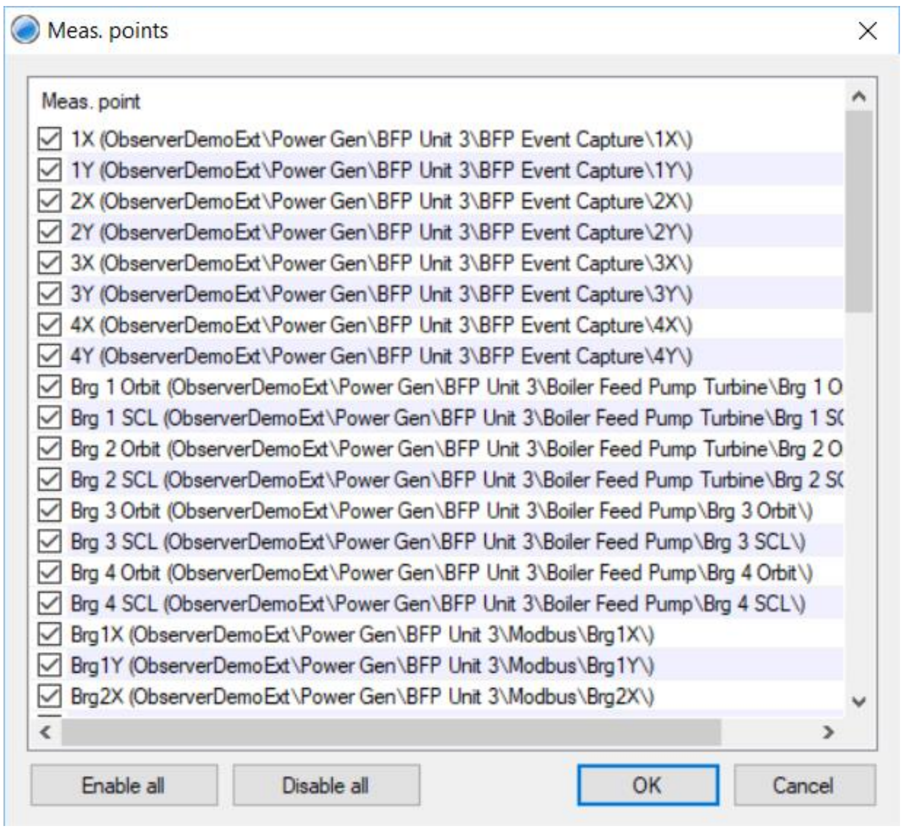


Figure 4 - 23
Example of Measurement Points Status

Enable or disable an individual measurement point by checking or un-checking each box or change the status of all the measurement points at once by using the **Enable all** or **Disable all** buttons.

Note that there are limitations for the total number of enabled points and within that a limit on the number that can be vibration/dynamic points. These form part of the device limitations for channels and points. For the IMx-S, IMx-8/IMx-8Plus, IMx-16/IMx-16Plus and variants of these, the following apply:

- Up to 32 external channels are allowed: these are used for externally sourced data such as data received from Modbus slaves, refer Configuring External Channels. These external channels are additional to physical device analogue and digital channels. Example: an IMx-S can have up to 56 channels comprising 16 analogue, 8 digital and 32 external channels.
- A maximum of 100 enabled dynamic and trend measurements of which up to 80 can be dynamic. The point type classifications dynamic and trend are explained in Measurement Points.

Connect

Connect function connects an IMx/MasCon16 device to the @ptitude Observer Monitor for a specified time (in minutes). The "Connect" function can be used when devices have been configured to only connect once a day to the Monitor service (by configuring the "Connection Interval" parameter). This can be useful when changing the configuration or checking vibration data before the next scheduled connection time of the device.

Figure 4 - 24
Example of Forced connection

To communicate with the device between scheduled connections, the connection must be established manually from the server side through @ptitude Observer.

IMx/MasCon16 devices initiate communication to @ptitude Observer Monitor on TCP port 1000 which is the default port. However, do not confuse this with the @ptitude Observer Monitor port (configured through Observer On-line Device Configurator).

For example, use port forwarding to access devices behind a router;

- 11.22.33.44 port 1001 ---> 10.0.0.101 port 1000 for IMx #1
- 11.22.33.44 port 1002 ---> 10.0.0.102 port 1000 for IMx #2
- 11.22.33.44 port 1003 ---> 10.0.0.103 port 1000 for IMx #3

IP Configuration

IP Config. function sends a network configuration file to the selected IMx/MasCon16 device. To create an IP configuration that can be sent to a DAD (data acquisition device), the tool called On-line Device Configurator should be used. It is available in the Observer installation package and can be started from the start menu if it is installed. For more information, refer to "On-line Device Configurator User Manual", part number 32170800.

Whilst a remote network configuration capability like this is very convenient, note that transferring an incorrect configuration can render the device inaccessible via the network and in need of 'local' recovery by a cable connection.

4-20 mA

For the IMx-T, 4-20 mA outputs can be configured. This process associates them with an existing measurement point and sets the measurement values that should correspond to 4 and 20 mA.

- More information can be found in the "IMx-T User Manual", part number 32096300.

Firmware

Firmware function opens the firmware interface for the database where it is possible to manage firmware for the different types of data acquisition devices available in @ptitude Observer such as IMx, Enlight Collect IMx-1 and MasCon16. The interface includes options to **Add** and **Delete** firmware stored in @ptitude Observer.

The same screen can be reached by selecting On-line > Firmware.

For IMx/MasCon devices the firmware is automatically sent the next time the device connects to the @ptitude Observer Monitor service. This means that it is not necessary to go through every device and upgrade it manually. To force all devices to upgrade the firmware immediately, simply restart the @ptitude Observer Monitor service and force a device restart by clicking on **Restart** as described in Restart in Managing IMx/MasCon Devices and Channels.

Note that the Firmware function manages firmware for all on-line devices not just those device types managed by the IMx/MasCon devices, functionality.

- The **Synchronize** functions available in the IMx/MasCon devices and IMx-1 System views are quite separate functions and apply only to their related hardware systems.

The implementation detail for Enlight Collect IMx-1 systems is a little different as the gateway receives both its own firmware updates and also those for the sensor, which it then re-distributes. After being added to @ptitude Observer both are automatically downloaded to connected gateways but a download can also be user initiated by way of the gateway, **Synchronize** function available in the IMx-1 system View. For Enlight Collect IMx-1 systems this synchronises both configuration and firmware.

To synchronise, select an appropriate gateway from the table list, confirm that its **Connection** state is 'Connected' and then press Synchronize.

Initially this sets the gateway and sensor status to "In progress" meaning the synchronisation process has been initiated. The gateway and all sensors reporting a Hardware ID will be synchronised, any sensors not yet reporting their ID will remain as in progress.

To ease commissioning, once any of these sensors join the system and report their Hardware ID then the gateway synchronisation will be automatically set to in progress so that they can be synchronised. This latter process of synchronising remaining sensors is automatic and doesn't require the user to manually synchronise the gateway again. Note that when a sensor is downloading firmware some missed measurements should be expected, typically corresponding to a period of around 7 hours.

As a further example of the differences between systems, note that because IMx-1 wireless sensor firmware is distributed via the gateway and that device holds a local copy of the firmware image, deleting a sensor firmware version from @ptitude Observer does not remove it from the gateway and if a distribution of that firmware has already been initiated, that process will continue.

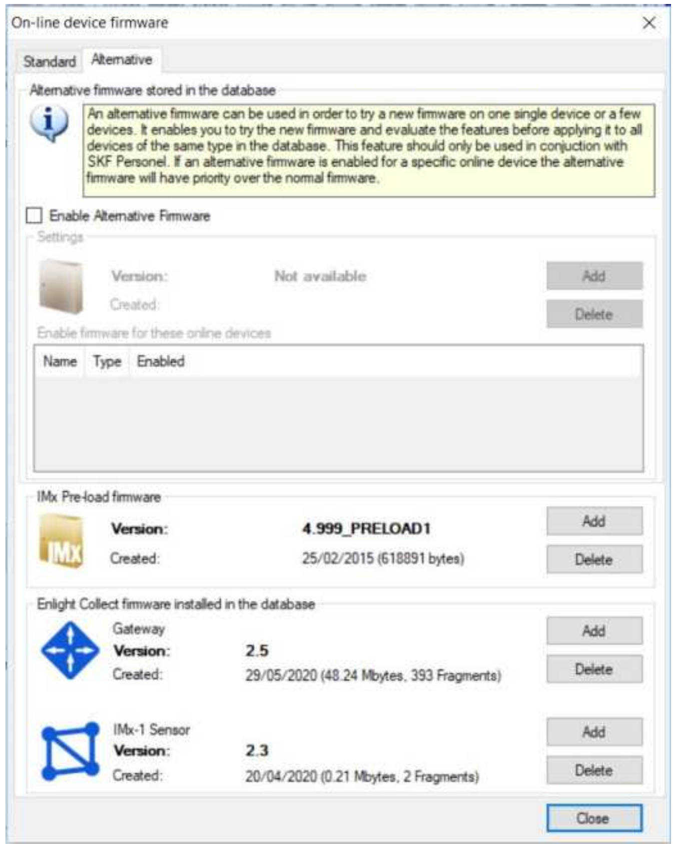


Figure 4 - 25
Example of Alternative Firmware

Alternative firmware can be used to try a new firmware on a single device or a few devices. It is mostly used to try out new firmware progressively before applying the firmware across all devices or to try features designed for a specific application.

- Alternative firmware overrides normal, standard firmware.

To utilise this interface, **Enable Alternative Firmware** box must be checked. Once the box is checked, alternative firmware settings can be added or deleted for the selected online devices.

Command

Select a device from the list and press this button to activate a command window that provides an interface to send commands to that IMx device. These commands can, for example, be used for viewing the network configuration of a device, (getcfg sys) or the device MAC address (get hw/macaddr).

When the command window is first opened, a help text is displayed that explains all the available commands and their usage. The figure below shows an example of that text:

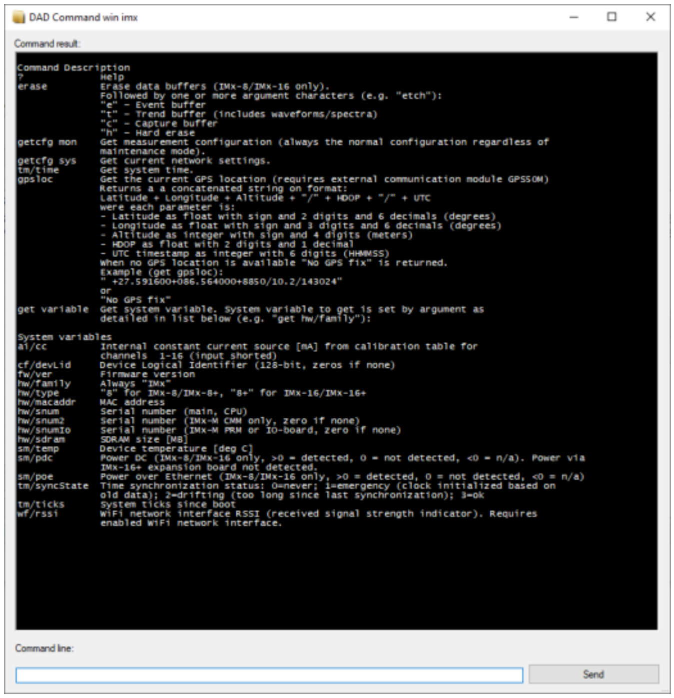


Figure 4 - 26
Example of the Command window, Help text

Use the command line area at the bottom of the window to type a command and the adjacent button to send. When a valid command is sent, it appears in the command window in bold and yellow with a leading time-date stamp. The response from the device will follow.

The command window is resizable and (when it extends past the extent of the window), scrollable. Information can be copied directly from the window. Note that the command functionality is only available for IMx devices and some commands are restricted to certain types of IMx device, refer initial window help text.

Analogue Channels

The Analogue channels interface provides a list of all the configured analogue channels of the selected device along with their settings. It also allows a user to create (configure) new analogue channels and edit, copy and delete any existing analogue channel from the list.

A channel is equal to a sensor input. To be able to create a channel*,* the device to which the channel will belong must be created and configured first.

To create an Analogue Channel:

- Select a device from the list of IMx/MasCon devices and then click **Create** below the **Analogue Channels** list. The Analogue Channel dialog opens at the General Tab. Note the dialog contents may differ dependent on the particular device type and channel selected.

General Tab

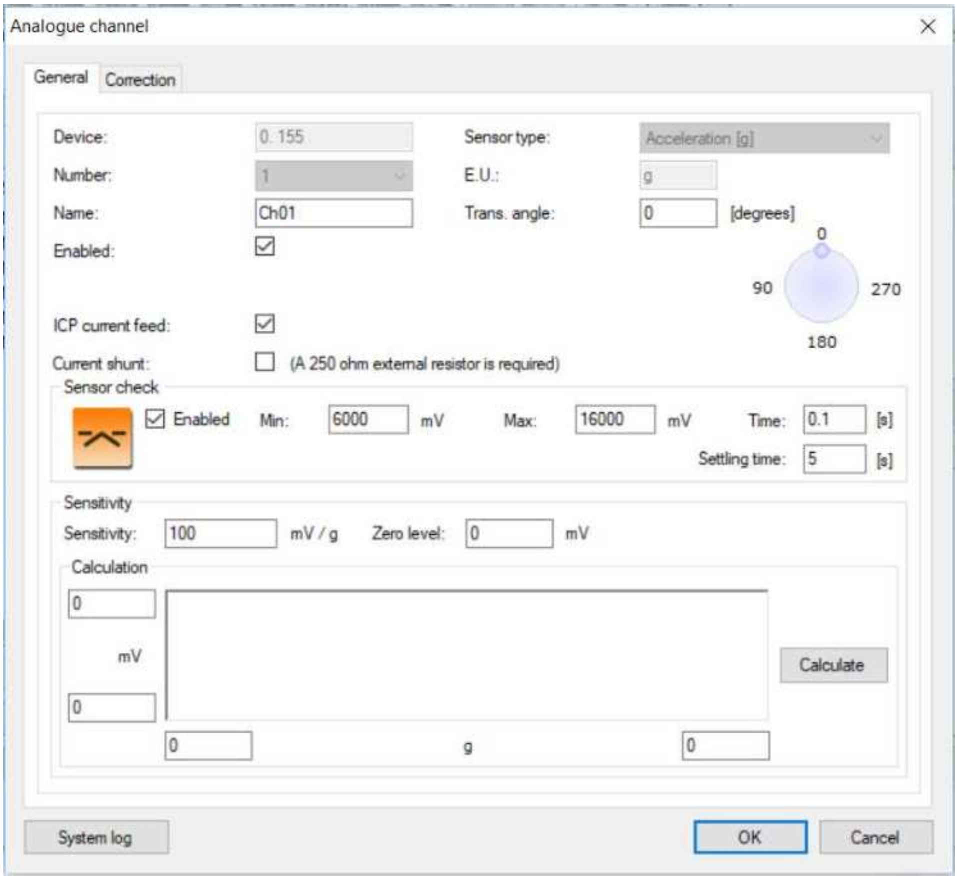


Figure 4 - 27
Example of Analogue Channel General Tab

Device is the name of the selected device (not editable).

Number is a unique number for the physical input channel on the device being configured.

Name of the channel can be used as a reference by the software.

Enabled indicates the status of the channel whether it is enabled or disabled.

IEC Long Name is for the channel's data source reference excluding domain name for IEC-enabled devices.

Isolated is used for external signals such as measuring process parameters for MasCon16 device's channels 15 and 16.

ICP Current feed indicates whether to use the IMx device to power the sensor or not (normally on accelerometers only and applies to IMx-W, IMx-T, IMx-8/IMx-

8Plus, IMx-16/IMx-16Plus and IMx-Rail). For some devices where this is achieved by setting hardware DIP switches, this option will not be visible in the dialog.

Sensor type is a sensor signal type which can be selected from the drop-down list.

- The inclusion of some sensor types in the drop-down list is conditional on a specific device type and even, device channel. For example, sensor types PT1000 (C) and PT1000 (F) are only available for channels 9 to 16 of an IMx-16/IMx-16Plus (or IMx-Rail).

E.U. (Engineering Unit) is a measurement unit which can be set only if sensor signal is set to *Other*, for example, a pressure sensor.

Trans. angle is the angle of the sensor mounted on a device, relative to twelve o'clock. A consistent convention should be adopted, for example 'as viewed from driving to driven machine'.

Current shunt is available for IMx devices where a shunt resistor has been added to the channel input. If a resistor has been added or enabled, check this field.

- For IMx-W device's channel 15 and 16, IMx-T and IMx-S this is achieved by appropriate DIP switch setting. For IMx-8/IMx-8Plus, IMx-16/IMx-16Plus and IMx-Rail an external 250-ohm resistor must be fitted.

Sensor check will raise a system alarm for a sensor fault if the signal goes outside of the range.

Enabled: Check the box to make the system perform a sensor check on the channel before a measurement is taken.

Min: The minimum output range of the sensor.

Max: The maximum output range of the sensor.

Time: The duration of the sensor check measurement.

Settling time: If an IMx detects a sensor bias output voltage (BOV) is out of range then this activates a sensor fault alarm state. The sensor fault is not considered cleared until the BOV is detected as having been in range for the configured settling time. This can help prevent repetitively changing alarm states due to drifting signals from defective sensors that may briefly enter the proper BOV range.

- The *Settling time* value must be between "0" and "60" seconds. The default is 1 second.

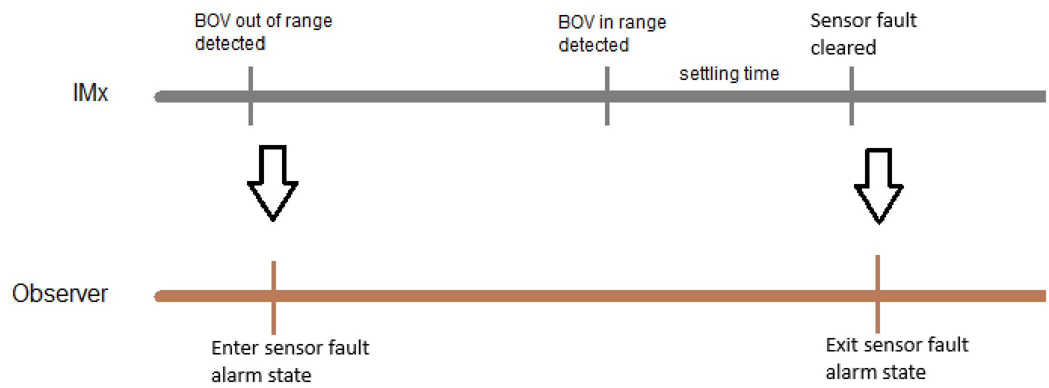


Figure 4 - 28
Settling Time Diagram

Sensitivity

Sensitivity is a property of the sensor expressing what output it gives for a certain measurement value. Typical nominal values are 100 mV/g for an accelerometer or 200 mV/mil or 7.87 mV/micron for an eddy current displacement measurement.

Note that for a **Displacement** measurement an additional **Type** selection can be made. If **Eddy current** is selected this has the effect of causing a sensitivity entered as 200 mV/mil to be treated as '-200' and shown as such in the **Sensitivity** column of the **Analogue channel** window. This is needed because an eddy current system returns an increasing negative voltage as the measured gap increases.

Zero level can in most cases be left set at zero, it is only used where the signal is DC and there is an offset that needs to be accounted for. Refer to the **Calculation** example below.

Calculation area is available to assist in calculating **Sensitivity** and **Zero level** values. As an example, consider that an analogue speed signal is connected and 1 to 5 V of output represents 0 to 500 rpm. Entering in this area, a millivolt range of 1000 to 5000 and a measurement range of 0 to 500, then pressing the **Calculate** button will auto populate the following.

Sensitivity: 8

Zero level: 1000

Note also that for **Sensor type PT1000 [F]** or **PT1000 [C]**, available only on channels 9 to 16 of an IMx-16/IMx-16Plus, **Sensitivity** and **Zero level** values are automatically set and the **Calculation** area is hidden.

Correction Tab

When using eddy current (displacement) probes there is an option to correct or compensate for shaft runout as follows:

Frequency: Four frequencies at which corrections are made.

Phase: Phase value for each frequency.

Amplitude: Amplitude for each frequency.

This function is used mostly for turbine monitoring. Refer also to Configuring Runout Compensation.

To edit an Analogue Channel:

- Select a device from the list of IMx/MasCon devices to get the list of all the corresponding analogue channels.
- Select a channel to edit, then click **Edit**.

All the fields in edit mode are the same as those described above, encountered when creating an analogue channel.

➢ Any setting except for **Device**, **Number**, **Sensor type** and **E.U.** attributes, may be edited.

To delete an Analogue Channel:

- Select a device from the list of IMx/MasCon devices to get the list of all the corresponding analogue channels.
- Select a channel to delete and then click **Delete**.
  - Note that a channel cannot be deleted if it is in use by one or more measurement points.
  - Note that pressing the CTRL key changes the button action from Delete (selected) to Delete all (analogue channels).

To copy an Analogue Channel:

- First select a device from the list of IMx/MasCon devices to get the list of all the corresponding analogue channels.
- Select a channel to copy to a new channel, then click **Copy**.
- Choose a channel number for the new channel from the drop-down list, then click **Ok**.

Digital Channels

Digital channels interface provides a list of all the configured digital channels of the selected device along with their settings. It also allows the user to create new digital channels and edit, copy and delete any existing digital channel from the list.

To create a Digital Channel:

- Select a device from the list of IMx/MasCon devices and then click **Create** in the digital channels window. The Digital Channel dialog opens:

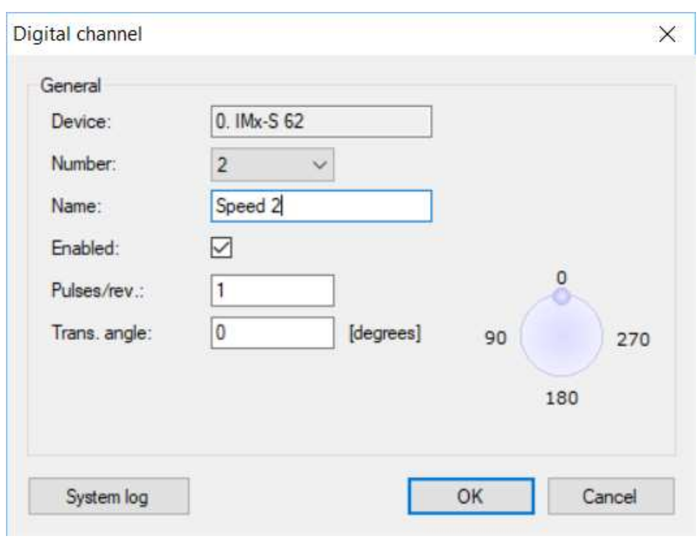


Figure 4 - 29
Example of a Digital Channel

Device is the name of the selected IMx/MasCon device (not editable).

Number is a unique number for the physical input channel on the device being configured.

Name is the name of the channel which the software can use as a reference.

Enabled indicates the status of the channel whether it is enabled or disabled. Enabled status activates the channel for measurement points.

Pulses/rev. is the number of pulses this sensor receives per shaft revolution.

Trans. angle is the angle of the sensor mounted, relative to twelve o'clock. A consistent convention should be adopted, for example ‘as viewed from driving to driven machine’.

Sensor feed (if shown) indicates whether to supply sensor power or not.

To edit a Digital Channel:

- First select a device from the list of IMx/MasCon devices to get the list of all the corresponding digital channels.
- Select a channel to edit and then click **Edit**.

All the fields in edit mode are the same as in **Initiating a Digital Channel**, described above.

- ➢ Any setting except **Device** and **Number** attributes, can be edited.

To delete a Digital Channel:

- First select a device from the list of IMx/MasCon devices to get the list of all the corresponding digital channels.
- Select a channel to delete, then click **Delete**.
  - ➢ Note that a channel cannot be deleted if it is in use by measurement point(s).
  - ➢ Note that pressing the CTRL key changes the button action from Delete (selected) to Delete all (digital channels).

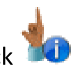
To copy a Digital Channel:

- Select a device from the list of IMx/MasCon devices to get the list of all the corresponding digital channels.
- Select an existing channel to copy to a new channel, then click **Copy**.
- Choose a channel number for the new channel from the drop-down list, then click **Ok**.

Machine Properties

Setting up machine data can be done at the machine properties screen.

To get to machine properties screen, perform one of the following options:

- Click the right mouse button on a machine in the hierarchy view, then select **Properties**.
- Select a machine in the hierarchy view first, click **Edit** on the toolbar, then select **Properties**.
- Select a machine in the hierarchy view first, then click  **Properties** icon on the toolbar.

The information provided in its multiple tabs includes both free text descriptions and names for inclusion in user reports and machine diagnostic configuration settings actively used by the @ptitude Observer analysis tools.

Machine properties tabs	Notes
General	Name, Description, Machine code and ISO class.
Extended Information	Can hold manufacturer's data for the machine.
Diagnosis	User configurable, automatic diagnosis algorithms.
Protean Diagnoses	Fully automatic, self-configuring diagnoses.
Attachments	Attached documents, pictures, sound files and similar.
Advanced	Including conditional activation based on an OPC data tag.
Machine Parameters	Process data stored alongside dynamic measurements (IMx).
RailMo	SKF Rail Track Monitoring only, refer to Add Trains.
Enlight Collect IMx-1 System	Assigned gateway, data storage settings for an IMx-1 system.

General Tab

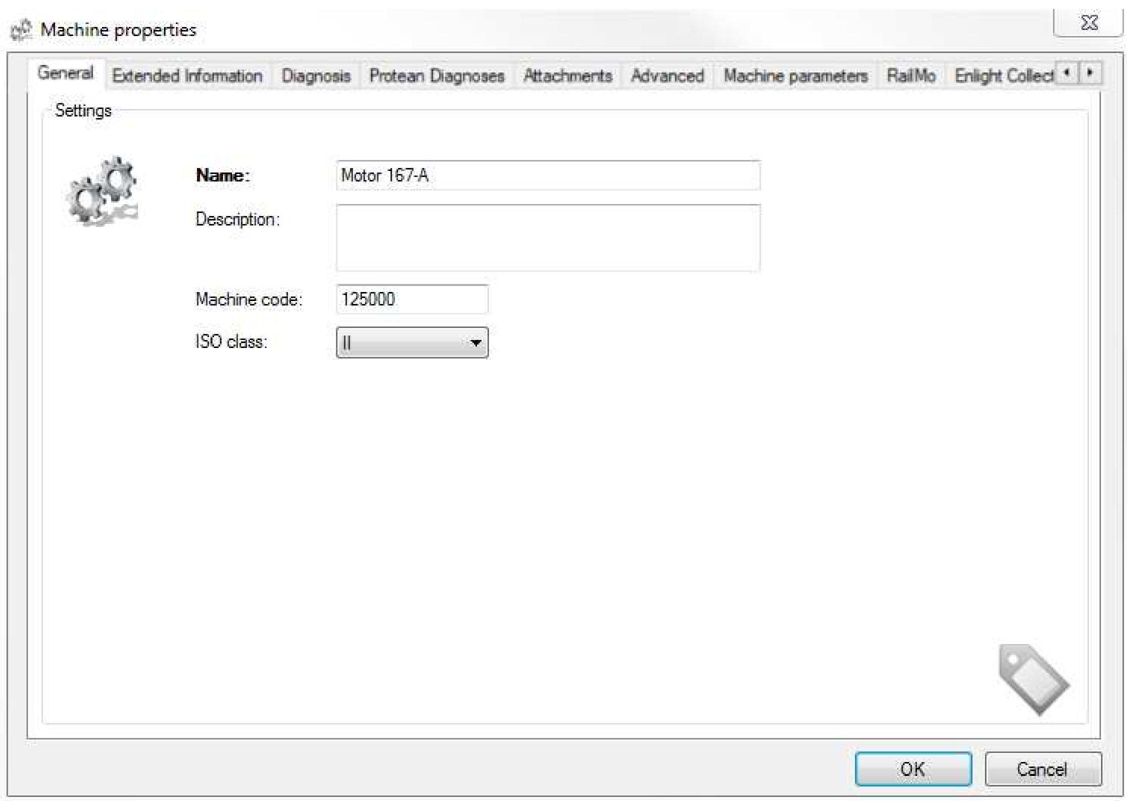


Figure 4 - 30
Example of General Machine Properties

- Enter **Name**, **Description**, **Machine code** and **ISO** (International Organization for Standardization) **class**.
  - The ISO classes are based on SS-ISO 2372 (Vibration and shock - Basis for specifying evaluation of vibration).

Extended Information Tab

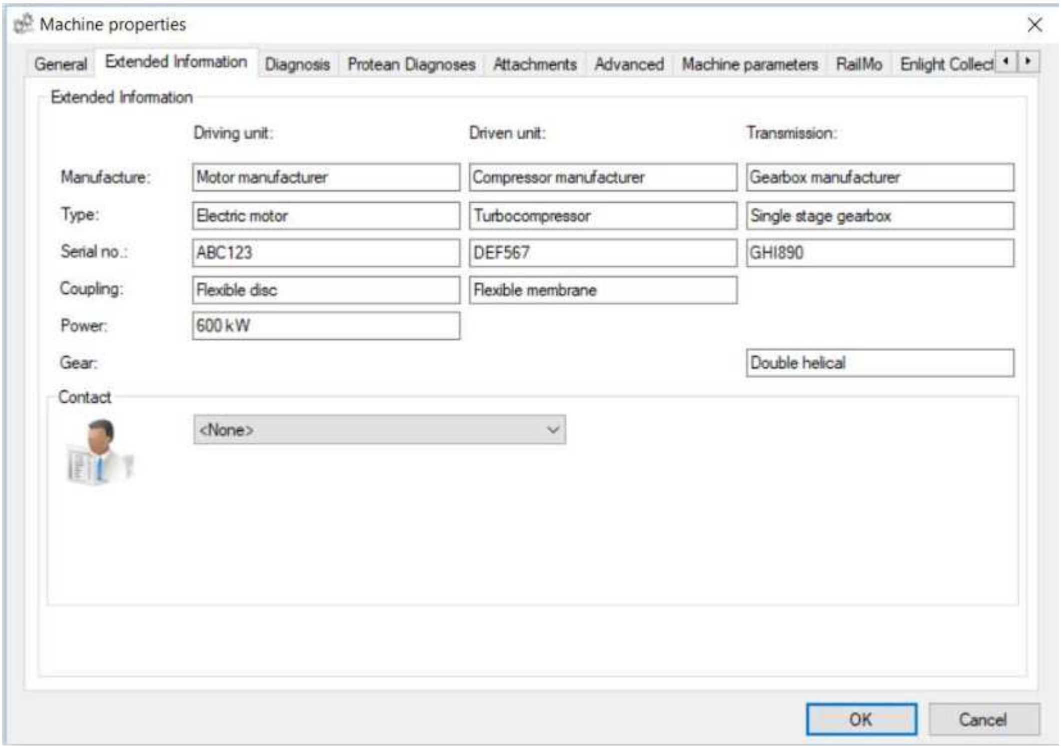


Figure 4 - 31
Example of Extended Machine Properties

- Enter **Manufacture** information, **Type** and **Serial number** for the **Driving unit**, **Driven unit** and **Transmission**.
- Enter **Coupling** information for the driving and driven units.
- Enter **Power** information for the driving unit.
- Enter **Gear** information for the machine transmission.
- **Contact** can be used to set a contact or receiver for this particular machine. The contact can be used for general information, who to contact when there is a problem with the machine, etc.

The contact name is selected from a drop-down populated from the receivers library. For more information refer to Receivers under Libraries within Database menu item.

Diagnosis Tab

The Diagnosis tab enables diagnoses to be assigned and manages the diagnoses already attached to the machine. Diagnoses are instances of predefined diagnosis rules. For more information on diagnosis rules, their properties and how to create them, refer to Diagnosis under Menu > Database.

Each machine diagnosis that has been attached to a machine uses one or more measurement points as data input, **Used points**. Attached diagnoses can be made Private.

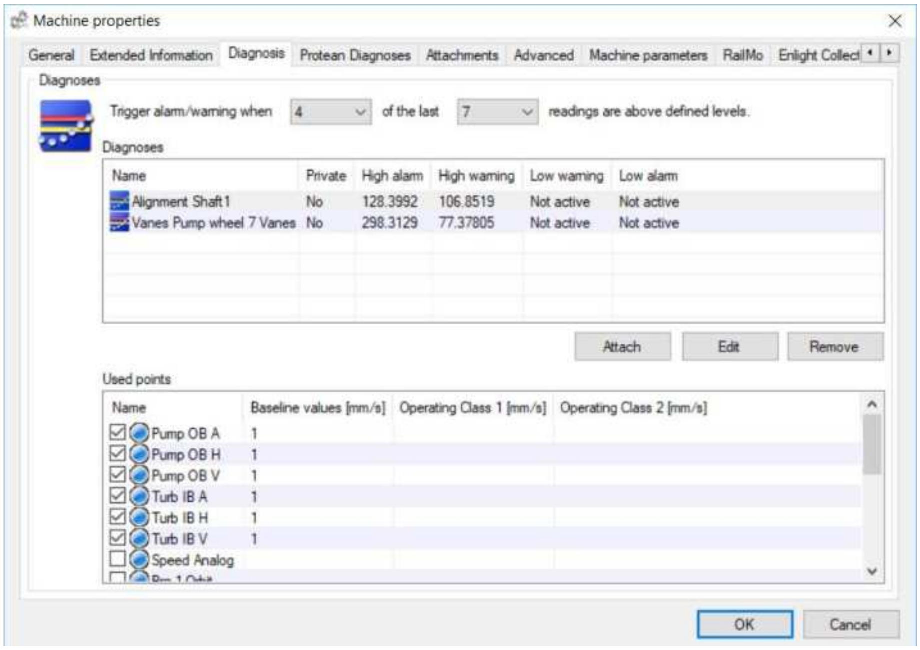


Figure 4 - 32
Example of Diagnosis settings, 4 of the last 7

Trigger alarm/warning configures the alarm hysteresis values used for calculating and triggering an alarm/warning. The method is to set the “Trigger alarm/warning when m (1 to 30) of the last n (1 to 30) readings are above defined levels.”

For example: If the setting is 4 out of 7 (the default values), then at least 4 measurements out of 7 must be over warning/alarm level before the alarm is set. When alarm is acknowledged, the alarm status is cleared. If the next measurement fulfils the configuration settings again, a new warning/alarm is generated.

Name identifies each diagnosis.

Private Privately attached diagnoses no longer link to the underlying rule. This means that they can edited or customised to a greater degree for the specific machine but if the rule is updated any change will not be reflected in the private diagnosis.

High alarm / High warning / Low warning / Low alarm are the alarm/warning level settings.

Attach attaches a diagnosis from a list of diagnoses. The user can select from the available Standard or Custom diagnoses, choose to create a private diagnosis and decide on which shaft or bearing and which measurement points to use. Note that any custom Protean diagnoses will not be visible in this list.

Edit edits the settings of the selected diagnosis. This launches the same dialog used for the initial creation of a diagnosis, refer to the Diagnosis dialog shown in the figure below. For more information on diagnostic rules, refer to Menu Items > Database > Diagnosis > Diagnosis rules.

Remove deletes the selected diagnosis from the machine.

The diagnoses can distinguish between data captured in the different Operating Classes. When attaching a diagnosis or later via its properties, there is a choice as to whether the diagnosis will use data captured in the different Operating Classes. This option is always editable, without regard to the particular diagnosis being a private diagnosis or not. For more information on Operating Classes refer to Multiple Gating Points.

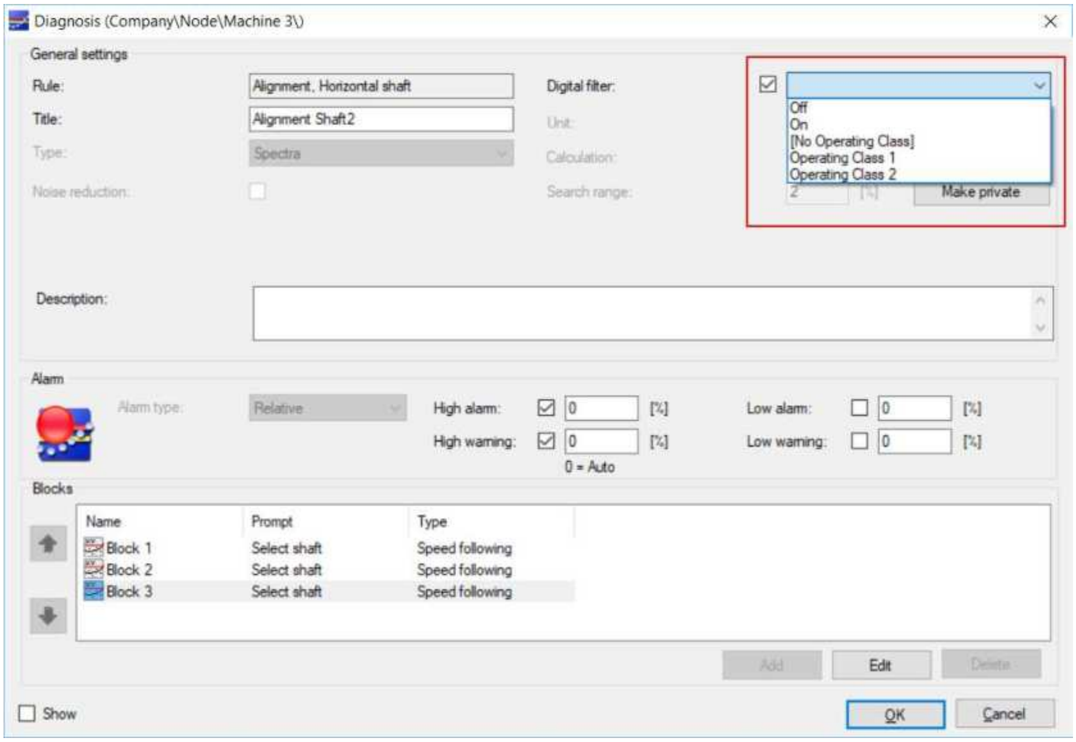


Figure 4 - 33
Example of Diagnosis Dialog

Select the **Digital filter** checkbox to enable the function. Then select the type of data to capture for the alarm:

Off (digital): operate in all conditions
On (digital): used with digital points, value true
No Operating Class: ignore the operating classes; use with multiple gating point (MGP)
Operating Class 1 [customised name]: use operating class 1 data only; use with multiple gating point (MGP)
Operating Class 2 [customised name]: use operating class 2 data only; use with multiple gating point (MGP)

The automatic alarms for the diagnosis will be calculated only in the specified operating class or digital state and will alarm only on the alarms in the specific class.

Only one MGP (multiple gating point) can be added to any diagnoses set. If adding a second MGP is attempted an Input Error message displays which identifies the affected diagnosis and measurement points:

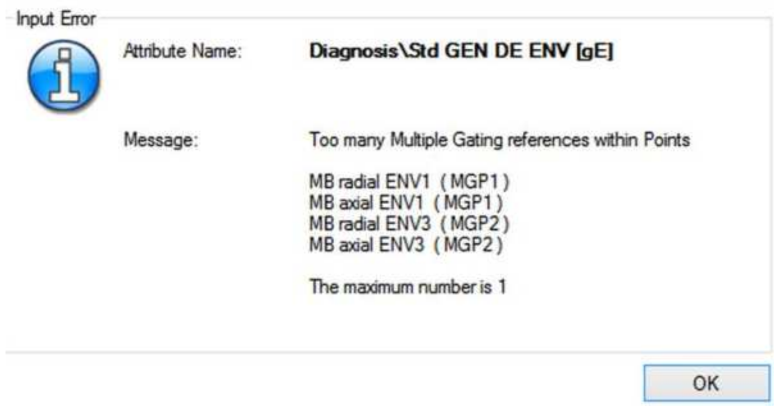


Figure 4 - 34
Diagnosis Input Error, Too Many Multiple Gating References

Protean Diagnoses Tab

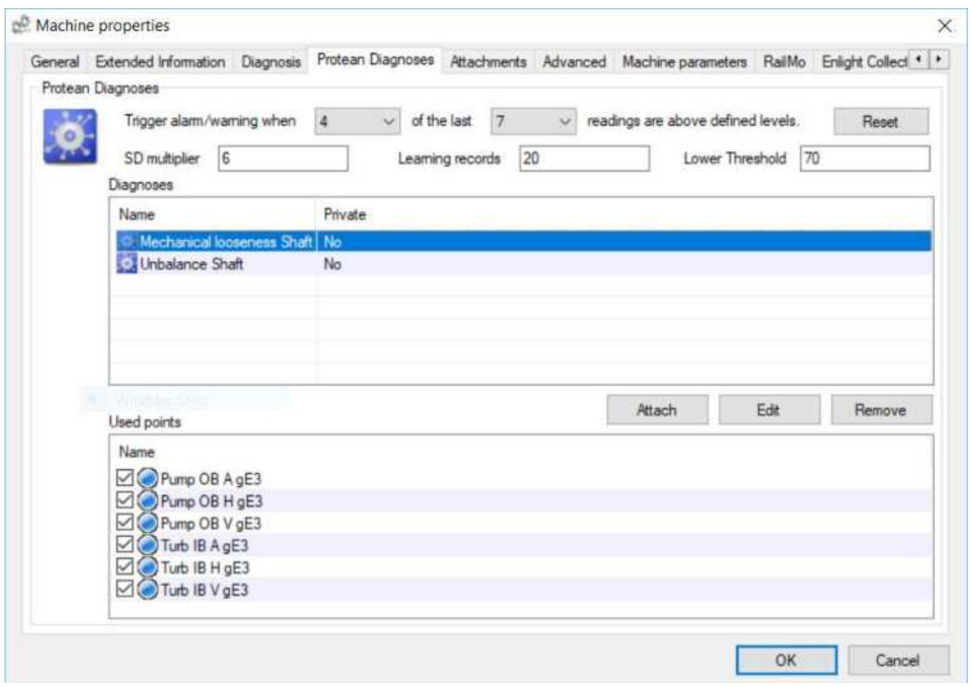


Figure 4 - 35
Example of Protean Diagnoses settings

The Protean Diagnoses tab is where predefined Protean diagnoses can be applied or attached to the selected machine. These diagnoses have a self-learning algorithm that tracks both improvement and deterioration in machine condition and generates an alarm if the machine's health has worsened. The Protean Diagnosis to be attached can either be an SKF defined Protean diagnosis rule or a user defined, Custom Protean diagnosis rule. For more information on diagnosis rules, their properties and how to create them, refer to Diagnosis under Menu > Database.

Trigger levels can be set manually using the following controls:

Trigger alarm/warning configures the alarm hysteresis values used for calculating and triggering a Protean alarm. The method is to set the “Trigger alarm/warning when m (1 to 30) of the last n (1 to 30) readings are above defined levels.”

For example: If the setting is 4 out of 7 (the default values), then at least 4 measurements out of 7 must be over warning/alarm level before the alarm is set. When alarm is acknowledged, the alarm status is cleared. If the next measurement fulfils the configuration settings again, a new warning/alarm is generated.

SD multiplier, **Learning records** and **Low Threshold** are used in combination as follows:

Learning records are the number of data sets to use, when evaluating what the Protean alarm level should be. The SD or Standard Deviation multiplier times the standard deviation of those records is added to their mean value to set the high alarm level. The **SD multiplier** is therefore the ‘number of standard deviations’. If an alarm is generated, an alarm threshold recalculation takes place. This sets a tighter alarm around the now higher amplitude data by using half the number of standard deviations: **SD multiplier**/2.

The Low threshold is set as a percentage of the mean value of the records. If the low threshold is crossed (m out of n) then that threshold is recalculated, based on the latest **Learning records**.

Reset button will set all the above parameters back to their default values. The default values are the same as those implemented previously when Protean settings were not user configurable.

Name identifies each attached Protean diagnosis.

Attach attaches a Protean diagnosis from a list of available Protean diagnoses and Custom diagnoses. Note that any Custom non-Protean diagnoses will not be visible in this list.

Edit edits the settings of the selected Protean diagnosis. A similar dialog is used to initially attach and later edit either a diagnosis or a Protean diagnosis. In the case of a Protean diagnosis note that the **Digital filter** function and the **Alarm** settings area are not available. For more information on diagnostic rules, refer to Menu Items > Database > Diagnosis > Diagnosis rules.

Remove deletes the selected Protean diagnosis from the machine.

Each Protean diagnosis that has been attached to a machine uses one or more measurement points as data input, (Used points).

Attachments Tab

Attachments are simply files that can be attached and stored with the selected machine. An attachment can be a .PDF file, Word report or even an MP3 file.

Advanced Tab

Conditional activation can be used to activate or deactivate measurements on the machine depending on a conditional input. The type of conditional input is an OPC Data tagging measurement point. This is particularly useful in test-bench monitoring where machine individuals and/or machine types (that is, gearbox individuals or gearbox types) need to be tracked in a test-bench environment.

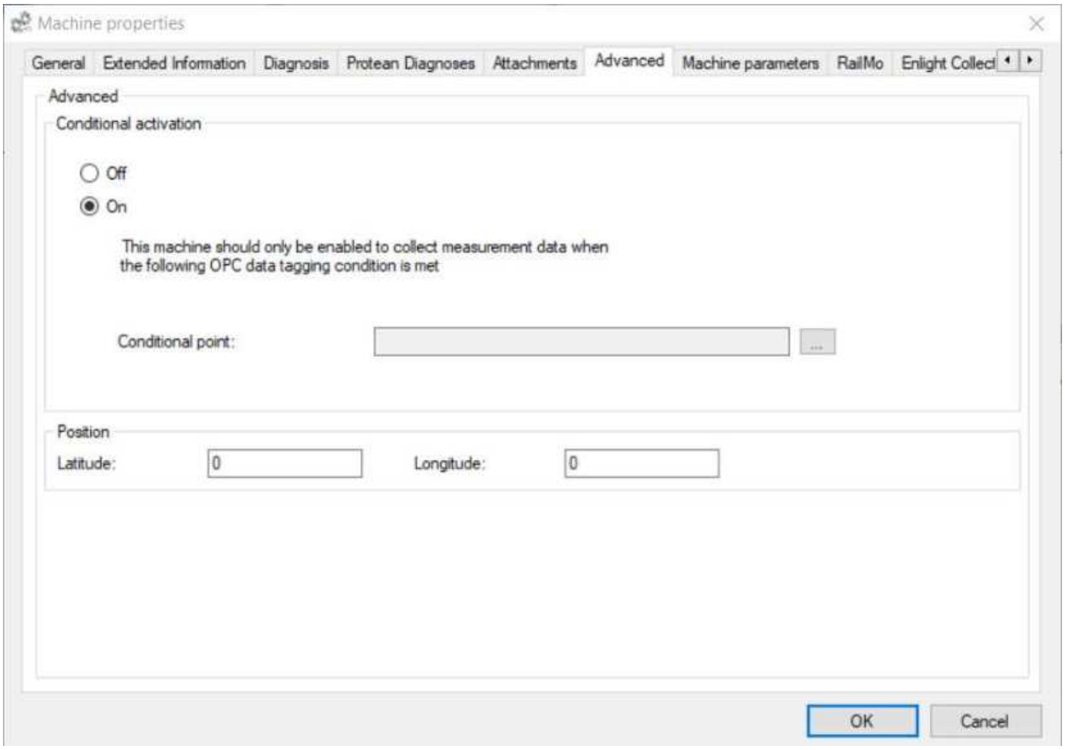


Figure 4 - 36
Example of Advanced Settings

To use the conditional activation, an OPC data tagging measurement point needs to be created and collect data from a specific OPC tag from an OPC Server.

When conditional activation is used on a machine and the tag value changes, it can take up to 30 seconds until the machine has been activated or deactivated.

Position - the position coordinates shown on this tab are not used.

Machine Parameters Tab

Machine Parameters are machine data that can be captured when using the IMx data acquisition device. The parameter data will be stored together with each dynamic measurement (FFT, Time waveform data) that is captured by the IMx.

For each IMx, up to 29 points can be used as machine parameters. These must be process parameter type points, not vibration points. They are selected by using a list in the **Machine Parameters** configuration window. They can be ordered in a user-defined list.

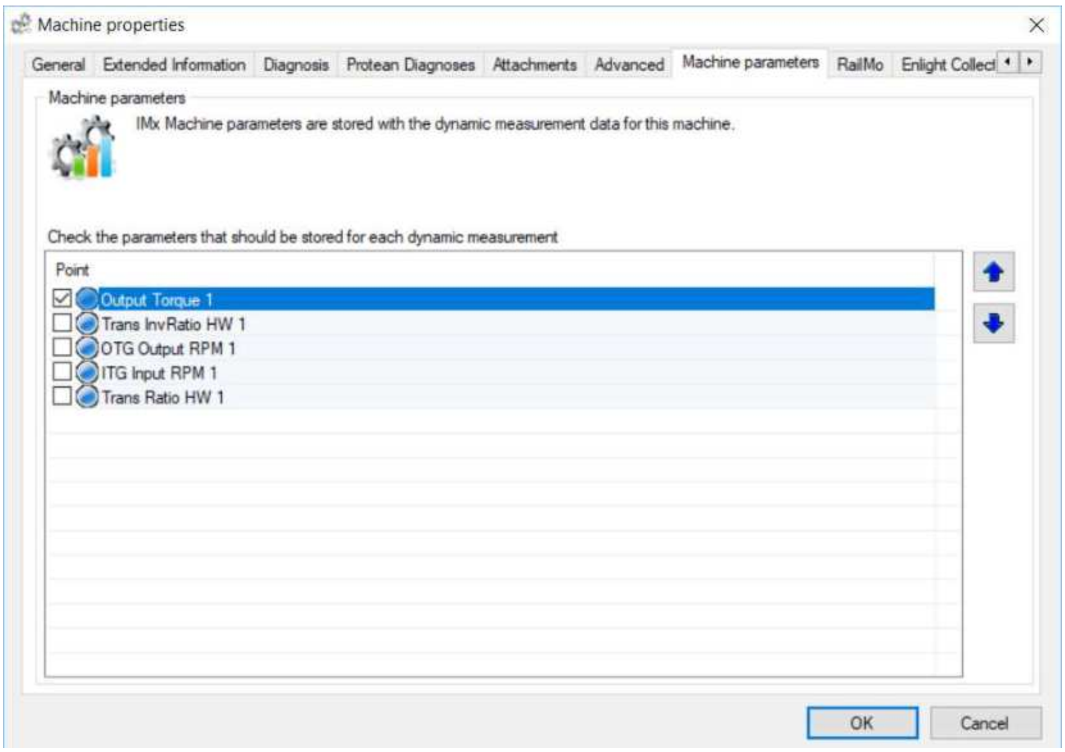


Figure 4 - 37
Example of Machine parameters settings

All machine parameters are:

- Displayed in the Measurement Date window (for each stored spectra/time waveform).
- Trend plot
  - Displayable in a trend plot like the existing three simultaneous parameters.
  - Displayed in a separate list for the current cursor position in the trend plot (because of the large number of parameters, they cannot be displayed in the legend of each trend when displaying multiple vibration points in the same window).
  - Selectable as the x-axis in a trend plot.
- Selectable for filtering in the buffer settings, one parameter at a time.

Enlight Collect IMx-1 System Tab

The **Enlight Collect IMx-1 System tab** is where a gateway is allocated to a machine, and therefore also to the IMx-1 sensors configured on this machine, and where Scheduled storage intervals are set. Note that before being allocated, gateways must first be created in the Enlight Collect IMx-1 System view.

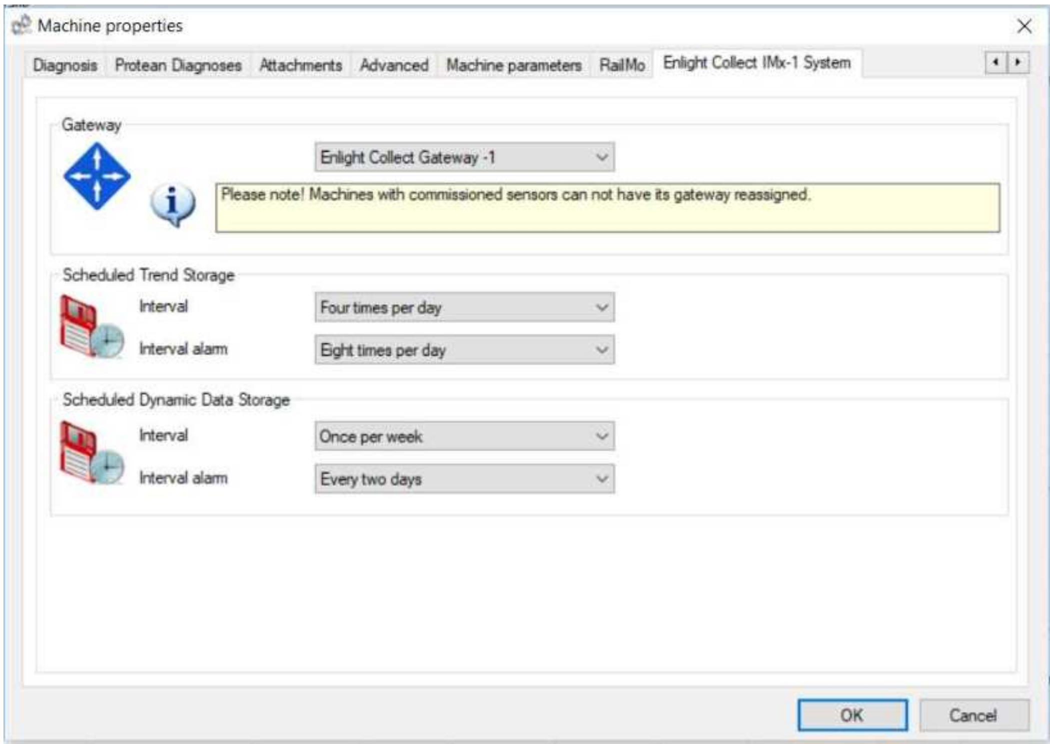


Figure 4 - 38
Enlight Collect IMx-1 System tab

Gateway contains a drop-down list that allows the selection of any gateway that exists in the system, or 'None'. Note also that whilst gateways can be associated with multiple machines, multiple sensors on a machine can only connect to the same, single gateway. In addition, whilst a machine has a commissioned sensor, it is not possible to change to another gateway or select 'None'.

Scheduled Trend and Scheduled Dynamic Data storage:

Both Interval and Interval Alarm settings for Trend storage default to 'Once per day' and for Dynamic Data storage, 'Once per week'. These are the least demanding, less frequent settings and if required can be set to shorter intervals:

Further options for the Trend storage: twice, four, or eight times a day or every hour.

Further options for the Dynamic Data storage: every two days, day, or every hour.

Note that the 'Every hour' selection for dynamic data is only available where the user has selected the same setting for the respective, Interval or Interval Alarm, Trend storage setting.

In addition, the Interval Alarm setting for Trend or Dynamic Data can only be set at the same or at a faster capture rate than the equivalent Interval setting.

SKF Enlight Collect Gateways and IMx-1 sensors

Where SKF Enlight Collect IMx-1 systems are in use, before on-site commissioning takes place, some pre-commissioning activity in @ptitude Observer is required:

- Enable an MQTT service to allow the Enlight Collect IMx-1 system and @ptitude Observer Monitor to communicate. Like the app, the gateway uses an MQTT login so that only devices with the correct rights, can connect.
- Ensure all personnel who will use the SKF Enlight Collect Manager app exist as users in @ptitude Observer and are allocated appropriate rights, (IMx-1 System access rights).
- Create relevant nodes, machines and sub-machines in the @ptitude Observer hierarchy and Add IMx-1 sensors and measurements to the appropriate sub-machine.
- Add the necessary Enlight Collect gateways and any relay nodes to the database, refer IMx-1 System view.
    - After creation, the gateway can then be allocated to a machine (Machine properties, Enlight Collect IMx-1 System tab). Note that a machine's sensors will all be associated with the same gateway and one gateway can support multiple machines.
    - Relay nodes carry sensor mesh communications but do not make any measurements.
- With this pre-commissioning activity complete, this information is now available for the on-site commissioning phase when the sensor/gateway hardware is in place. At that time the SKF Enlight Collect Manager app, can login to retrieve the data it needs for the initial commissioning, that will allow the gateway to connect to the @ptitude Observer system and the sensors to their local gateway.

Add IMx-1 sensors and measurements to a sub-machine

When adding an IMx-1 sensor to a sub-machine in the hierarchy, an IMx-1 sensor node along with a measurement cluster is created. This 'cluster' consists of the four measurements that this sensor type is able to make:

Acceleration, **Velocity**, **Envelope** and **Temperature**.

Most @ptitude Observer hierarchical status indications like Not measured, are supported or applicable to an IMx-1 sensor and its measurements, except the following:

Not active, Outside measurement range, Transient, Outside active range and Outside active range unstable.

Whilst the gateway can detect a failure to receive sensor data and communicate events to monitor that will cause @ptitude Observer to set a 'Not measured' or 'Sensor fault' status, 'Not measured' can also be triggered by @ptitude Analyst not having received measurement data for twice the expected interval.

Notes on hierarchy operations:

- IMx-1 sensor nodes can only be added to a sub-machine.
- The automatic measurement point naming takes the user chosen sensor name, adds a dash/hyphen and then 1 or 2 characters to identify the measurement type, A, V,

E3, or T. Measurement naming is automatically updated if the sensor name is subsequently changed.

- Neither IMx-1 measurements nor IMx-1 sensor nodes can be copied by using the 'standard' copy mechanisms, but they are included when using the Machine Copy Wizard.
    - The assigned gateway will not be copied, during the copy process the user will be asked to select a gateway or 'None', for this, copied, machine.
- Users can drag and drop an IMx-1 sensor node but only within the same sub-machine.
- Users can only drag and drop an IMx-1 measurement point within its sensor node.

Sensor properties

To open up the properties of an existing sensor node, right click and select Properties or double click.

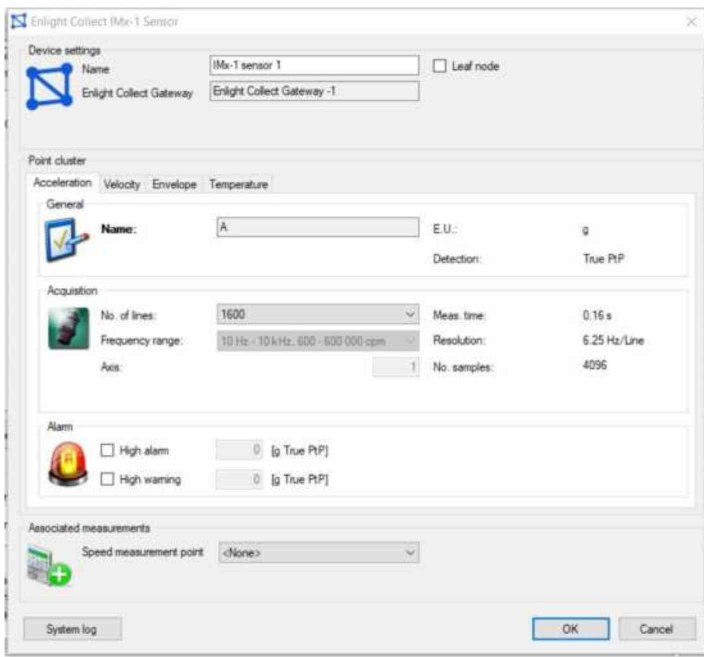


Figure 4 - 39
IMx-1 sensor measurements

Main tab: in the upper area are the sensor 'Name' and the 'Leaf node' selection, noting that the node type, Leaf or not, cannot be changed once the sensor is commissioned. Name can usefully be used to indicate the sensor's physical location using standard, vibration measurement point, taxonomy.

Also provided is a read back of the gateway allocation: 'Enlight Collect Gateway'. For sensors, this gateway allocation process is indirect, in that measurement sensors are associated with a machine and in the machine's properties it, including all sensors, has a gateway allocated to it.

Note:

- It Is recommended to use the default mesh mode unless it is known that the sensor location is subject to movement or its 'wireless environment' is subject to temporary interruption by vehicle/machinery movements. In these cases, leaf mode can be selected.
- Relay nodes, these make no measurements but are there to support/extend the mesh infrastructure, are created and configured in the IMx-1 System view.
- Mesh networks auto-adapt but have a rebuild time, therefore:
    - Do not activate sensors until they're at their mounting position

On the lower main tab is the possibility to add an associated measurement. This can only be a software speed point used to associate a machine speed with the data.

System log is common to many configuration dialogs. In this case it opens a configuration log of all the changes made to the IMx-1 measurement point cluster.

The four measurements each have their own sub-tab in the sensor configuration dialog:

Sub-tabs: each measurement type typically has three zones where aspects of that measurement can be configured or are available for review:

General: an area to report the measurement name, engineering units and detection. Note that the choice of IMx-1 measurement units and the detection used is a database-wide setting, made in Database > Options, Enlight Collect IMx-1 System Global Settings Tab.

Acquisition: for the vibration measurements, an area to configure the number of lines and to view the measurement configuration. The **No. of lines** is configurable as *400*, *800* or *1600.*

Alarms: for all measurements an area to configure, set or disable alarms associated with each. Note that low warning and low alarm are available only for temperature measurements. All alarms are disabled by default, with thresholds set to zero.

Creating OPC Server and OPC Channels

OPC stands for object linking and embedding (OLE) for process control. It is an open, flexible and plug-and-play software communication standard for modular software inter-operability in the automation industry. OPC is a specification that has been developed by a team of more than 120 different companies to produce an efficient specification for data/information standardisation.

OPC server enables software, such as @ptitude Observer, to route its data to OPC server. In return, OPC server stores and shares data from all the OPC clients.

Generally, there are two different generations of OPC; OPC referred to as Standard OPC and OPC UA.

There are two ways of working with OPC in conjunction with SKF @ptitude Observer.

- Using the Internal Built-in OPC Server. In @ptitude Observer Monitoring Suite, there is a built-in OPC UA Server in the monitor service component. It can, if enabled, automatically publish all data that @ptitude Observer system captures.
- Using External OPC Servers

To be able to use OPC servers in @ptitude Observer, the user must set up a configuration for the available OPC servers in @ptitude Observer, so that the @ptitude Observer Monitor service can recognize the OPC servers.

Not only can the @ptitude Observer Monitor handle IMx/MasCon devices, but it can also be the logical data gatherer/distributor for OPC. Therefore, it is not necessary to have the @ptitude Observer running to use OPC. However, it is necessary to set up the OPC servers and OPC channels in @ptitude Observer whilst the @ptitude Observer Monitor is connected to @ptitude Observer.

The following steps are an overview of the procedure using external OPC servers:

1. Install the OPC server and set up tags correctly according to the OPC manual.
2. In @ptitude Observer create a connection to the OPC server by following: Adding an OPC Server, below.
3. In @ptitude Observer create OPC channels to the OPC server created in step 2 by adding OPC channels as shown in Creating OPC Channels, below.

Warning: When using DBCS (double byte character set) operating systems, both the OPC server and the @ptitude Observer Monitor computer must use DBCS. DBCS is the character set used by Korean, Chinese, Japanese Windows, etc.

Internal OPC Server

To configure the built-in OPC Server in Observer:

- Click **On-line** on the toolbar, then select **OPC Servers** and select to configure **Internal OPC Server**.

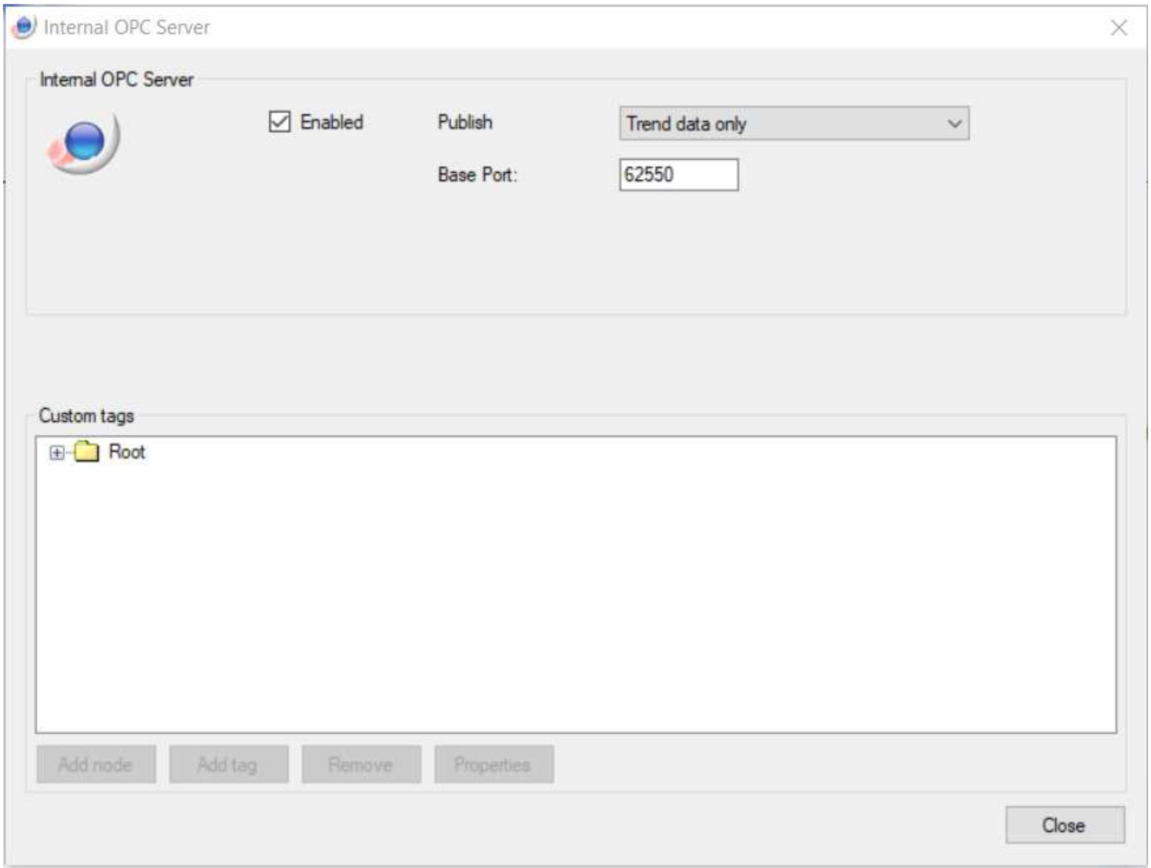


Figure 4 - 40
Example of Internal OPC Server

When enabled, the Internal OPC Server will automatically publish the latest measurement for all measurement points that have been captured with the @ptitude Observer system, in addition it is also possible to configure custom tags that can be used. The custom tags can be used by other OPC Clients to communicate data to and from the server, but the Observer system will not modify or use the data of these tags.

Enabled indicates the status of the OPC server whether it is enabled or disabled.

Publish selects which type of data that should be published. The option is to publish trend data or trend data and dynamic data. Dynamic data is FFT, Time waveform, etc.

Base port defines the base communication port for the internal OPC Server.

The default setting is 62550. If it is set to the default it will use the base port and the base port plus 1 when the Internal OPC Server starts. Which means that the Internal OPC Server will communicate on port 62 550 and 62 551.

Usually the base port does not need to be changed unless on the same computer, ports 62 550 or 62 551 are in use by another application or there are multiple monitor services with the OPC Server enabled.

Add node adds a folder to the custom tag hierarchy.

Add tag adds a custom tag to the custom tag hierarchy.

Remove removes the custom selected tag or the selected folder.

Properties brings up the configuration for the custom selected tag or the selected folder

External OPC Servers

To configure external OPC Servers in Observer:

- Click **On-line** on the toolbar, then select **OPC Servers** and select to configure **External OPC Servers**. Ensure the appropriate **Database** is selected from the drop-down.

To add an OPC Server:

- Click **Add** just below the **OPC Servers** area, the OPC Server dialog launches:

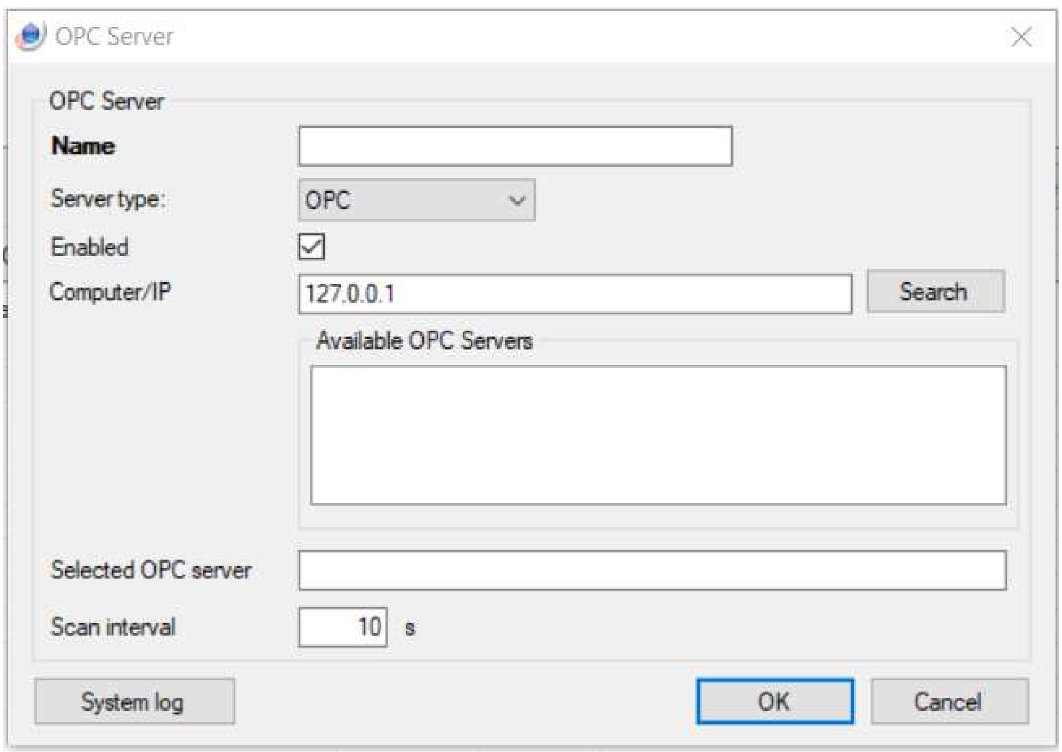


Figure 4 - 41
Example of Add an OPC Server

Name is the name for this OPC server registration.

Server type specifies whether this server is an OPC or OPC UA server.

Enabled indicates the status of the OPC server whether it is enabled or disabled.

Computer/IP is the computer name or IP number for which the OPC server is located.

Search returns a list of the available OPC servers at the specified IP address.

Available OPC Servers lists the OPC Servers found when clicking the "Search" button.

Selected OPC server is the predefined name of the OPC server being used. This is not editable.

Scan interval is the scan time interval in seconds. The @ptitude Observer Monitor uses it to scan the OPC server for current values. Default is 10 seconds which means that the @ptitude Observer Monitor checks for the current values of the OPC server every ten seconds.

System log is a configuration log containing all the setup activities which can be useful when investigating or tracking changes made during the setup.

To edit an OPC Server:

- Click **Edit** in the OPC servers window. The settings available for editing an OPC server are the same as in Adding an OPC Server from above.

To remove an OPC Server:

- Select an OPC server from the list of OPC servers
- Click **Remove** in the OPC servers window to remove the OPC server from the list.

To create OPC Channels:

- Select an OPC server to use, from the list of OPC servers.
- Click **Add** in OPC channels window.

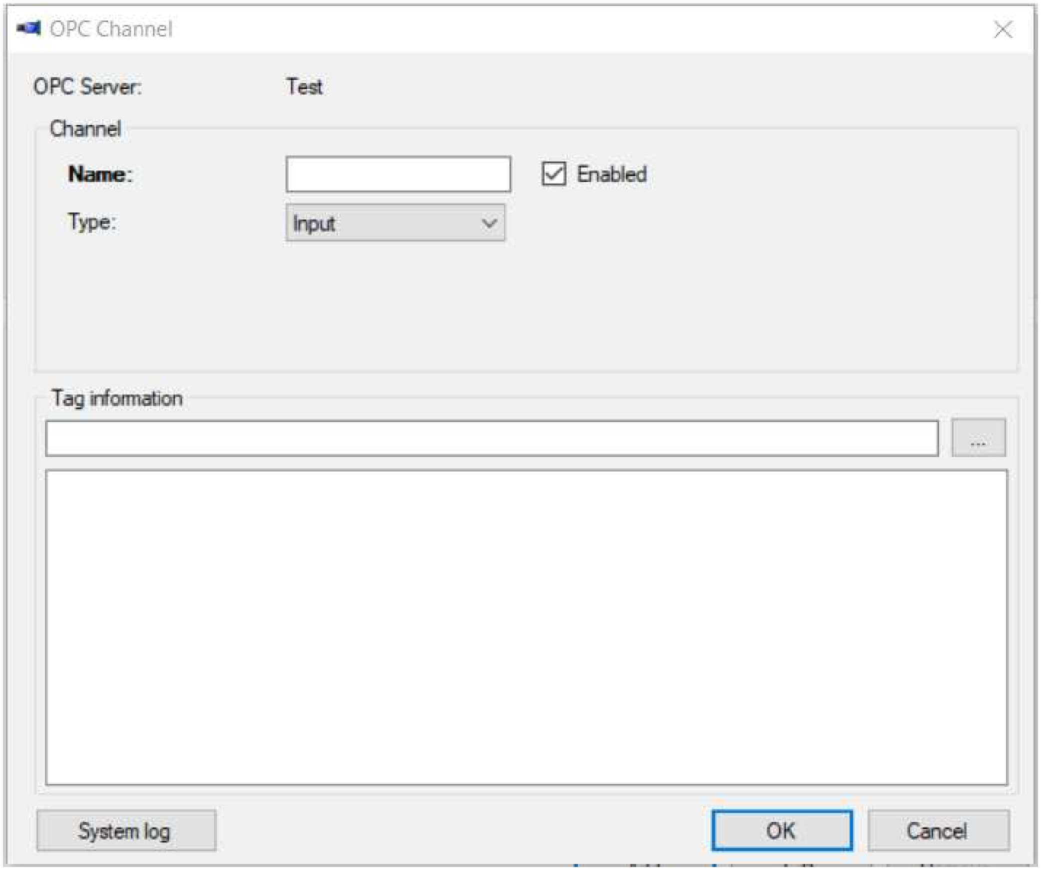


Figure 4 - 42
Example of Create an OPC Channel

OPC Server is the name of the OPC server selected in the previous screen. This value is not editable.

Channel name is a name for this OPC channel.

Enabled indicates the status of the channel whether it is enabled or disabled.

Type

Input: a channel that sends data from an OPC server to @ptitude Observer.

Output: a channel that sends data from the @ptitude Observer to an OPC server and subsequently to another system.

Source specifies which measurement point to retrieve data values from @ptitude Observer and send data to the OPC server. It is available only when the type is set to *Output*.

Data type is available only when the type is set to *Output*.

Overall: sends the overall value to the OPC tag on the OPC server.

Status: (advanced) sends the bitwise internal status of the measurement point to the OPC tag on the OPC server.

Tag selects the unique tag name to be used. Note that tags must be created in the OPC server itself. For further information on how to create tags, refer to the OPC server manual.

Once OPC input channels have been created, the next step is to create OPC measurement points for them. To do this, refer to Setting up Measurement Points and Alarms in System Configuration.

The most common problem when troubleshooting connections to OPC servers is the security. OPC makes use of DCOM which can be quite difficult to configure for those unfamiliar with it. Request assistance from IT-personnel when setting up the OPC configuration.

OPC Server Status Tag Value

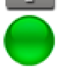
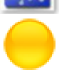
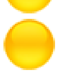
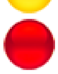
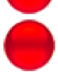
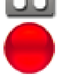
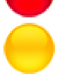
Each OPC server status tag displays its status icon along with its numeric value.

When multiple states exist on a measurement point at the same time, the icon with the highest priority will be displayed. The priority list of status for measurement points is listed in Priority List of Status under Tree View in System Operation chapter.

As an example, if Vector Alarm and Trend Alarms are active at the same time, then the Alarm icon, , will be showing along with the numeric value of **8449**.

8449 = 1 (Ok) + 256 (Trend Alarm) + 8192 (Vector Alarm)

For each status icon below, a link is provided to the entry in the 'Status in the Hierarchy View' section, where an explanation of the state is given.

Icon	Numeric Value	Description
	0	Unknown
	1	Ok
	2	Not measured
	4	Protean decrease
	8	Protean increase
	64	Low Warning active
	128	High Warning active
	256	High Alarm active
	512	Low Alarm active
	1024	Outside measurement range
	2048	Sensor fault
	4096	Not active
	8192	Vector Alarm active
	16384	Vector Warning active

Icon	Numeric Value	Description
	262133	Pre/Post data capture in progress
	1048576	Trip in progress
	8388608	Relation Alarm active
	33554432	Diagnosis warning
	67108864	Diagnosis alarm
	134217728	No Trend Alarm levels set. Refer to No alarm levels set
	268435456	Outside active range unstable
	536870912	Transient
	1073741824	Outside active range

Setting up Measurement Points and Alarms

A user can add new measurement points and edit or delete existing measurement points on machines and sub machines.

To add a measurement point:

- First, select a machine or a sub machine to which a measurement point is to be added in the hierarchy view.
- Click on the right mouse button, select **Add**, then select **Meas. point**.

To edit a measurement point:

- First select a measurement point to be edited in the hierarchy view.
- Perform one of the following options.
  - Click on the right mouse button and then select **Properties**.
  - Double click on the measurement point.
  - Click on **Edit** on the toolbar and then select **Properties**.
  - Click on Properties icon on the toolbar.

To delete a measurement point:

- First, select a measurement point to be deleted from the hierarchy view.
- Click on the right mouse button, then select **Delete**.
  - ➢ If the point being deleted is referenced by a Multiple Gating Point, the system will remove that reference.

It is also possible to use one of the following wizards to help with the add and edit, measurement point processes:

Machine copy wizard. Refer to Machine Copy Wizard in System Configuration.

Multiple point update wizard. Refer to Multiple Point Update Wizard in System Configuration.

Measurement Points

Different types of measurement points are available depending on the selected device. The following figure is an example of measurement points available for an IMx device in @ptitude Observer.

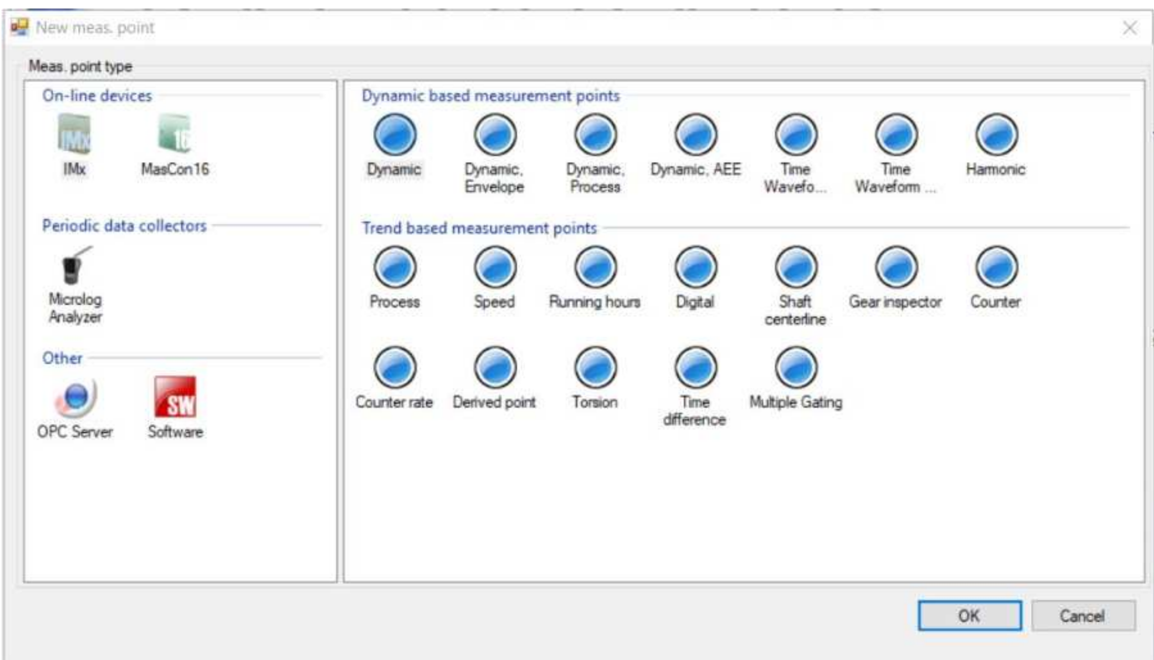


Figure 4 - 43
Example of New Measurement Point Types

Point types based on hardware (for example an IMx or a Microlog) can generally be of a Dynamic or a Trend based type, whereas those that are not (for example OPC and Software) are always Trend based. Descriptions of some of the key types of measurement point follow.

Dynamic based measurement points – Select one of the following measurement point types to create a measurement point that will ultimately produce spectrum and/or time waveform graphs.

Dynamic is a measurement of a dynamic signal such as vibration sensors, AC current or any other dynamic signal that could change at a frequency faster than 0,1 Hz.

Dynamic, Envelope is a measurement of repetitive frequencies. It is used to detect and monitor repetitive frequencies, such as bearing failure detection and monitoring.

Dynamic, Process is similar to a Dynamic measurement point, but instead of a vibration signal, it uses an analogue sensor for the measurement. For example, it can be used for motor current analysis.

Dynamic, AEE is a measurement of an acoustic emission signal.

Time Waveform Analysis is a measurement of the time waveform and applies algorithms such as crest factor, kurtosis and skewness to detect failures.

Time Waveform Analysis, AEE is same as Time Waveform Analysis but used for acoustic emission signal.

Harmonic is a measurement of a dynamic signal with vibration sensors or Eddy Current Probes such as vibration monitoring on turbines.

SEE® (spectral emitted energy) is designed especially for measuring high frequencies for Microlog CMVA series only. It requires a special sensor kit.

Trend based measurement points – Select one of the following measurement point types to create a measurement point that will ultimately produce trend graphs.

Process, when a hardware related point, is a measurement of a static/process signal such as from a load, temperature, pressure or flow sensor. When a software point, no actual process measurement is made, rather the process values can be manually input using Meas. date.

Speed, when a hardware related point, is a measurement of the rotational speed of a shaft. It is used to measure rotational speed of a shaft with a speed sensor. When a software point, no actual speed measurement is made, rather the speed is specified as part of the point configuration.

Running hours is a measurement point for IMx/MasCon devices. It provides an effective usage for Observer's Maintenance Planner feature. It keeps track of running hours of a machine.

Digital is a measurement of an IMx device, digital input. It can have only two states: a digital 1 and a digital 0 or relay closed, and relay opened. A digital measurement point can be used to control when to take trend vibration data and when to take spectrum data.

Shaft centerline is a measurement that uses information from two radial displacement sensors located in the same axial position 60 to 120 degrees from each other in IMx devices.

Gear inspector is useful when analysing impact energy as a function of shaft/gear revolutions in wind turbines.

Counter is a measurement that counts digital pulse changes which produces a value with the total amount of digital value changes. It can be reset, and the value will start from zero again. It is currently available for IMx/MasCon16 devices only.

Counter rate creates a new measurement that counts pulses per second, minute, hour, day or week on a digital channel. This measurement point can be used to measure a particle counter.

Derived point (IMx) is an IMx based calculation measurement point that uses existing IMx measurement points to calculate a value to trend.

Torsion is a measurement of shaft torsion that uses two digital channels of an IMx device.

Time difference is a measurement of the time difference between pulses on two digital channels of an IMx device.

Multiple Gating is a measurement that references values from up to five other points and then performs a logical evaluation on the current measurements to determine if the IMx should take measurements. Each reference point has two distinct gating conditions, Operating Class 1 or Operating Class 2, with the point output determined by which set of the two gating conditions is set to TRUE. These reference measurements can include process, speed and digital measurements.

HFD (High **F**requency **D**omain**)** is a type of vibration measurement like an envelope measurement. It produces only an overall value and is used only for the Microlog Analyzer.

OPC is a measurement that is used when the system requires data from an external system with the help of an OPC Server.

- Before starting the configuration of an OPC measurement point, make sure to complete the setup for OPC server and OPC channels. If not, refer to Creating OPC Server and OPC Channels in System Configuration.

Data tagging is used to track down material related or characteristic related data. Measurements can be marked with a specific tag such as paper quality, motor brand, revision number or any other property of a machine. Data can be tagged manually with Software data tagging point or automatically by OPC data tagging points.

Speed from spectra searches spectral data from a designated measurement point and uses the frequency of the highest amplitude peak as the speed value. The measurement point 'Spectra source' and search frequency range, Min. speed / Max. speed, are configurable in the Trend Configuration area of the Acquisition tab. Note that this point type is only available for the Micrprincipal Analyzer.

Derived (Software) is an @ptitude Observer based calculation measurement point that uses existing measurement points to calculate a value to trend. For example, it could be used to trend the sum of all vibrations of a machine or the average efficiency of four different turbines. The @ptitude Observer derived measurement can take data from all available sources, for example IMx and OPC etc.

When using a Derived (Software) point type, especially one using a *Trend Delta* parameter type there are a number of interacting time settings to consider:

- Refer to the Acquisition Tab section for an explanation of the various configurable settings and their names.
- The derived value is based on a source Trend value which will have an associated **Storage Interval** in minutes. Ensure that the **Deviation time** set for the derived measurement is greater than this storage interval so that the *Trend Delta* calculation will normally have a 'last value' it is able to use.

- With the above in place, when making the derived calculation this will be based on the last value and then an earlier value corresponding to **Delta time**, minutes earlier.
    - ➢ It is not necessary for there to be source data available at that exact moment in time as the calculation will linearly interpolate across the target time using the nearest previous and next measurements.
- The difference between those two values the *Trend Delta* per **Delta time**, is the value the parameter returns and is used in the subsequent calculation.
- The derived measurement value is calculated in @ptitude Observer Monitor every 10 seconds but stored according to the **Interval** set in the configuration of the derived measurement point.

An example will illustrate these and related considerations:

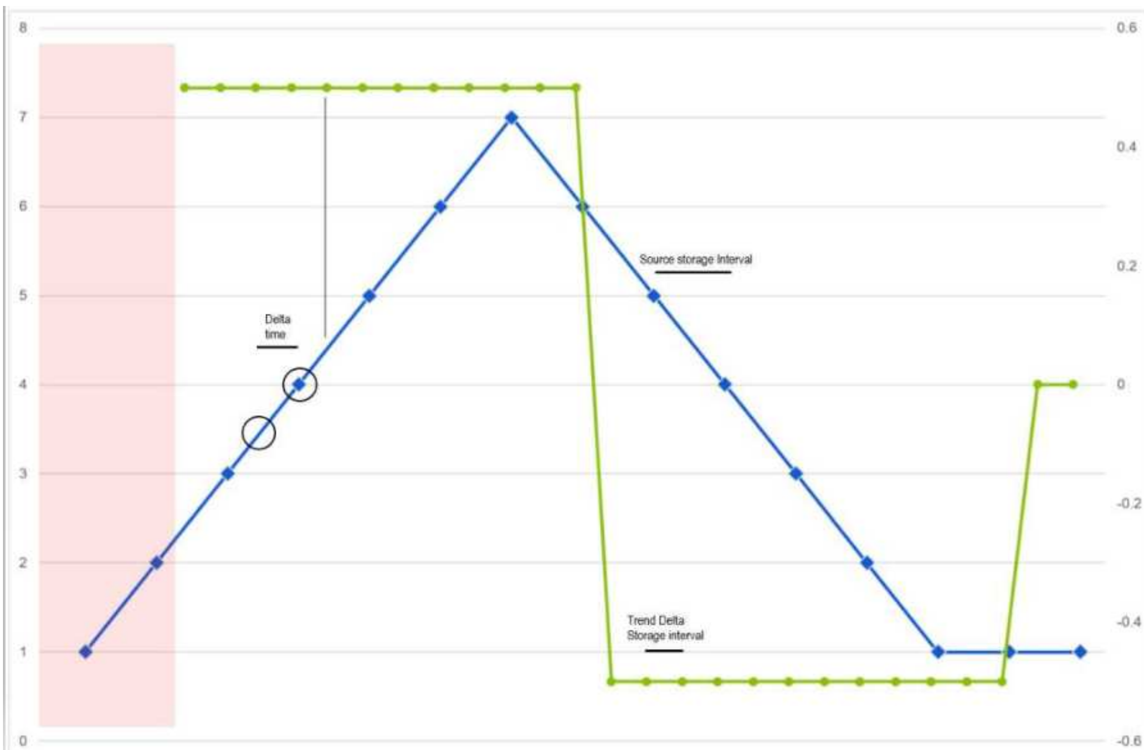


Figure 4 - 44
Illustration relating to Derived measurement Trend Delta

The line and points in blue represent the selected source data and those in green the *Trend Delta* parameter value.

- If the first source data point shown is the earliest source data available in the database then it takes some time before the derived measurement can be calculated. This is illustrated in the example by the red shaded zone.
    - ➢ To interpolate a value for **Delta time** earlier than the last measurement there must be an existing source measurement value for a time earlier than that.

- Once sufficient historical data is available for the source measurement then the derived measurement can begin. As illustrated next, the point in time at which the calculation and storage is done is arbitrarily aligned with the storage schedule for the source data. At the designated measurement interval, the calculation will look for the last stored source measurement data then further back to a point in time that is **Delta time** earlier.
- It is this point for which interpolation will be applied. In the example above as **Delta time** is smaller than the source storage interval then it is the last and the next to last readings that are used. In the general case if the source storage interval is much less than the configured **Delta time** then the two adjacent data points used to interpolate the required value will be further back in the trend.
- As the timing for the calculation and storage for the derived measurement is arbitrarily aligned with the storage schedule for the source data, if the **Deviation time** were less than the source **Storage Interval** then there is the likelihood that calculation and storage of the derived measurement would sometimes fail because no valid source data was available.

Direct Modbus Point is a type of software, trend based measurement point that is available both in this dialog and as a dedicated entry in the hierarchy right click menu at machine or sub-machine level. Direct Modbus Points store the data received from Direct Modbus devices.

Meas. (Measurement) Point tabs and sub-tabs

Meas. point main tabs	Sub tabs		
General			
Acquisition	Reference point selection		
	Class 1 gating		Reference point 1
	Class 2 gating	Reference point 1	Reference point 2
		Reference point 2	Reference point 3
		Reference point 3	Reference point 4
		Reference point 4	Reference point 5
		Reference point 5	
Operating and Storage Conditions			
Shaft properties			
Monitoring	General		
	Frequency 1		
	Frequency 2		
	Frequency 3		
	Frequency 4		
	1 x N		
	2 x N		
	3 x N		
	4 x N		
	Overall		
	Custom band		
Adaptive alarming			
Transient			
Observer display options			

Tabs, sub-tabs and their content are dynamic and context specific, so all options will not be visible in all circumstances. Examples:

- Acquisition sub-tabs relate to Multiple Gating Points (MGP).
- Shaft properties tab applies to a Shaft Centerline measurement.
- Monitoring sub-tabs vary depending on whether Trend or Dynamic based, and the type of dynamic measurement point selected.

Note that naming is not unique across all tabs and sub-tabs, example ‘General’.

Different settings are available for different device types and different attributes are available for different measurement point types.

System log is common to all main measurement point tabs. It opens a configuration log of all the changes made to the measurement point.

General Tab

On the **General** tab, the general attributes required to create various measurement points can be configured. The following is an example of the **General** tab as it appears for an IMx dynamic vibration measurement point.

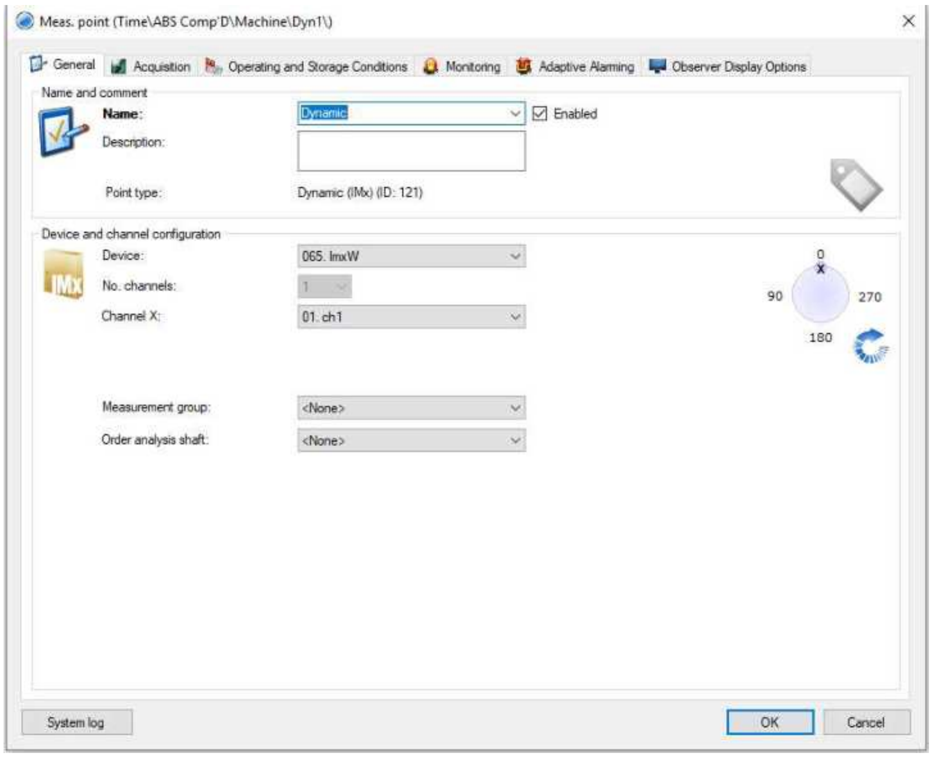


Figure 4 - 45
Example of Dynamic Measurement Point General Settings

The **General** tab can contain any of the following elements, depending on the device type and measurement point type being configured:

Name and comment area

Name is a short description of the measurement point. All names are saved and can be used by other measurement points if desired.

Enabled sets/indicates the status of the measurement point, whether it is enabled or disabled. Refer also Measurement Points.

Description is any additional comments for the current measurement point.

Point Type is the measurement point selected along with the device type and the database ID for the point.

MPA code is for Microlog Analyzer USB and 1-channel communication only. It is used to group measurement points together.

Sensor type is for Microlog Analyzer only. It can be *accelerometer*, *displacement probe* or *velocity sensor*. Note that once the sensor type has been set, it cannot be changed.

No. of directions is for Microlog Analyzer only.

- *Use TriAx sensor* allows the use of a tri-axial sensor when measuring single axis measurement points. Select which axis to use for the point.

Orientation is a suitable sensor orientation.

Meas. interval is for Microlog Analyzer only. It is the measurement interval that the point should be measured by personnel. If this time is exceeded the system will generate an alarm.

Device and channel configuration area

Device is an IMx/MasCon device in which the measurement point can be set up.

MasCon/IMx unit (for Multiple Gating Points only) is the MasCon/IMx unit a Multiple Gating Point will reference.

No. channels is used by the selected measurement point, for example, for vibration, envelope, harmonic, process FFT, process and speed measurement points.

- Multiple Gating Points (related to Dynamic and Dynamic Envelope points only), cannot be used with multiple channel points.

Channel (Channel X / Channel Y / Channel 1) is the channel in which the measurement point should be performed. Multiple channels can be selected. However, for shaft centerline, torsion and time difference measurement points, two different channels must be selected. Note that speed channels must be configured in IMx/MasCon units before they can be selected here.

Trigg channel is the trigger channel which can be used for phase measurement and torsion measurement points. A channel having more than one pulse per revolution cannot be used. Note that a trigger channel must be selected for condition monitoring on turbines.

Measurement group is a logical grouping of measurement points on a specific IMx/MasCon device, used for example for event or transient captures or collecting data at the same time and synchronously. The different group types and their configuration are described in Database > Measurement Groups in the menu items section.

Order analysis shaft is the shaft on the machine that should be used for order analysis in the spectrum, history and 3D plot.

Rotation direction indicates the rotational direction for vibration measurement points, *clockwise, counter-clockwise* or *both.*

OPC Server and channel settings area (for OPC measurement points only)

Note that to send data from @ptitude Observer to an OPC server, a setup of an OPC measurement point is not required. Instead, this is completed through OPC channel setup.

OPC server is the OPC server to be used for this measurement point.

OPC channel is the channel to connect to.

OPC Server and channel settings area (for Software, Data tagging measurement points only)

Data tagging group allows a data tagging group to be selected from the drop-down list. Data tagging groups are created through the Data tagging group interface under Menu > Database > Libraries.

Acquisition Tab

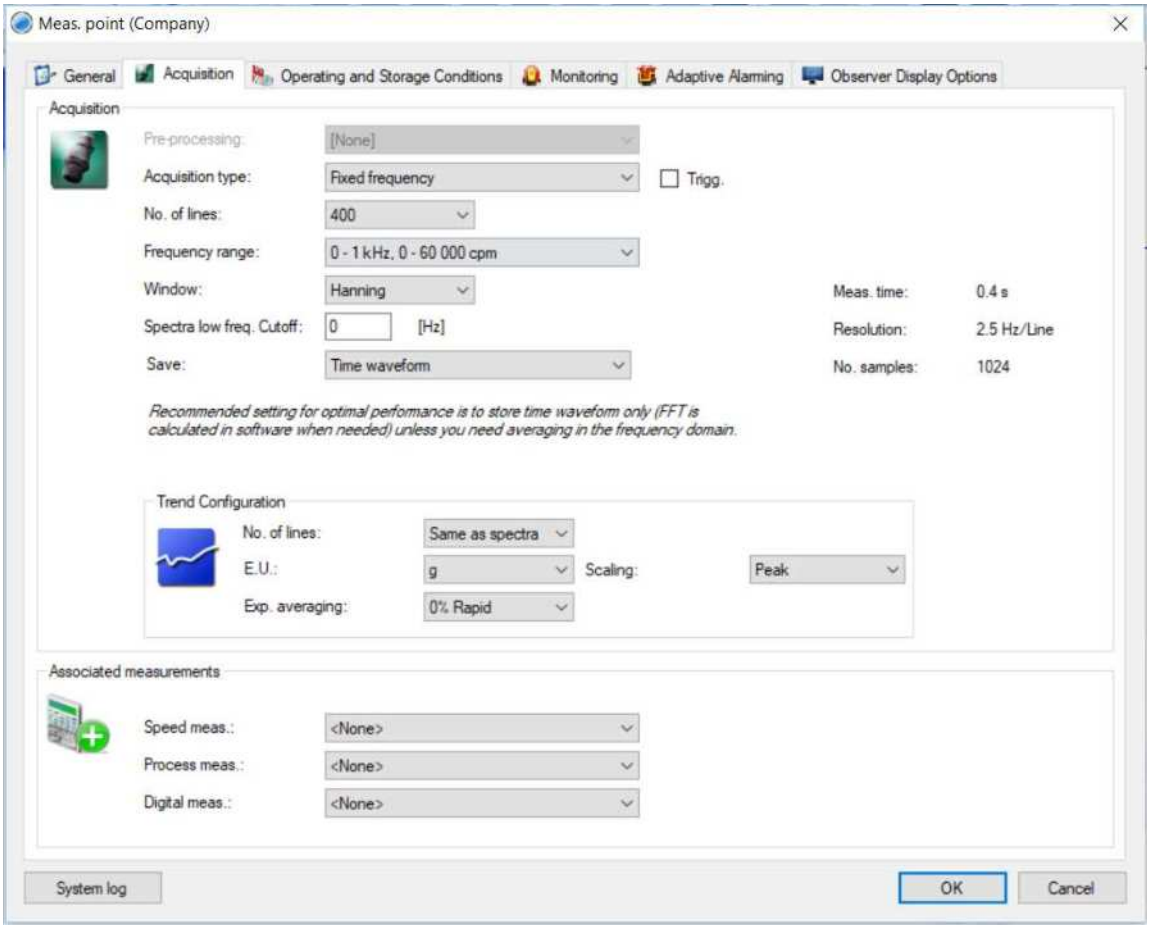


Figure 4 - 46
Example of Dynamic Measurement Point Acquisition Settings

The **Acquisition** tab can contain any of the following elements:

Acquisition area

Pre-processing is a pre-processing type, such as *Envelope*.

Acquisition type can be *Fixed frequency* or *Order Tracking*.

Fixed frequency: Sampling occurs at a fixed frequency to provide the desired analysis **Frequency range** and so is particularly suited to a fixed speed machine. Being as the sample rate is fixed, a **Meas. time** can be calculated and displayed.

Order Tracking: Sampling occurs at a variable rate linked to the shaft rotation so that the number of samples per rev remains constant. The number of samples per rev is a function of the **No. of lines** (dictates **No. samples**) and the **No. revolutions** over which the samples will be taken.

The number of samples per rev, effectively the order tracking sample rate, determines the equivalent of frequency range for an order tracked measurement: **Max order**. In addition, where an Order analysis shaft has been defined for this measurement point on the **General** tab, a further entry such as

'**Shaft 1**' (the actual, Order analysis shaft, name is used), will be shown below **Max order** to convey the analysis range in terms of orders of that shaft as well.

Using order tracking acquisition is particularly helpful on variable speed machines. Only configurations that result in a **Max order** of no more than 400x are allowed.

- Reducing the **No. of lines** or increasing the **No. revolutions** will reduce the calculated **Max order**.

Trigg indicates if the selected speed measurement should be used as the trigger for the measurement point. If trigger is set, then the phase information will be available for the measurement.

- 'Trigg' will be automatically set if Acquisition Type is set to Order Tracking.

No. of lines is the number of lines needed to construct the FFT (Fast Fourier Transform).

Frequency range is the maximum frequency for the FFT or time waveform. Select a frequency range from the drop-down list or choose *Custom* option to enter the end frequency in Hz. The end frequency can be between 5 and 40 000 Hz in integer numbers only.

Window is the window type for the FFT which can be Hanning or Uniform.

Spectra low freq. Cutoff is the low frequency cut-off which can be used as a filter to limit unwanted peaks or "ski slopes" at the start of the FFT. For example, setting this value to *5* will zero out all values between 0 and 5 Hz in the FFT.

Save determines which format of the captured data should be stored in the system. Storing time waveform only is the recommended setting. Observer will on the fly calculate and display the FFT based on the time waveform when clicking the spectra button.

Meas. time describes the current measurement time calculated with the currently selected number of lines and frequency range.

Resolution describes the current resolution calculated with the currently selected frequency range and number of lines.

No. samples is the number of samples needed to construct the time waveform.

Sampling revolutions indicate how many revolutions the trend value should be based on for shaft centerline measurements only.

Max time is the time allowed for measuring a trend value for shaft centerline measurements only. If it takes longer time than the specified time to measure the desired sampling revolutions, the trend value will still be calculated and stored.

Formula area

Parameters and a formula are used during the definition of both **Derived point** (IMx) and **Derived** (Software) measurements. For either type of derived measurement point, basic parameter configuration consists of a **Name** (to refer to it in the formula) and a **Type**. Depending on which type the measurement point is there are either two or three available parameter types:

Constant: this is for a value in the formula that never changes. Give it a **Name**, set the **Type** to *Constant* and then assign it a numeric **Value**.

Trend: will bring a value from another measurement point in the system. Give it a **Name**, set the type to *Trend* and select a measurement point from the system as the **Source**.

- For a **Derived point** (IMx) the source selected here must be from the same IMx/MasCon device.

Trend Delta: an extension of the '*Trend*' functionality where the parameter represents the change in the selected source point value per time period. Give it a **Name**, set the type to *Trend Delta* and select a **Source**. The additional control for a **Delta time** in minutes, sets the time period that the delta value will be calculated for. Example: configure as *60* minutes for the parameter to calculate the hourly change in the source value.

- As the *Trend Delta* parameter type requires access to historical data to calculate a delta value, it is only available to an @ptitude Observer **Derived** (Software) measurement point.
- For further information and an example refer to Trend Delta.

Formula is the calculation formula using the assigned parameters from above for derived point/derived measurements. The normal calculation methods [+ , - , * , / , ^ , (,)] and mathematical functions are available to build a formula.

Check verifies if @ptitude Observer and @ptitude Observer Monitor can understand the formula entered. An automatic verification is performed, on clicking **OK** as well.

Trend Configuration area

No. of lines is the number of lines needed to construct the FFT (Fast Fourier Transform).

E.U. (Engineering Unit) is the engineering unit in which this measurement is to be displayed. If the scale factor is set to *1,* then E.U. will be set to *degrees*. However, if the measurement point is a counter rate, this acts as a user editable text field. See **Time Unit**, below.

Scale factor is used to set a different scale factor than the engineering unit (E.U.) of degrees. The default is *1*.

Time unit is available for counter rate measurement points only. It can be pulses of seconds, minutes, hours, days or weeks. Note that for counter rate measurement points, **E.U.** is a user entered text that will be displayed on graph only. Which means that it will not affect the measurement at all. The text should reflect the selected time unit, for example if time unit is selected as Seconds, E.U. should be changed to Pulses/second.

Resettable sets whether the measurement point's value can be set to zero or not. It is available for count measurement points only.

Unit is the unit on which the trend measurement should be performed.

Scaling defines how the trend values should be calculated and stored in the database.

Counter type sets the calculation method that should be used for this counter measurement point.

Pulses: The value collected is added to the previous value. This is a normal counter.

Stops: Each time a value is collected, the previous value is incremented by one (1).

Pulses between stops: The value collected is the value used. This can be used, for example measuring the distance between two train stations if an IMx has been fitted on a train.

Exp. averaging (exponential averaging) is a setting to perform an automatic trend curve smoothing or to stop the system from giving alarms when intermittent disturbances occur. The function applies the following formula:

new calculated = measured * (1 - exp value) + last calculated * exp value

Compensate for speed is available for "running hours" measurement points only. It compensates the running speed of a machine by comparing the active speed of the machine against a nominal speed of the machine. The **Nominal speed** of the machine is entered by the user.
For example, if the active speed of the machine is 1 000 cpm and the nominal speed is set to 2 000 cpm, then after the machine has been run for two hours, because of the difference between the active speed and the nominal speed, the running hours value will be one hour instead of two hours.

Compensate for load is available for "Running hours" measurement points only. It enables a compensation for the active load or any other process signal compared to a **Nominal load** value entered by the user. Compensate for load works the same way as Compensate for speed.

Spectra source is the measurement point where that maximum amplitude is being searched to get the speed reading.

Min. speed / Max. speed is the start and stop search range of the spectra source.

Machine part can be a gear or a shaft that helps to get more precise speed reading by using its fault frequency.

Speed is the running speed in rpm (revolutions per minute).

Deviation is the percentage the speed can vary during the measurement of the machine. This is used in the diagnosis calculation when obtaining the fault frequencies. It sets the search range of frequencies for the diagnosis calculation.

Deviation time: when calculating a value dependent on other parameters, this is the time tolerance applied when collecting those parameters. For example, a deviation time of 5 minutes means that the parameter values collected from IMx/MasCon or OPC should be no more than 5 minutes old.

Associated Measurements area

Speed meas. is a speed measurement point to which the currently selected measurement point should be connected/linked. The selected speed measurement point will be taken with the current measurement point's data.

- If 'Trigg' has been checked manually or because of order tracking, speed channels from Modbus external channels will be unavailable for selection as an actual tacho signal, a pulse train, is required.

Speed controlled sampling indicates whether to use speed-controlled sampling or not. If it is checked, then all the samples during one revolution of the shaft will be used to calculate the average position of the shaft. If unchecked, then the samples during 0,1 second will be used to calculate the average position of the shaft. It is used to get a better reading of the shaft position. Therefore, for measuring the shaft position it is strongly recommended to enable this field.

Process meas. is a process measurement point to which the current measurement point should be connected/linked. The selected process measurement point will be taken with the current measurement point's data.

Digital meas. is a digital or Multiple Gating measurement point to which the current measurement point should be connected/linked. The selected digital or Multiple Gating measurement point will be taken with the current measurement point's data.

If the current measurement point is a Dynamic or Dynamic Envelope point, then all Multiple Gating Points assigned to the same IMx as the current point appear in the **Digital meas.** drop-down list.

- To successfully set up the current measurement point to be referenced by a Multiple Gating Point, the **No. channels** value on the **General** tab must equal ***1***.

Settings area (for Microlog Analyzer only)

E.U. is the engineering unit in which this measurement is to be displayed.

Scaling is used to change the display scaling (detection) of the measurement.

Pulses/rev. is the number of pulses the device receives per shaft revolution.

Full scale is used to scale the values.

Full scale, Env. is used to scale the values for Envelope.

Full scale, Veloc. is used to scale the values for Velocity.

Full scale, Temp. is used to scale the values for Temperature.

Zero level is the value that should be equal to zero in the measurement unit.

Sensitivity specifies the sensor sensitivity.

Envelope filter is a pre-processing type such as Envelope, for example.

ICP current feed indicates whether the sensor is to be powered or not.

Frequency type can be Fixed freq. range or Order tracking.

No. of lines is for the FFT taken for extracting trend values.

Save specifies what kind of data that should be collected and stored. Choose between *FFT*, *Time waveform* or both. Data called *FFT and Phase* are also available for order tracking.

Window can be *Uniform*, *Hanning* or *Flattop*.

Speed sets a static speed value that will be stored with the measurement.

End freq. is the highest frequency that should be measured.

Low freq. is the lowest frequency that should be measured.

No. of averages is the number of measurements the Microlog Analyzer should measure to get the average reading by combining all measurements. However, this number is ignored if the averaging is *Off*.

Averaging is a type of averaging method which the system should perform on the data before it is stored to the database.

Speed meas. selects a speed measurement point whose value will be measured and stored as the speed for this measurement point. This overrides the static speed setting.

Order analysis shaft is the shaft on the machine that should be used for order analysis in the spectrum, history and 3D plot.

General Settings area (for Multiple Gating Points only)

For a description of the General Settings area and sub-tabs applicable to Multiple gating points, refer to the topic About Multiple Gating Points.

Operating and Storage Conditions Tab

On the **Operating and Storage Conditions** tab, the user can configure when the measurement should be taken.

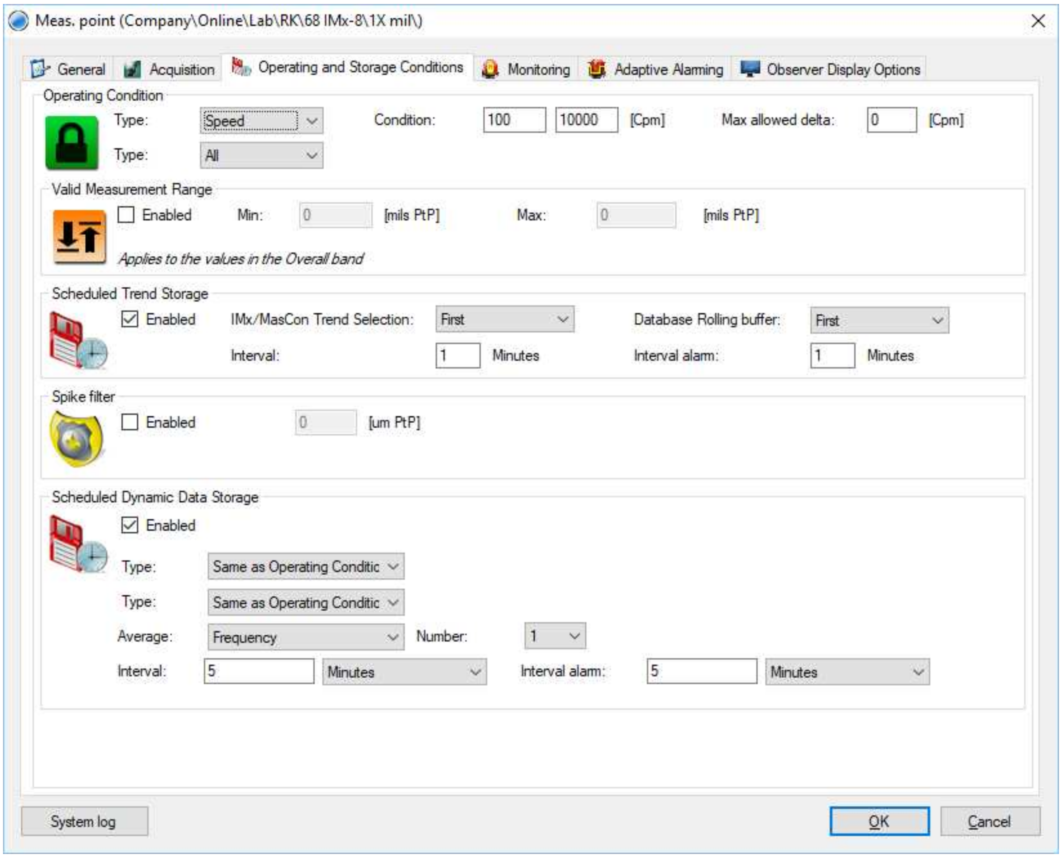


Figure 4 - 47
Example of Dynamic Measurement Point Operating and Storage Condition Settings

The **Operating and Storage Conditions** tab can contain any of the following elements:

Operating Condition area

Operating condition is calculated with the help of the measurement points specified in the **Associated Measurements** of the **Acquisition** tab settings. For example, if *speed* is selected as an active range type, a speed measurement point must be selected in the Associated measurements section as well.

Important - The specified conditions must be met for the measurement point to collect and store data in the database. The assigned conditions must be met before the system raises any alarms.

In any configuration dialog with two Operating Condition/gating controls note that AND logic is applied: therefore, if both conditions are specified, they must both be met for the expected action to be taken.

Type is the type of gating which can be set to one of the following values:

All: means that the active range check is disabled. In other words, the active range that the measurement point is using is all values.

Speed: means that the active range check is determined by the speed measurement point readings selected in the **Associated Measurements** of the **Acquisition** tab settings.

Process: means that the active range check is determined by the process measurement point readings selected in the **Associated Measurements** of the **Acquisition** tab settings.

Digital: means that the active range check is determined by the digital measurement point readings selected in the **Associated Measurements** of the **Acquisition** tab settings.

Condition is the gating parameter range with minimum and maximum values.

- (For Dynamic and Dynamic Envelope points only) If the **Type** selected is *Digital* and the **Digital Measurement** selected on the **Acquisition** tab is a Multiple Gating Point, then this drop-down list box will allow the user to select one or both of the operating classes established for that Multiple Gating Point. Once one or both of the operating classes have been selected, the **Enable class dependent alarms** checkbox on the **Monitoring** tab becomes enabled but remains deselected (unchecked) by default.

Max allowed delta is the maximum accepted change of the gating parameter during the measurement. Use this setting to force the system to take data when the operating mode of the machine is stable which may be the only way to capture accurate and reliable data.

This is an important setting when performing a process measurement point on variable speed machines. This is not important for a speed measurement point. It depends on the application. For example, for measuring bearing temperature, this function can be deactivated by setting it to 0.

Valid Measurement Range area

The system can be forced to take data only when the amplitude reading is at a certain level, by assigning a minimum and a maximum value of the measurement range. If the measured value is outside the measurement range, then the system alarm will be generated instead of an alarm on the measurement point.

System alarms are displayed in the *system view* or *system alarm* window from the icon bar, instead of in the *alarm list.* For example, if the range is set to 0 to 300 °C and the temperature sensor output is above 300 °C, then this value will be treated as an unrealistic value and the IMx/MasCon system will generate a system alarm in the *system alarm list* instead of in the *alarm list*. The cause of this alarm could be a bad earth connection or surrounding interference that disturbs the output signal from the sensor.

Enabled is the status of this measurement range, enabled or disabled.

Min. is the minimum value of the measurement range.

Max. is the maximum value of the measurement range.

Scheduled Trend Storage area

Enabled box allows the Scheduled Trend Storage function to be enabled or disabled.

IMx/MasCon Trend Selection defines which measured values to keep during the storage **Interval** (as the device is constantly measuring during the time period set for the interval).

Max: Keeps the maximum value for the entire storage interval period.

Min: Keeps the minimum value for the entire storage interval period.

First: Keeps the first value measured in the storage interval period.

Database Rolling buffer determines which trend value to keep as data is being thinned out by the rolling buffer feature in the monitor service.

Max: Keeps the maximum value for the time period.

Min: Keeps the minimum value for the time period.

First: Keeps the first value for the time period.

Interval is the desired interval for data capturing which depends on the application.

There are four different buffers in the @ptitude Observer database, an initial buffer, an hour buffer, a day buffer and a week buffer.

In each buffer 3 000 values can be stored as default. For example, if the measurement interval is set to 1 minute, the length of time encompassed by the first buffer will be 3 000 minutes (50 hours). As more data comes in, values are moved to the hour buffer. For a specific hour, all values in the 'minute buffer' are analysed and the system will move one of the values during this time period to the hour buffer. This logic works similarly for the hour to day buffer and so on. The default of 3 000 values for each buffer can be configured in the Database > Options > Data tab.

The type of the value to be moved from one buffer to the next is determined by the **Database Rolling buffer** field in the Scheduled Trend Storage, above.

Interval alarm is the desired interval for data capturing when the level is in warning or alarm condition.

Exception based storage settings are only shown for trend-based measurement points.

Save (Delta) checkbox – Select (check) to set the system to capture and store measurement trend data whenever there is a change in condition.

- ➢ To disable interval-based trend storage, enter a zero in the **Interval** text box.

Spike filter area

Enabled box allows the Spike filter function, to be enabled or disabled.

The spike filter is useful to avoid alarming on high peak readings that could be picked up by the sensors caused by other sources rather than the machine itself. These measurements are not the ones that should raise alarms and should not be stored in the database either. For example, setting this value to 20 m/s^2 will set the system to ignore any measurements above this level completely. However, when the system detects high peak reading, the measurement will display the status of

"Outside measurement range"  **,** indicating that the values coming from this measurement point are outside of the acceptance range.

Scheduled Dynamic Data Storage area

Enabled box allows the Scheduled Dynamic Data Storage function to be enabled or disabled.

Dynamic Data Storage is calculated with the help of the measurement points specified in the **Associated Measurements** of the **Acquisition** tab settings. For example, if *speed* is selected as an active range type, a speed measurement point must be selected in the Associated measurements section as well.

Important - The following specified conditions must be met for the measurement point to collect and store data in the database. The assigned conditions must be met before the system raises any alarms.

In any configuration dialog with two Operating Condition/gating controls note that AND logic is applied: therefore, if both conditions are specified, they must both be met for the expected action to be taken.

Type is the type of gating which can be set to one of the following values:

Same as Operating Condition: configures the dynamic data storage range to be same as the Operating Condition range.

Speed: means that the dynamic data storage range check is determined by the speed measurement point readings selected in the **Associated Measurements** of the **Acquisition** tab settings.

Process: means that the dynamic data storage range check is determined by the process measurement point readings selected in the **Associated Measurements** of the **Acquisition** tab settings.

Digital: means that the dynamic data storage range check is determined by the digital measurement point readings selected in the **Associated Measurements** of the **Acquisition** tab settings.

- (For Dynamic and Dynamic Envelope points only) If the **Digital measurement** point selected in the Associated measurements section of the Acquisition tab is a Multiple Gating Point, these **Type** menus will not contain a *Digital* option. Multiple gating is only performed on overall (static), process, speed or digital measurements and it cannot affect gating of dynamic measurements.

Condition is the gating parameter range with minimum and maximum values.

Max allowed delta is the maximum accepted change of the gating parameter during the measurement. Use this setting to force the system to take data when the operating mode of the machine is stable which may be the only way to capture accurate and reliable data.

This is an important setting when performing a process measurement point on variable speed machines. This is not important for a speed measurement point.
It depends on the application. For example, for measuring bearing temperature, this function can be deactivated by setting it to 0.

Average is a type of averaging which the system should perform on the data before it is stored to the database.

For example, when storing FFT selecting *Frequency* for the average and *4* for the number, the on-line device will take *4* FFT's, average them and store the averaged FFT in the database. If the averaging method is selected as *Time*, multiple waveform averages will tend to remove vibration components that are not synchronous with the shaft rotation whilst emphasising those, at 1x or higher harmonics, that are. Note that when using time averaging, in the **Acquisition** tab settings **Trigg.** must be enabled and a speed point using a physical tacho selected in the **Associated Measurements** area.

Number is the number of averages that should be taken for the specified average type selected from the above.

Interval is the desired interval for data capturing. It depends on the application.

Interval alarm is the desired interval for data capturing when the level is in warning or alarm condition.

Shaft Properties Tab

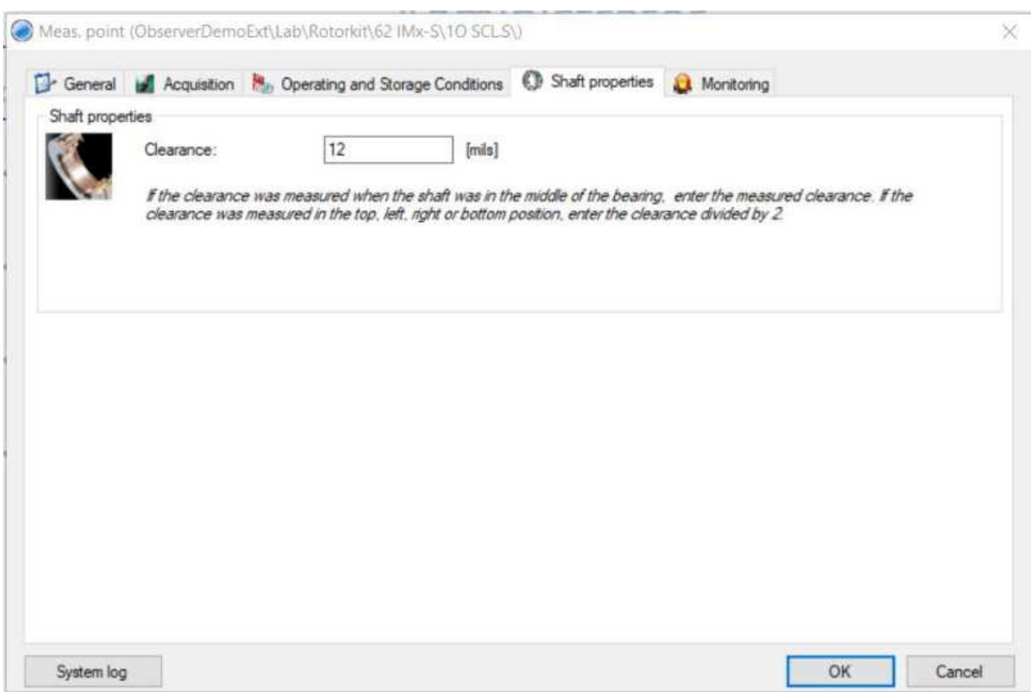


Figure 4 - 48
Example of Shaft Centerline Measurement Point Shaft Properties Settings

Shaft properties area

Clearance: the software displays important guidance text about measuring clearance and the value to be entered. It explains that the value entered here is the total bearing clearance divided by 2, so equivalent to the difference between the bore radius and shaft radius dimensions.

Monitoring Tab

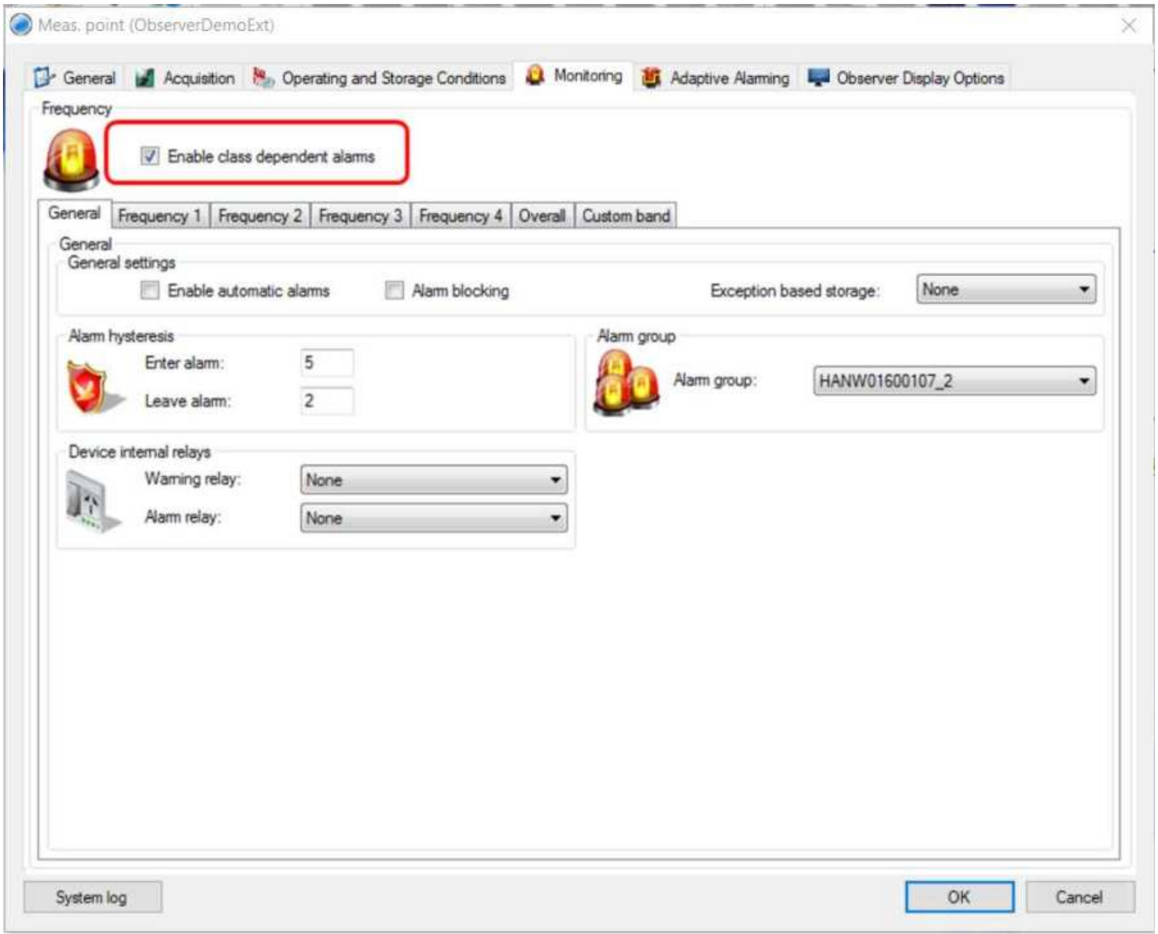


Figure 4 - 49
Example of Dynamic Measurement Point Monitoring Settings

Frequency area

Enable class dependent alarms box (for Dynamic and Dynamic Envelope points only), when selected (checked), enables extra alarms dependent on the two Multiple Gating Point operating classes and disables other alarms. If disabled, alarms and diagnoses are calculated for all classes.

When a Multiple Gating Point has been selected as the digital gating Condition on the Operating and Storage Conditions tab, this box become enabled but remains deselected (unchecked) by default.

When this checkbox is selected (checked), the system performs the following actions:

– Disables the Adaptive Alarming area on the **Adaptive Alarming** tab.

– Displays two alarm levels on each of the **Monitoring** tab’s **Frequency #** sub-tabs and **Overall** sub-tab corresponding to the two Multiple Gating Point operating classes.

– Disables the **Level ctrl.** (or **Adaptive alarming**) checkbox on each of the **Monitoring** tab’s **Frequency #** sub-tabs and **Overall** sub-tab.

– Hides the **Store delta** text box on each of the **Monitoring** tab's **Frequency #** sub-tabs and **Overall** sub-tab.

– Disables the **Monitoring** tab's **Custom Bands** sub-tab.

General sub-tab, **General settings** area

Enable automatic alarms checkbox enables the automatic alarm functionality when checked.

Automatic alarm enables the measurement point to use automatic levels for the selected active trend alarms. The system will automatically calculate the alarm and warning level after a minimum specific number of historical values have been stored in the database.

For Microlog Analyzer measurement points, the minimum number of trend values to calculate the automatic alarm levels is five and it will be based on a maximum of 40 measurements. For IMx/MasCon measurement points, the minimum number of trend values to calculate the automatic alarm levels is 20 and it will be based on a maximum of 100 measurements.

The calculation algorithm uses a specific number of standard deviations from the average level to determine the warning level. The number of standard deviations is determined by **Auto alarm** setting on the **Thresholds** tab for Options under Database in Menu Items. To determine the alarm level the system uses twice as many standard deviations as for the calculation for the warning level.

When a new trend value is stored in the database, the system always checks if new automatic alarm levels should be set for the measurement point. Once they are set, they will not be recalculated again unless the user specifically resets the automatic alarm levels by editing the measurement point properties or by right-clicking in the hierarchy and selecting **Reset the automatic alarm levels**.

When the system has calculated the warning and alarm levels for the active alarms on a measurement point, the measurement point properties will be updated with the new levels and the system log for the measurement point will be updated as well.

When a new measurement point is created by copying an existing measurement point with the automatic alarm enabled, the alarm level of the new measurement point will be set to 0. The automatic alarm for the new measurement point will be calculated when enough data has been stored for the new measurement point.

Automatic alarm cannot be combined with adaptive alarm.

Alarm blocking is a setting that makes it possible to temporarily disable the alarm check.

Exception based storage is a setting of what to store if the trended value changes.

General sub-tab, **Alarm** area

This area sets up alarm levels for measurements which are of a DC type (such as speed or shaft centerline) or alarm states for those that are Digital. Individual alarms can be enabled or disabled as required via the controls provided:

High alarm can be enabled or disabled and have a level set.

High warning can be enabled or disabled and have a level set.

Low warning (when available) can be enabled or disabled and have a level set.

Low alarm (when available) can be enabled or disabled and have a level set.

Condition is setting the digital condition or state that will cause the alarm to be raised. The three available options are *None, Open* and C*losed*.

General sub-tab, **Alarm hysteresis** area

This section controls how many times a value can be over and under the alarm limits before @ptitude Observer goes into or releases the alarm state.

Enter alarm is the number of consecutive measurements that must be over the alarm level before an alarm is reported. Default is set to 2.

Leave alarm is the number of times that a value must be under the alarm level before @ptitude Observer releases the alarm state. Default is set to 5.

General sub-tab, **Alarm group** area

A drop-down allows the measurement point to be added to any one of the existing alarm groups. The system will store data for all members of the group when one of the members triggers an alarm.

General sub-tab, **Device internal relays** (or **Relay**) area

Warning relay on the WindCon/IMx/MasCon device is used when a warning level is reached. It can be used to trip the machine upon warning.

Alarm relay on the WindCon/IMx/MasCon device is used when an alarm level is reached. It can be used to trip the machine upon alarm.

General sub-tab, **Vector alarming** area

Type is a selection of alarm type in the complex plane. This setting can be either Circular or Sector.

Frequency # sub-tab

Type is the type of frequency band or time waveform component to monitor.

For frequency:

Fixed frequency: monitors a specific frequency with a search area around in order to trend.

Speed following: monitors specific frequencies related to the speed of the machine when machine speed varies. It is possible to set up to monitor a specific gear on the selected machine part by choosing a machine part from the drop-down list.

 # x N sub-tab

Level ctrl. triggers the alarm levels to be automatically adjusted according to the settings and curve information provided in Adaptive Alarming Tab in Setting up Measurement Points and Alarms.

Channel X Enabled enables the Channel X.

Channel X Warning level / Alarm level sets up normal level alarm *warning* and *alarm* for trends 1 x N, 2 x N, 3 x N and 4 x N.

Overall sub-tab

This tab is used to configure an overall measurement.

Type specifies the method to use to calculate the overall.

Frequency band means that the overall will be calculated from a defined band in the frequency domain.

TruePtP means that the overall will be calculated from the time waveform (true peak-peak) and then scaled to RMS, peak or left as peak-peak (latter with no scaling) according to the Trend Configuration settings in the Acquisition tab.

None means the overall is not calculated.

Name is a name for the overall measurement.

Start is the start frequency of the frequency band to monitor.

Stop is the end frequency of the frequency band to monitor.

Adaptive alarming triggers the alarm levels to be automatically adjusted according to the settings and curve information provided in Adaptive Alarming Tab under Setting up Measurement Points and Alarms in System Configuration.

Relation indicates a percentage, which means that the system will trigger an alarm if the ratio exceeds the number set in this field. The ratio is calculated by *(Total - 1 x N - 2 x N - 3 x N - 4 x N) / Total.* Relation alarm monitors the frequencies in between the frequencies: 1 ´ N, 2 ´ N, 3 ´ N and 4 ´ N, for example, sub harmonics.

Alarm - Warning level/Alarm level is the warning level/alarm level of the Channel X alarm.

Custom band sub-tab

Band is the band number.

Name is the name of the band.

Type is the type of frequency or time waveform component to monitor:

Fixed frequency monitors a specific frequency with a search area around in order to trend.

Frequency band means that the value will be calculated from a defined band in the frequency domain.

Speed following monitors specific frequencies related to the speed of the machine when machine speed varies. The system can be set to monitor a specific gear on the selected machine part by choosing a machine part from the drop-down list.

True PtP means that the value will be calculated from the time waveform (true peak-peak) and then scaled to RMS, peak or left as peak-peak (latter with no scaling) according to the Trend Configuration settings in the Acquisition tab.

None means custom band is not being used.

Source is the selection of sensor multi-channel points.

HW is the high warning level.

HA is the high alarm level.

Additional configuration levels are available on selecting a custom band on this list and clicking **Edit**.

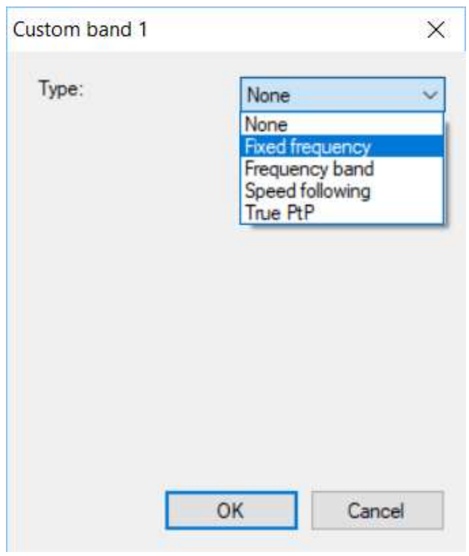


Figure 4 - 50
Example of Edit Custom Band Dialog, Type

In the **Custom band x** dialog, the **Type** options match those just described above. On selecting the **Type**, additional fields display. The examples below show the available options for *Fixed Frequency* and for *Speed Following*.

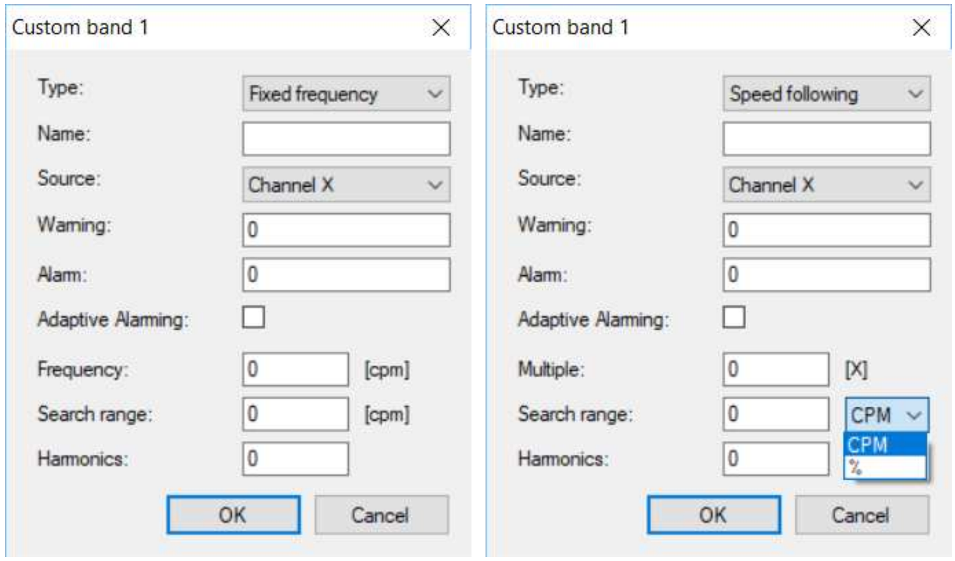


Figure 4 - 51
Examples of Edit Custom Band Dialog with Different Types

Source is the selection of sensor multi-channel points.

Alarm - Warning level/Alarm level is the warning level/alarm level of the Channel X alarm.

Adaptive Alarming triggers the alarm levels to be automatically adjusted according to the settings and curve information provided in Adaptive Alarming Tab in Setting up Measurement Points and Alarms.

Search range performs a search for maximum amplitudes within this range.

Harmonics specifies the number of harmonics that should be included in the calculation.

Adaptive Alarming Tab

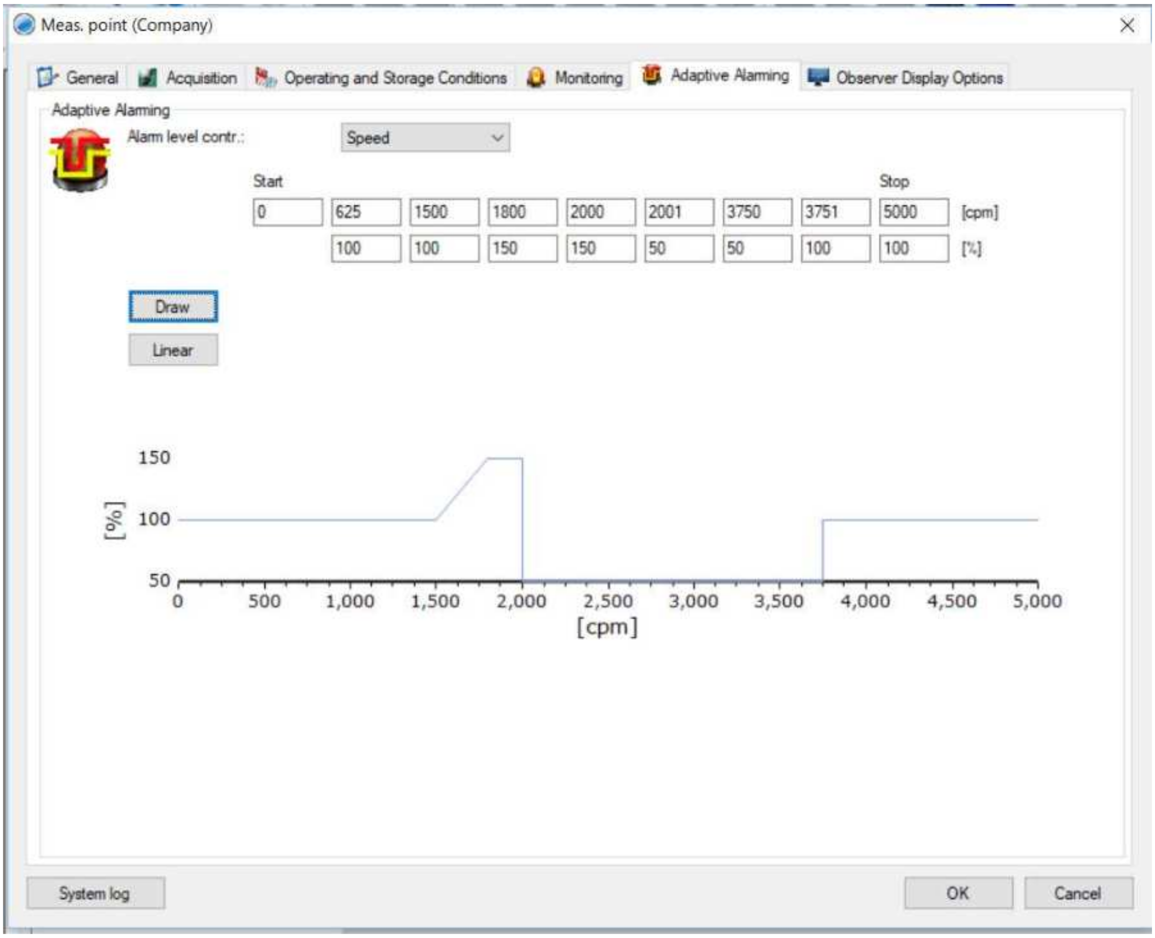


Figure 4 - 52
Example of Dynamic Measurement Point Adaptive Alarming Settings

Adaptive Alarming area

- If the **Enable class dependent alarms** box (for Dynamic and Dynamic Envelope points only), on the **Monitoring** tab is selected (checked), then all controls on this tab are disabled.

Note that to activate advanced settings for each trend, **Level ctrl.** (or **Adaptive alarming**) in Monitoring Tab under Setting up Measurement Points and Alarms in System Configuration, must be set.

Alarm level contr. controls the alarm levels; for example, for rotational speed or a process value such as motor load. Use the graph and its settings to construct the curve to be used for altering the alarm levels during measurement.

Start / Stop defines the range in which the control is to take place. The boxes above the graph are used to specify the alarm values as percentages of the alarm levels set in the Monitoring Tab.

Transient Tab

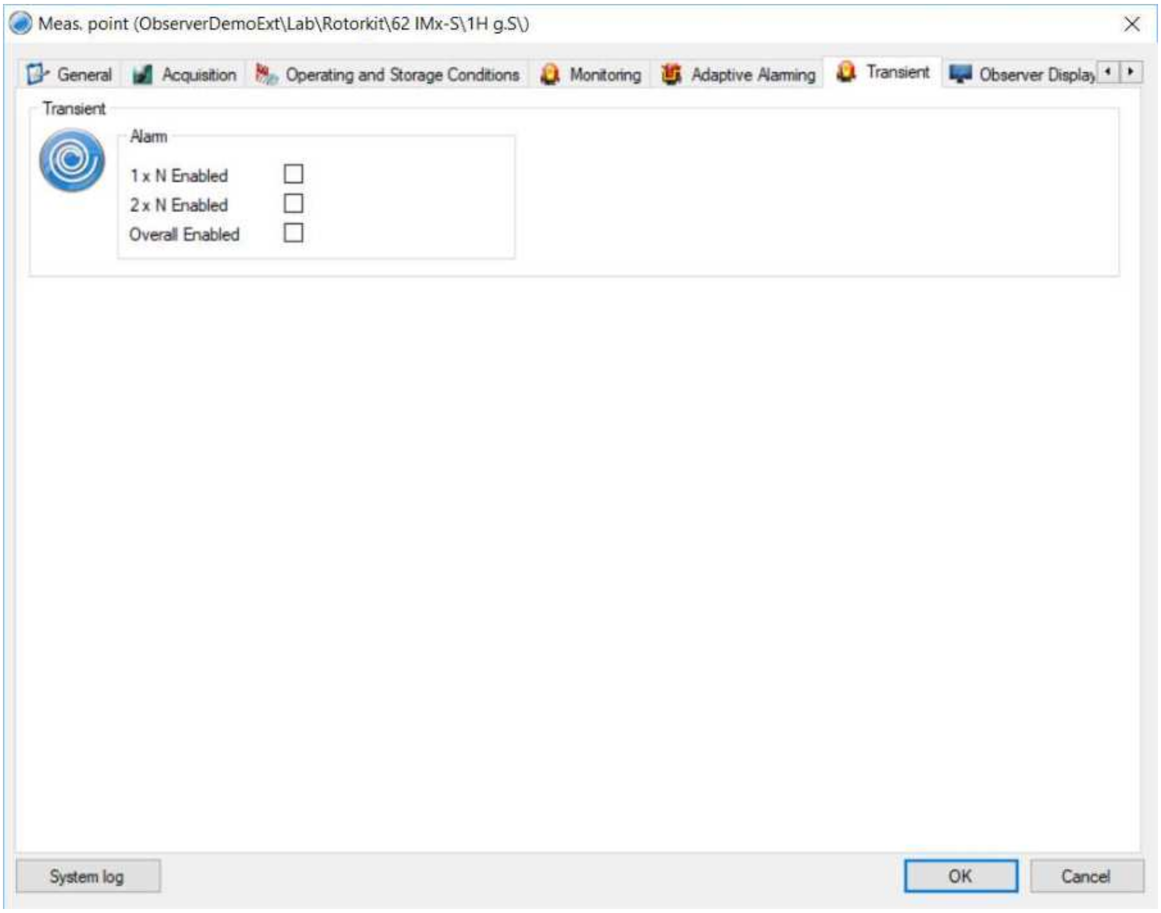


Figure 4 - 53
Example of Harmonic Measurement Point Transient Settings

Transient area

Alarm indicates whether to enable or disable alarms in transient ranges such as 1 x N, 2 x N and Overall in the measurement group.

Observer Display Options Tab

These options relate only to the display of information to the user, not to the measurement itself.

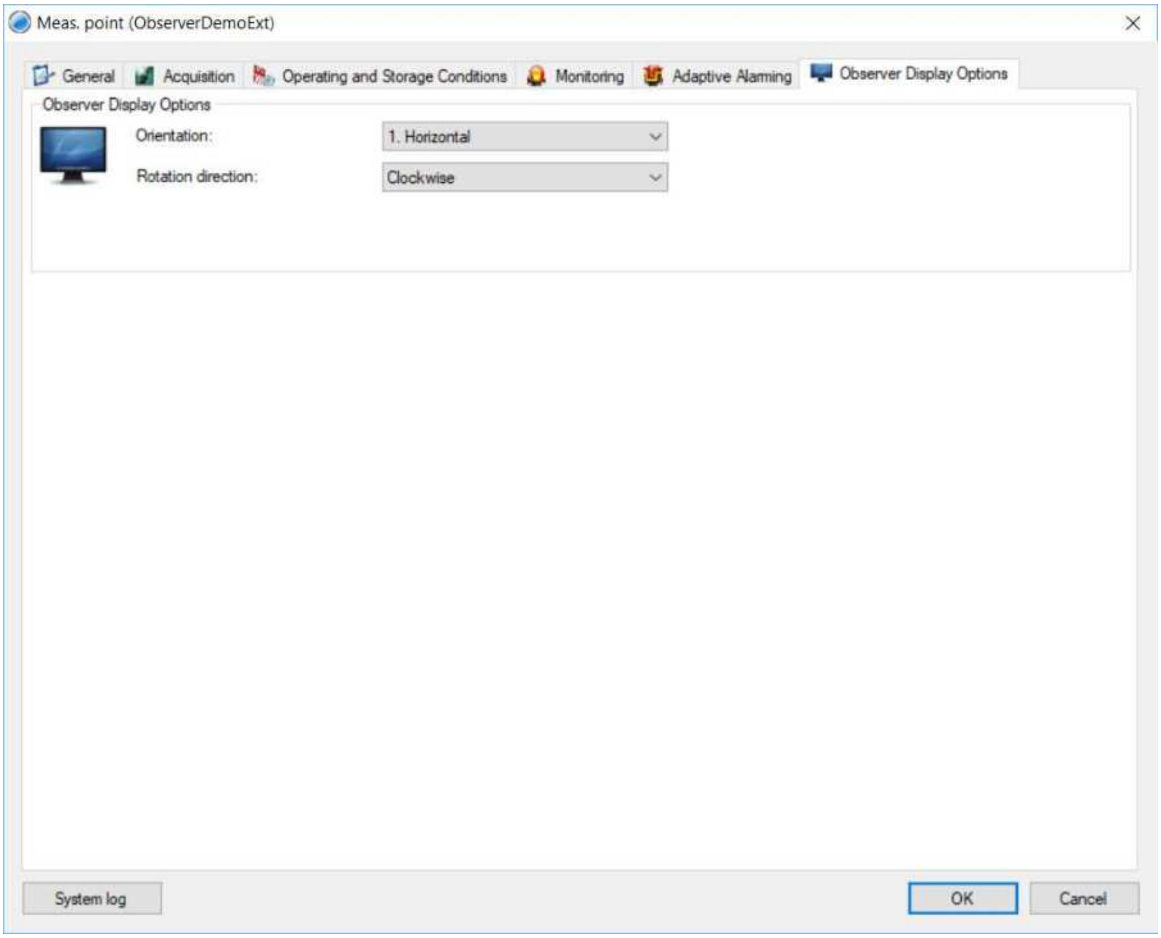


Figure 4 - 54
Example of Dynamic Measurement Point Observer Display Options Settings

Observer Display Options area

Orientation is a suitable sensor orientation which can be *1. Horizontal*, *2. Axial*, *3. Vertical*, *4. Tangential*, *5. Radial* or *6. Axial/Vertical*.

Rotation direction indicates the rotational direction which can be *Clockwise* or *Counter-clockwise*.

Order analysis shaft is the shaft on the machine that should be used for order analysis in the spectrum, history and 3D plot.

About Multiple Gating Points

A Multiple Gating Point (MGP) is a point type that references values from up to five other points and then performs a logical evaluation on the current measurements to determine if the IMx should take measurements. Each reference point has two distinct gating conditions, Operating Class 1 or Operating Class 2, with the point output determined by which set of the two gating conditions is set to TRUE. These reference measurements can include process, speed and digital measurements.

The display name of the operating classes can be edited on **Database > Options, Data** tab.

To create an MGP:

- Within the Hierarchy view, right-click on the machine or sub machine that the MGP is being added to and select **Add > Meas. point** from the resulting context menu. The **New meas. point** screen appears.
- Click on the **IMx** device option on the left side of the screen.
    - ➢ The measurement point type options available vary depending on the device selected.
- Click on the **Multiple Gating** measurement point option and click **OK** (or double-click on the **Multiple Gating** option). A new **Meas. point** screen appears with the **General** tab displayed.

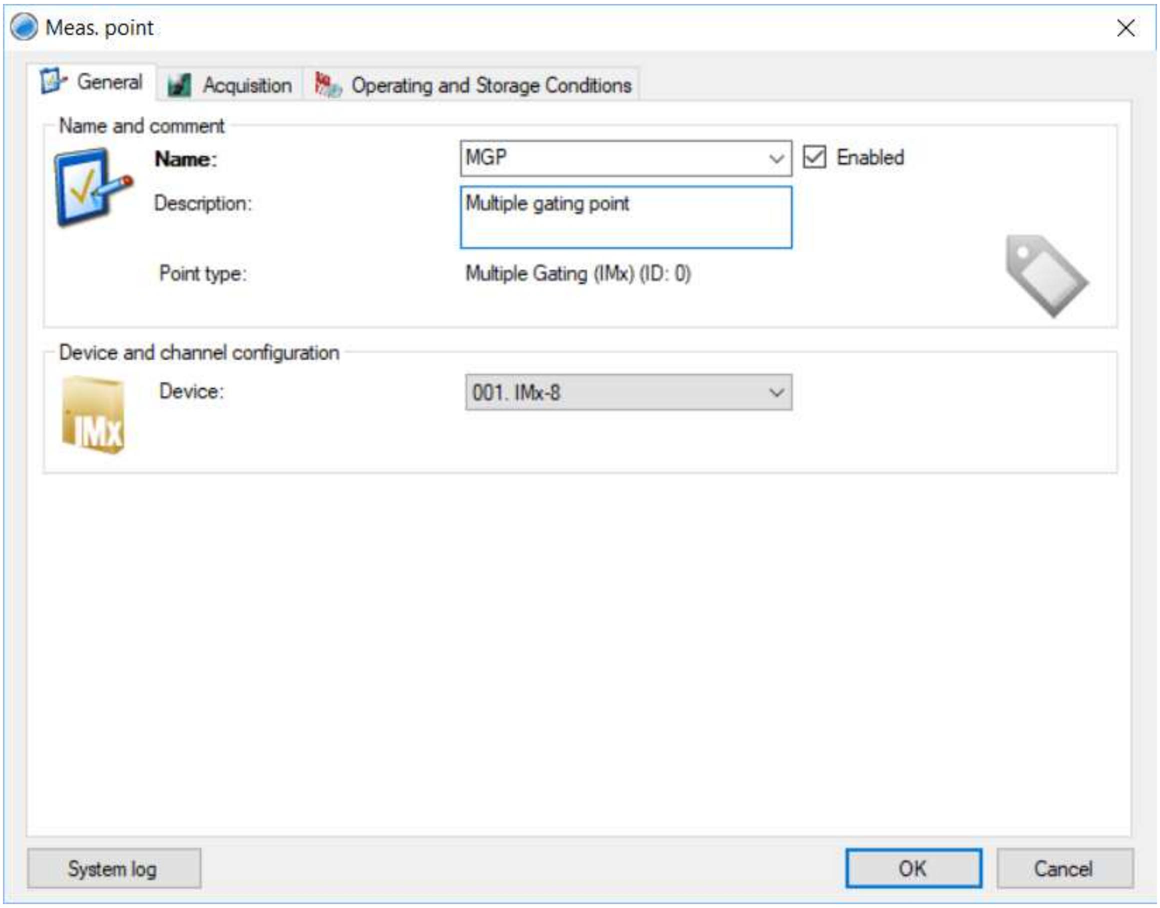


Figure 4 - 55
Meas. point's General tab for new MGP

- Enter a **Name** and **Description** for the new MGP.
- Select the IMx that is collecting the measurement data from the **Device** drop-down list button.
- Click on the **Acquisition** tab.

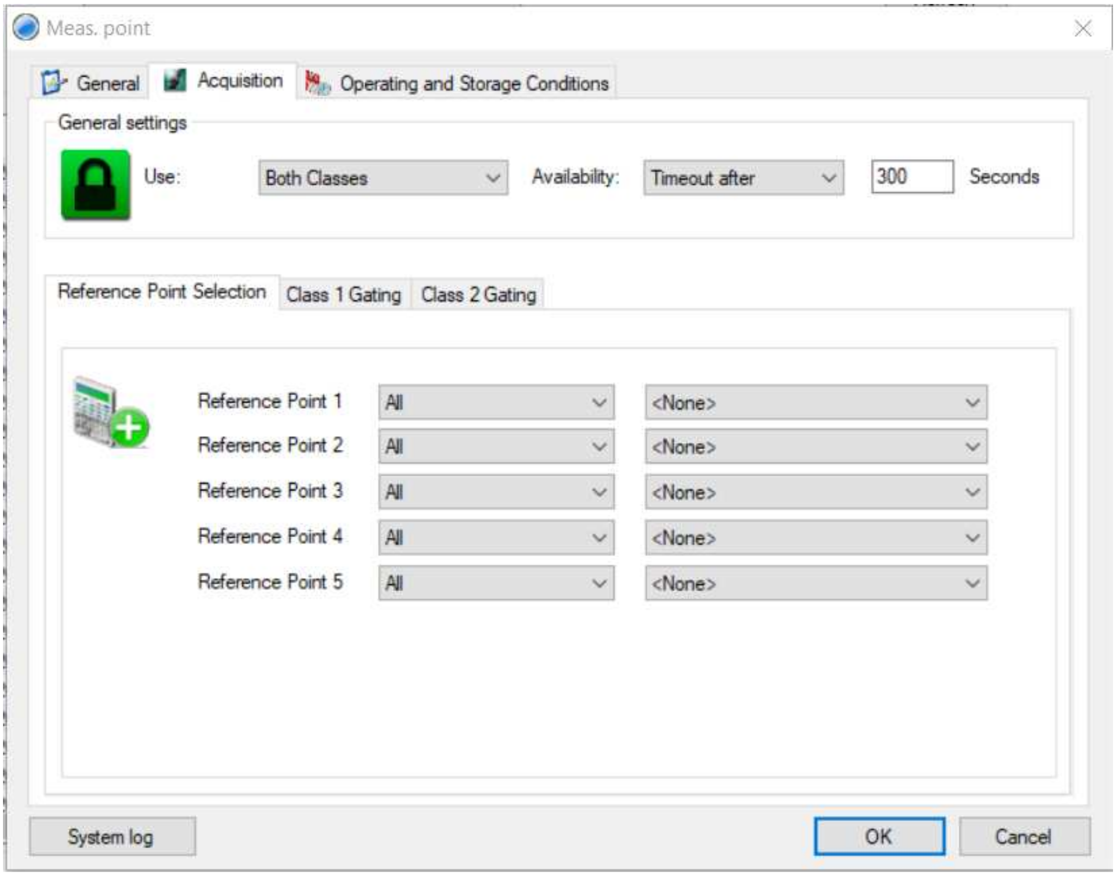


Figure 4 - 56
Meas. point's Acquisition tab (Reference Point Selection sub-tab) for new MGP

- From the **Use** drop-down list button, select whether the MGP will base its evaluation on a *Single Class* or *Both Classes*. When *Single Class* is selected, a single gate range can be set for each of the five reference points (on the **Class 1 gating** sub-tab). When *Both Classes* is selected, two different gate ranges can be set for each of the five reference points (on the **Class 1 gating** and **Class 2 gating** sub-tabs).
- From the **Availability** drop-down list button, select if and how gating should be suspended if one of the required reference points becomes unavailable:

  Timeout after: Select to have the system suspend gating until a specified period of time has elapsed. Enter that period in seconds. The default is 300 seconds.

  Timeout disabled: Select to have the system continue gating.

  On next evaluation: Select to have the system suspend gating until the next measurement.
- On the **Reference Point Selection** sub-tab, select up to five points from the selected IMx unit for the Multiple Gating Point to reference. From each left drop-down list button, select a point type to reference from the IMx: *All*, *Process*, *Digital* or *Speed*.

- From the right drop-down list button in the same row, select a measurement point to reference from the IMx. Options in this drop-down are filtered based on the target point type selected.
  - If *All* was selected from the left drop-down list button, that point type will update according to the measurement point selected from the right drop-down list button.
  - A measurement point reference list can be reset at any time by selecting *All* from the point type list.
- Click on the **Class 1 Gating** sub-tab.

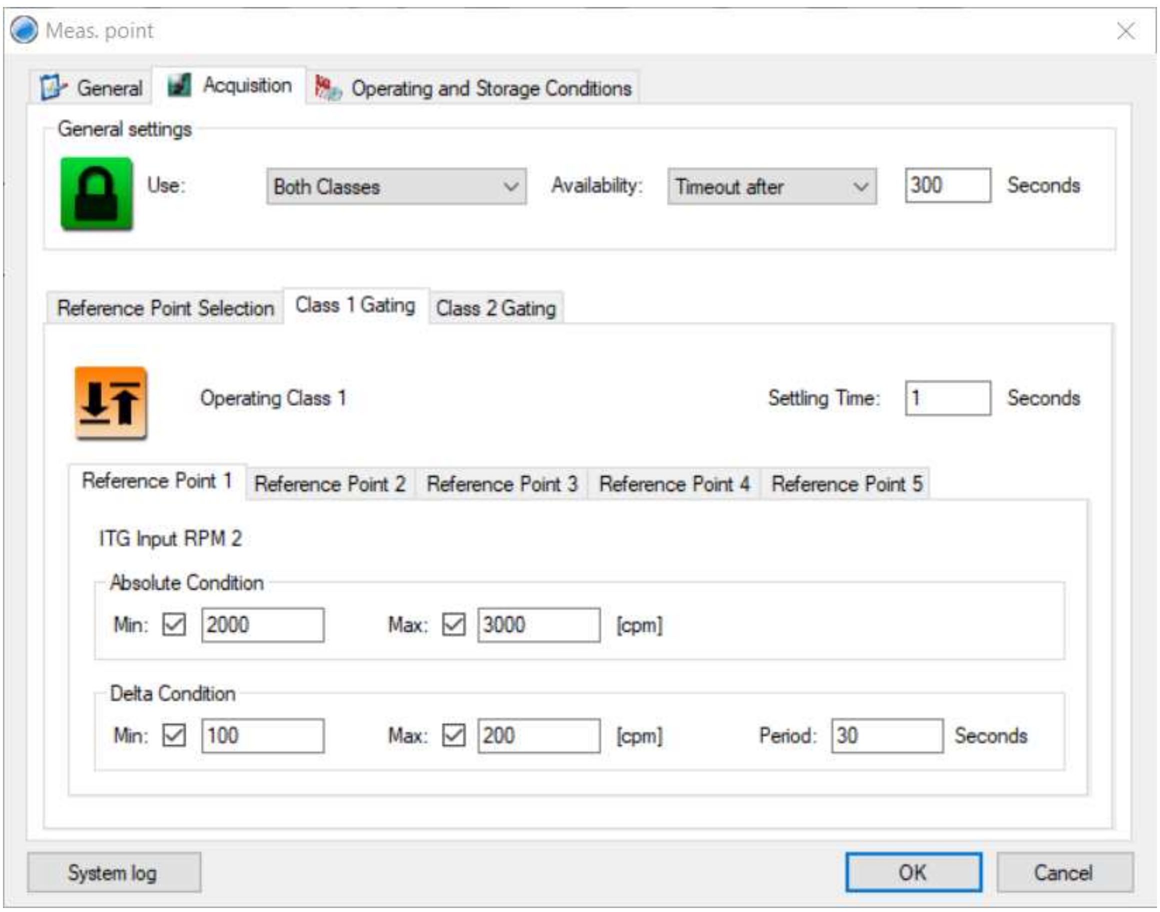


Figure 4 - 57
Meas. point's Acquisition tab (Class 1 Gating sub-tab) for new MGP

  - The class name that appears at the top of this sub-tab is a global property set from the **Database > Options** screen's **Data** tab.
- **Settling Time**: the class's gating output is enabled only when all required conditions have been met for this period. The default is 1 second.

- On the **Reference Point 1** sub-tab, select the gating conditions for that reference point:
  - Select (check) the **Min** and/or **Max** checkbox(es) and then enter a value or values to set an **Absolute condition** gating parameter range.
    - If either value must be a negative number, include a minus sign (-) before the number.
    - If both **Min** and **Max** are selected, the gating parameter range falls between the two. If either is not selected, the range extends infinitely in that direction.
  - Select (check) the **Min** and/or **Max** checkbox(es) and then enter a value or values to set a **Delta condition** permitted parameter change range.
    - If either value must be a negative number, include a minus sign (-) before the number.
    - If both **Min** and **Max** are selected, the accepted gating parameter change range falls between the two. If either is not selected, the range extends infinitely in that direction. If neither is selected, there is no accepted gating parameter change range.
  - Enter the **Period**, in seconds (up to 60), for which the system must check the **Delta Condition** thresholds.
    - **Delta Condition Period** is disabled if both the **Min** and **Max** checkboxes are deselected (unchecked).
- Continue selecting gating conditions for the other reference points on their respective tabs, as appropriate.
    - These sub-tabs are enabled for assigned reference points only.
- If appropriate, click on the **Class 2 Gating** tab to assign a **Settling Time** and select gating conditions for the reference points, for that class.

Important - One or more of the reference point gating ranges (conditions) must be different between two classes.

Digital point example, Acquisition tab

To have digital point gating in one class but not in the other, a **Condition** checkbox is provided for each **Reference Point** sub-tab on the **Class 1 Gating** and **Class 2 Gating** tabs.

When the **Condition** checkbox is not selected, the condition is excluded from the MGP evaluation without de-referencing the digital point in the Reference Point Selection tab.

When the **Condition** checkbox is selected, a drop-down combo box displays to its right, with the options *Open* or *Closed* for the digital parameter.

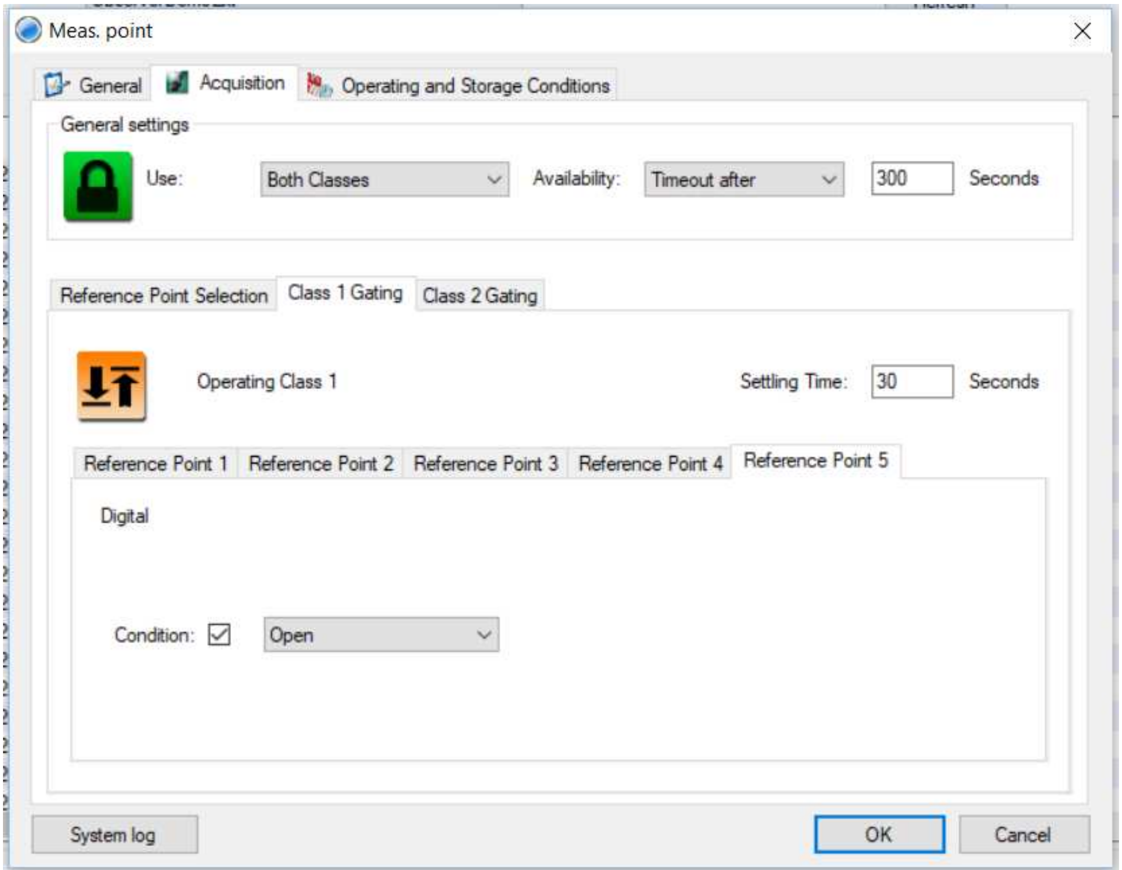


Figure 4 - 58
Meas. point's Acquisition tab, Reference sub-tab for a Digital Point

- Click on the **Operating and Storage Conditions** tab.

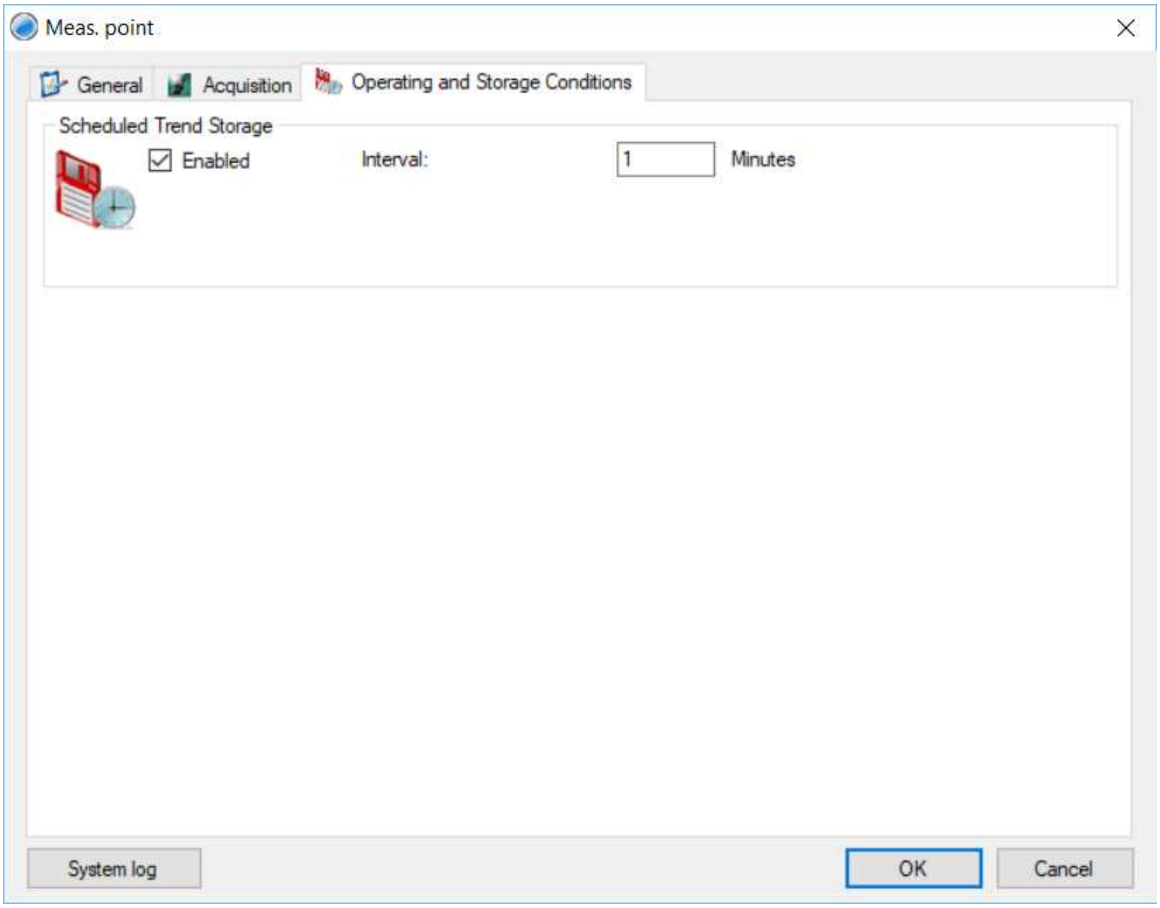


Figure 4 - 59
Meas. point's Operating and Storage Conditions tab for new MGP

- Keep the **Enabled** box selected (checked) to have the **Scheduled Trend Storage** function enabled.
- Enter the desired **Interval** for data capturing.
- Keep the **Exception based storage** box selected (checked) to only store trend values for those measurements that reflect trend value changes.
- Click **OK** to finish creating and save the new MGP.

To set an existing (or newly-created) Dynamic or Dynamic Envelope point to be referenced by the Multiple Gating Point:

- Create a new Dynamic or Dynamic Envelope type IMx measurement point. The new measurement point screen opens with the **General** tab displayed.

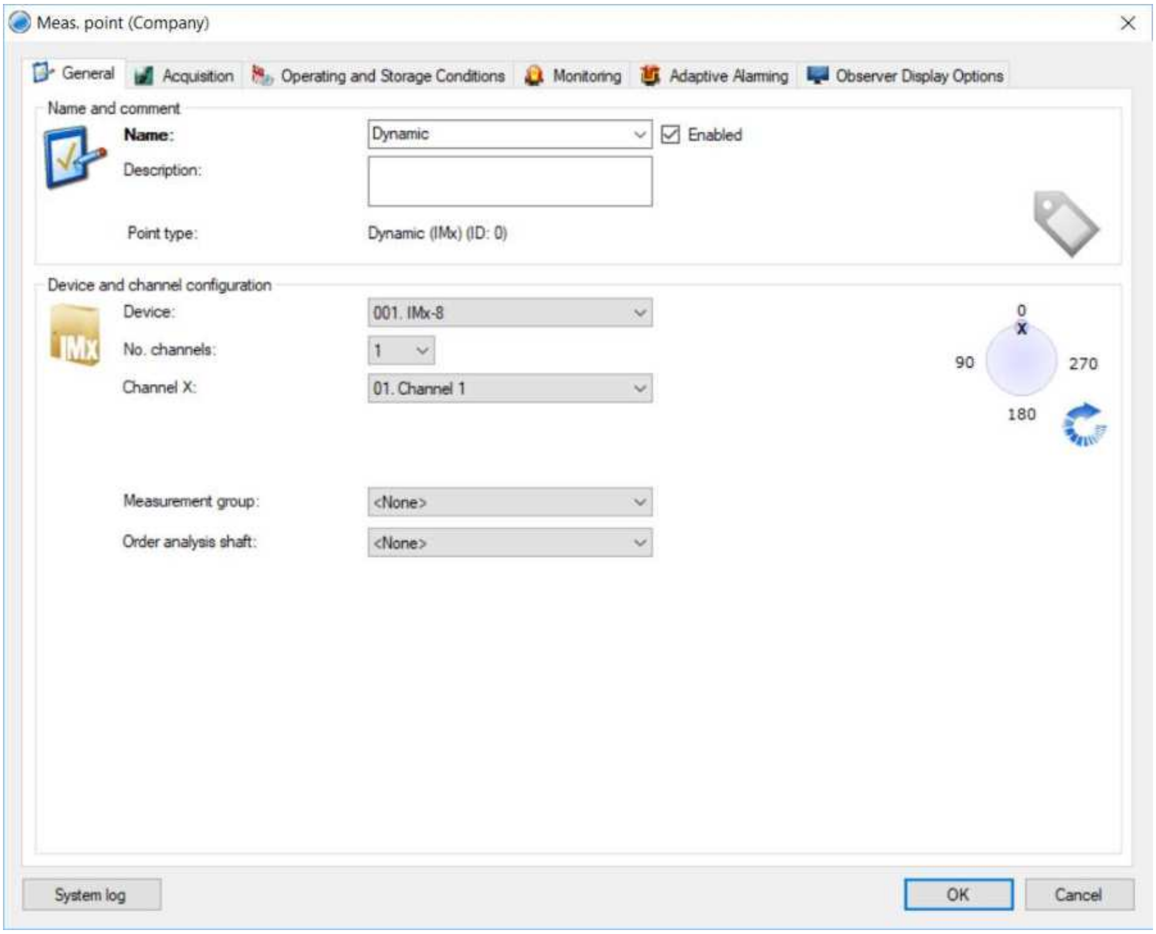


Figure 4 - 60
Associating a Dynamic Measurement Point with a Multiple Gating Point – General Tab

- Enter a **Name** and **Description** for the point.
- Select the desired IMx.
- Select *1* from the **No. channels** drop-down list. Multiple Gating Points can reference only single channel points.
- Complete other **Device and channel configuration** information as appropriate.
- Click on the **Acquisition** tab.

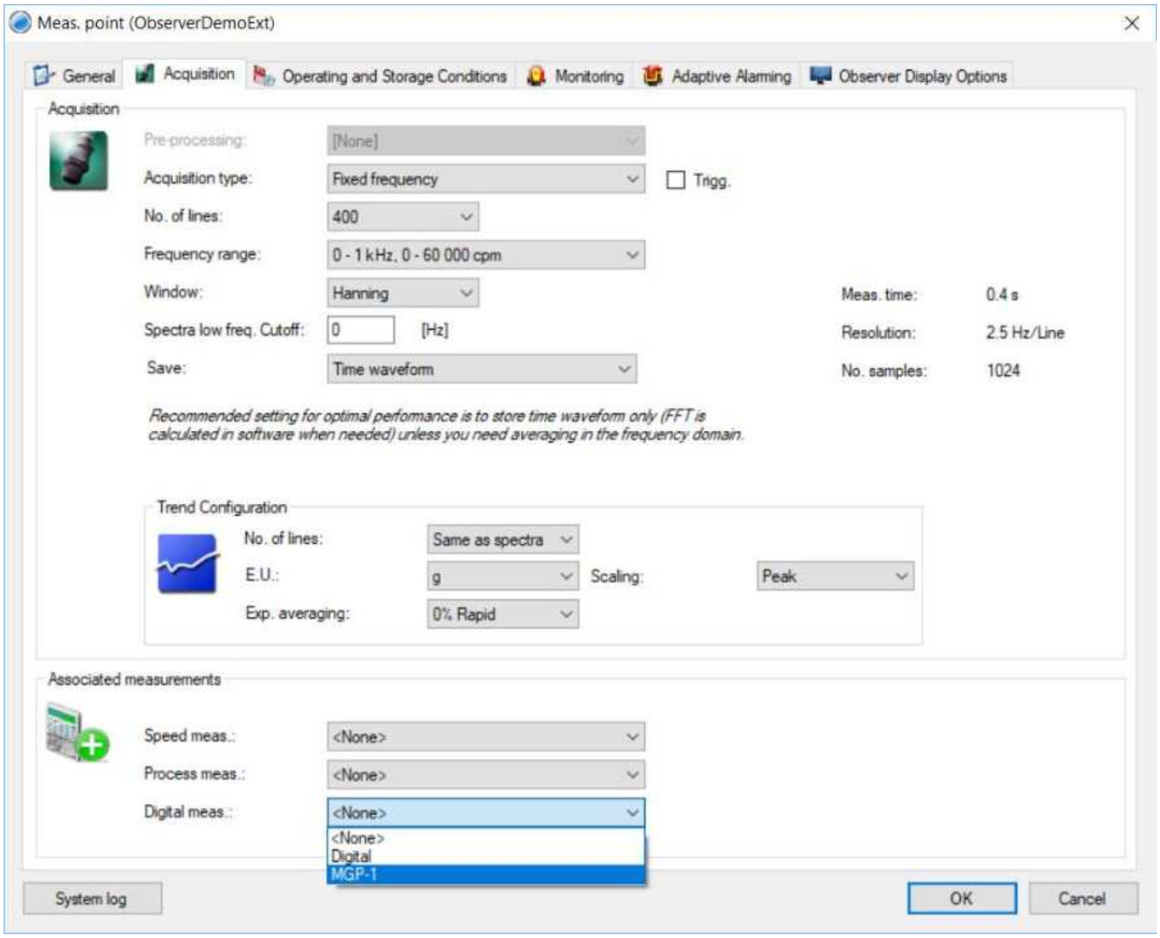


Figure 4 - 61
Associating a Dynamic Measurement Point with a Multiple Gating Point – Acquisition tab

- Complete **Acquisition** information as appropriate.
- Select the desired Multiple Gating Point from the **Associated measurements** area’s **Digital meas.** drop-down list box.
- Click on the **Operating and Storage Conditions** tab.

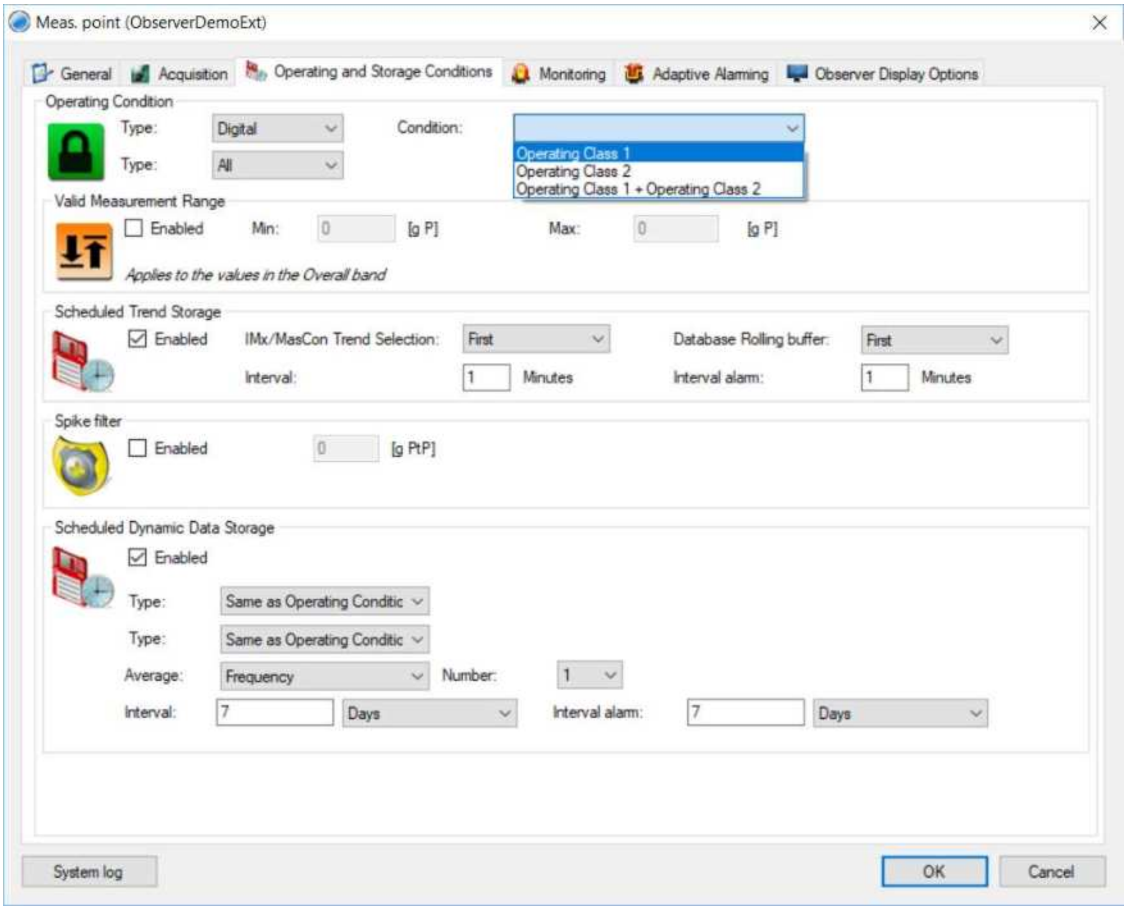


Figure 4 - 62
Associating a Dynamic Measurement Point with a Multiple Gating Point – Operating and Storage Conditions tab

- Select *Digital* from either of the **Operating Condition** area's **Type** drop-down list boxes. The **Condition** drop-down list box appears.
- Select one or both Multiple Gating Point operating classes from the **Condition** drop-down list box.
- Click on the **Monitoring** tab.

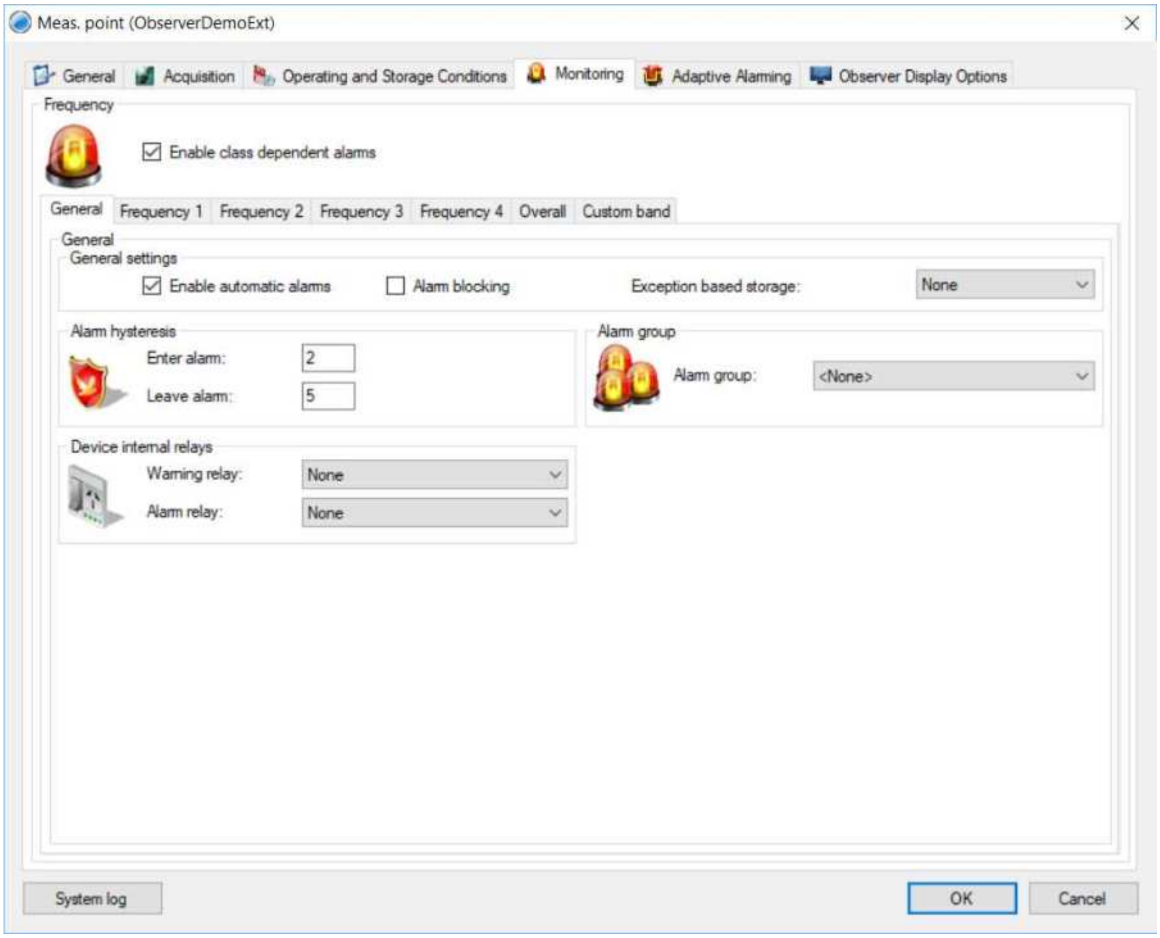


Figure 4 - 63
Associating a Dynamic Measurement Point with a Multiple Gating Point – Monitoring tab

- If desired, select (check) **Enable class dependent alarms**.

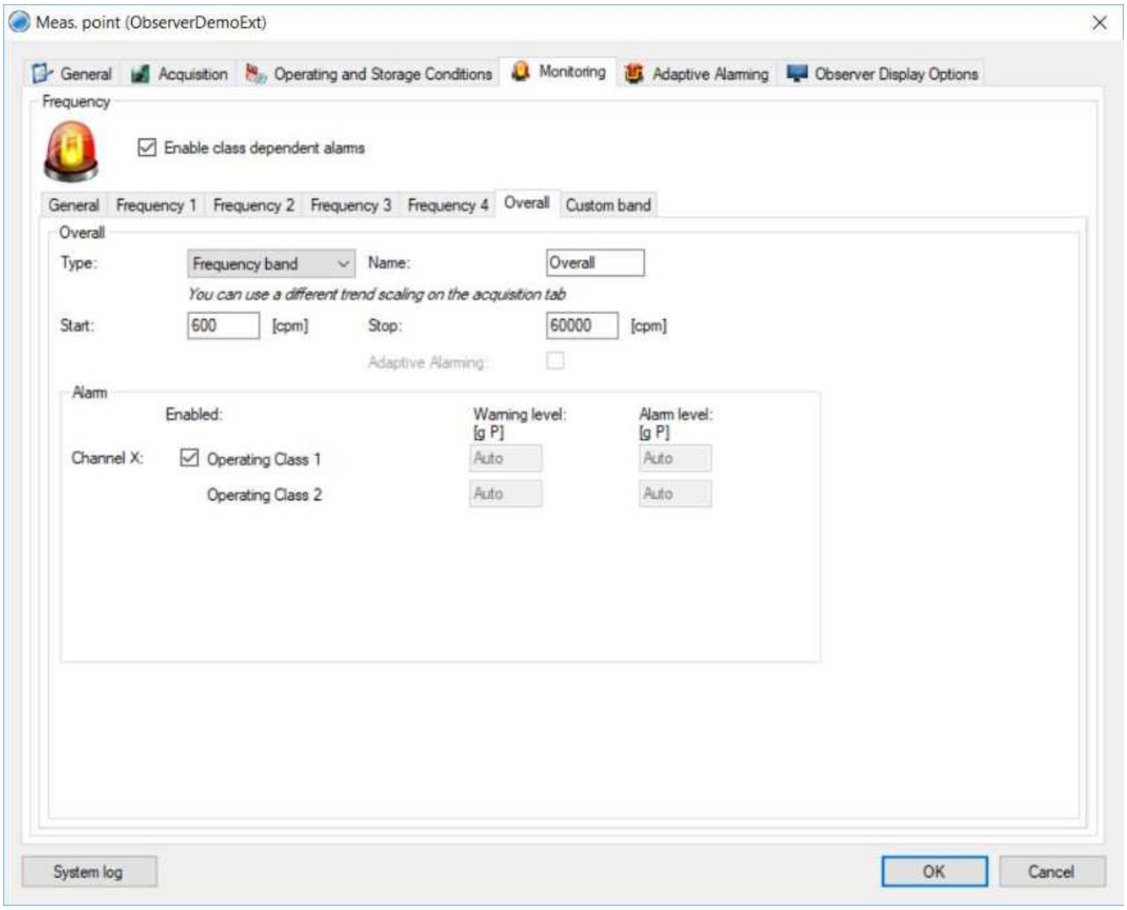


Figure 4 - 64
Class dependent alarms

When **Enable class dependent alarms** is checked, the following changes occur:

– The Adaptive Alarming area on the **Adaptive Alarming** tab becomes disabled.

– Two alarm levels display on each of the Monitoring tab's Frequency # sub-tabs and Overall sub-tab corresponding to the two Multiple Gating Point operating classes. Separate alarm levels can be set for the two classes.

– The **Level ctrl.** (or **Adaptive Alarming**) checkbox on each of the Monitoring tab's Frequency # sub-tabs and Overall sub-tab becomes disabled.

– The **Store delta** text box on each of the Monitoring tab's Frequency # sub-tabs and Overall sub-tab is hidden.

– The **Monitoring** tab's **Custom Bands** sub-tab becomes disabled.

➢ On deselecting (unchecking) **Enable class dependent alarms**, all controls revert to their normal state.

Configuring Runout Compensation

Runout compensation can remove the pseudo-vibration signal, that is due to the shaft being out-of-round. Runout compensation settings can only be applied to harmonic measurement points.

To set the compensation, the shaft is rotated at low speed and sensor values are collected during the slow roll speed range (see transient group configuration).

To start capturing data when in slow roll, right-click on the machine and select "Runout compensation".

Runout compensated data can be viewed in the trend plot and in the polar plot for harmonic measurement points.

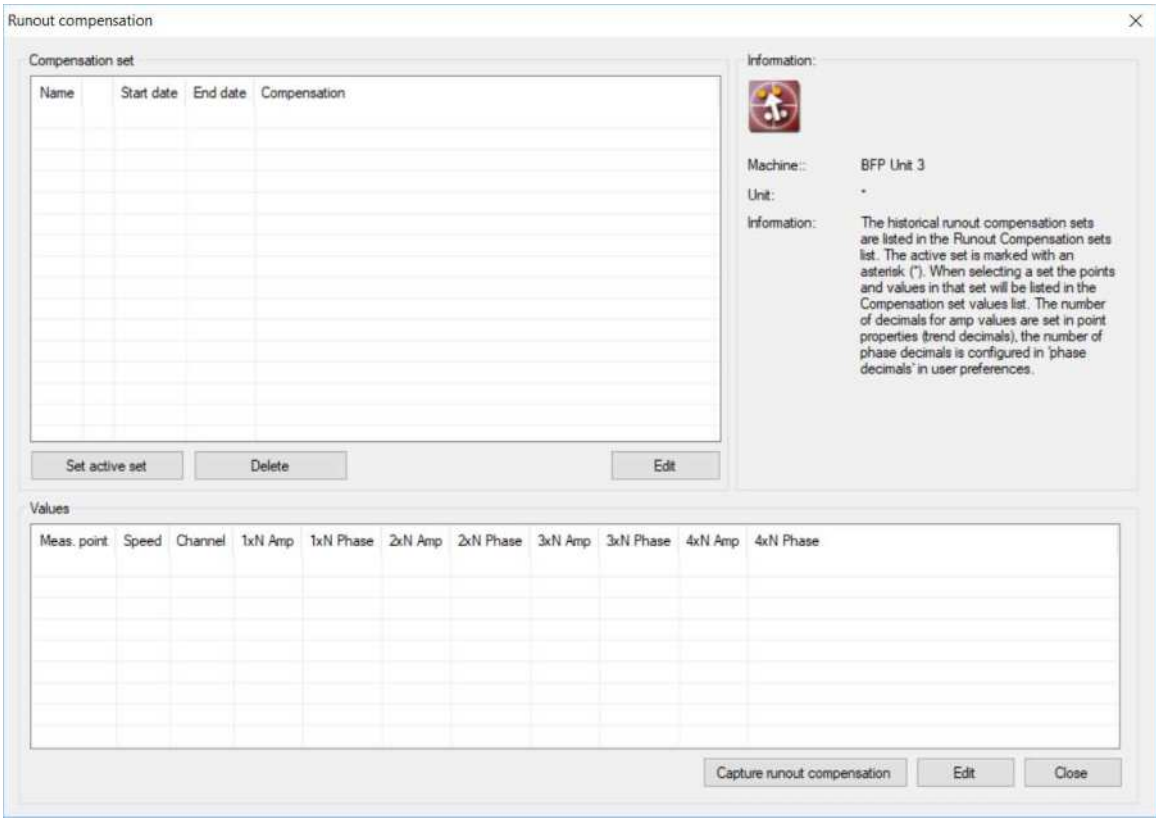


Figure 4 - 65
Example of Runout compensation

Set active set if there are several different sets captured for the machine. The active set that should be used can be set by clicking this button.

Delete deletes the compensation set and its data from the database.

Edit allows the user to edit the properties of captured runout compensation data.

Capture runout compensation opens a new window to capture live data to store in a new runout compensation set.

Edit allows the manual editing of the runout compensation data for a selected measurement point in a set.

Close closes the window.

Editing a runout compensation set

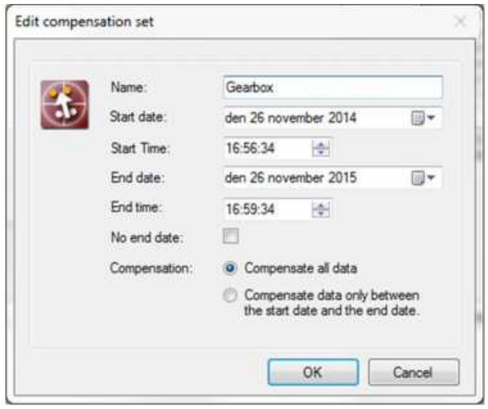


Figure 4 - 66
Example of editing a compensation set

Name sets a custom name for the set

Start date and Start time sets the start of the set

End date and End time sets the end of the set

No end date box checked indicates that the compensation set will compensate data between the start and the future.

Compensation allows the user to select whether data should be compensated between the start and the end or whether all data should be compensated when using this compensation set in the graphs to display data.

Calibrating Shaft Centerline Graph

To calibrate the shaft centerline graph, right-click in the hierarchy on any of the node types, machine, sub machine or measurement point and select the menu option "calibrate shaft centerline graph".

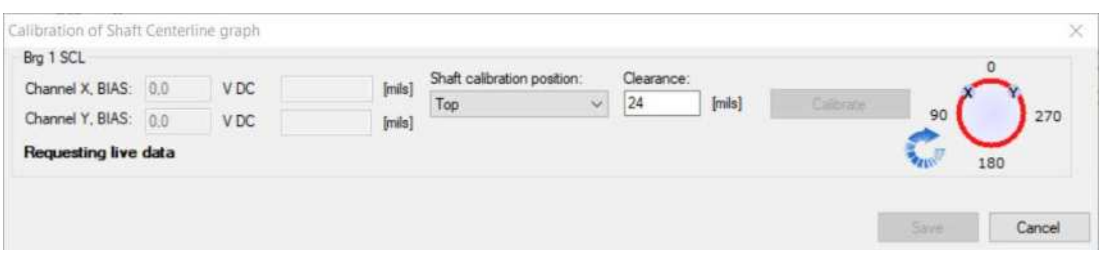


Figure 4 - 67
Example of Calibration of Shaft Centerline graph

Before starting the calibration process make sure that the device is connected, and the Monitor service is running. This feature will automatically connect to the IMx device and retrieve live values for the shaft centerline measurement point and get data of the current location of the shaft.

Shaft calibration position allows the current position of the shaft to be selected and where the shaft should be located after the calibration of the shaft centerline graph has been completed.

Clearance of the bearing should be measured and entered in this dialog box.

Calibrate sets the new calibration parameters for the sensor once live values has been captured and the shaft calibration position and the clearance have been set.

Save click this button to save the changes to the database. Note that to see the new calibration position live in the SCL graph, allow up to 30 seconds (until the device reboots with the new calibration factors).

Machine Parts

Different machine parts can be combined to create a machine or a sub machine. With the help of Machine parts tool, models of machines can be created including shafts, gear boxes, engines, fan casings, blades, generators, etc. The machine parts tool is used to calculate the disturbance frequencies specific to a particular machine, such as gear and bearing frequencies, etc., by using the defined machine data. In this way, the task of finding out which machine component is generating a certain anomaly in the frequency spectra is facilitated. It is possible to go back to the machine parts and edit as often as changes are needed.

Important - The first machine part created should always be a shaft to which the remaining parts are connected.

Important - The speed measurement point must be configured before the running speed can be used.

To get to machine parts screen, perform one of the following options:

- Select a machine from the hierarchy or workspace view, then click the right mouse button and choose **Machine parts**.
- Select a machine from the hierarchy or workspace view, then click  **Machine parts** icon, on the toolbar.

Creating a Model with Machine Parts

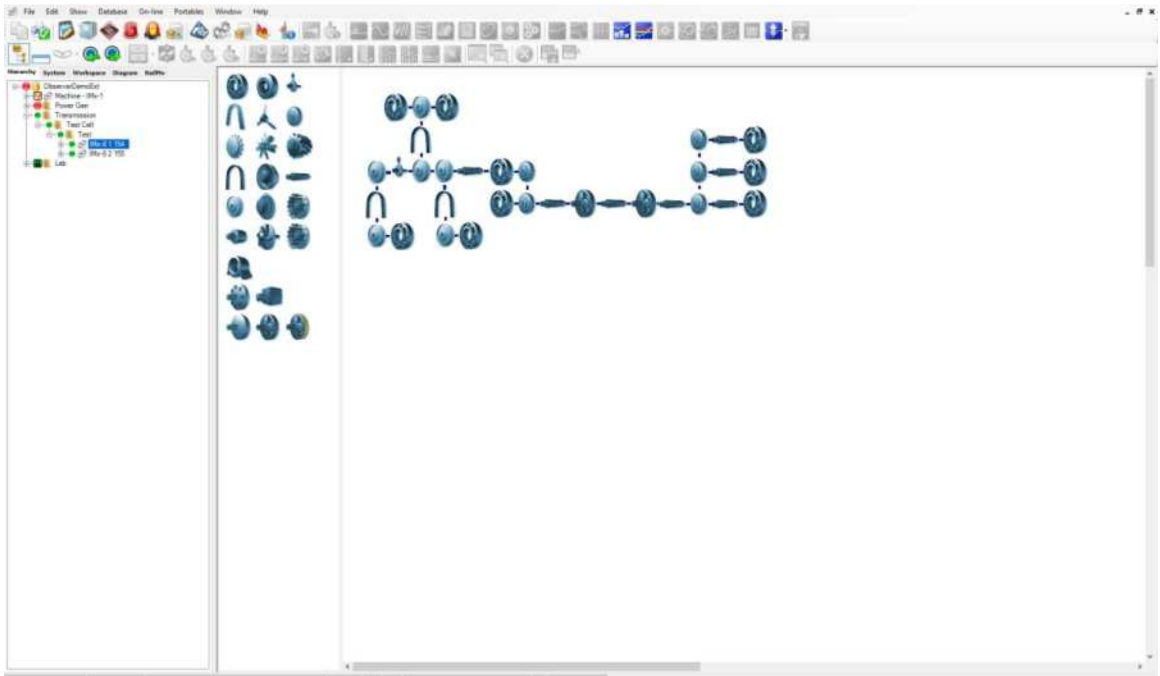


Figure 4 - 68
Example of Create a Model with Machine Parts

To create machine parts, perform one or a combination of the following options:

- Copying a model from another machine is possible. Click on the right mouse button on the blank area of Machine parts' working screen and select **Copy from existing machine**.
  - This will overwrite any existing machine parts with the copied machine parts.
- Simply drag and drop the desired parts from the parts toolbox window to the working area on the right. Dragging and dropping parts close to each other will create a link between them. For example, to link one gear wheel to another, simply drag and drop a wheel on top of the other.
- Once one or more parts have been created, use the copy function in the right click menu to copy then paste parts.

To link the model to the pre-selected machine, drag ***speed*** from the Parts toolbox window. This speed is used to calculate the defect frequencies for bearings, gears and other parts. In addition, it is also possible to link diagnosis and vibration spectra to the model.

By using ***bearing*** from the parts toolbox window, a bearing type can be selected from the bearing library. In total a bearing library can hold approximately 30 000 bearings from SKF and a number of other vendors. It is also possible to add new bearings if bearing pitch diameter, roller diameter, number of rollers and contact angle are known.

To add a new bearing to the current machine in the machine parts view:

- Drag the bearing part from the parts toolbox window and drop it into the working area next to the appropriate part of the current machine. This action creates a link between the added bearing and the appropriate machine part. A **Machine parameters** dialog appears.

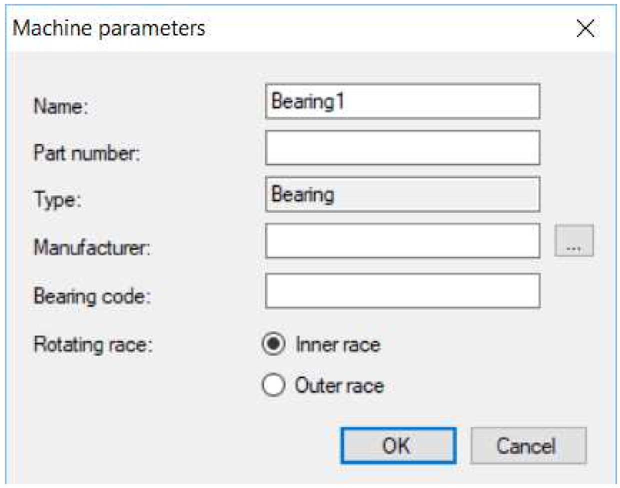


Figure 4 - 69
Machine Parameters Dialog

- Enter a unique identifying **Name** for the bearing or keep the default provided.
- Enter a **Part number** for the bearing.
- Click the browse (ellipsis) button to access the bearing library. There, locate and select the **Manufacturer** and manufacturer's **Bearing code** for the bearing. For more information, see Bearing Library.
- Select whether the bearing **Inner** or **Outer race**way is **Rotating** in this application.
    - ➢ A bearing returns a different cage fault frequency depending on whether the outer raceway is fixed while the inner raceway rotates, or the inner is fixed while the outer rotates. Selecting which raceway is rotating allows the cage frequency to be correctly shown when fault frequencies are displayed in spectral diagrams.

The model of the machine created in this way is a schematic illustration and should not be regarded as a scaled CAD (computer aided design) drawing.

Right-clicking on a machine part in the working area provides the following options:

- **Calculate gear** calculates the speed of the selected machine part. This is also done automatically when closing the machine parts window.
- **Delete** deletes the selected machine part.
- **Flip** rotates or flips the graphic about the vertical axis so for example a standard parts graphic with the shaft appearing to protrude leftwards would seem rotated horizontally so that the shaft now protruded rightwards.
- **Copy** is a menu item that copies the selected part(s) so that they can be subsequently pasted as new parts into the same machine:

- Multiple parts can be selected, then right click and choose **Copy**. Now right click in the working area and choose **Paste**. The copied part(s) can be pasted multiple times.
- When copying, if the copied items are multiple linked parts, the newly created parts will be similarly linked.
- As the copied part(s) are pasted they remain selected so they can easily be dragged to the desired location and linked as needed to existing parts.
- The part details for the pasted parts will be the same as the source part but the name(s) will have a numerical suffix that will be incremented at each paste. They can be subsequently edited as required.
- Works for all machines and all part types but copied parts cannot be pasted to a different machine.
- In addition to using the right click menus, the copy and paste functionality can be achieved by selecting a part or parts and copying using Ctrl and C. Paste into the working area using the key combination Ctrl and V.

- **Bring to front** brings the selected machine part to the front of the others when machine parts are staggered on top of each other.
- **Send to back** puts the selected machine part to the back of the others when machine parts are staggered on top of each other.
- **Properties** brings up the properties of the selected machine part and allows its characteristics to be configured.

Right-clicking on the working area provides the following options:

- **Calculate gear** calculates the speed of all the machine parts. This is also done automatically when closing the machine parts window.
- **Copy from existing machine** copies a model from a selected existing machine to the current machine.
  - ➢ This removes/overwrites any existing machine parts on the current machine.
- **Paste** pastes part(s) that have been copied (refer Copy above).
- **100%**, **75%**, **50%**, **25%** allows the zoom level of the machine parts window to be adjusted by the selected scale to better accommodate large models.

Setting up Process Overview

Process overview is a human machine interface (HMI) tool that can be configured to create an easy to use and understand display for control rooms and operators. This display illustrates the current status of the machine through bars and process values.

The process overview is directly linked to the hierarchy, which means that upon opening a machine, all the measurement points on the machine are automatically available. On the top of process overview screen, there is a header displaying the total status of the process overview.

To get to process overview screen, perform one of the following options:

- Select a node, machine or sub machine from the hierarchy view, then click  **Process overview** icon on the toolbar.
- Or, click the right mouse button on a node in the hierarchy view and then select **Process overview**.

Navigation within the process overview is assisted by the following controls:

 **Enterprise Process Overview** is the main process overview of the top level of the hierarchy view which includes all databases.

 **Back** to the previous screen.

 **Up** one level.

 **Refresh** updates the process overview screen.

In addition to the navigation controls:

Prints the active window.

Configuration of the Process Overview

To be able to configure the process overview, first set the process overview in edit mode. This can be achieved by right-clicking in the working area and selecting **Edit mode** or clicking on  **Edit mode** button in the right-hand corner of the process overview screen. The edit mode control toggles between edit mode and non-edit mode.

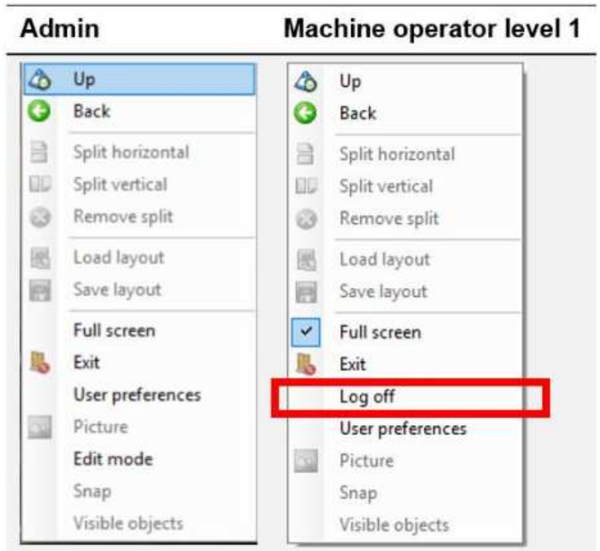


Figure 4 - 70
Right-click Context Menu

The context menu choices also include the up and back controls as well as the following functions:

Split horizontal/Split vertical splits the working area horizontally or vertically. The working area can be split into several different sections. This can be efficient when there are several machines under a specific node and it is desired to browse through them simultaneously. Each time the working area is split, the child or children of the first item of the screen in which the split command was issued, appear in the newly opened screen.

Remove split removes split screen(s).

Load layout loads a layout from the layout list.

Save layout allows a user to save, delete or rename an item from the layout list.

 **Full screen** toggles between full screen mode and partial screen mode.

Exit closes the process overview.

Log off: this option is only visible for a user with ‘Machine Operator Level 1’ security role because this role only has access to the process overview. It allows these users to switch their user type without exiting the application. **Log off** and the **Logon** dialog opens automatically. Log on as a different type of user, such as Admin, to perform tasks requiring different user rights. Note that Log off and Logon are not applicable to users authenticated using Active directory groups.

User preferences opens the User Preferences interface for the Process Overview features, where the icon sizes, background and foreground (text) colours can be changed.

Picture opens a dialog that allows the user to select a picture to be used as the background for the process overview. The picture is selected from those pictures already stored in the database and uses a dialog very similar to the one shown there to select and add a picture to the process overview.

Snap snaps items to a hidden grid when dragging them.

Visible objects determines which points to display.

Right click context menu for a measurement point in the Process Overview

Diagram allows the user to choose an associated diagram to plot.

Event Log opens an event log window, with the display data filtered by setting the selected measurement point as the Data source.

When in edit mode, **Properties** is also available to select

Properties configures how the measurement point is displayed by editing the following fields.

Name is the name of the selected measurement point which is displayed when choosing Name as Text.

Short name is the user configured name displayed when choosing Short name as Text.

Type is the display type that determines which type to represent the data. The options vary depending on the type of measurement point.

Text determines how the name of the item in the process overview will be displayed.

Name: displays the full-length name for the measurement point.

Short name: displays the customised short name for the measurement point.

None: displays no name. Instead, it displays the icon.

Width allows the value of width to be adjusted, instead of changing it with the mouse.

Height allows the value of height to be adjusted, instead of changing it with the mouse.

Show values determines which components of the measurement point should be displayed in graph.

Visible checkbox is used to enable/disable the display of the selected measurement point.

Show EU checkbox shows or hides the engineering units in all the different graph types it is possible to show in the process overview. The default value is checked, meaning the engineering units are displayed. If the engineering units are hidden, they will still display as mouse over information (a tooltip).

Machine Copy Wizard

The machine copy wizard is a process that copies an existing machine with all the machine information, to a new machine.

Note that the wizard doesn't overwrite any existing devices, it will generally create new devices as part of the process, so there is no need to create these before launching the wizard (except IMx-1 gateway, if needed).

The following data is copied when appropriate:

- Machine specific information
- Machine parts
- IMx/MasCon, IMx-1 sensor devices
- Channel configuration
- Online measurement points
- Offline measurement points
- Diagnosis
- Process overview information
- Measurement group

Note that for IMx-1 systems, additional/multiple machines can be added to an existing gateway so the machine copy wizard doesn't attempt to create a new gateway but simply allows a selection from a list of existing gateways. If a new gateway is envisaged, create it before copying the machine.

To open the machine copy wizard, perform one of the following options:

- Click the right mouse button on a node in the hierarchy view and select **Add**, **Machine**, then select **From machine template**.
- Click the right mouse button on a node in the hierarchy view and select **Add**, **Machine**, then select **Existing machine**.
- Select a machine in the hierarchy view first, then click **Edit** on the toolbar and select **Copy node**.

Using the Machine Copy Wizard

After the opening screen, step 2 of 5 allows the user to select a **Destination** for the copied machine, where name, code and location can be specified:

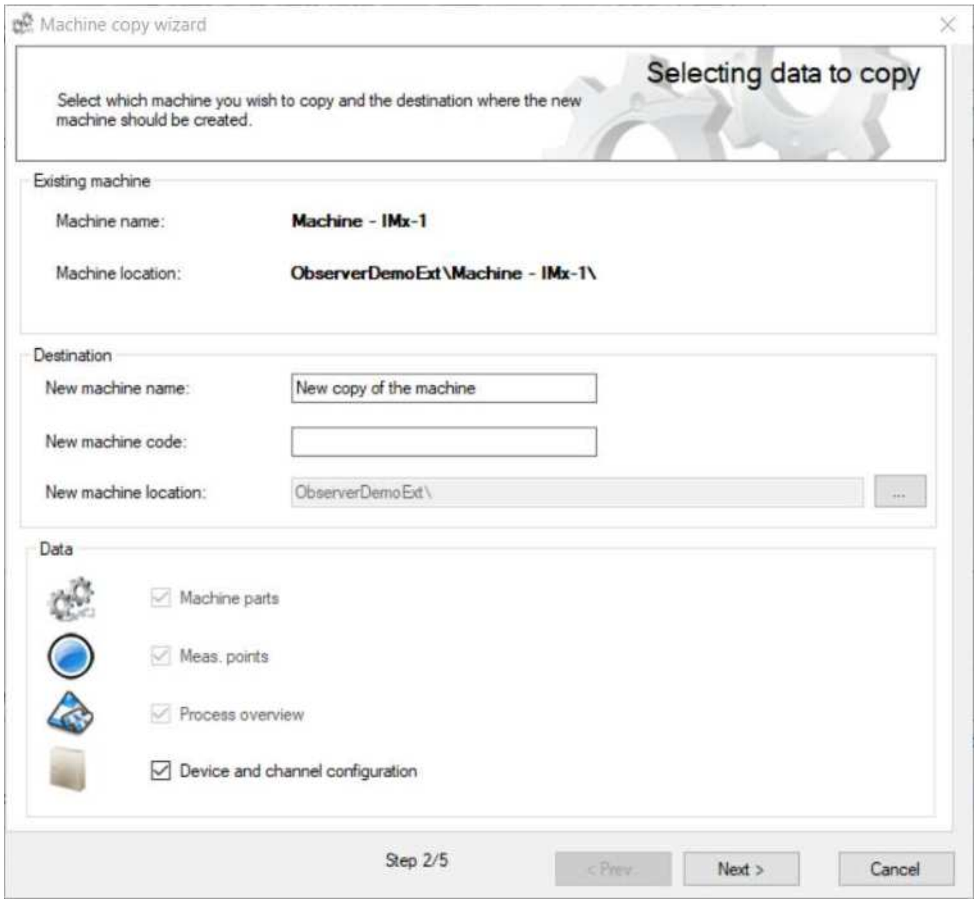


Figure 4 - 71
Example of data to copy

Existing **Machine name** displays the name of the machine selected in the Hierarchy view.

Existing **Machine location** displays the location of the machine selected in the Hierarchy view.

<u>Destination</u>

New machine name specifies the name for the new machine.

New machine code allows a machine tag or ID number to be entered (optional).

New machine location provides a means to select from the list of nodes in the hierarchy view.

<u>Data</u>

Machine parts, **Meas.** (Measurement) **points**, **Process overview** will all be copied, **Device and channel configuration** is an optional selection.

Step 3 of 5 is Measurement points:

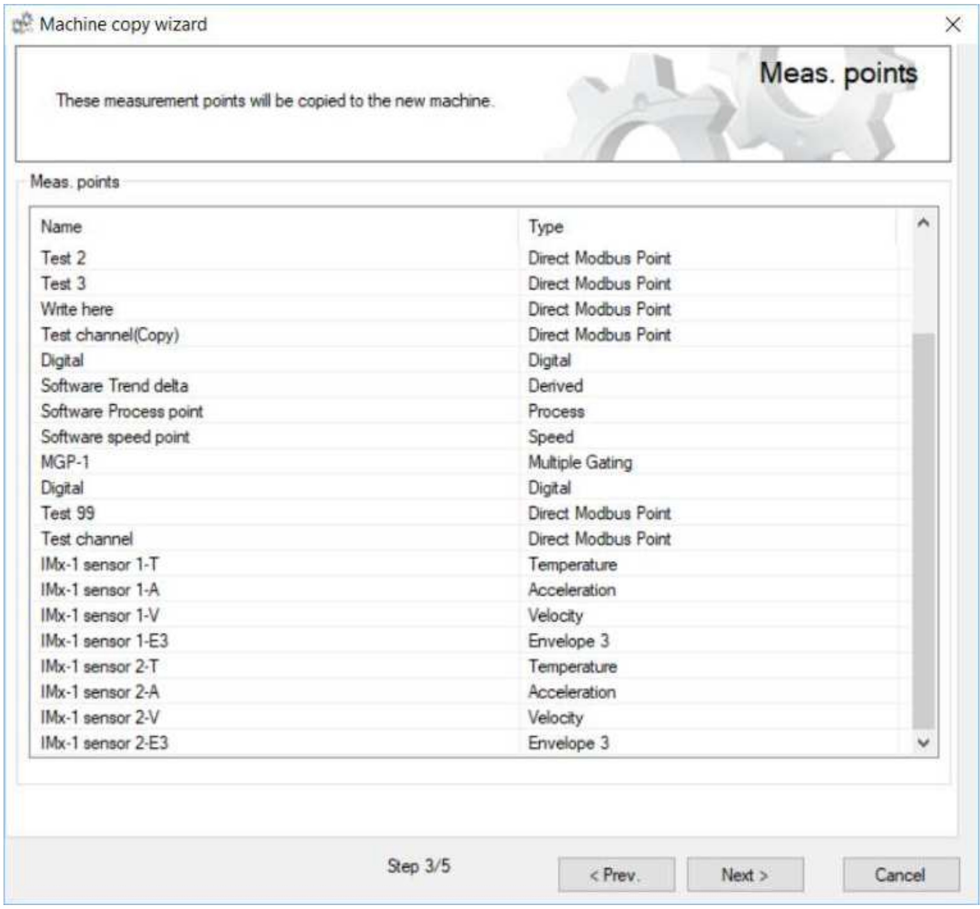


Figure 4 - 72
Example of Measurement points to copy

The measurement points window shows a list of all the measurement points on the source machine. All will be copied to the new machine.

Name displays the name of the next highest level ':' the measurement point name. Generally, 'the next highest level' may be sub-machine if one exists, for an IMx-1 measurement this will be the IMx-1 sensor name.

Type displays the type of measurement point.

Step 4 of 5 is Units and channels:

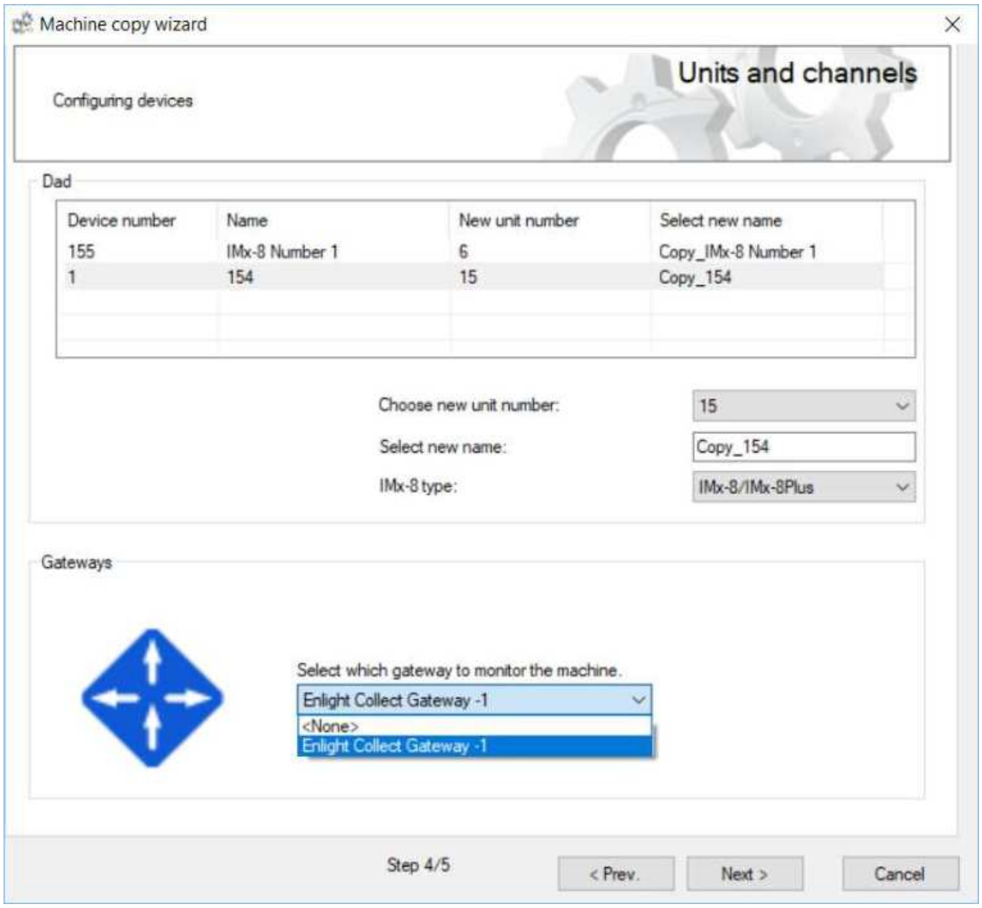


Figure 4 - 73
Example of Units and channels

- ➢ Whether **Dad** and **Gateways** areas are populated depends on whether the machine being copied has those relevant point types. For any machines monitored by both types of system, both areas will be available and appropriate selections should be made in each.

In the upper half of the screen, the wizard lists the Data Acquisition Devices (DAD) associated with the source machine so it can create new devices for the target (copy) machine, based on the user allocating new unit numbers and names.

Device number displays the unique device numbers of the existing DADs.

Name displays the names of the existing DADs.

Now select each entry in the DAD table in turn and for each, set:

New unit number being the number selected from the 'Choose new unit number' drop-down list, below.

Select new name reflects the text in the field 'Select new name', below. This will automatically be given a default 'Copy_' name but can be changed if desired.

IMx-8 type drop-down is active when the existing device is an IMx-8/IMx-8Plus. It reflects the possibility that it cannot only be copied to an IMx-8/IMx-8Plus but alternatively to the first 8-channels of an IMx-16/IMx-16Plus or IMx-Rail device.

- It is not possible to reverse this process: an IMx-16/IMx-16Plus or IMx-Rail to IMx-8/IMx-8Plus.

Gateways section is available when copying machines monitored by IMx-1 systems. Here the drop-down allows an existing gateway to be selected by name. That gateway will be assigned to the copy machine.

- There is no capability once at this point in the process, to create a new gateway.

Step 5 of 5 is the last (**Finish**) step but also lists any **Direct Modbus** devices that are being copied:

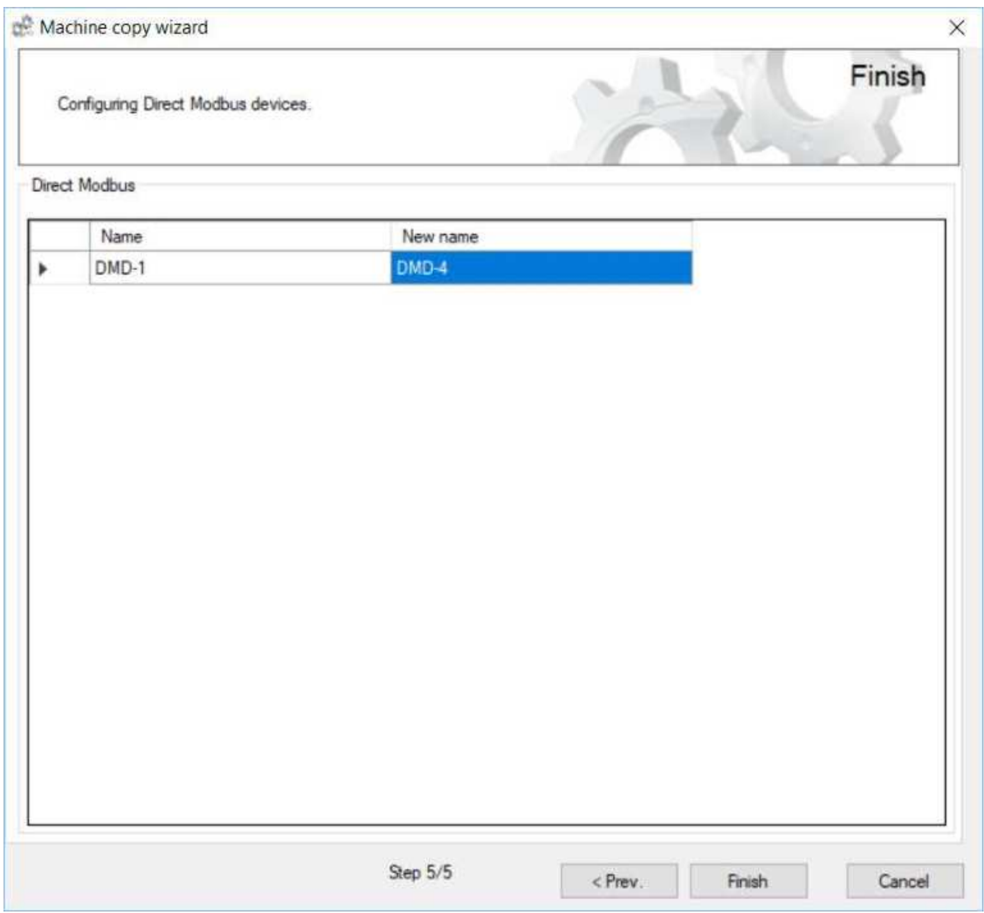


Figure 4 - 74
Example of Finish/Direct Modbus devices step

Where applicable, allocate the copy devices a **New name** and then click **Finish** to save all the changes made.

The step 5 screen contents are then replaced by a **Summary**. This displays details of the copy process and can be printed as required (**Print summary** button). When complete, press **Close**.

Example Scenario

There is a wind turbine with one IMx system with measurement data. To add a second wind turbine to the @ptitude Observer database, the entire setup of the existing wind turbine can be copied to the new one by using the machine copy wizard. A new device number and name for the new IMx device will be requested by the wizard.

Multiple Point Update Wizard

The multiple point update wizard is a tool for updating several measurement points with one or several properties. It can be anything from a simple edit such as changing an active status on a few measurement points in a machine, to more complex edits such as updating a frequency range and number of lines on all IMx/MasCon vibration measurement points in the entire database. The wizard can filter out specific measurement point types based on the selections made.

To open the multiple point update wizard:

- To update a certain set of measurement points:
    1. First select a database, a node, a machine or a sub machine in which these points reside in the hierarchy view.
    2. Click **Edit** on the toolbar, then select **Multiple point update wizard**.
    3. In the wizard, **Data source**, **Based on my current selection in the hierarchy**, should be selected.
- To update all the measurement points in all the databases:
    1. There is no need to select a particular node.
    2. Click **Edit** on the toolbar, then select **Multiple point update wizard**.
    3. In the wizard, **Data source**, select **All measurement points in all databases**.

Using the Multiple Point Update Wizard

Screen 1, Figure 4 – 75, is Selecting data to modify.

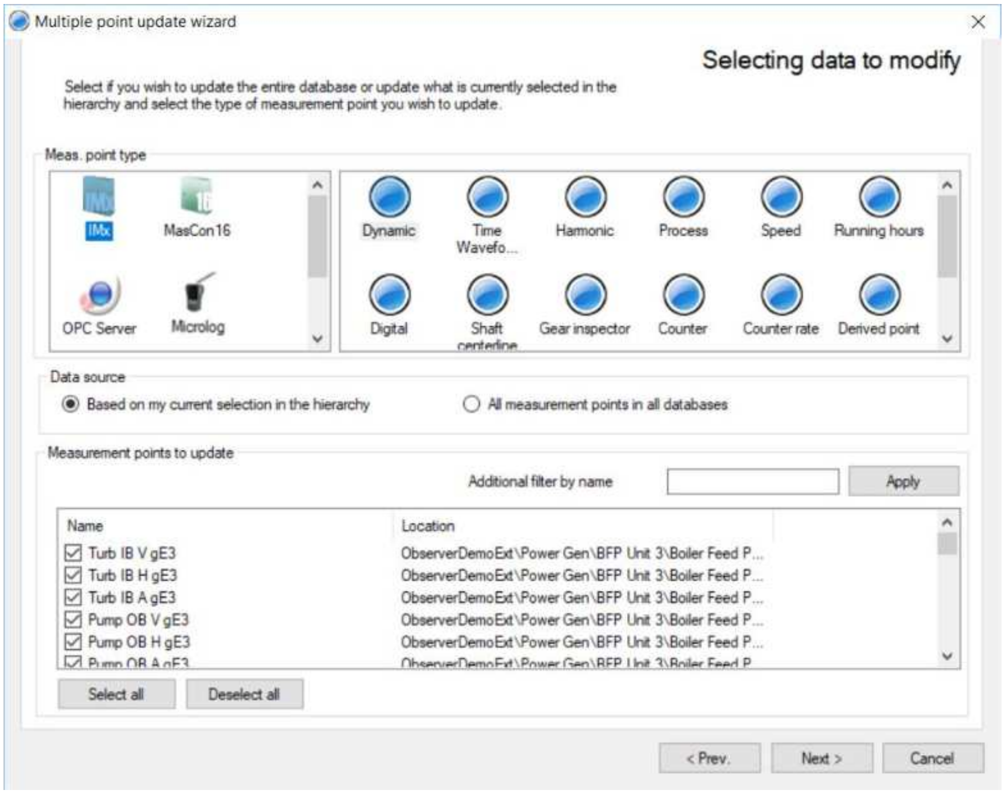


Figure 4 - 75
Example of Selecting Data for Multiple Point Update Wizard

Measurement point type enables selection of a type of hardware and then a measurement point type that is to be updated. Only one type of measurement point can be updated at a time.

Data source selects which measurement points in the database, should be updated.

> *Based on my current selection in the hierarchy:* a list of measurement points that were selected in the hierarchy view before entering the Multiple point update wizard screen.
>
> *All measurement points in all databases:* a list of all the measurement points in all the databases.

Measurement points to update are all the measurement points which can be updated by the wizard. Points can be unchecked, to exclude them from the update.

Additional filter by name enables filtering of the list of measurement points, by a certain name.

Apply applies filtering by the specified name.

- For example, enter "NDE" in the *Additional filter by name* field and click the **Apply** button, the list of the measurement points will only contain those with name containing the text "NDE".

Select all selects all measurement points in the list.

Deselect all unselects all measurement points in the list.

Screen 2, Figure 4 – 76, is Attribute selection.

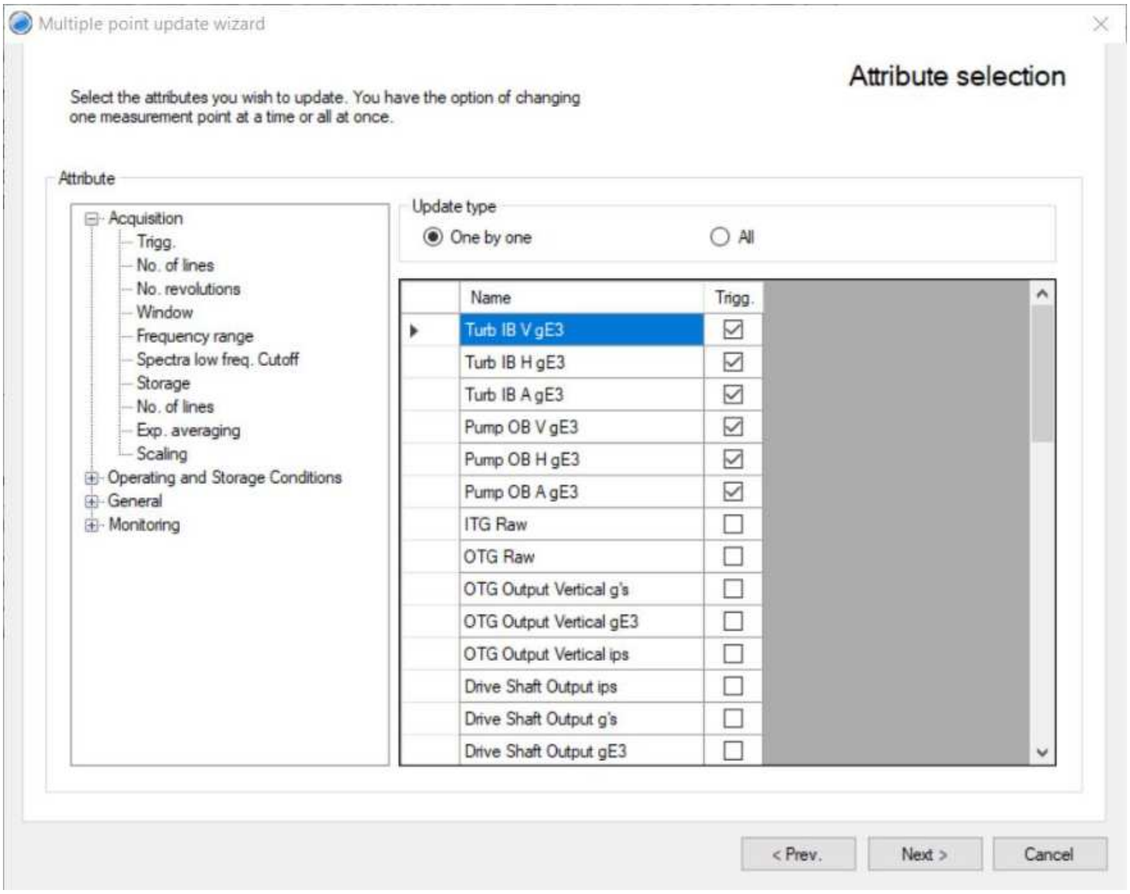


Figure 4 - 76
Example of Attribute Selection for Multiple Point Update Wizard

Attribute uses a tree view to select an attribute to update. A list of all the selected measurement points with the current value of the selected attribute is shown on the right side of the screen. The value of the attribute can be changed directly on the list one at a time or all at once.

One by one updates only the current measurement point being edited.

All updates all the measurement points with the edited value.

Screen 3 is Finish. This is the final confirmation to proceed with updating measurement points.

After clicking **Finish,** the wizard starts saving the configuration and any changes made cannot be undone.

Screen 4 is Summary. This provides a list of how many measurement points were updated and how many measurement points could not be updated. If there were any measurement points that could not be updated, the reasons are stated in the **Details** section.

5
System Operation

Startup View

@ptitude Observer remembers each user's departure view so that each session starts from where the previous session ended. For a new user, after a successful logon, @ptitude Observer will start with the hierarchy view in the tree view window as the default view.

Tree View

Tree view window consists of the following types of user interfaces.

Hierarchy View shows machines and their measurement points in a tree structured hierarchy with the corresponding status for each object. The hierarchy can display data from several databases at the same time.

System View shows the status from a hardware point of view which is based on IMx/MasCon devices, sensors and measurement points. It shows the communication status as well.

Workspace is the hierarchy view of user selected machine(s). It is an individual work space to keep track of only the machines for which the user is responsible. A workspace can only span over one single database.

Diagram View is the hierarchy view of all the saved settings of graphic diagrams including selection of measurement points as well as buffer settings. This is to be able to have predefined views of the data.

If the @ptitude Observer licence includes additional features such as SKF Rail Track Monitoring, then further views may be available.

Hierarchy View

To get to the hierarchy view screen:

- Click **Show** on the toolbar and then select **Hierarchy**.
- If the tree view window is already open, select the **Hierarchy** tab directly from the tree view window.

The hierarchy view displays each object's status with small icons. Status indication/level is inherited upwards in the hierarchy view. For example, if a measurement point on a machine has an alarm status, all the levels above this machine will also be upgraded to an alarm status. The status in the hierarchy view is updated each time a trend is stored in the database by the @ptitude Observer Monitor service.

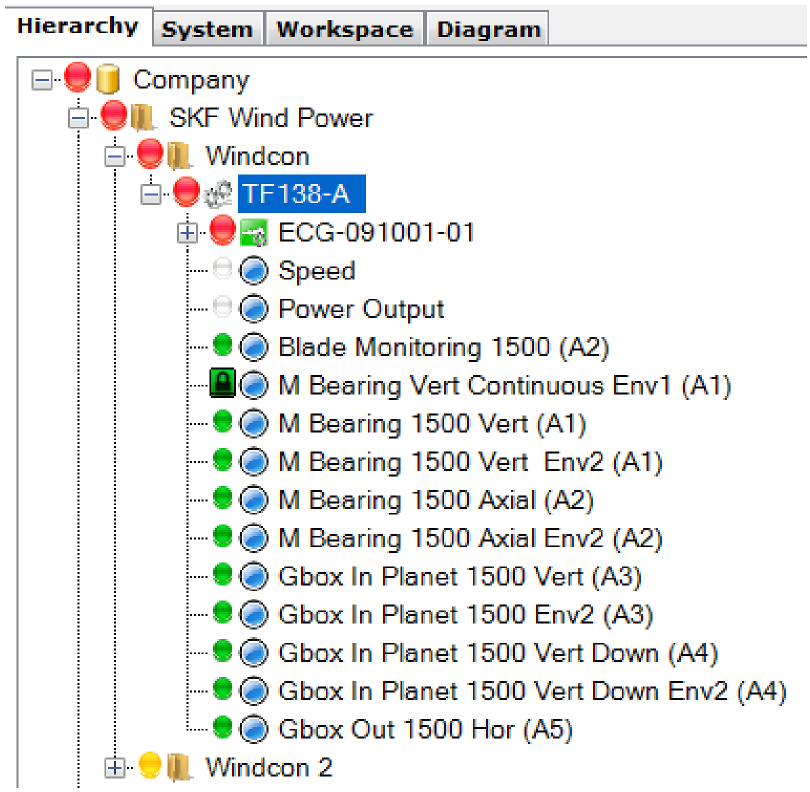


Figure 5 - 1
Example of @ptitude Observer hierarchy view

Status in the Hierarchy View

**Unknown** indicates that the measurement point data is missing, and the system is unable to determine the condition of the machine. This is the initial status of new measurement points.

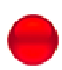
Note that if the unknown state persists and is not subsequently replaced for example by ‘Not measured’, this can be indicative that the configuration is incomplete. Examples of this include IMx measurement points not allocated to an IMx channel (left unallocated) or for IMx-1 where the machine doesn’t yet have a gateway associated with it.

The various other status icons are described below and are presented in their priority order for an IMx measurement point (ordered from highest to lowest priority). Following that, a priority list for IMx-1 sensor and measurement points and then one for other hierarchy nodes are presented.

**Not active** (priority 1) indicates that the measurement point is disabled and is on hold. No data will be collected for this measurement point.

**Sensor fault** (priority 2) indicates that the IMx/MasCon device has detected a sensor fault on the channel that this measurement point uses. The detection is achieved by bias ranges that are set in the *Sensor check* field under the setting analogue channels section for IMx/MasCon devices. For Direct Modbus devices, the same icon/status is used where the IMx reports it has not been possible to communicate with the slave. For IMx-1 sensors, the same icon/status is used for situations where the gateway reports a 'Sensor not available' event.

**Outside measurement range** (priority 3) indicates that the values coming from this measurement point are outside of the acceptance range. The bias on the channel is Ok but the produced values are too high or too low. The measurement range is set in the active range *condition* field with minimum and maximum values of the trend settings of measurement points.

**Alarm** (priority 4) indicates that this measurement point has received values that triggered an alarm. The values can be *High alarms, Low alarms, Relation alarms* or *Vector alarms*. The alarm status can be confirmed by acknowledging the alarm from the alarm list (refer to Alarm list under Show in Menu Items section). After the alarm has been acknowledged and new data has been stored in the database, the measurement point will release the alarm status.

**Protean** (priority 5) indicates that the built-in machine learning has detected a Protean diagnosis change and the system has generated an alarm. All rules and levels for Protean triggering are determined based on machine learning algorithms developed by SKF and the Protean graph can display the history.

**Diagnosis alarm** (priority 6) indicates that an alarm has been raised by the built-in intelligent machine diagnostics of the system. The rules and logic of the diagnosis alarm can be defined in the diagnosis settings section of setting up measurement points and alarms. Alarm levels for the diagnosis are easily set in the diagnosis trend plot (refer to Diagnosis under Graphic Displays and Tools in System Operation).

**Warning** (priority 7) indicates that this measurement point has received values that triggered a warning. A warning is a pre-state prior to alarm which can be *High warning, Low warning* or *Vector warning.* The warning status can be confirmed by acknowledging the warning in the alarm list (refer to Alarm list under Show in Menu Items). After the warning has been acknowledged and new data has been stored in the database, the measurement point will release the warning status.

**Diagnosis warning** (priority 8) indicates that a warning has been raised by the built-in intelligent machine diagnostics of the system. The rules and logic of the diagnosis warning can be defined in the diagnosis settings section of setting up measurement points and alarms. Warning levels for the diagnosis are easily set in the diagnosis trend plot (refer to Diagnosis under Graphic Displays and Tools in System Operation).

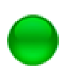
**Not measured** (priority 9) indicates that data has not been measured and stored for the measurement in the time frame the system expected it to be. The time frame is typically double the storage interval for trend. The system is unable to determine the condition of the machine. For IMx-1 sensors, the same icon can also be triggered as a result of the gateway reporting the sensor as ‘temporarily unavailable’.

**Outside active range unstable** (priority 10) indicates that not only are the conditions specified by active ranges on the measurement point not met by the system, but the measurement is varying too much and triggers the maximum allowed delta value of the active range making it unstable.

**Outside active range** (priority 11) indicates that the conditions specified by active ranges on the measurement point are not met by the system. One or more active ranges can be configured on measurement points in the spectra settings and trend settings.

**Transient** (priority 12) indicates that the measurement point is in transient mode which means that a run-up or coast-down is currently occurring. Once the run-up or coast-down of the machine is completed the machine will release the transient status.

**No alarm levels set** (priority 13) indicates that the measurement point is active and measurement data is coming in but there are no configured alarm levels for the system. The system cannot determine whether the status of the measurement point is acceptable or not.

**Ok** (priority 14) indicates that the measurement point has no known problems. Data coming in is valid and resides within the specified active range and measurement range. Alarm levels are specified for the measurement point and the data is within the specified alarm and warning levels.

Priority List of Status

An object in the hierarchy view can have several different states and in the case of higher nodes is representing multiple measurement points etc. In such case, the status with the highest priority is shown in the hierarchy view. For IMx measurement points the priority order is as shown above.

The following is the list of **Priority Order for both IMx-1 measurement points and sensor nodes:**

1. Sensor fault (gateway sent ‘Sensor not available’)
2. Alarm
3. Protean diagnoses
4. Diagnosis alarm
5. Warning
6. Diagnosis warning
7. Not measured (gateway sent ‘Sensor temporarily not available’ or no data for twice the storage interval)
8. No alarm levels set
9. Ok
10. Unknown (persists until a gateway is allocated)

The following states are not used by or are not applicable to an IMx-1 system: Not active, Outside measurement range, Outside active range unstable, Outside active range and Transient.

The following is the list of **Priority Order for all the others such as a database, node, machine and sub machine:**

1. Alarm
2 Protean diagnoses
3. Diagnosis alarm
4. Warning
5. Diagnosis warning
6. Sensor fault
7. Outside measurement range
8. Not measured
9. Transient
10. Outside active range unstable
11. Outside active range
12. OK
13. No alarm levels set
14. Not active
15 Unknown (persists until the lower level node structures are defined)

Configuration Mode Indicators

The nodes in the database can have different configuration mode indicators set depending on the validity of the current node or if the configuration of the specific node or measurement point is not set by the @ptitude Observer software. If there is a configuration mode indicator set for a node or measurement point the normal icon displayed for the node will be replaced by one of the following icons:

Obsolete indicates that this node or measurement point is obsolete and is no longer valid for capturing data. The Observer system can set nodes to this status when nodes need to be retained in the system because they contain measurement data that can be analysed but the conditions of the system has changed in such a way that the specific node is no longer valid to capture data with. If an Obsoleted node is no longer needed, the user can choose to delete the node and its data permanently.

Hierarchy right click functions

Right-clicking on a hierarchical level (database, node, machine, sub machine, IMx-1 sensor or measurement point) accesses the following functions.

Common Functions

Add is available in some form at almost all hierarchical levels.

Add at database or node adds a node or a machine. Refer to Node or Machine under Building a Hierarchy View in System Configuration section. For machine, sub machine or measurement point refer those sections below.

Delete is available at all hierarchical levels below Database. Note that:

- If the deletion includes points referenced by a Multiple Gating Point, the system will remove those references.
- If a machine being deleted includes a capture group, the system will remove the group and its related measurement points.

Event log displays system level events, refer to Event Log under On-line in Menu Items.

Process overview is available at sub-machine and higher levels. It enables the creation of user defined mimic displays with measurement points, including IMx-1 measurements, and links to other displays overlaid on graphic pictures like drawings, digital photos, etc. Refer to Process Overview in System Configuration section.

Properties allows editing of the properties of the selected level.

Refresh the current hierarchy view with status changes, if any.

Report generates documents that contain text-based information as well as diagrams and pictures of selected data. Refer to Report under File in Menu Items.

Database and Node Levels

In addition to the Common functions listed above:

Configure offers the following functions for the selected level.

Reset automatic alarm levels for trend

Reset automatic alarm levels for diagnosis

Recalculate diagnoses

Disable all measurement points

Enable all measurement points

Block alarm on all measurement points

Remove alarm blocking on all measurement points

Tools enables a user to:

Update graph settings of many measurement points at the same time.

Machine Level

In addition to the Common, plus **Configure** and **Tools**, functions listed above:

Add adds a measurement point (**Meas. point**), a sub machine, Direct Modbus Points, an event capture, run cycle capture or a scheduled capture group. Refer to Measurement Point or Sub Machine under Building a Hierarchy View in the System Configuration section. Refer to Configuring an Event Capture Group under Database > Measurement Groups in the Menu Items section or for specific information on the use of run cycle capture groups, to the SKF Rail Track Monitoring appendix.

In addition, there are the following capabilities to add supporting information:

Add note adds a note for the selected machine or sub machine. Refer to Notes in System Operation section.

Add event case adds a document report, information and history regarding a specific event tied to the selected machine. Refer to Event Cases in System Operation section.

Add attachment attaches any file to the selected machine. Refer to Machine Properties.

Copy copies the selected machine. Refer to Machine Copy Wizard in System Configuration section.

Paste works in conjunction with the copy function at the lower levels. Here it pastes a copied sub machine or a measurement point, in to the selected machine.

Calibrate shaft centerline graph connects to the IMx device and retrieves live data for the current cold gap location of the shaft. Refer to Calibrating Shaft Centerline Graph in System Configuration section.

Machine parts enables a model of a machine to be built by combining different machine parts. Refer to Defining Machine Parts in System Configuration.

Maintenance planner keeps track of maintenance tasks. Refer to Maintenance Planner in System Operation section.

Runout Compensation captures runout compensation data for the specific machine. Refer to Runout Compensation under Setting up Measurement Points and Alarms in System Configuration section.

Tools has an additional function.

Generate machine template opens a dialog for generating a Machine template of the selected machine.

Tag categorises the selected item with a specifically defined tag from the Tag Library.

Sub Machine Level

In addition to the Common, plus **Add note**, **Calibrate shaft centerline graph**, **Update graph settings** and **Tag**, functions listed above:

Add has at this level in addition to a measurement point, the option to add an Enlight Collect IMx-1 sensor and Direct Modbus Points.

Copy copies the selected sub machine.

Paste works in conjunction with the copy function at the measurement point level. Here it pastes a copied measurement point into the selected sub machine.

Diagnose automatic alarm levels for the selected sub machine.

Recalculate diagnoses for the selected item.

Trend automatic alarm levels for the selected sub machine.

Enlight Collect IMx-1 Sensor Level

When added to a sub-machine, this type of sensor automatically includes a four-measurement cluster corresponding to the measurements that this sensor type makes. The right click context menu at this level therefore has diagram options restricted to Multi trend, doesn't include Add, and at the Sensor measurement level it also doesn't include Delete. Otherwise, functions available closely mirror those available at a Measurement Point level.

Measurement Point Level

In addition to the majority of the common, plus **Add note**, **Recalculate diagnoses** and **Tag**, functions listed above:

Copy the selected measurement point.

Paste the copied measurement point to a new location.

Diagram to select and access a graphical display of the measurement point data. Available diagrams relate to the type of data the measurement point provides, for example, IMx-1 temperature and vibration points have different diagram availability and for IMx-1 vibration points, diagrams which require multi-channel data or a tacho reference for phase information, are unavailable.

Note that if diagram windows are currently minimised or they were closed when minimised, opening further diagrams (even of different type or relating to different measurement points) will also open them minimised and so it may not be immediately apparent to the user that the window has opened as expected. To correct, identify the window visually or select it from the Window menu list and then maximise it.

Reset automatic alarm levels for trend for the selected measurement point.

Reset automatic alarm levels for diagnosis for the selected measurement point.

System View

The System view shows the database from the system point of view with IMx/MasCon devices, sensors/channels and measurement points.

To access the system view screen:

- Click **Show** on the toolbar and then select **System**.
- If the tree view window is already open, select the **System** tab directly from the tree view window.

Figure 5 - 2 below, is an example of a system view.

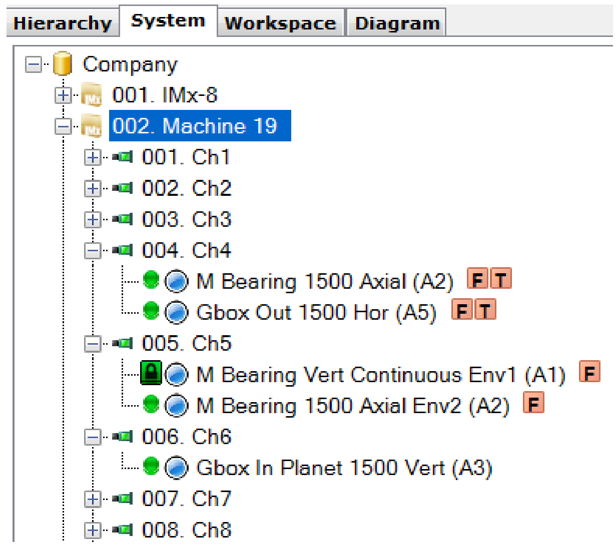


Figure 5 - 2
Example of System View

By right-clicking on a database, node, machine, channel and measurement point, there are options to **Refresh** data or open the **Property** settings of the selected node and edit.

By right-clicking on a measurement point, there are also options to open a graphic display **Diagram** to edit, **Delete** the selected measurement point or set a **Tag** on the measurement point.

Workspace

A Workspace is an individual work space area consisting of some portion or elements of the hierarchy view. It can be used to keep track of specific machines for which the user is responsible. Note that a workspace cannot span multiple databases.

To open Workspace screen:

- Click **Show** on the toolbar and then select **Workspace**.
- If the tree view window is already open, select the **Workspace** tab directly from the tree view window.

Figure 5 - 3 below, is an example of the Workspace tab.

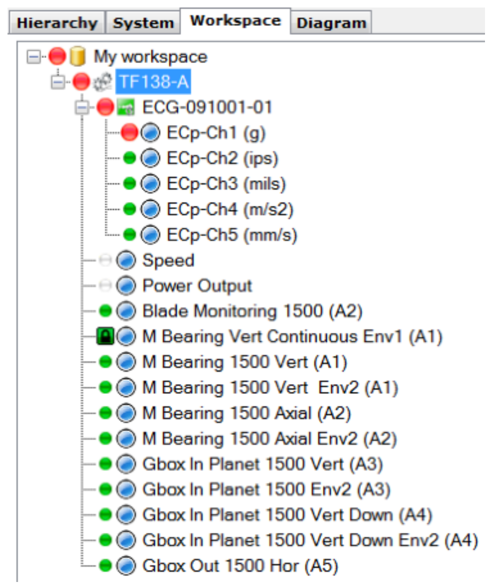


Figure 5 - 3
Example of Workspace

To configure a workspace, select **Workspace** from the **Edit** menu. Refer to Workspace under Edit, in Menu Items section.

Note that in that same dialog is a control for opening a selected workspace: only the open workspace appears in the Workspace tab of the tree view window, it does not automatically display a workspace even if it is the first and only workspace created.

Diagram View

The Diagram view is a list of saved diagram boxes. Diagram boxes are predefined views of the data which contain specified graphic settings including selection of measurement points as well as buffer settings.

To open Diagram screen:

- Click **Show** on the toolbar and then select **Diagram view**.
- If the tree view window has been opened already, select the **Diagram** tab directly from the tree view window.

Figure 5 - 4 below, is an example of a Diagram view.

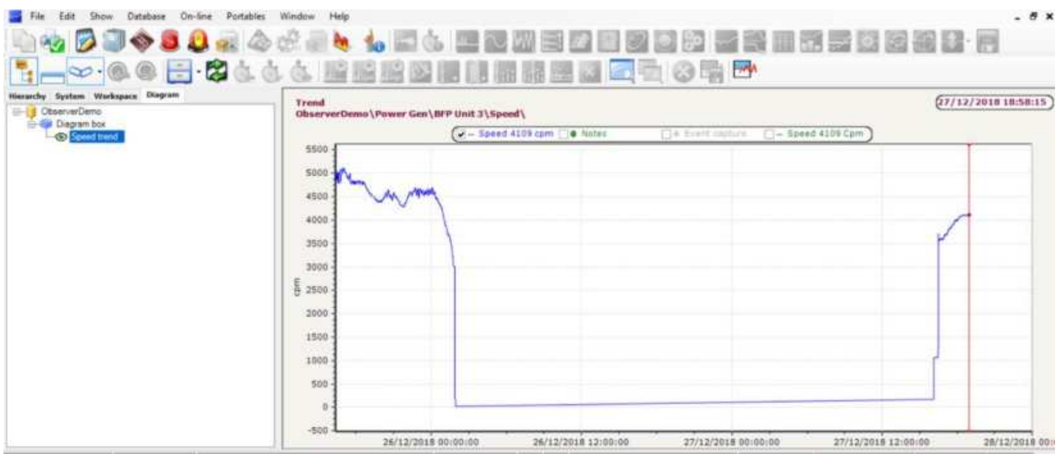


Figure 5 - 4
Example of Diagram View

To bring up the graphic display with the saved settings, double click on a selected diagram box.

RailMo

The RailMo view is used only for SKF Rail Track Monitoring and is described there. To access the RailMo view activate the tree view window and then click on the RailMo tab.

Enlight Collect IMx-1 System view

SKF Enlight Collect gateways and IMx-1 sensor hardware are maintained in the IMx-1 System view. It shows the status of SKF Enlight Collect gateways and IMx-1 sensors and is where gateways and relay nodes are created and configured. It opens in the main window area as used by the DASHBOARD and analysis diagrams. Changes in gateway or IMx-1 sensor status are reflected here, by system alarms and in some cases in the mesh network information log. Note that some errors, such as (mesh) Network instability, can have significant ramifications for sensor battery life and urgent action should be taken, refer to the *SKF Enlight Collect IMx-1 System User Manual*, part number 15V-090-00087-100, for further details.

To open the view:

- Click **On-line** on the toolbar and then select **Enlight Collect IMx-1 system view**.
- Alternatively, if the view is already open, but just hidden beneath another, select **Window** and then **Enlight Collect IMx-1 system view** from the numbered list of open views.

Figure 5 - 5 below, is an example of an IMx-1 System view, with on the left, the tree view window active.

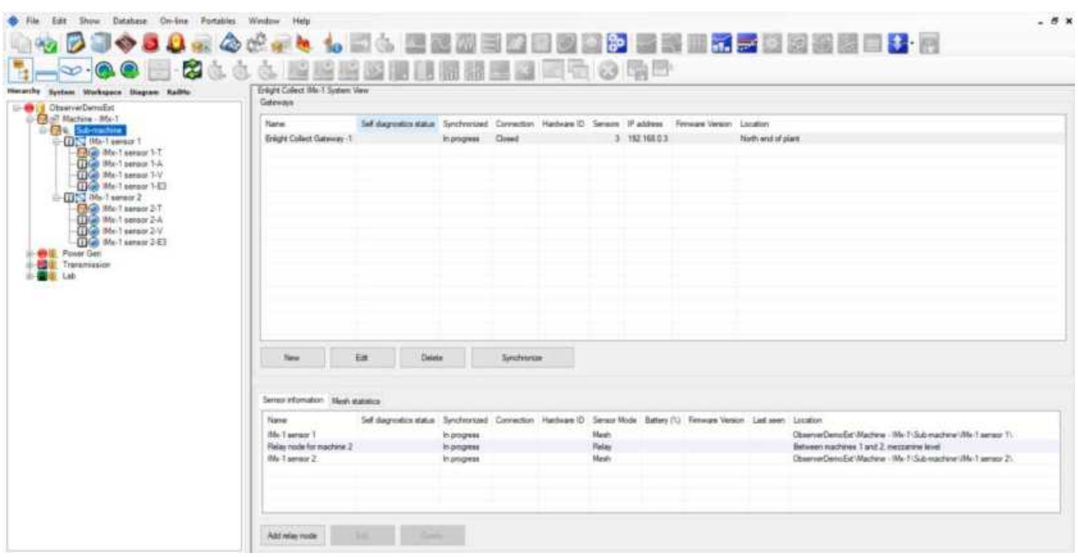


Figure 5 - 5
Example of IMx-1 System view

In this view the upper area is a table of all gateways in the database (see also note about external databases, below). The lower area lists sensors and can be filtered by gateway or by hierarchical position:

- Filter by gateway
  - Select an entry in the gateway table/list and the associated measurement and relay sensors for the selected gateway are shown.
- If 'Link to hierarchy' is on.

- In the Hierarchy view, select a machine or lower level node: if that machine has a linked gateway, the measurement sensors associated with it are shown. The sensor list is cleared if there is no gateway linked to that machine.
- **Important note**: if an external database has been added, ‘Link to hierarchy’ must be on for the gateway table to update and reflect the gateways in the database that is currently selected by hierarchical position.

For each gateway the following properties are shown in the gateway table:

Name: Name given to the gateway.

Self diagnostics status: Displays the latest reported self-diagnostic status or in case of multiple errors the item considered most critical.

- "Ok" or an error in the following priority order:
- Mesh module licence error.
- Missing/invalid network and identity configuration. This is a configuration known as ‘configuration 2’, in the event log.
- Missing/invalid ‘other’ configuration.
- NTP Error.

The status field will initially be empty until the actual gateway status has been received. If the gateway status deviates from OK, this will also be reflected by appropriate system or critical system alarms being raised.

Note that double clicking a gateway entry or selecting it and then choosing Edit will launch the gateway properties dialog where extended status information can be viewed.

Synchronized:

- No: the configuration held by @ptitude Monitor/Observer is different to that in the gateway.
- In progress: a synchronise action is under way.
- Yes: the configuration in @ptitude Monitor/Observer and in the gateway are verified as being the same.

Connection:

- Connected
- Closed

Hardware ID: The unique identifier of the gateway. If the gateway is commissioned and successfully connected to @ptitude Observer, it will show a MAC address in this field.

Sensors: The number of sensors linked to the gateway.

IP Address: The IP address that is used by the gateway.

Firmware Version: The version of firmware, installed in the gateway.

Location: A name given to the physical location.

Similarly, for sensors the following properties are shown in the sensor table:

Name: Name given to the sensor.

Self diagnostics status: Displays the latest reported self-diagnostic status or in case of multiple errors the item considered most critical.

"Ok" or an error of any of the following types. Values in brackets are decimal values corresponding to the bit set in the mesh network information log, Self-Diagnostic entry, when the error is true:

- Battery level low (1)
- External Flash memory failure (16)
- Configuration CRC failure (64)
- Firmware update error (128)
- (Watchdog reset (256) – only available in the log file)
- Network instability (512)

The status field will initially be empty until the actual sensor status has been received.

Double clicking a sensor entry or selecting it and then choosing Edit, will launch the sensor properties dialog where extended status information can be viewed on the second tab, named Status.

The above self-diagnostic errors will also raise a system or critical system alarm in @ptitude Observer. Note that the network instability error can have significant ramifications for sensor battery life and urgent action should be taken, refer to the *SKF Enlight Collect IMx-1 System User Manual*, part number 15V-090-00087-100.

Synchronized:

- No: the configuration held by @ptitude Monitor/Observer is different to that in the sensor.
- In progress: a synchronise action is under way.
- Yes: the configuration in @ptitude Monitor/Observer and in the sensor are verified as being the same.

Connection: Current connection status for the sensor, may indicate OK, Temporarily unreachable or Unreachable.

Hardware ID: The unique identifier for the sensor, if the sensor is commissioned and successfully connected (via the gateway) to @ptitude Observer, it will show a MAC address in this field.

Sensor Mode: Mesh, Leaf or Relay. Refer description and notes on Sensor Mode in Hierarchy view and IMx-1 system (Sensors) configuration.

Battery (%): A battery health (percentage remaining) indication. Note that before a connection to the sensor has been established this field will be empty.

Firmware Version: The firmware version that is installed in the sensor. Note that before a connection to the sensor has been established this field will be empty.

Last seen: A date and time corresponding to when the sensor was last communicated with.

Location: For a measurement sensor (Leaf or Mesh), the hierarchical location where that sensor and measurement points have been created. For a relay node, this field contains the descriptive location information entered by the user, when configuring the relay node.

Beneath both the gateway and sensor tables are buttons for **Edit** and **Delete** functions as well as a button for adding a **New** gateway or **Add relay node**. In addition, because all synchronisation is carried out at a gateway level, under the gateway table is a **Synchronize** button.

Gateway: **New**, **Edit**, **Delete** and **Synchronize** buttons. Gateway properties can be accessed by double clicking on a selected gateway.

Sensors: **Add relay node**, **Edit** and **Delete** buttons. Sensor properties can be accessed by double clicking on a selected sensor.

Notes:

- A gateway or sensor that is not shown as **Synchronized**, indicates that its configuration does not reflect the current @ptitude Observer settings. For an IMx-1 system the synchronisation process is automatic on configuration change or when a firmware update is available in @ptitude Observer but it can also be manually initiated. To do this use the **Synchronize** button, but only when the gateway is online, **Connection** state is Connected. Initially this sets the gateway and sensor **Synchronized** status to “In progress” meaning the synchronisation process has been initiated. The gateway and all sensors reporting a Hardware ID will be synchronised, any sensors not yet reporting their ID will remain as in progress.
- **Measurement sensors** of types Mesh and Leaf are created, deleted and configured in the hierarchy view.
    - **Leaf nodes** are sensors that make measurements and use the mesh to exchange their data but don’t contribute to mesh, inter sensor, communication linking for other sensors.
- **Relay nodes** are created, configured and deleted in the IMx-1 system view.
    - Relay nodes are sensors dedicated only to mesh, inter sensor, communication linking, they make no measurements.
    - Note that like **Add relay node**, the **Delete** sensor button is only usable for relay mode, sensors.
- IMx-1 systems are also supported by @ptitude Observer system alarm functionality.
- For further information on procedures related to commissioning and decommissioning, refer to the SKF Enlight Collect IMx-1 System User Manual, part number 15V-090-00087-100. Note however that using the **Delete** button (Enlight Collect IMx-1 System View) to remove a gateway is not normally used for system maintenance as it has the following implications:
    - Associated relay sensors will be deleted.
    - Gateways cannot be deleted without first unlinking them from associated machines.
    - Unlinking a gateway from a machine requires any commissioned sensors to be deleted first, thereby losing any associated measurement data.

Gateways

Being part of the mesh infrastructure, gateways are mostly configured in the @ptitude Observer, Enlight Collect IMx-1 system view. Select a gateway from the upper gateway table/list then double click or right click and select properties or for a new gateway, press **New**:

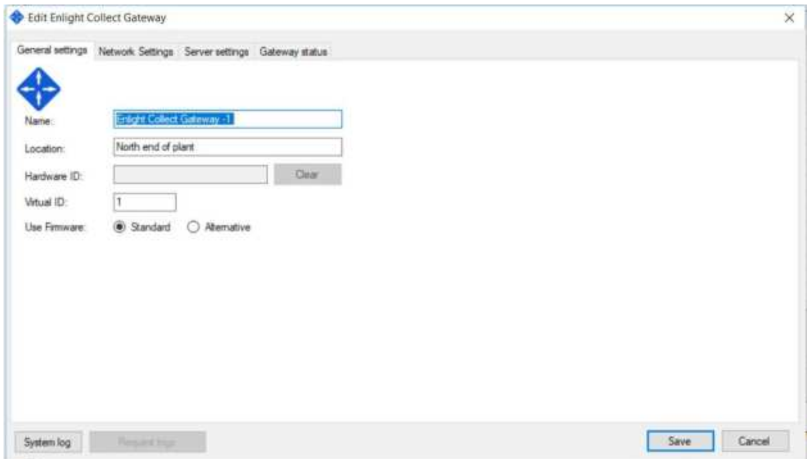


Figure 5 - 6
Edit or create new gateway (gateway properties)

When a new gateway is created, where appropriate, the properties of the last gateway created/modified will be re-used.

The General settings tab has user editable areas for a gateway descriptive **Name**, a descriptive **Location**, a **Virtual ID** and a firmware type to use, *Standard* or *Alternative*.

Virtual ID is a unique identifying number for each gateway in the database. Valid assignments are in the range 1 to 65 535, the system will suggest the lowest available Virtual ID.

The **Virtual ID** can be thought of as a reference to a specific 'slot or position' in the database. During commissioning an individual gateway (Hardware ID) is assigned to that position to ensure that data reaches the intended destination. If a gateway has to be replaced, that assignment of Hardware ID to Virtual ID has to be cleared before the new gateway can connect to that Virtual ID.

If a user has appropriate rights, the **Request logs** button can be used to upload log files from the gateway to the file system on the @ptitude Observer computer. The log files can be useful for IMx-1 system troubleshooting and are uploaded as a single, password protected, zip file. The file transfer dialog will confirm the location where the file has been stored.

For further information on troubleshooting, commissioning and decommissioning topics refer to the *SKF Enlight Collect IMx-1 System User Manual*, part number 15V-090-00087-100.

The Network settings tab allows the gateway network connection to be selected as **Ethernet (wired)** or **WiFi** and to be set for dynamic (**DHCP**) or **Static** addressing and as appropriate to allocate static settings for its own **IP Address**, **Sub-net Mask**, the network **Gateway** address, DNS addresses, etc.

Wi-Fi specific selections include **Security** type, **Password**, **Country** and **SSID** for the wireless network. For security there is a choice between *WPA2-Personal* and *WPA2-Enterprise*. Note that the country setting is used by the gateway to determine the correct frequencies to be used for Wi-Fi.

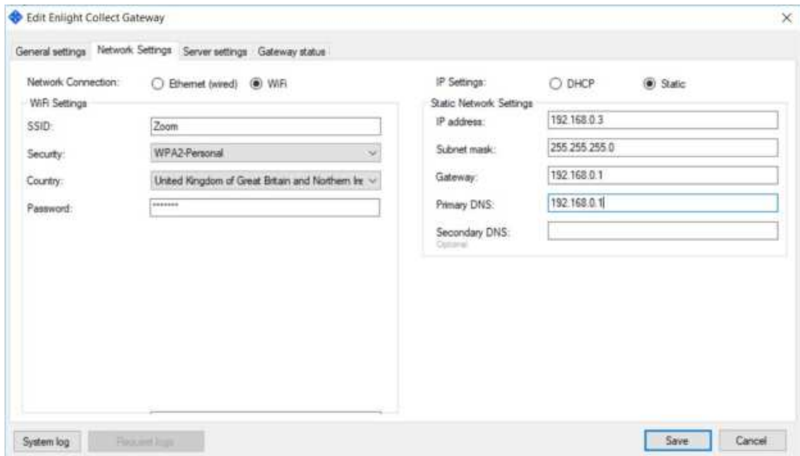


Figure 5 - 7
Gateway properties – Network settings tab

The third tab is Server settings:

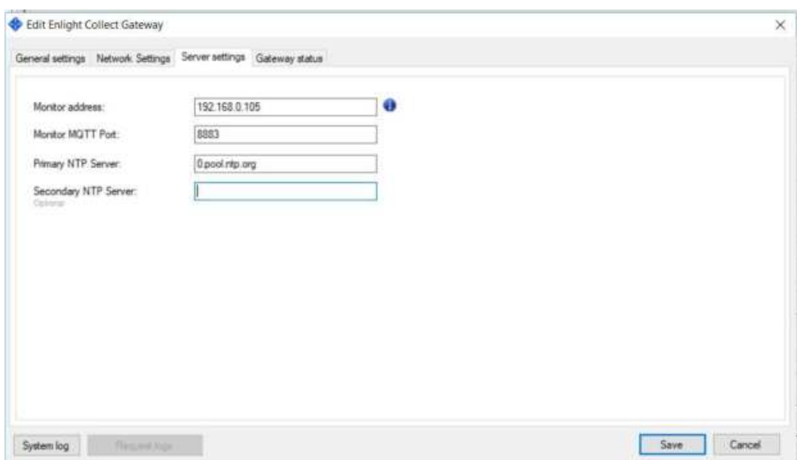


Figure 5 - 8
Gateway properties – Server settings tab

There, the 'address' and 'Port' relate to how the gateway will access Monitor via MQTT. In general, the address can be entered using domain naming or IP addressing noting that if an IP address is entered here for a system communicating across public networks, it should be the external facing or public IP address for the Monitor server.

- Note though that when using TLS and a trusted public Certificate Authority, the **Monitor address** must match the DNS name used in the certificate. The connection must not be specified by either an IP address or a DNS naming related, for example, to a web service provider's domain. The information tool-tip text reinforces this point.

NTP settings indicate to the gateway where an NTP server can be contacted. An entry for at least the 'Primary', is required before the configuration can be saved. Like other IMx devices Enlight Collect gateways support Time Synchronization Thresholds.

Status information when/as it is available, is presented on the Gateway status tab:

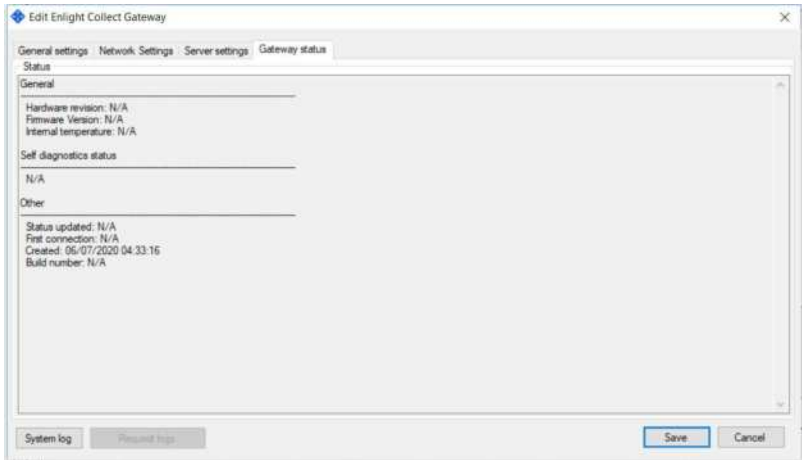


Figure 5 - 9
Gateway properties – Gateway status tab

Status feeds back information on **Hardware revision** and **Firmware version**, gateway **Internal temperature, Self-diagnostics status, Wi-Fi SSID**, **Signal Strength** and when **Created**/**First connection/Status updated,** firmware **Build number**.

Note that the gateway allocation to a particular machine or machines is set on the Machine Properties > Enlight Collect IMx 1 System tab, and must be allocated before commissioning.

IMx-1 sensors

All IMx-1 sensors, of whatever type/mode, can be viewed in the IMx-1 System view but their attributes available here are mostly read only and relate only to their operation and status within the wireless system.

As they make no measurements and only contribute to the wireless network, relay mode sensors are entirely created and managed within this view: **Add relay node** beneath the sensor table launching a dialog to create a new relay sensor for the system.

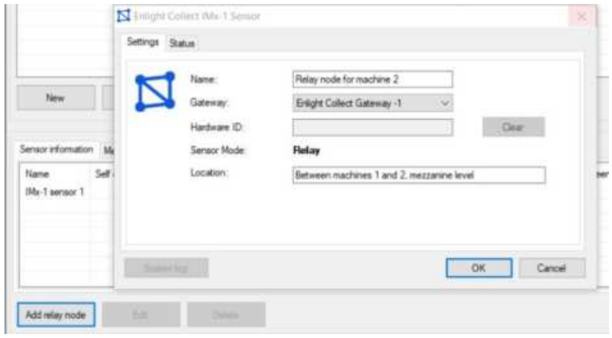
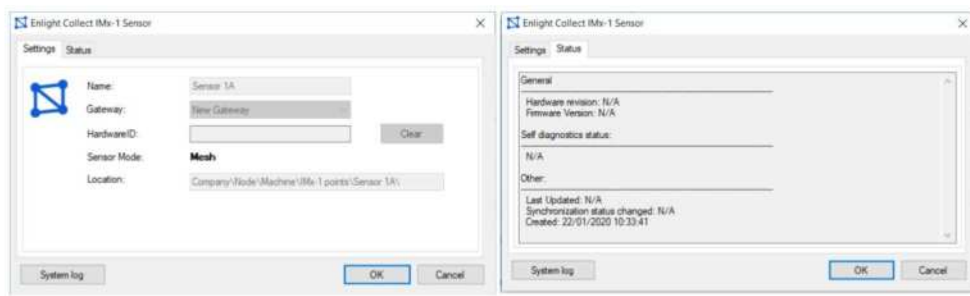


Figure 5 - 10
Add relay node

Although the location field entry will be displayed in the app during commissioning, when configuring a relay node, a name that also hints at its physical location or position in the mesh may still be useful.

To edit or view the properties dialog of any sensor, select its associated gateway to update the sensor list and then select the sensor from that list. Click the **Edit** button below the sensor list or directly double click the table entry to open the sensor properties dialog.



a) Settings tab b) Status tab

Figure 5 - 11
Enlight Collect IMx-1 System view, sensor properties

A mesh or leaf mode sensor is configured in the hierarchy so most settings/actions, aside from **Clear Hardware ID**, are read only. Similar to a gateway that has to be replaced, the assignment of sensor **Hardware ID** has to be cleared before a new sensor can connect to that hierarchical location. For further information on activities related to commissioning and decommissioning, refer to the *SKF Enlight Collect IMx-1 System User Manual*, part number 15V-090-00087-100.

A second tab, Status, feeds back information on **Hardware revision** and **Firmware version**, **Self-diagnostic status** and when **Created**/**Last updated/Synchronization status changed**. Note the information provided is updated on opening the dialog box, not in real time.

Mesh Statistics

Within the sensor table area, a second tab Mesh statistics, provides data to support an understanding of how the wireless mesh is performing and adapting to the physical sensor layout.

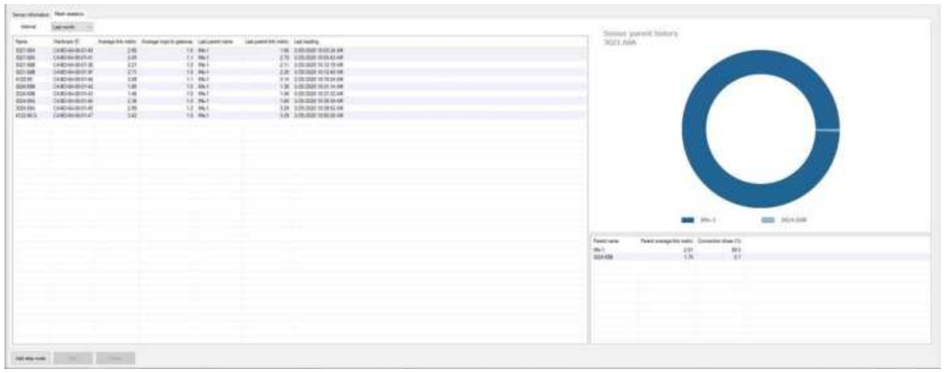


Figure 5 - 12
Mesh statistics

The mesh statistics can be based on an **Interval** setting of *All*, *Last day*, *Last week*, *Last month* or *Last year*.

In the main table each sensor occupies one row and is identified by a **Name** and a **Hardware ID**. The statistics give an indication of the routing being taken by providing **Last parent name** and **Average hops to gateway**. A guide to the ‘quality’ of the routing is offered by way of **Average link metric** and **Last parent link metric**. Here the metric is effectively the average number of attempts needed to make the communication so a metric of 1 is ‘perfect’ and a metric of 7 would indicate a poor quality routing that invoked the maximum number of retries allowed. The mesh statistics are only updated when a particular sensor is communicating, the time/date provided in the **Last reading** column will convey when that was.

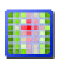
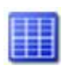
Selecting a particular entry in the main table populates the **Sensor parent history**. For the selected sensor this will show not just the last parent but all parents within the selected interval. For each a **Parent name**, **Parent average link metric** and **Connection share (%)** will be shown. The connection share shows the proportion of the total connections that were made through that particular parent.

Graphic Displays and Tools

There are many graphical displays available in @ptitude Observer to facilitate data analysis. The accessibility of graphical displays depends on the selected item.

To access a graphic display screen:

1. First select a measurement point, a sub machine or a machine in the hierarchy view, system view or workspace.
2. Select one of the following graphic display icons on the toolbar. Alternatively, if a measurement point has been selected, right click on the measurement point then click **Diagram** and choose a graphic display.

 Spectra	 Time waveform	 Phase	 History	 3D plot
 Topology	 Orbit	 Profile	 Gear inspector	 Trend
 Bode plot	 Trend list	 Multi trend	 Diagnosis	 Protean
 Polar	 Shaft centerline	 Combination plots	 Capture	

Graphic Features

Multi-point analysis is possible in most displays by dragging and dropping more measurement points onto the same graph. Holding **[Ctrl key]** down while releasing a measurement point on a graph adds the measurement point on the display overlaying the data if the graph supports it.

Cursors of various types appropriate to the plot can be added. When moving any cursor (except band cursor) across a Spectra, Time waveform, Phase or Trend plot the cursor will automatically snap to the nearest point in the plot. To override that 'snap' functionality, press **[Ctrl key]** whilst moving the cursor.

Legend is included in all displays and gives information on selected values, cursor positions, type of data and more. Legend can be repositioned and enabled in all graphs. It can be enabled by checking the *Visible* field. It also has an option to have display positioned at *Top, Bottom, Left* or *Right* of a graph.

Buffer setting sets the depth and conditions on which data to retrieve and display in the graphs. The access to buffer setting can be done by clicking on the buffer icon on the toolbar after opening a graph. The graph will be updated with the new data from the buffer settings automatically. Refer to Buffer in System Operation.

Graph Settings

To access graphic settings:

- Click on the right mouse button on the graphic display screen, then select an option from the pop-up menu.
- It is also possible to update graphic settings of many measurement points at the same time by **right-clicking on a node or a machine** in the hierarchy view, then selecting **Tools** and then **Update graph settings**.

Some edited graph settings can be saved on the measurement point while the others are only temporary changes. When certain settings are modified within any one of the following graph types for a single point, the system will automatically save the modifications as the preferred settings for that graph and point. The next time the user accesses the same graph for the same point, the graph will retain any applicable preferences that have been set.

Graph types that save preferences/modifications include:

- Multi-Trend
- Orbit
- Shaft Centerline
- Spectra
- Time Waveform
- Trend

Graph settings that will be saved, where applicable, for the above graphs (specifically, graph type/point type pairs) include the following:

Direction	Legend Visible/Alignment	Show phase
Display style	Line style	Start/stop markers
Frequency unit	Mode	Title Checkboxes
Invert rotation direction	Set speed	X axis
Invert view position	Shaft cycle time	Y axis

3D settings enable editing of zoom, rotation and elevation scales for 3D plots.

Add cursor adds available cursors (markers) one at a time in the graph. Although temporary, where the plot is linkable and Link to hierarchy is enabled, plot cursors and cursor positions will be maintained when moving between measurement points. Descriptions of available cursors can be found in Tools for Graph Display section below.

Alarm circles hides/shows alarm circles for polar types of plots. One warning circle (yellow) and one alarm circle (red) is drawn.

Annotations can be added as temporary notes for the current graph. They can be useful for printouts of the current graph or screenshots. To add an annotation, right- click on the graph and select the menu item **Annotation/Add**. A text box appears on the top left corner. To edit the text in the text box, double click the text box. To end editing, click the ESC key on the keyboard. Click the mouse and drag the annotation where it is to be placed.

Auto alarm is available for diagnosis display only. It is based on the data in the graph which configures the alarm settings for the built-in intelligent diagnostic system.

Copy is available on all graphs in @ptitude Observer. It creates a screenshot of the graph and copies it to the clipboard.

Correlation tolerance is available for the multi trend plot only. Correlation tolerance sets a tolerance for how far apart correlated measurements can be and still be displayed. Can be set to Exact or in a range from 1 second up to 1 hour.

Curve fitting applies an approximation of a curve fit to the data currently displayed in the plot. Options are 1st Degree, 2nd Degree, 3rd Degree and None.

DiagX brings up a list of machine parts and the probability for each being related to the selected frequency. This edit is temporary. See **DiagX** in Tools for Graph Display below.

Exclude from diagnosis calculation excludes an FFT from diagnosis.

Export is available on all graphs in @ptitude Observer. It brings up an **Export** dialog where data can be selected for export in several different formats, including as Excel and text files.

Frequency unit switches the frequency unit between *Hz, cpm* and *Order.* The change made to frequency unit can be saved on the measurement point.

Fault frequencies brings up a dialog where the user can choose machine parts from the machine that the user is currently analysing. When one or more machine parts are selected, the frequencies for them are drawn in the graph and these choices are saved for that measurement point. In this way, the user can clearly see which of the machine parts may be causing high readings. The frequencies displayed for the machine parts are automatically calculated using the running speed.

Go to [Double click] for a diagnosis display, toggles back and forth between the main diagnosis screen and the one graph selected. **Go to [Double click]** for a history display opens the selected graph in full screen mode.

Inverted changes the sign of all data in the plot.

Legend sets the preferred position of the legend. Refer to Graphic Features for detailed information. A general position of legend can be set for all graph displays at User Preferences under Edit in Main Item.

Line style specifies the style of line to graph temporarily. The available line styles are *Line, Point* and *Line and point* noting that all styles are not necessarily applicable to all point types, example: for Digital points only *Point* applies.

Listen to time waveform enables ‘playback’ of the time waveform if there is a sound card installed in the computer.

Markers allows markers to be added by **[shift+click]** or the nearest marker to be temporarily removed by **[Ctrl+click]**.

Max scale provides a list of predefined maximum scale settings to select temporarily. Selecting *auto* will cause the system to select the most appropriate maximum scale setting for the current data.

Min scale provides a list of predefined minimum scale settings to select temporarily. Selecting *auto* will cause the system to select the most appropriate minimum scale setting for the current data.

Mode is available for history graphic display only. Mode temporarily switches between spectra, time waveform, phase, spectra/time waveform and spectra/time waveform/phase.

Noise reduction sets the noise reduction level in percentage.

Order analysis shaft is available for diagrams that include amplitude spectra: history, spectra and combination plots. These plot types will supplement the spectra time/date text line with associated measurement data and in the case of speed data, with a ‘1X’ entry or where an order analysis shaft is set in the measurement point properties, an entry where that shaft name will be explicitly used:

13/02/2019 10:34:57; Speed: 559.3 cpm (1X: 559.3 cpm) OR

13/02/2019 10:34:57; Speed: 559.3 cpm (Input shaft: 559.3 cpm)

The purpose of this control is to allow an order analysis shaft to be selected for the active spectra, this change being temporary and not affecting the selection made in the point configuration nor the order analysis shaft selection when the diagram is next opened. If the **Frequency unit** is *Order*, the spectral plot will be redrawn for the new **Order analysis shaft** selection and the text line will anyway update to reflect its new naming and rotational speed, example:

13/02/2019 10:34:57; Speed: 559.3 cpm (Output shaft: 2237.2 cpm)

Palette steps is available for gear inspector graphical display only. It indicates the total number of different colours used for the display.

Reference stores the current active measurement in the graph as reference data for the active measurement point or clears the existing reference data. When setting a measurement as a reference, the measurement will automatically be set with the Keep forever flag. Keep forever flag can be edited in Meas. date interface. The reference data is shown in the background of this graph every time data is displayed for this measurement point.

Remove DC provides the option to exclude the DC part of the signal. Often when showing time waveform data, the DC part is removed, leaving just the AC signal content.

Runout compensation is used to avoid that shaft out of roundness, is included as vibration.

Save to Diagram Box saves the current graph settings under an assigned name. For detailed information refer to Diagram View under Tree View in System Operation.

Scale allows a value selection from the list of predefined scale settings. Selecting *Auto* will cause the system to select the most appropriate scale setting for the currently displayed data. In most graphs, the mouse wheel can be used to increase or decrease the max scale. The change made to scale can be saved on the measurement point.

Scale type switches between *Lin (linear)* and *Log (logarithmic)* scale. If Log is selected, then the system will use the number of decades as the scale. Number of decades in logarithmic scale is set in User Preferences interface under Edit in Menu Items section. The change made to scale type can be saved on the measurement point.

Scaling temporarily changes the display scaling (detection) of the measurement point. Scaling options are P*eak, PtP (peak to peak)* or r*ms.* The original measurement point scaling is restored when that particular graph is closed.

Sectors is available for gear inspector graphical display only. It indicates the number of gear sectors. The default is 360 which means that there are 360 sectors each 1 degree wide, whereas if 180 was chosen, there are 180 sectors each 2 degrees wide.

Set Speed enables manual adjustment for the speed reading of the current measurement displayed in the Spectra plot.

Shaft is available for profile display only. It can be selected to determine for which shaft the profile should be calculated.

Shaft Cycle time is available for Orbit plot only. Select from *Tacho shaft*, *Order analysis shaft* or *custom speed*.

Show phase is available for trend graphic display only. It brings up the phase graphic display on a split screen.

Show pulses is set by default which displays pulses in the graph. It can be unset if needed.

Show values displays the values in 3D plots.

Start/stop markers hides/shows the start and stop markers for displays. The markers typically show the first and the last value drawn in the graph.

Type selects the type of orbit graph to display.

Unit is the measurement unit of the data displayed which can be changed temporarily. Changes can be made between velocity, acceleration and displacement. The original measurement point units are restored when that particular graph is closed.

X-axis changes the x-axis value to *date/time, speed, process* or *values* temporarily. For multi trend plot, it is also possible to set the x-axis to another measurement point which will correlate the measurements of measurement points with each other.

Y-axis changes the y-axis value to *amplitude* or *percent* temporarily.

Z-axis is available for 3D plot only. Change the z-axis value to *date/time, speed, process* or *even spreading* temporarily.

Zero padding: where a spectral component in the signal falls between the FFT bins/lines then a wider peak may result because the energy is being spread across these bins. Although the underlying signal sampling remains unaltered, the technique known as 'zero padding' increases the resolution of the FFT and so may be able to provide better discrimination of such wide spectral peaks. If beneficial, this will be evident by a narrower, sharper peak in the spectrum graph when zero padding is enabled.

Tools for Graph Display

Graph Display Toolbar

 **Fault frequencies** brings up a dialog where a user can choose machine parts from the machine that the user is currently analysing. When one or more machine parts are selected, the frequencies for them are drawn in the graph and these choices are saved for that measurement point. In this way, the user can clearly see which of the machine parts may be causing high readings. The frequencies displayed for the machine parts are automatically calculated based on running speed.

 **Previous fault frequency** moves the active cursor to the previous machine part. **[Ctrl+right arrow key]** also moves the active cursor to the previous machine part.

 **Next Fault frequency** moves the active cursor to the next machine part. **[Ctrl+left arrow key]** also moves the active cursor to the next machine part.

 **DiagX** is an intelligent part of the built-in diagnostic system. To use it, select a frequency in the graph that looks interesting and click **DiagX** button. A dialog will appear listing all the machine parts and the probability that the selected frequency including harmonics belong to a specific machine part. It is an easy way to find out which part of the machine causes a high peak at a specific frequency. DiagX feature also works for sideband and band cursors.

- DiagX calculates by how much the selected frequency, including harmonics, deviates from the expected components due to a specific machine part. So, 0% indicates a good match, high probability.

Single cursor adds a single cursor to the graph. Once a single cursor has been added, switch between cursors by clicking on them which makes cursors active. A single cursor can be moved with the **[left arrow key]** or **[right arrow key]**. **[shift+left arrow key]** or **[shift+right arrow key]** causes a cursor to move in bigger steps.

When viewing a trend/spectra plot, this button will activate a secondary cursor on the trend and display a secondary spectrum plot, shown alongside the first or primary spectrum plot. For further detail, please refer to the section **Combination plots**.

Band cursor adds a band cursor to the graph. It allows, by dragging the handles of the band, to position and resize the band freely. A single band cursor can be moved with **[left arrow key]** or **[right arrow key]. [shift+left arrow key]** or **[shift+right arrow key]** causes a cursor to move in bigger steps.

A band cursor has three handles at the top of the band:

First handle: makes the band cursor bigger or smaller by clicking and dragging.

Third handle: makes the band cursor bigger or smaller by clicking and dragging.

Middle handle: repositions the band by clicking and dragging.

Harmonics produces a harmonic cursor of the currently selected frequency. This cursor can also be moved with **[shift key]** or **[Ctrl key]** in combination with **[left arrow key]** and **[right arrow key]** or by clicking and dragging with the mouse. Harmonic cursors can be between 10 and 200 which can be set in User Preferences in Edit menu item.

Sidebands inserts a side band marker, marking 5 side bands below and 5 above an X marker. There are two modes of a side band marker:

First mode: is the default mode. X is selected. The arrow keys move the sideband marker but keep its size.

Second mode: is set by selecting -1 to -5 or 1 to 5. The arrow keys now resize the side band cursor.

Amplitude peaks cursor displays the highest peaks in the graph. It consists of a horizontal line stretching across the graph. The horizontal line is movable in the vertical axis by clicking and dragging the line. Peaks found above this line are marked with a number.

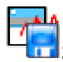
Clear clears the graph of all tools, cursors and other custom markers that have been added.

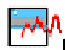
Plot Tools Toolbar

Zoom is available on almost all graphs. It zooms in only once at a time. Once the graph has been zoomed in, the graph is no longer in the zoom mode. Zoom mode must be re-instated by clicking the zoom icon each time. Click and drag the mouse to the desired area. It is also possible to scroll the zoomed graph by pressing **[shift key]**, then click and drag.

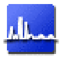
 **Zoom out** brings a graph back to its original size.

**Delete** deletes a measurement from the database. Spectra, time waveform and phase are considered as a single measurement, which means that deleting a spectrum will also delete the corresponding time waveform and phase data, if there are any.

**Save** saves the current live measurement from the graph to the database. The measurement will be marked with the storage reason *manual* because it was manually saved and not by the time-based schedule.

**Live** reads data immediately from the measurement point(s) and displays the data in the graph. To get live data, a connection to the @ptitude Observer Monitor computer must be established. @ptitude Observer sends a request to @ptitude Observer Monitor which redirects the request to the correct IMx/MasCon device which then collects the data and sends it back through the reverse path. The update rate is determined by the setup and time involved in capturing the actual data.

Spectra


Spectra display shows the vibration amplitude as a function of frequency using a linear or logarithmic amplitude scale. For three of the main vibration measurement types (A, V and D but not gE), the subsequent analysis can be displayed in terms of either Acceleration (m/s^2 or g), Velocity (mm/s or ips) or Displacement (um or mils). All defect frequencies for the whole machine are automatically calculated and can be easily displayed in a plot as vertical bars.

Harmonics of defect frequencies or any other frequency can be displayed by an automatic fitting function. The spectra can be zoomed easily to any frequency range inside the original spectra. Auto scaling or fixed scales can be applied, and the frequency scale can be either Hz, cpm or order.

In addition, spectra display supports the zero padding which can be used to more easily identify specific peaks in the FFT. With a simple right-click, it is possible to set the data currently displayed in this graph as reference data for the future.

Below, Figure 5 – 13, is an example of a spectra display with overlay data.

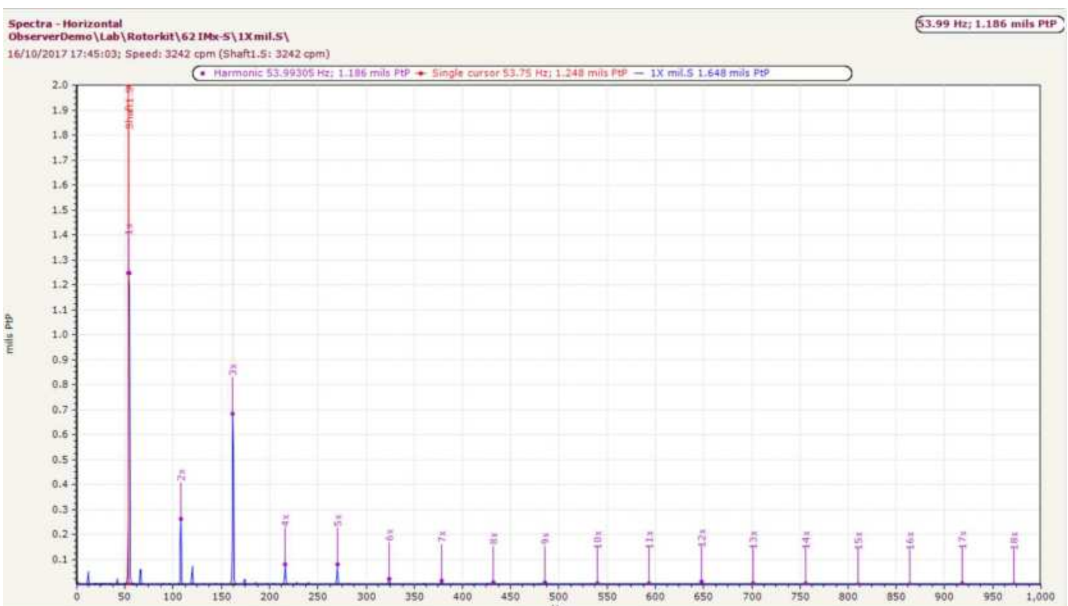


Figure 5 - 13
Example of Spectra Display

Full Spectrum

The Full Spectrum is used to display a graph of spectrum data collected from two, orthogonally mounted sensors in a dual channel point.

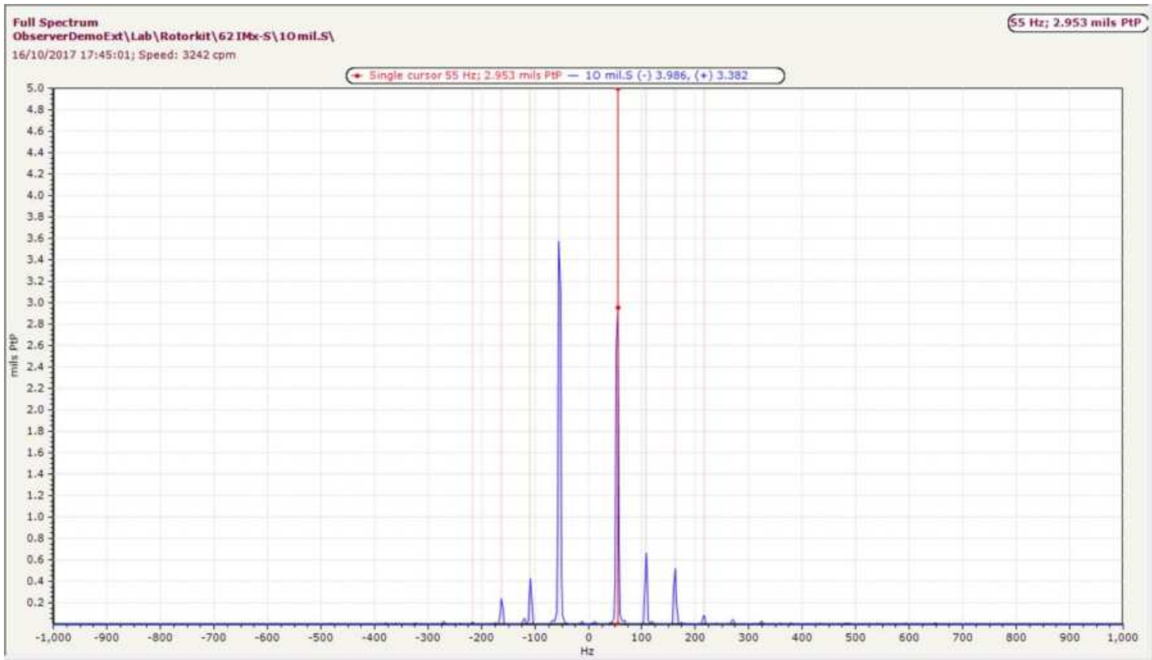


Figure 5 - 14
Example of Full Spectrum Plot

Initial Plot description

The horizontal axis represents frequency (in Hz, CPM or Orders). A frequency of zero is central in the plot. Negative values extend to the left and positive to the right. The first four orders of running speed are marked in both the positive and negative directions with light red vertical lines. A single cursor is displayed on the highest amplitude in the positive direction. Scaling is set to automatic.

Displaying Full Spectrum plot

The **Full Spectrum** is not the default diagram for spectral data. By default, the Spectrum is the default, which is displayed by first selecting a point that collects time-waveform data (either Dynamic or Harmonic), then selecting the **Spectra** menu button or right-clicking the point and selecting **Diagram/Spectra**.

If the user enters the **Edit/User Preferences** menu and selects the *Full Spectrum = True* option, clicking on the **Spectra** menu button or right-clicking the point and selecting **Diagram/Spectra** will launch the Full Spectrum assuming the following criteria are met:

- The point has 2 channels
- Time waveform data has been collected.

If these criteria are not met, the normal Spectrum is displayed.

The user may also launch the Full Spectrum from the Spectrum display by right-clicking the plot and selecting Full Spectrum. Likewise, the user may launch the Spectrum display from the Full Spectrum.

Option Menu

The Option Menu is displayed when the user right-clicks on the Full Spectrum. Most options supported by the Spectrum are also supported for the Full Spectrum plot.

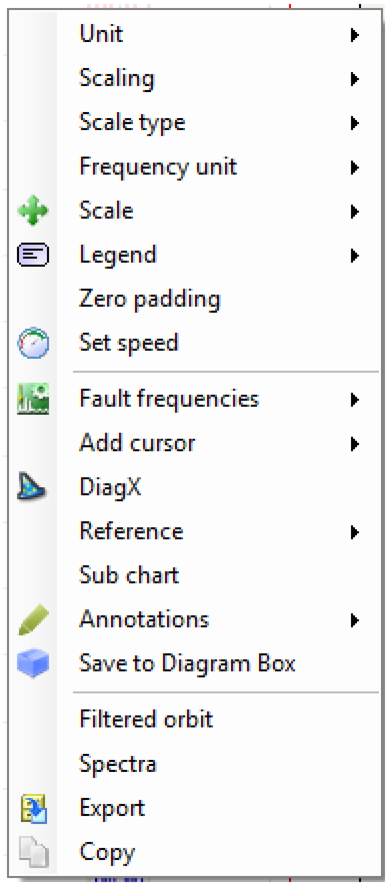


Figure 5 - 15
Example of Full Spectrum Option Menu

In addition to the Full Spectrum amplitude plot the following ‘Full Spectrum plot versions’ are also available: Full Spectrum Phase, Full Spectrum History, Full Spectrum 3D Plot and the Full Spectrum Topology Graph.

All comments above apply similarly to these plots.

Time Waveform

Time waveform display shows the vibration signal against time. Just as with a spectra, for three of the main vibration measurement types (A, V and D but not gE), the subsequent analysis can be displayed in terms of either Acceleration (m/s^2 or g), Velocity (mm/s or ips) or Displacement (µm or mils). If the measurement on display is triggered using a digital input, the tacho pulses are shown automatically making it easier to track each revolution.

The time waveform can be easily zoomed, and the scaling can be done automatically or manually.

By a simple right-click on the mouse, the user can listen to the time waveform using the computer speakers and can detect, by listening to the sound of the machine, abnormal sounds. Listen function of time waveform is opened in an external window. Here, speed and length of the time waveform can be modified while listening.

Figure 5 - 16 below, is an example of a time waveform display with tacho pulse markers, single and band cursors.

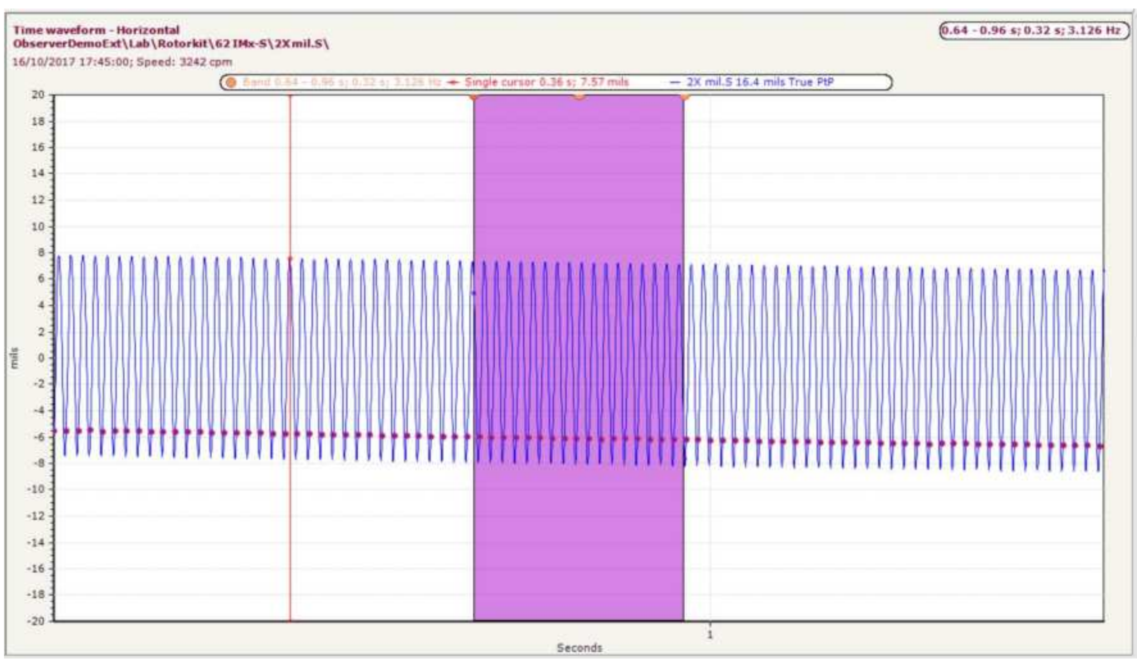


Figure 5 - 16
Example of Time Waveform Display

Phase

Phase spectrum shows the phase with respect to the frequency. Combined with the amplitude spectrum, it is easy to get the phase lag for any peak in the vibration spectrum. If multiple points are measured synchronously, it is possible to determine the phase relationship of any peak between two different points, especially if data from different measurement points are overlaid.

As in time waveform display and in spectrum display, the unit can be recalculated on the fly between acceleration, velocity and displacement and can show relative to the frequency in Hz, cpm or order.

The phase can be easily zoomed, and the scaling ranges can be between -180 and 180 degrees.

Figure 5 - 17 below, is an example of a phase display.

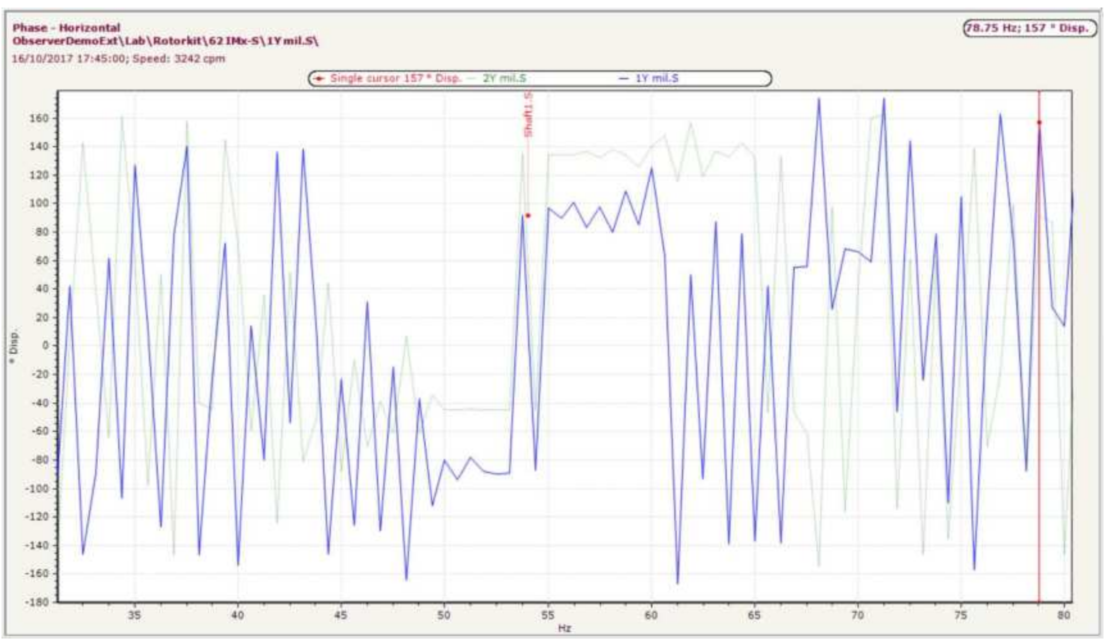


Figure 5 - 17
Example of Phase Display – two adjacent measurement points overlaid

Full Spectrum Phase

The Full Spectrum Phase is used to display a graph of spectrum data collected from two, orthogonally mounted sensors in a dual channel point.

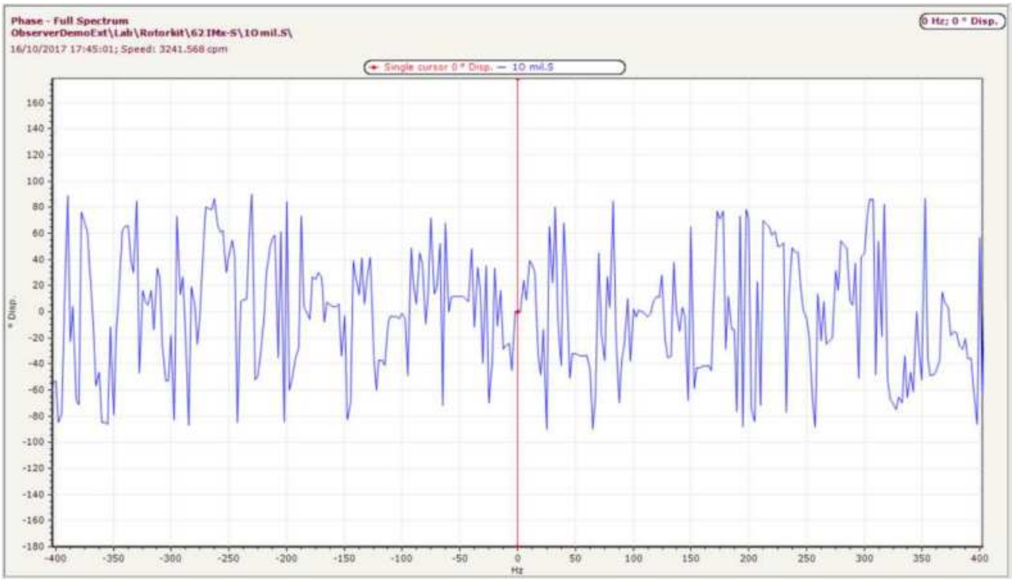


Figure 5 - 18
Example of Full Spectrum Phase Plot

For more information on enabling and using Full spectrum data, refer Full Spectrum.

Option Menu

The Option Menu is displayed when the user right-clicks on the Full Spectrum Phase plot. All relevant options supported by the Phase plot are also supported for the Full Spectrum Phase.

- Note that as indicated below, the right click options for phase plots do not support switching directly between 'normal' and full spectrum' versions, but the user preference setting can still be used.

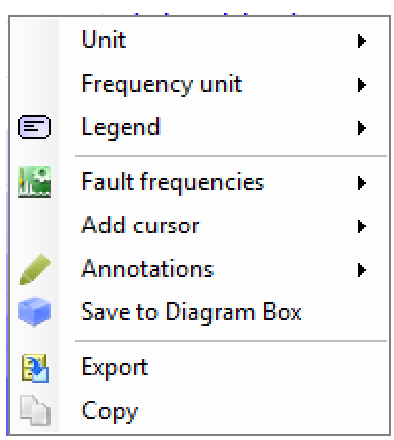


Figure 5 - 19
Example of Full Spectrum Phase Option Menu

History

 History display is used to visualize the variation in machine condition over time in order to identify impending machine faults. History display supports amplitude spectrum, phase spectrum, time waveform and some combinations of those. By mouse right-click, it is easy to change the type of data or mode parameter to be displayed. If the single cursor is moved to one of the graphs by the user, all other graphs with the same data type will also be updated to that position making it easier to follow specific frequencies over time. The type of data selected to be displayed with the mode parameter is remembered for this measurement point the next time the history display is opened.

Zooming in one graph also triggers a zoom in the other graphs with the same data type.

Double clicking on one graph opens the plot in full size screen mode.

Figure 5 - 20 below, is an example of a history display.

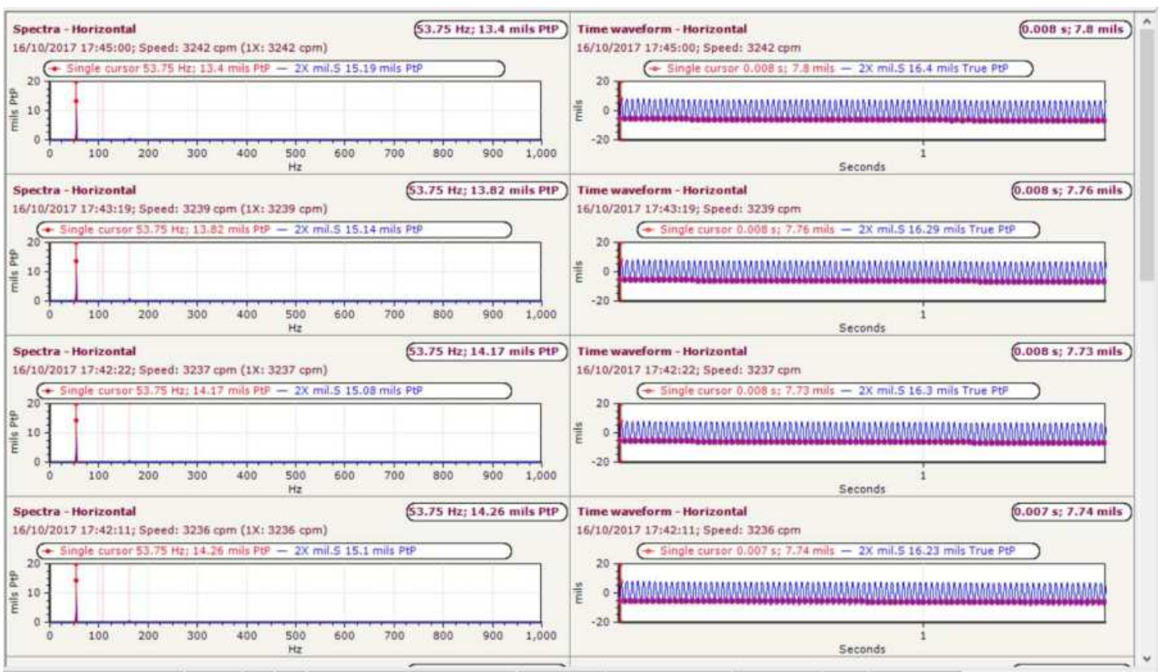


Figure 5 - 20
Example of History display

Full Spectrum History

The Full Spectrum History provides a history of Full Spectrum plots. A Full Spectrum plot is used to display a graph of spectrum data collected from two, orthogonally mounted sensors in a dual channel point.

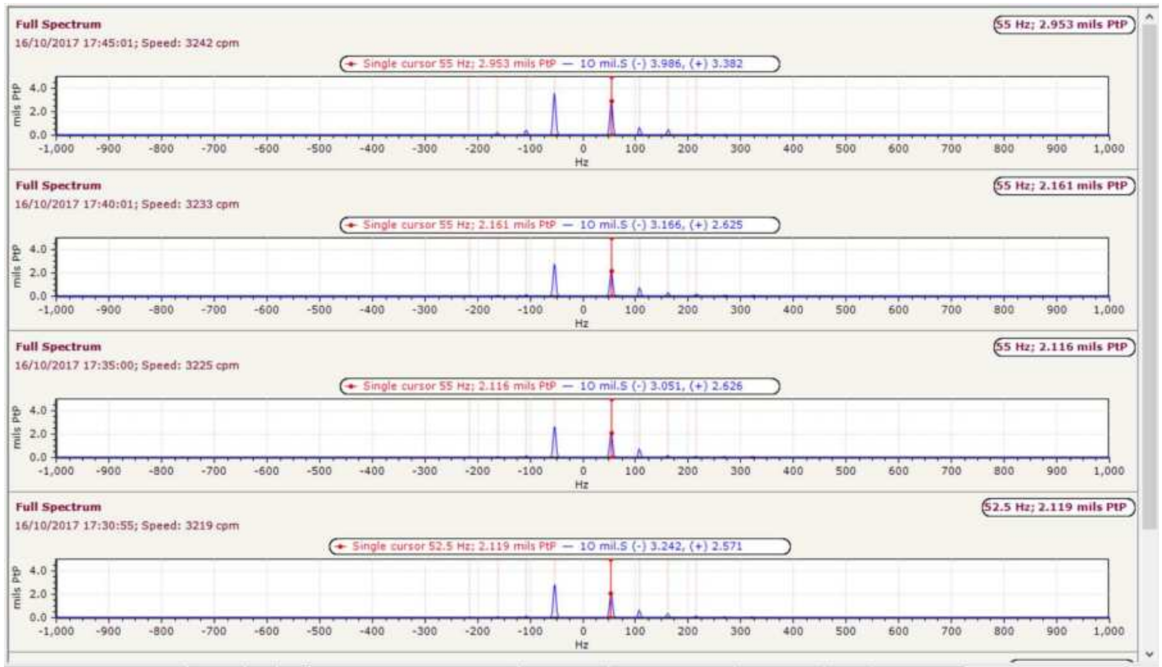


Figure 5 - 21
Example of Full Spectrum History Plot

For more information on enabling and using Full spectrum data, refer Full Spectrum.

Option Menu

The Option Menu is displayed when the user right-clicks on the Full Spectrum History plot. Most options supported by the Spectrum plot are also supported for the Full Spectrum History.

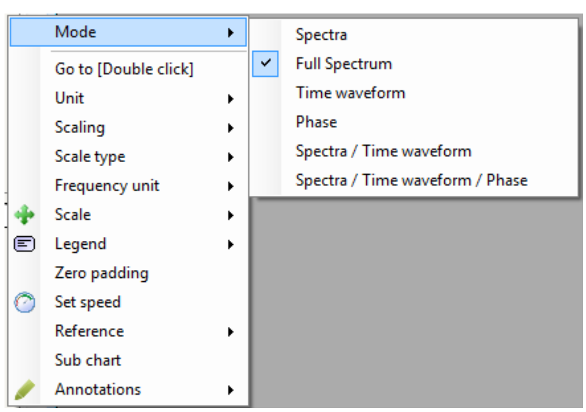


Figure 5 - 22
Example of Full Spectrum History Option Menu

3D Plot

 Use this icon to generate a 3D/waterfall display of a selected measurement point or multiple selected points when available. As in time waveform and spectrum displays, the amplitude axis can be recalculated between acceleration, velocity and displacement. 3D plots also have a z- or depth-axis, where the depth is date/time, speed, power or any other DC parameter.

They are commonly used during run-up and coast-down but can also be used for other types of data. A 3D plot can be freely rotated and elevated by the user to improve visibility and the user can select to display a 3D plot as transparent or filled by the user preferences settings. An option “even spreading” that displays the FFT data evenly spaced on the z-axis, is also available.

Figure 5 – 23 below, is an example of a 3D plot of spectral data, against time/date.

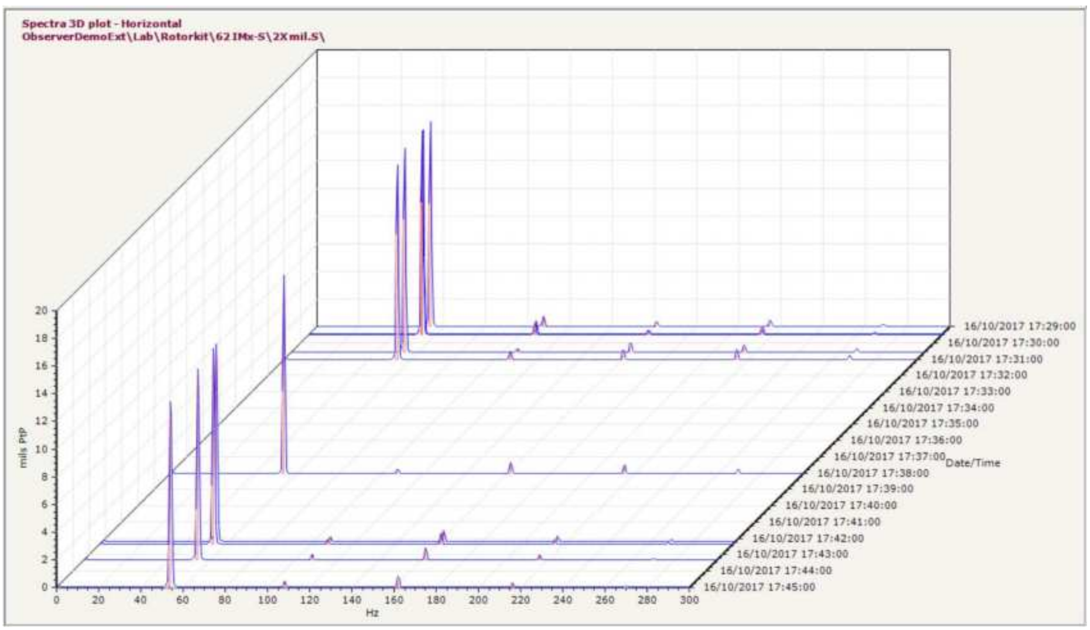


Figure 5 - 23
Example of a 3D Plot Display

Full Spectrum 3D Plot

The Full Spectrum 3D Plot is used to display a graph of spectrum data collected from two, orthogonally mounted sensors in a dual channel point.

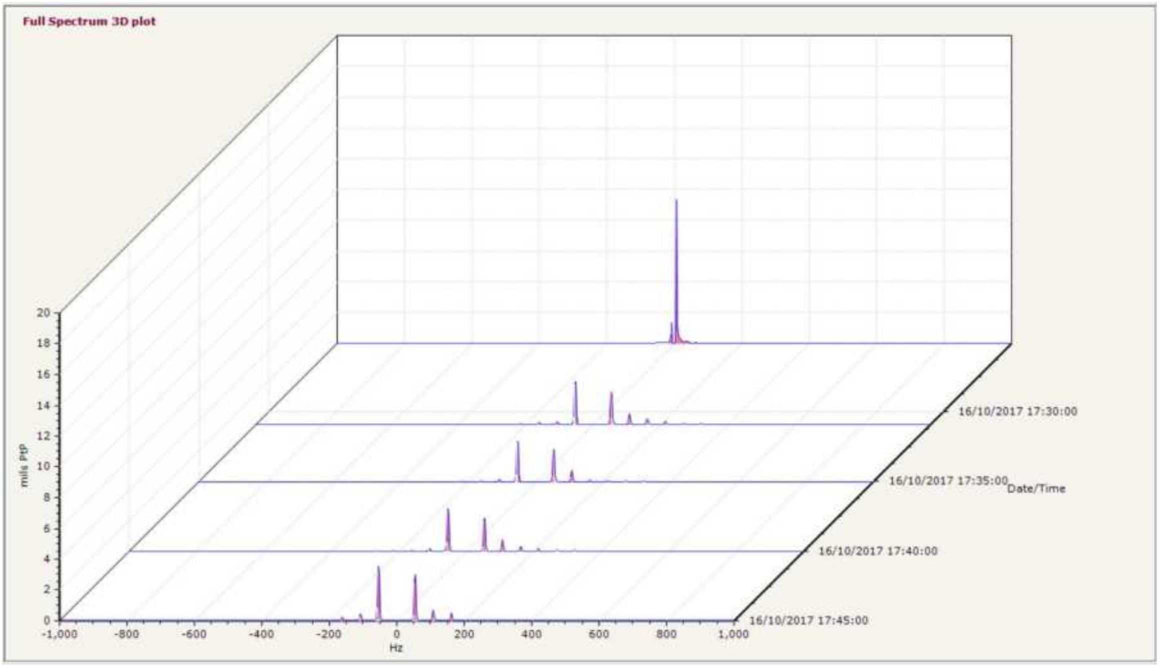


Figure 5 - 24
Example of a Full Spectrum 3D Plot

For more information on enabling and using Full spectrum data, refer Full Spectrum.

Option Menu

The Option Menu is displayed when the user right-clicks on the Full Spectrum plot. All relevant options supported by the Spectrum 3D plot are also supported for the Full Spectrum version.

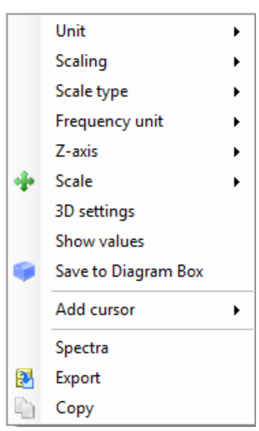


Figure 5 - 25
Example of Full Spectrum 3D Plot Option Menu

Topology

Topology shows the frequency versus the time or speed with the amplitude colour coded. This is a useful display to study transient data like run-ups or coast-downs. A topology plot is like a 3D plot, but the user is looking at the data from above. With the colour encoding, it is easier for the eye to identify patterns in the data.

As in other displays, the data can be recalculated on the fly to display data in acceleration, velocity or displacement terms and the y-axis can represent data from a different time/date, speed or process value.

Just like the z-axis of a 3D plot, even spacing of data on the y-axis is also possible.

Figure 5 - 26 below, is an example of a topology display.

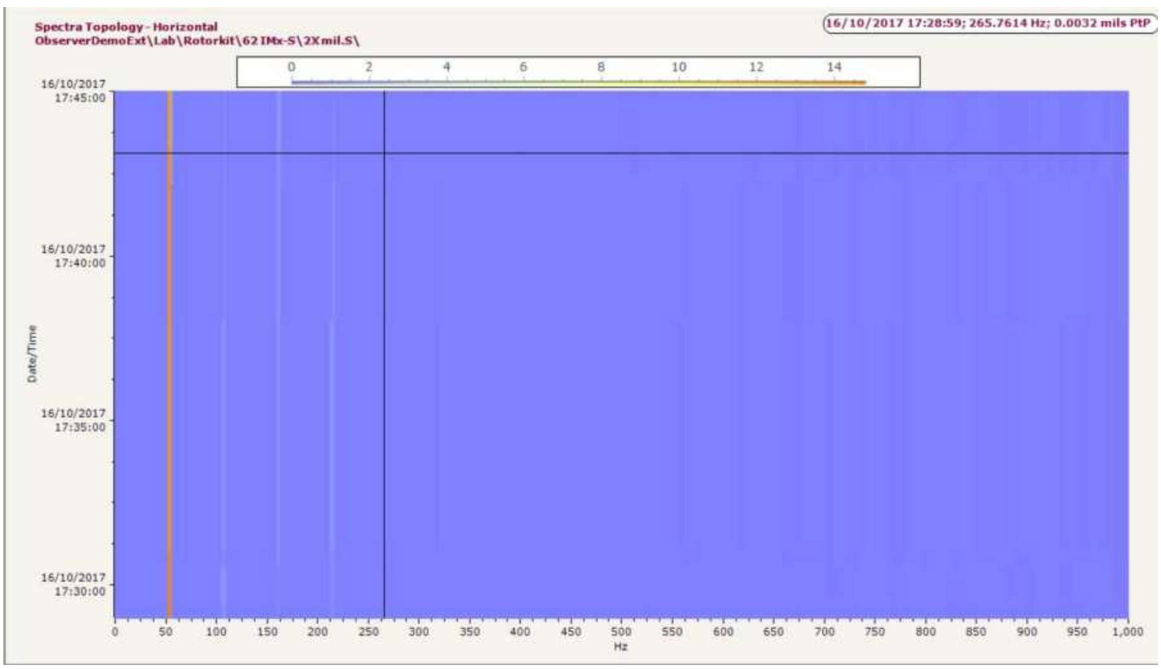


Figure 5 - 26
Example of a Topology Display

Full Spectrum Topology Graph

The Full Spectrum Topology graph is used to display a graph of spectrum data collected from two, orthogonally mounted sensors in a dual channel point.

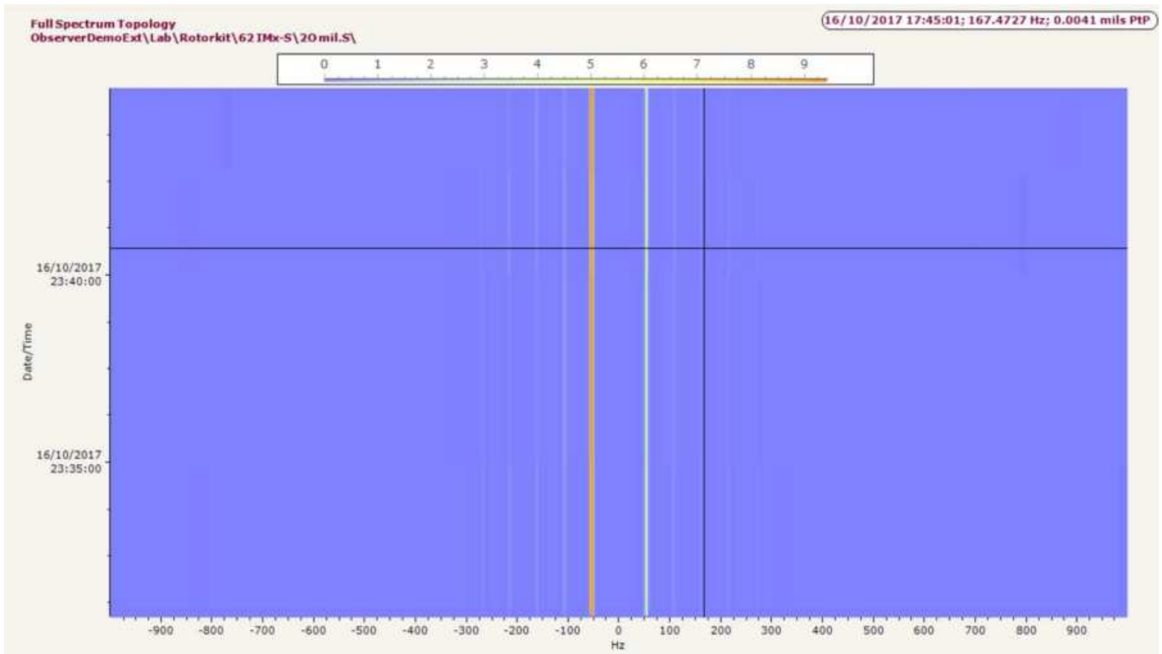


Figure 5 - 27
Example of a Full Spectrum Topology Graph

For more information on enabling and using Full spectrum data, refer Full Spectrum.

The Option Menu is displayed when the user right-clicks on the Full Spectrum plot. All relevant options supported by the Spectrum Topology graph are also supported for the Full Spectrum version.

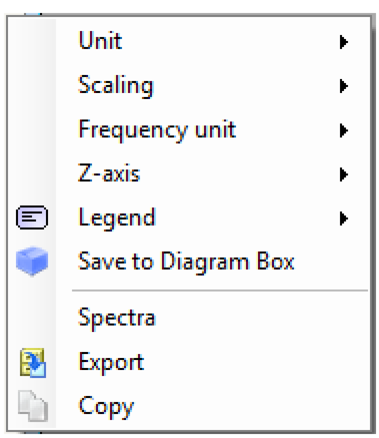


Figure 5 - 28
Example of Full Spectrum Topology Graph Option Menu

Orbit

An orbit display is one of the best ways to visualise machine movement by combining time waveform signals from two sensors and plotting them as an X and a Y. Whether it includes DC as well as AC, vibration, information depends on point acquisition and @ptitude Observer (Option Menu) settings, but typically it is used to investigate AC, vibration phenomena.

The two channels should have the same acquisition settings and be measured simultaneously and/or measured with a trigger pulse. For best results it is important that the sensors are mounted at the same location but orientated close to 90 degrees apart. For multi axis sensors this is automatically the case but when using separate sensors appropriate mounting locations must be selected.

If trigger pulse information is available, this is represented by small circles in the time waveform displays. The figure below is an example of a filtered orbit with trigger pulses shown, with the orbit display presenting the data selected by the time waveform band cursor.

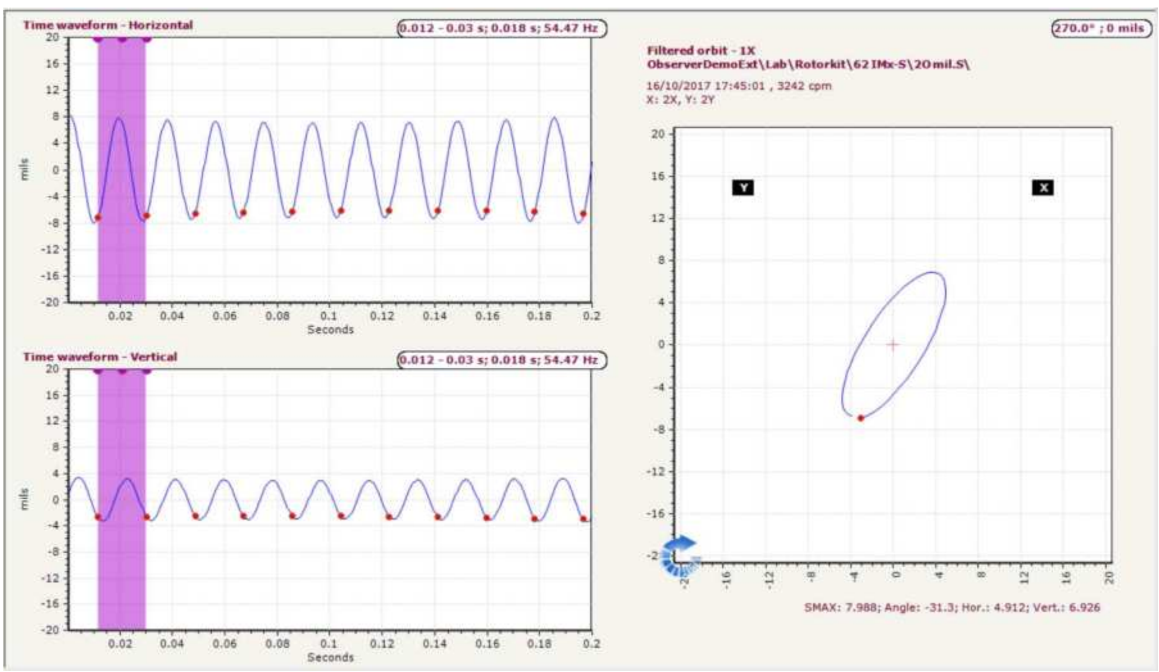


Figure 5 - 29
Example of an Orbit Display

Profile

 Profile is a powerful tool which uses triggered acceleration time signal data to represent the roundness of any circular object. Examples of components that can be analysed using this feature are paper machine rollers and train wheels. The profile display can use displacement, acceleration, velocity or envelope as the measuring unit but displays an acceleration time signal representing the smoothness of the round object. To get an accurate profile, it is necessary to make sure that the time signal contains at least 20 samples per revolution, over at least the minimum number of revolutions. Note though, for a good representation, it is recommended that there are at least 180 samples per revolution.

Figure 5 - 30 below, is an example of a profile graphic display with the data from two shafts, overlaid.

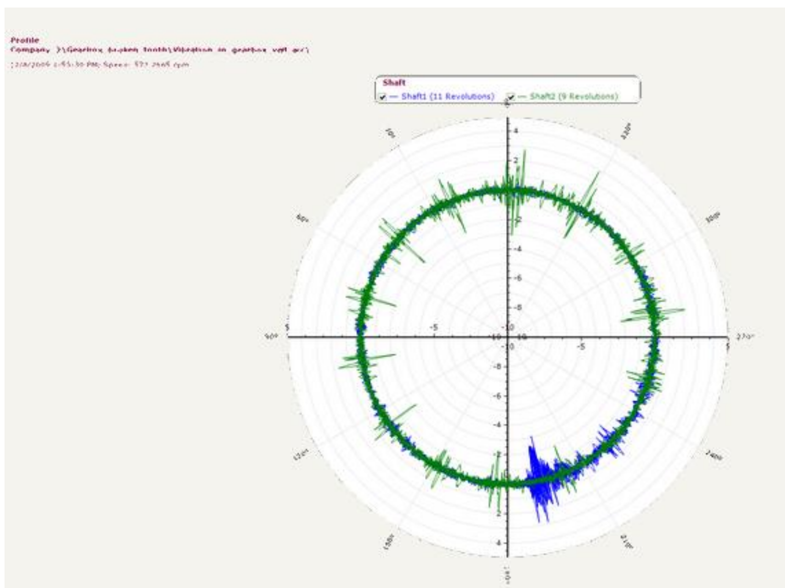


Figure 5 - 30
Example of a Profile Display

Gear Inspector

 Gear inspector is both a graphical display and an intuitive data gathering technique that helps detecting and visualizing the impact energy as a function of shaft/gear revolutions. It harnesses the best possible method of detecting this energy by using all channels in simultaneous data gathering mode. One graph for each shaft is plotted in a single view using the treated simultaneously gathered data. Impact energy is visualized by using a colour palette. Plots are auto-scaled and speed deviations are compensated automatically. Sensing channels can be freely configured using the measurement groups and sub machine setup.

This is useful in analysing gearbox problems in constantly varying speed and load applications as well as steady state applications. It is effective in detecting broken or damaged gear teeth, loose or worn gears, shaft problems, oval gears and other cyclic related problems.

Figure 5 - 31 below, is an example of a gear inspector display.

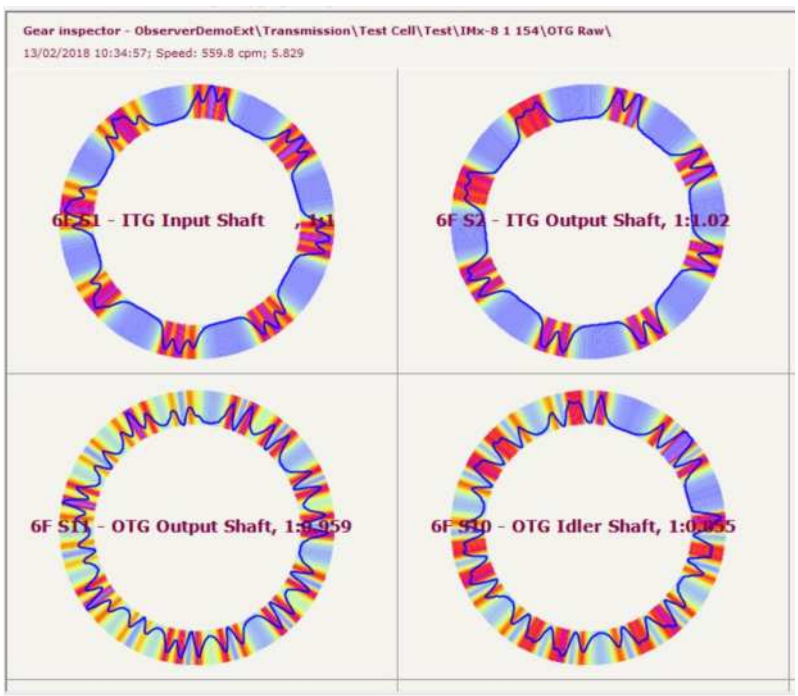


Figure 5 - 31
Example of a Gear Inspector Display

Trend

Trend shows data such as vibration amplitude/phase or process data as a function of time, speed or other process data. It is also possible to show the data evenly spaced by simply selecting *x-axis* and *values* which will cause the graph to display the data in the order that the values were taken. This x-axis setting is preferred when viewing live data. Not only can the graph display data as a function of speed and process data, but it can also overlay bias, process, phase, speed and digital data on extra axes.

In the legend area as well as choosing the data sources to display, spectra and notes flags can be enabled. By clicking these flags with the mouse, the user can quickly display the corresponding spectra data and note information.

When trending measurements from a Multiple Gating Point, the legend shows the name of the operating class active at the time of the measurement.

When trending measurements linked to a capture group with stored captures, clicking the capture indicator will open a window for further analysis. The window displays the available captures for the point. The list view selection shows the capture that was selected on the trend plot and a thumbnail display showing the same.

During run-up/down a reference measurement can be shown in the same display with actual values or a value calculated as a percentage of the alert level.

Below, Figure 5 – 32, is an example of a trend display with notes, spectra flags enabled.

Figure 5 - 32
Example of a Trend Display

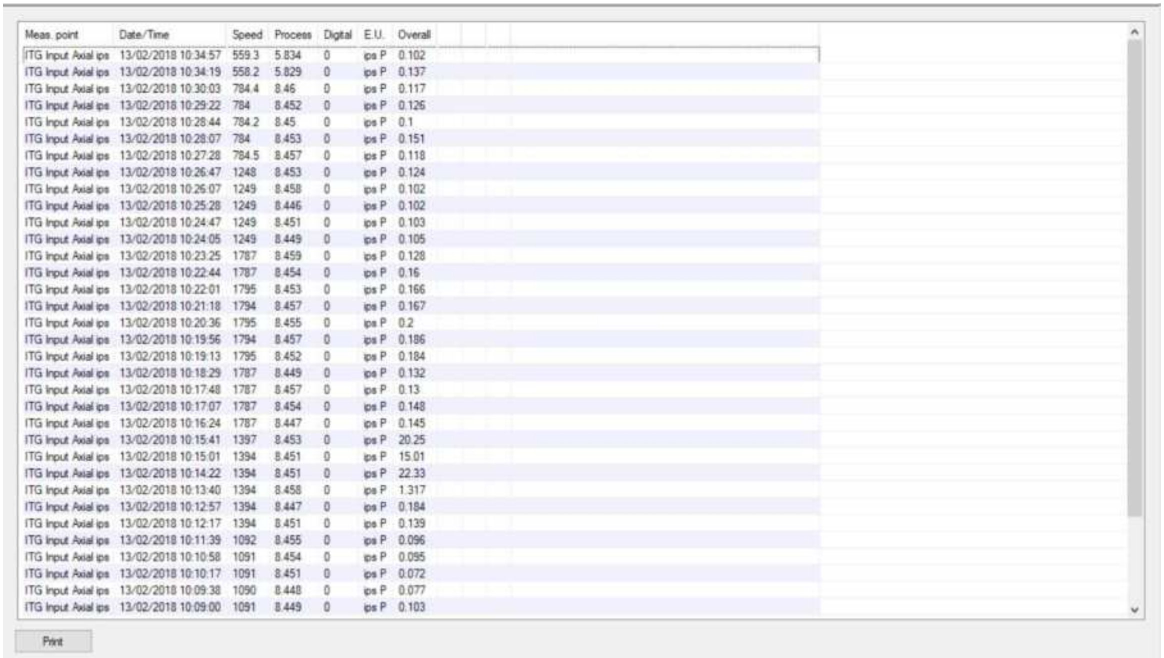
Bode

Bode plots usually show vibration amplitude/phase as a function of speed. A Bode plot is identical to that of trend display with the x-axis set to speed and with phase always visible. See also Trend diagram.

Trend List

Trend list shows the trend data values in a tabular format. The data can be sorted by clicking on any column header. The data can also be printed as a report.

When listing measurements from a Multiple Gating Point, the **Overall** column shows the name of the operating class active at the time of the measurement.



Meas. point	Date/Time	Speed	Process	Digital	E.U.	Overall
ITG Input Axial ips	13/02/2018 10:34:57	559.3	5.834	0	ips P	0.102
ITG Input Axial ips	13/02/2018 10:34:19	558.2	5.829	0	ips P	0.137
ITG Input Axial ips	13/02/2018 10:30:03	784.4	8.46	0	ips P	0.117
ITG Input Axial ips	13/02/2018 10:29:22	784	8.452	0	ips P	0.126
ITG Input Axial ips	13/02/2018 10:28:44	784.2	8.45	0	ips P	0.1
ITG Input Axial ips	13/02/2018 10:28:07	784	8.453	0	ips P	0.151
ITG Input Axial ips	13/02/2018 10:27:28	784.5	8.457	0	ips P	0.118
ITG Input Axial ips	13/02/2018 10:26:47	1248	8.453	0	ips P	0.124
ITG Input Axial ips	13/02/2018 10:26:07	1249	8.458	0	ips P	0.102
ITG Input Axial ips	13/02/2018 10:25:28	1249	8.446	0	ips P	0.102
ITG Input Axial ips	13/02/2018 10:24:47	1249	8.451	0	ips P	0.103
ITG Input Axial ips	13/02/2018 10:24:05	1249	8.449	0	ips P	0.105
ITG Input Axial ips	13/02/2018 10:23:25	1787	8.459	0	ips P	0.128
ITG Input Axial ips	13/02/2018 10:22:44	1787	8.454	0	ips P	0.16
ITG Input Axial ips	13/02/2018 10:22:01	1795	8.453	0	ips P	0.166
ITG Input Axial ips	13/02/2018 10:21:18	1794	8.457	0	ips P	0.167
ITG Input Axial ips	13/02/2018 10:20:36	1795	8.455	0	ips P	0.2
ITG Input Axial ips	13/02/2018 10:19:56	1794	8.457	0	ips P	0.186
ITG Input Axial ips	13/02/2018 10:19:13	1795	8.452	0	ips P	0.184
ITG Input Axial ips	13/02/2018 10:18:29	1787	8.449	0	ips P	0.132
ITG Input Axial ips	13/02/2018 10:17:48	1787	8.457	0	ips P	0.13
ITG Input Axial ips	13/02/2018 10:17:07	1787	8.454	0	ips P	0.148
ITG Input Axial ips	13/02/2018 10:16:24	1787	8.447	0	ips P	0.145
ITG Input Axial ips	13/02/2018 10:15:41	1397	8.453	0	ips P	20.25
ITG Input Axial ips	13/02/2018 10:15:01	1394	8.451	0	ips P	15.01
ITG Input Axial ips	13/02/2018 10:14:22	1394	8.451	0	ips P	22.33
ITG Input Axial ips	13/02/2018 10:13:40	1394	8.458	0	ips P	1.317
ITG Input Axial ips	13/02/2018 10:12:57	1394	8.447	0	ips P	0.184
ITG Input Axial ips	13/02/2018 10:12:17	1394	8.451	0	ips P	0.139
ITG Input Axial ips	13/02/2018 10:11:39	1092	8.455	0	ips P	0.096
ITG Input Axial ips	13/02/2018 10:10:58	1091	8.454	0	ips P	0.095
ITG Input Axial ips	13/02/2018 10:10:17	1091	8.451	0	ips P	0.072
ITG Input Axial ips	13/02/2018 10:09:38	1090	8.448	0	ips P	0.077
ITG Input Axial ips	13/02/2018 10:09:00	1091	8.449	0	ips P	0.103

Print

Figure 5 - 33
Example of Trend List Display

Multi trend

Multi trend offers extended functionality to the normal trend plot as it is possible to fully overlay data with different measurement units making it easier to compare and distinguish common or differing behaviours. This display consists of two parts; one trend display and the other a bar display:

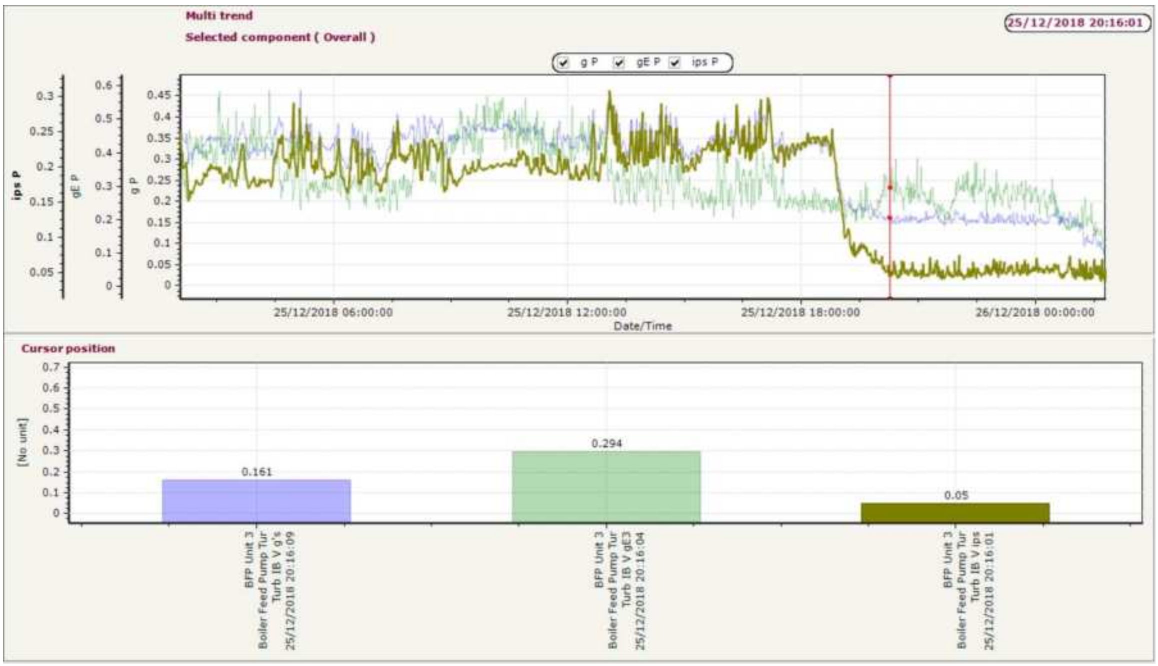


Figure 5 - 34
Example of Multi Trend Display

The trend display shows historical data in measurement units or in percent of warning level. The bar graph shows the current cursor value in the trend graph where it is easier to compare values against each other for the data selected.

The multi trend can have one active measurement point at a time. The trend graph line for the active measurement point is thicker, has no transparency and the units text for the Y-scale that the active measurement point uses will be made bold. To switch active measurement point, use the TAB and the SHIFT+TAB keys. Once a measurement point is selected, it can be navigated with the arrow keys just like in the normal trend plot.

Alternatively, clicking the cursor on any bar in the lower view similarly causes the associated trend in the upper view to become selected and any previously selected trend will then become deselected.

The legend here differs from the legend in other graphs because it is grouped by different types of measurement units available in all the measurements that are displayed and unchecking any of the units will hide all the measurement points that use this specific measurement unit.

When multi-trending a group of measurements that includes one or more measurements from a Multiple Gating Point, the legend and the bar graph labels show the name of the operating class active for each applicable Multiple Gating Point at the time of the measurement.

Component Selection on a Multi Trend Plot

When viewing a multi trend plot, another measurement component can be chosen to be the active measurement instead of the *Overall* value. Dynamic points can have up to four extra measurement components.

- If a point doesn't have additional components, the *Overall* value is used.

To select another component:

- Right-click on the plot to open the context menu.

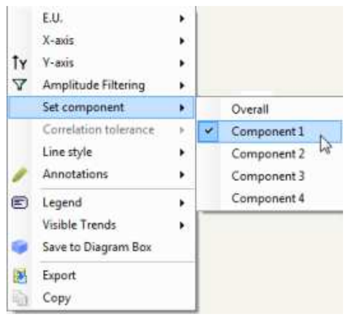


Figure 5 - 35
Context Menu with Set Component Options

- Click **Set component** and then select the desired component from the available measurement components shown in the graph. The component selected is indicated with a check mark.

The selected component (whether Overall or not) is always mentioned in the plot sub-header:

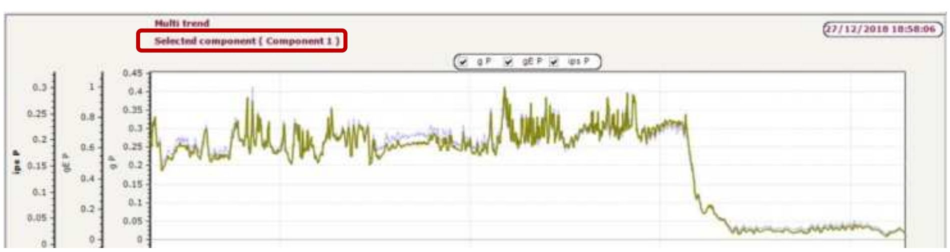


Figure 5 - 36
Selected Component in Sub-header

Visible Trends on a Multi Trend Plot

Whilst as described previously, unchecking a measurement unit will hide all associated measurement points in both plots, use instead **Visible Trends** to only hide traces in the upper display area.

Right-click the multi-trend plot to open the context menu and select **Visible Trends**.

- Note that the options offered in the **Visible Trends** sub-menu are filtered by the checkboxes selected in the legend. For example, if *g P* were unchecked in the legend, then associated measurements would have been removed from the **Visible Trends** options.

In the figure below, all three trends are enabled in the legend, but **Visible Trends** has been used to clear the '*Turb IB gE3*' trace from the trend display:

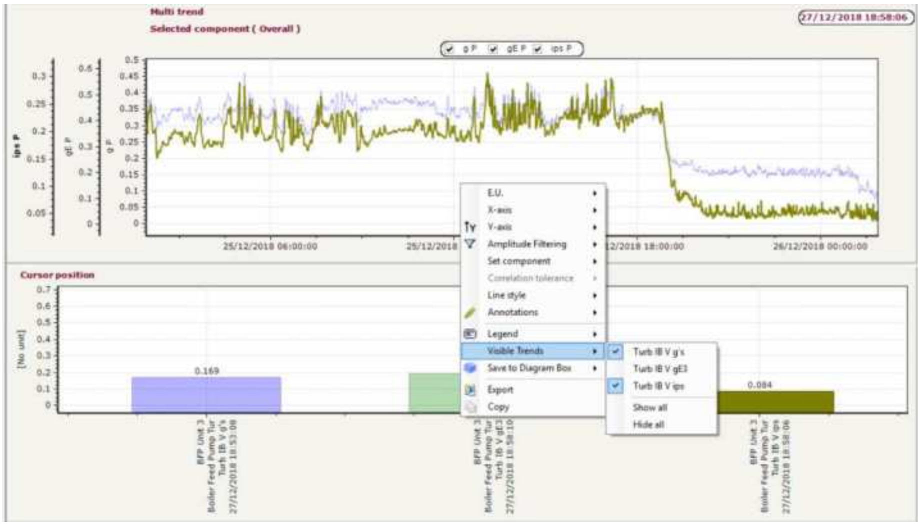


Figure 5 - 37
Example of Multi Trend Display, Visible Trends Options

- The **Visible Trends** sub-menu will list all measurement points enabled by the legend's, units tick boxes. All sub-menu items are selected by default, making them visible.
- Untick a specific visible point to hide it from the trend view. Deselecting an item causes the named trend to be hidden and the associated cursor position bar to be unselectable even though still visible. Assuming the trend just hidden is the selected trend, then the next available (and visible) trend will be selected instead.
  - ➢ Although the individual trends are hidden, the (red spot) cursor positions remain unchanged.
  - ➢ Check the item again to reverse the process described above.
- Select the submenu item **Show all** to cause all unchecked submenu items to be checked and all hidden trends to become visible.
- Select the submenu item **Hide all** to cause all checked submenu items to be unchecked and all visible trends to become hidden.

Amplitude Filtering on a Multi Trend Plot

Amplitude Filtering enables values from a measurement point in the multi-trend plot to be filtered, to “fine tune” the display of machine characteristics. When point data is filtered in this way, measurements for the selected point that are outside the filter range are excluded from the trend.

Using the amplitude filter:

- With a multi trend plot open, right-click on the plot to open the context menu.
- Select the **Amplitude Filtering** option.
- Select a point from the list of visible points.
- Define the filter **Range** by entering both the minimum and maximum values.
  - ➢ If the entered range is invalid the green check mark will become a red cross and the values will not be accepted.
- On clicking Enter, the plot is redrawn using the new filter range. The filtered plot is drawn as if the measurements filtered out did not exist, that is, they cannot affect the vertical or horizontal ranges of the plot and do not appear in cursor readouts.
- Repeat as required for the remaining measurement points.

When this menu is brought up again after filtering has been applied to one or more points, the points being filtered are indicated by a blue pencil icon on the menu. The submenu for this point presents the current filter values, which may again be modified.

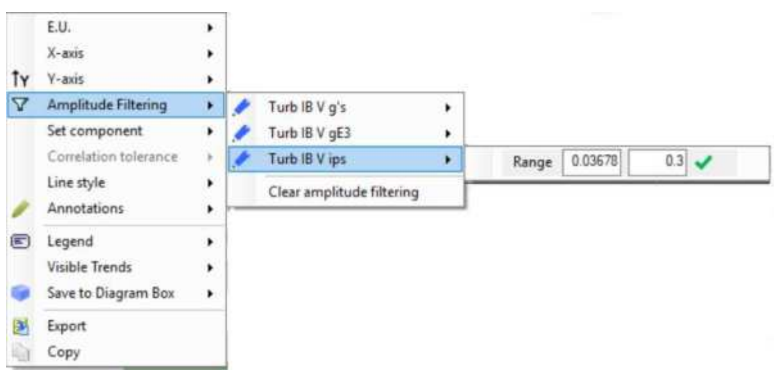


Figure 5 - 38
Amplitude Filtering Applied

Select **Clear amplitude filtering** from the submenu to clear the filtering and redraw the plot.

Correlation on a Multi Trend Plot

The multi trend plot can be used to show the correlation between measurement data from different measurement points:

- From **X-axis** select which of the measurement point to correlate to (plot against)
- Then the **Correlation tolerance** option is active and can be set:

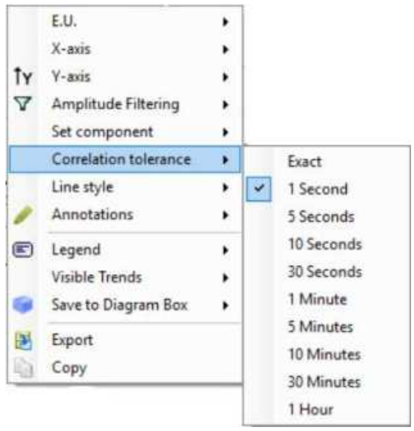


Figure 5 - 39
Correlation Tolerance

In the example shown two shaft centerline measurements are being correlated to speed. The straight line is speed itself (could be hidden if desired using either the **Legend** or **Visible Trends**, controls) with the two position signals showing a broadly linear but diverging response in the higher speed range.

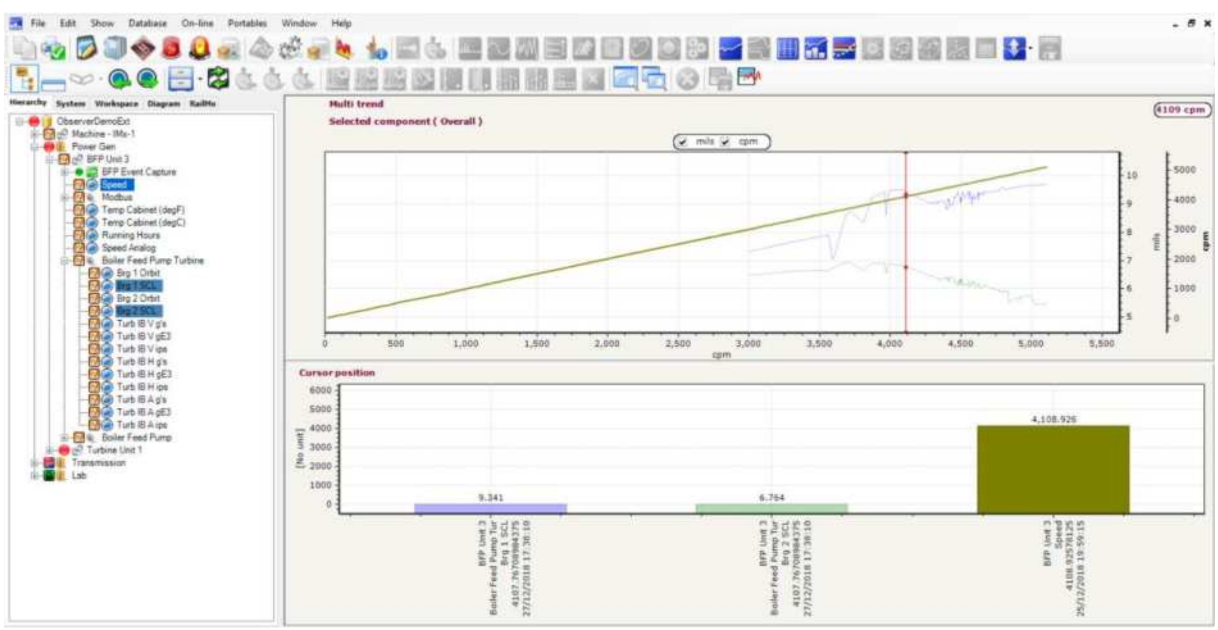


Figure 5 - 40
Multi-trend Correlation

Diagnosis

Machine Diagnosis is a powerful tool to display and follow the progression of machine faults. Sophisticated diagnosis rules can be applied using defect frequencies of the whole machine with baseline values and alarm thresholds set automatically and manually adjusted as required. There are many types of built-in diagnoses available to the user that can detect specific common machine faults like misalignment, cavitation, mechanical looseness, electrical faults and more.

When positioned at a machine or lower level in the hierarchy, this will open the diagnosis display and show all the diagnoses applicable to that machine or sub-machine. Figure 5 - 41 below, is an example of a machine level, diagnosis display. It is from a machine with two diagnoses that both use three measurement points from each of two sub-machines:

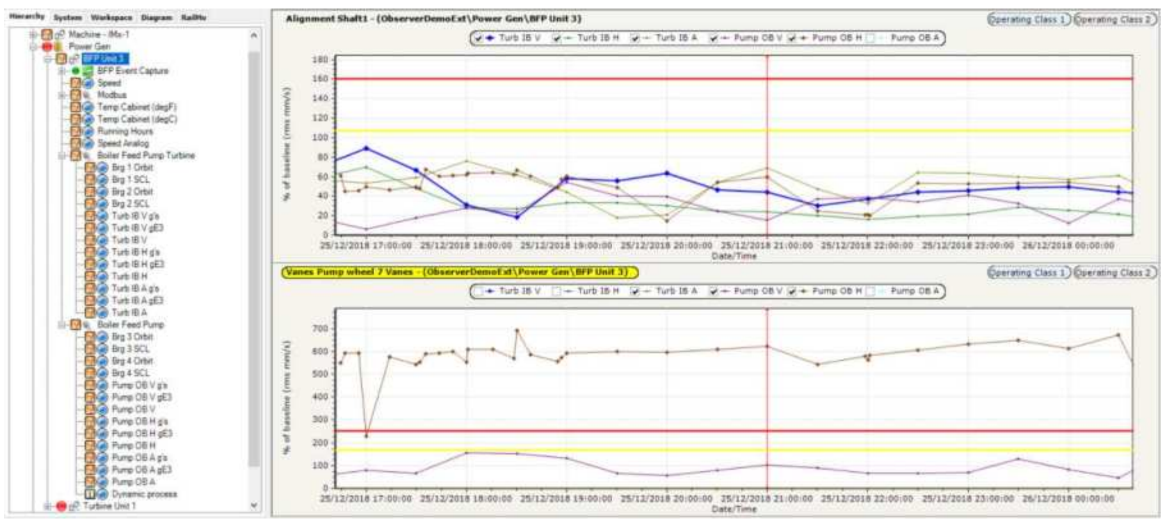


Figure 5 - 41
Example of Diagnosis Display

The two diagnoses attached to the machine are shown, including in each, diagnosis trends for the six points from two sub-machines (turbine part and pump part). Hierarchy linking is automatically enabled for this plot type so, clicking either on one of the three individual measurement points within one sub-machine or on the sub-machine level itself will still show the same two diagnoses but with only the measurement point data relevant to that sub-machine (a sub-set of three measurement points).

Diagnosis diagrams show calculated diagnosis parameter trends over time (as a percentage of a baseline value) and display them along with the alarm levels. These calculated trends are based on spectrum data stored in the database. This means that diagnosis can be attached and recalculated retrospectively, to data stored to the database. The alarm levels can be adjusted by simply ‘dragging and dropping’.

If a point is associated with an MGP as a digital measurement in the Associated measurements area (on the Acquisition tab), the actual running class type is indicated by the background colour in the graph. Note: This occurs only if the x-axis is set to date/time. There is a legend, top right window corner that shows the colour coding.

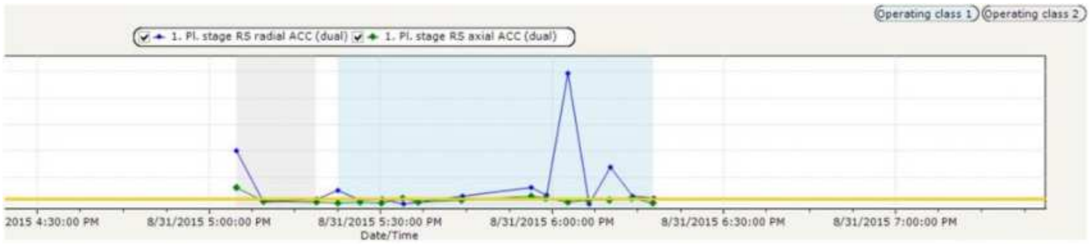


Figure 5 - 42
Example of Diagnosis Display with Operating Class Data shown

The buffer data can be filtered for a specific class by enabling the **Digital** condition and selecting the data class type. Only data for that class will display. When the **Digital** condition is disabled, all data class types are shown in the graph. Refer to **Buffer** in System Operation.

Commonly, in a diagnosis diagram there will be multiple diagnoses trends from the different measurements, displayed overlaid. These can be selectively enabled or disabled by the tick box controls above the trend data display or in the right click menu there are quick options to *Deselect all* or *Select all*.

Also accessed by the right click menu, baseline values can be configured for the different measurement points associated with the diagnosis, either set manually or set from the data:

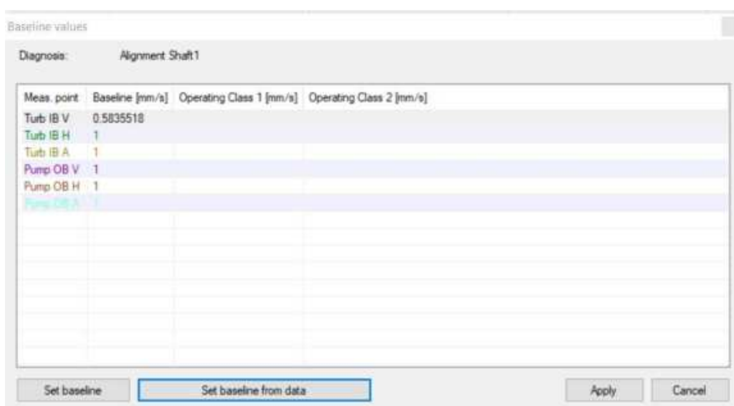


Figure 5 - 43
Example of Baseline Values for Diagnosis Display

If the measurement point has dual class configuration, baselines can be configured for "No operating class", "Operating class 1" and "Operating class 2".

Protean

 Use this icon to open the Protean diagnosis display for the measurement point and display all the attached diagnoses.

The @ptitude Observer Machine Protean diagnosis is a powerful tool to display and follow the progression of machine condition indicators. Protean diagnosis uses parts of the traditional Observer diagnoses and added AI (**A**rtificial **I**ntelligence), machine learning. For the user this means:

- All condition indicators are generated by the AI/machine learning algorithm with no input from the user (formerly called alarms).
- The alarm mechanism is intelligent and can notify the user when the condition of the machine has worsened. When detecting machine incidents with continuing deterioration there will be a, further, second indication if the machine health reaches another much more severe state.
- Condition indicators will also identify positive changes in the machine, like a bearing replacement and then adjust for the new baseline.
- The AI/machine learning for Protean diagnoses has been evaluated and fine-tuned by SKF using data lakes with several years of data from millions of data streams to ensure they are extremely accurate.

The Protean diagnosis diagram shows calculated diagnosis parameters over time relative to the learned alarm level.

There are many types of built-in Protean diagnoses available to the user for detection of specific common machine faults like unbalance, bearing damage and mechanical looseness. These built in Protean diagnoses have been pre-learned using real data, so as to be very accurate. The user need not do any setup to find and identify common machinery problems.

In the diagnosis display, all the different diagnoses attached to a measurement point are shown in the trend-type display and calculated based on spectrum data stored in the database. This means that Protean diagnosis can be attached and recalculated even after the measurements have been stored to the database with the choice of generating alarms.

The figure below is an example of a Protean diagnosis of mechanical looseness.

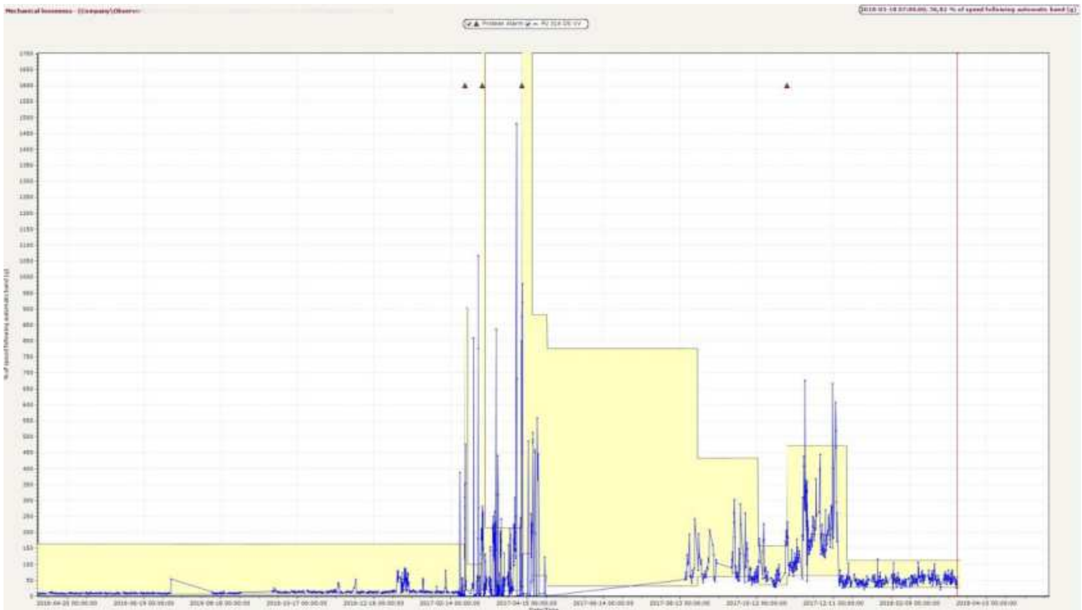


Figure 5 - 44
Example of Protean Diagnosis with self-learnt trigger level

The Protean Diagnosis diagram shows the trend of the condition indicator and overlays as a yellow shaded area an alarm window. The initial alarm window limits are generated automatically from the data after a period of self learning.

When a higher than alarm situation is consistently detected by M out of N logic, a Protean alarm is generated and indicated on the diagram by a red triangle. This also initiates a re-evaluation of the alarm window so that further deterioration can be properly detected.

Reductions in the alarm window are similarly automatic once a sustained reduction in condition indicator level is detected, so that the system can adapt once corrective action has been taken to fix the problem.

For more information refer to Appendix C, **Protean Diagnosis**.

Polar

 A Polar display is a circular format plot where the vibration signal at 1, 2, 3 and 4 times the shaft speed is plotted vectorially, taking account of both amplitude and phase. A polar data presentation can be an effective tool for detecting changes in amplitude and/or phase that is useful in the analysis of both steady state and transient data.

Figure 5 - 45 below, is an example of a polar display:

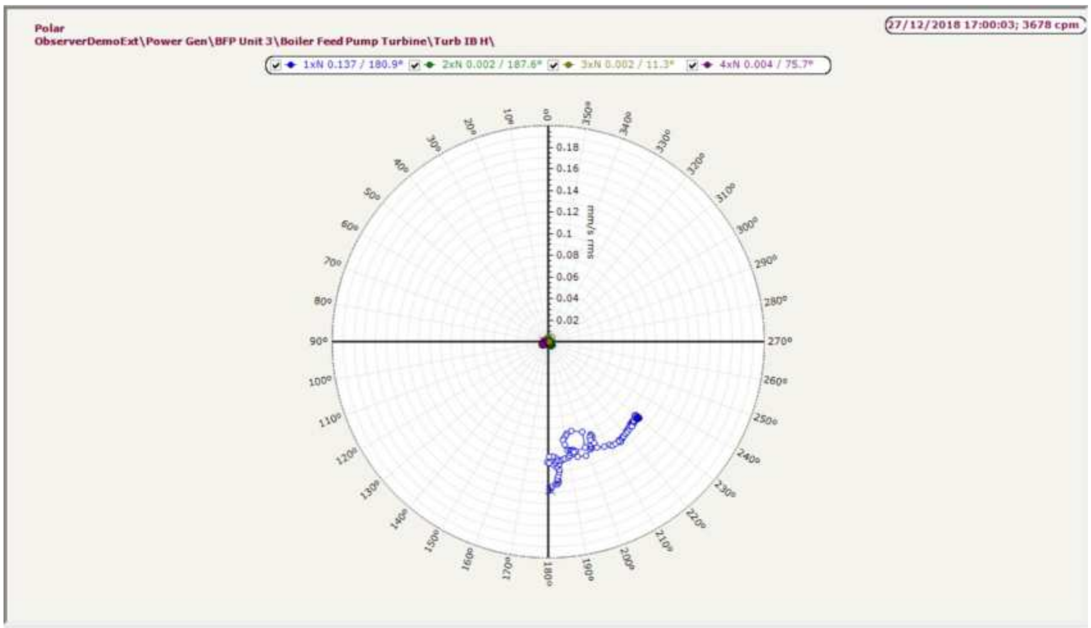


Figure 5 - 45
Example of Polar Display

As similarly for other diagram types, the data plotted (in this case 1xN to 4xN) can be individually enabled or disabled using the tick boxes in the legend area.

Through the right click menu the user can enable **Start/stop markers** or add custom **Markers** to highlight specific readings and if circular alarms have been configured for the measurement point, **Alarm circles** can also be displayed.

Shaft Centerline

 A shaft centerline display plots rotor positional changes within the available bearing clearance. Like an orbit this is based on data from two orthogonally mounted transducers but in this case it is a DC measurement requiring a two channel, shaft centerline measurement point to be configured. This provides trend data representing the average position of the shaft (shaft centerline) over a number of revolutions. When successive measurements are plotted in this display it provides a visual track of the shaft movement. This is particularly useful in monitoring a machine during start-up or its reaction to load changes.

Shaft centerline measurements utilise some specific Acquisition tab settings, the Shaft Properties tab and a procedure for setting the cold gap (cold rotor position) by right-clicking in the hierarchy and selecting the option "Calibrate shaft centerline graph". Note that a shaft centerline display does not show the extent of vibrational shaft movement about its average position.

Shaft centerline can be displayed in a circular or 'squared' plot format, refer User Preferences. The figure below is an example of the circular format.

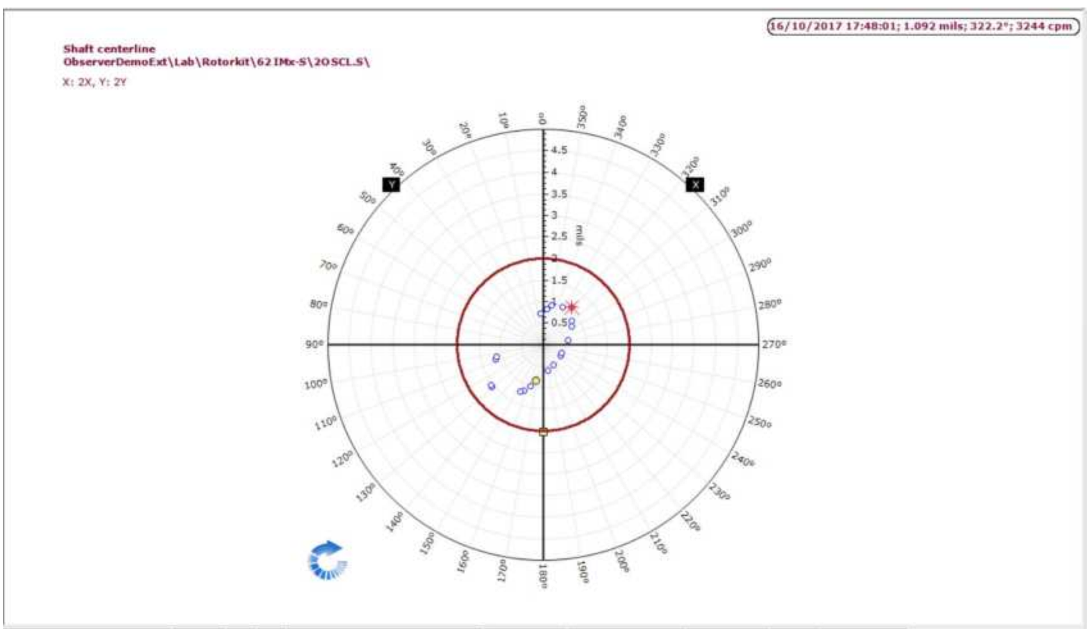


Figure 5 - 46
Example of Shaft Centerline Display

In this example the two channels providing the X and Y data are named '2X' and '2Y' and the **Clearance** has been set at 2 mils in the measurement point, **Shaft properties** tab, calibrated with the shaft resting at its *Bottom* position.

Combination Plots

 Use this icon to display a list of available combination plots in the system. Combination plots show two or more types of diagrams for the same measurement. The individual parts of the combination plot often work cooperatively so once one part is zoomed, the other is also zoomed making it easier to follow the same type of data from two or more types of displays.

The following combination plots are available.

- **Spectra/Time waveform**
- **Spectra/Phase**
- **Trend/Spectra**: including an enhanced plot for spectral comparisons, see example.
- **Diagnosis/Spectra**
- **Diagnosis/Spectra/Time waveform:** this plot follows the cursor on the diagnosis plot and displays the simultaneous FFT and time waveform.
- **Trend/Spectra/Time waveform:** this plot follows the cursor on the trend plot and displays the closest FFT and time waveform.

Some combination plot examples follow.

Figure 5 - 47 below, is an example of a spectra and time waveform, combination plot.

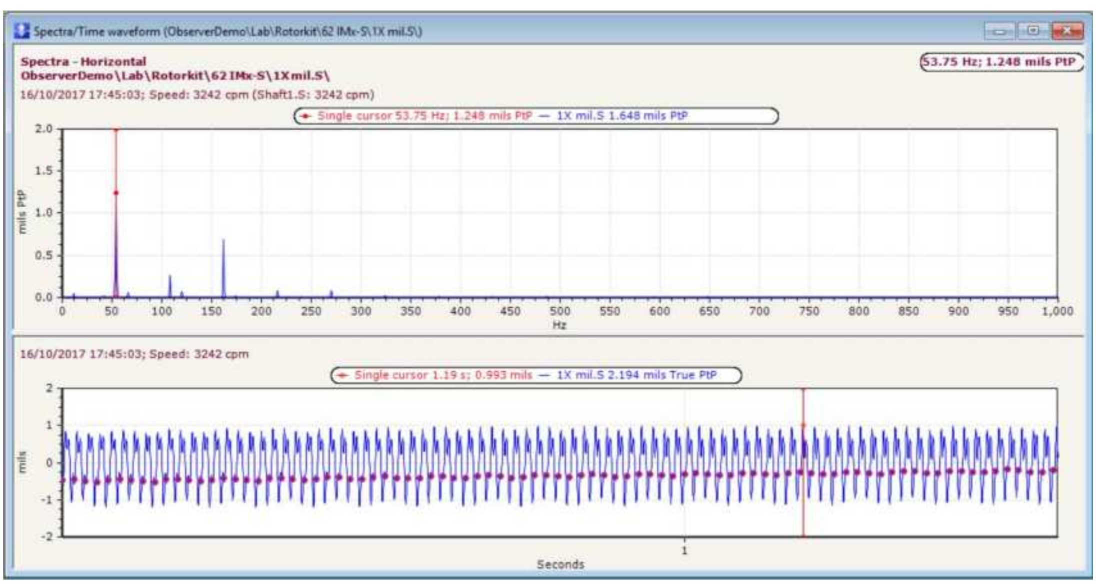


Figure 5 - 47
Example of Spectra and Time Waveform Combination Display

Figure 5 - 48 below, is an example of a trend and spectra, combination plot.

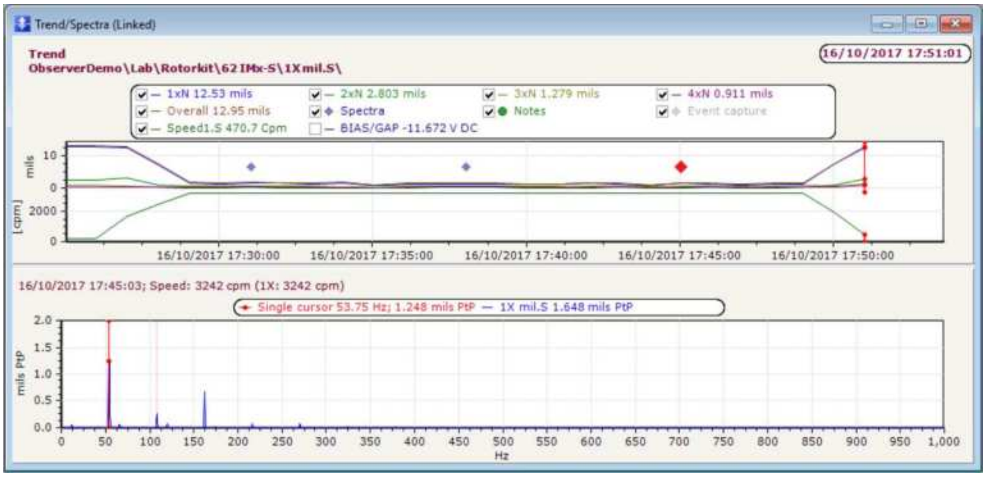


Figure 5 - 48
Example of Trend and Spectra Combination Display

When viewing a trend/spectra plot, it is possible to activate a secondary cursor on the trend and display a secondary spectrum plot, shown below the trend plot alongside the first or primary, spectrum plot:

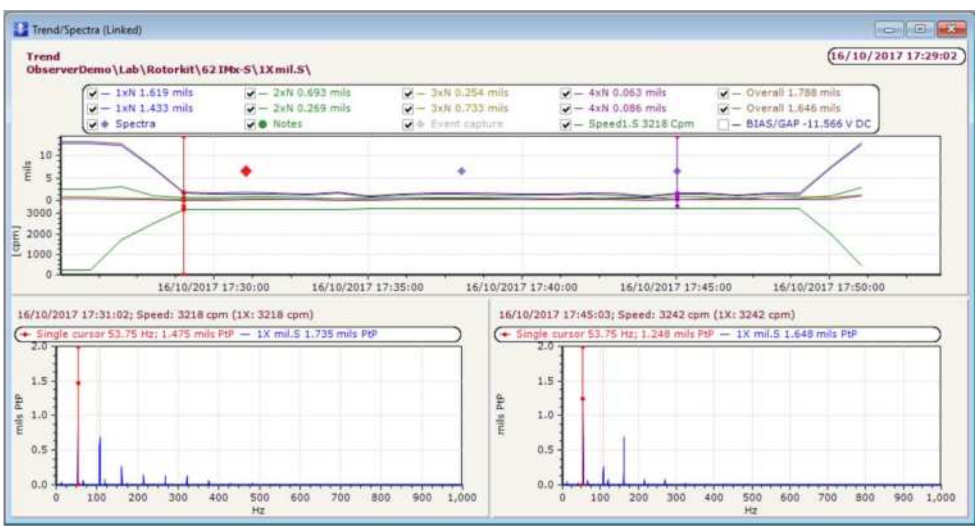


Figure 5 - 49
Trend/Spectra Combination Display with secondary cursor enabled

The legend panel in the trend plot will show an additional set of values for the overall and up to four bands. Moving the new, secondary, cursor on the trend plot will change the spectrum displayed in the secondary spectrum panel on the right hand side.

Control may be passed back to the original or primary trend line in the trend plot by moving the mouse over that cursor line and clicking on it. Cursor control will then update the primary spectrum plot. It is possible to switch between the two cursors in this way, at any time.

Capture (Event, Run cycle or Scheduled)

These are all types of measurement group that are used to capture long time waveforms. Normal measurements taken at different sampling frequencies continue to operate as usual while a time waveform is collected.

Event captures can be triggered by the following:

- An alarm in the event capture group triggers event capture (for simple alarms).
- An alarm in the same alarm group as the event capture group triggers event capture (for complex alarms).
- Clicking the **Capture** button triggers a manual capture.
- IEC status codes configured for event capture.

Scheduled captures, as the name implies, are similarly used to capture long time waveforms but at regular intervals, for example daily.

Whilst run cycle captures can be used with IMx-8/IMx-8Plus, IMx-16/IMx-16Plus or IMx-Rail devices in a general way, their specific use with IMx-Rail for rail track monitoring is discussed in *Appendix D, SKF Rail Track Monitoring.*

The following plots are available from the capture view.

- **Capture Time waveform** - the true peak-peak is calculated from the time waveform.
- **Capture 3D** – shows spectrum graphs taken from successive measurement values in the selected continuous time waveform capture. The z-axis represents time intervals in the capture from which spectrum graphs were generated.

Working with captures

This section describes working with captures, for details about the behaviour of the event capture function, refer to *Appendix A, What to Expect When Using Event Capture* in this user manual.

Displaying the capture view from the hierarchy

- From the hierarchy tree view, highlight a capture group. The capture view tool in the toolbar is enabled.
- Click the capture view tool to launch the capture view.

OR

- Right-click a capture group and then select **Diagram**.

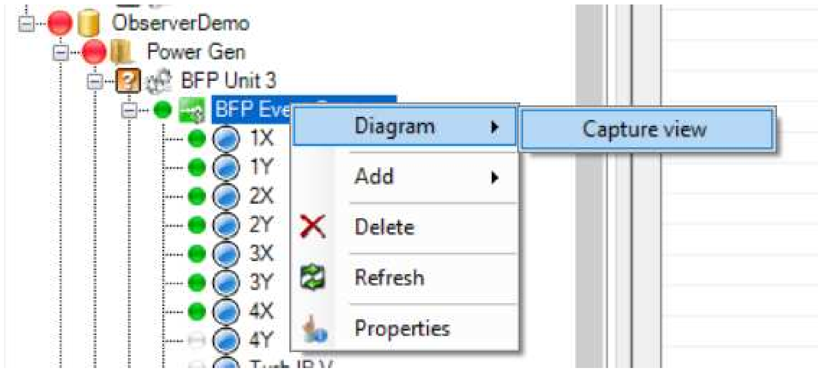


Figure 5 - 50
Example of Diagram Options from a Capture Group

- Select **Capture view**. The capture view displays all points available in the capture. Each capture point reflects a single channel.

From the hierarchy tree view, highlight a capture point node and right-click to select **Diagram**.

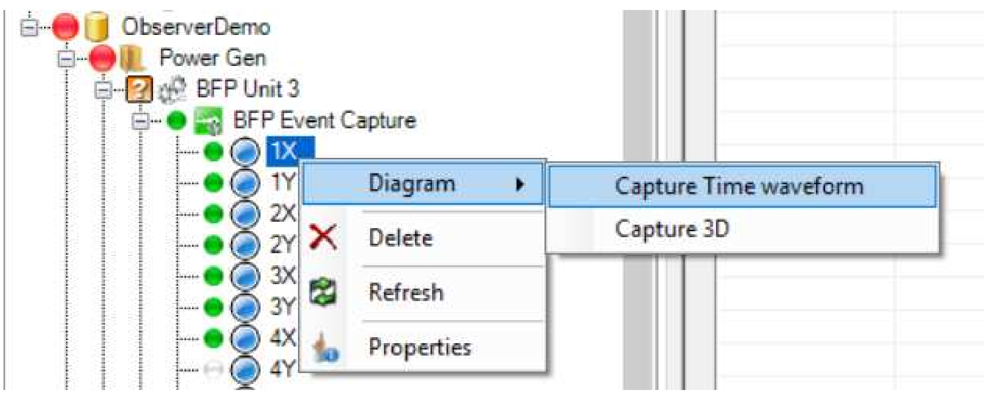


Figure 5 - 51
Example of Diagram options from a Capture point

- Select either **Capture Time waveform** or **Capture 3D**, the capture window opens and displays the available capture data for the selected point.

The Trend plot function is enabled for capture measurement points which have alarms enabled. Select the capture measurement point in the hierarchy view and then click Trend  to display the plot. The trend depicts capture flags in the plot as grey diamonds. When a capture indicator in the trend plot is clicked, a new window opens to display the corresponding capture for further analysis. The list view selection shows the capture that was selected on the trend plot and a thumbnail overview display of the same.

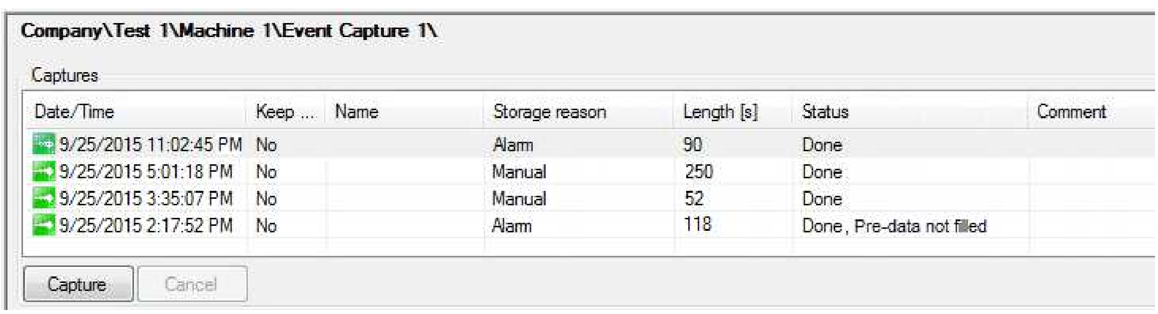
Initial capture view description

Figure 5 - 52 below, is an example of the capture view.

Figure 5 - 52
Example of Capture View

The work space contains a list of the captures available for the capture measurement group plus the overview of the time signal plots for the channels in that group.

The captures list displays information for each capture.



Company\Test 1\Machine 1\Event Capture 1\

Captures

Date/Time	Keep ...	Name	Storage reason	Length [s]	Status	Comment
9/25/2015 11:02:45 PM	No		Alarm	90	Done	
9/25/2015 5:01:18 PM	No		Manual	250	Done	
9/25/2015 3:35:07 PM	No		Manual	52	Done	
9/25/2015 2:17:52 PM	No		Alarm	118	Done , Pre-data not filled	

Capture Cancel

Figure 5 - 53
Example of a Captures List for an Event capture group

Date/Time when the capture was triggered.

Keep forever *Yes* or *No*.

Name is the descriptive name given to the capture.

Storage reason can be *Alarm, Manual* or *Unknown* for Event captures

Alarm - The event capture was triggered by the IMx due to an alarm.

Manual – The user clicked the **Capture** button to request the capture.

Unknown - @ptitude Observer does not know yet if the incoming event capture is part of an alarm or a manual request.

Length [s] The actual length in seconds of the captured time signal.

Status can be *In Progress*, *Done*, *Truncated*, *Cancelled by user* or *Done, Pre-data not filled*.

In Progress – the capture is being received from the IMx.

Done – the capture has received all expected data as configured on the measurement group.

Truncated - the capture was closed because it could not be completed. The capture may not have received the expected end packets for each channel's long time waveform signal or it may have lost sync for some reason.

Cancelled by user - the user clicked the **Cancel** button. When @ptitude Observer is connected to the Monitor Service, clicking this button will cause the IMx to restart and cancel the ongoing capture.

An ongoing capture cannot be cancelled if @ptitude Observer is not connected to Monitor.

Done, Pre-data not filled - the capture did not receive all expected data as configured on the measurement group, but it did receive all the data the IMx had to send.

Comment text is shown here (and can be added/changed using the **Edit** functionality).

Capture Controls

Beneath the **Captures** list are a number of controls, the first is **Capture**:

- Click **Capture** to initiate a capture. The capture will display *In progress* as the **Status**. While the capture is ongoing, a message beneath the capture list states: Capture not allowed: capture is pending. When the capture completes, the status dynamically updates to **Done**. If the capture cannot complete or no progress is detected for one minute, the capture attempt is ended and the status updates to *Truncated.*
    - ➢ The manual **Capture** function is not included in the count of maximum captures stored per day. A manual capture is stored even if the limit of captures per day is reached.
    - ➢ The **Capture** function is unavailable when @ptitude Observer is not connected to a Monitor service or when the associated IMx unit is not available (connected). The following message is displayed to the right of the Capture button: Capture not allowed: Observer is not connected to the Monitor Service.
    - ➢ After the IMx has re-established communication with the Monitor service, there is a period of at least 60 seconds before the **Capture** button is re-enabled. The following message is displayed: Capture not allowed: waiting [number of] seconds on ready for event capture.
    - ➢ If a sensor or cable problem (sensor fault) occurs during the capture, the following message displays: All or partial data stored out of sensor OK range.
- Another capture may be initiated when the previous manual capture is *Done* or in any **Status** except *In Progress*.
- Click **Delete** to delete a selected capture from the list, provided that the **Status** is not *In Progress*.

To edit a capture:

- Select a capture in the list and click **Edit** to open the **Edit capture** dialog.

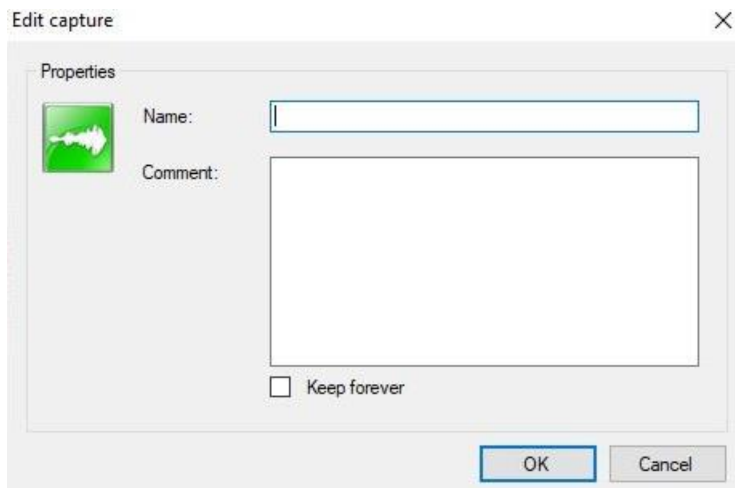


Figure 5 - 54
Example of Edit Capture dialog

- Enter the **Name** of the capture.
- Enter a **Comment**, if desired. The comment will display in the captures list.
- Select the **Keep forever** checkbox to save the capture until the measurement group or measurement point is deleted. Captures not marked as **Keep forever** can be deleted by the usual methods (the Delete Data interface or setting up the Automatically delete old data option under Database > Options)
- Click **OK**.

To export to UFF (Universal File Format):

- Select a capture (with **Status** *Done* or *Truncated*) in the list and then click **Export**. Only one capture can be exported at a time.
- The **Export to UFF** dialog opens. The capture **Group** name of the selected group is displayed. Specific-channels can be exported to a UFF.

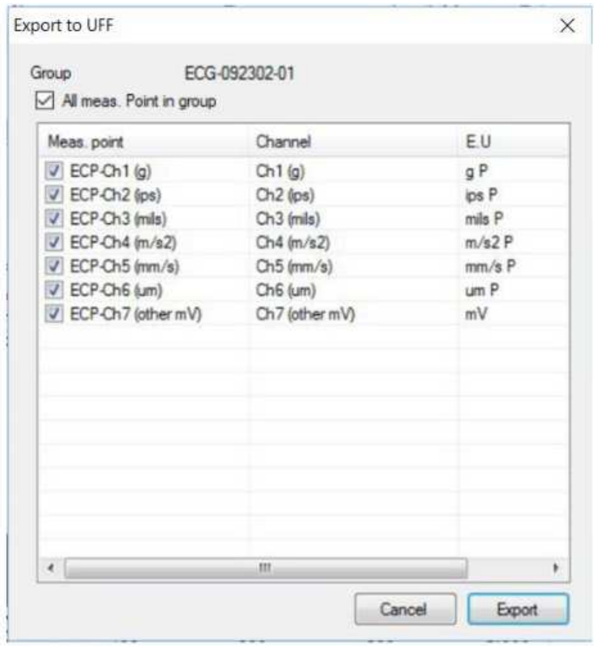


Figure 5 - 55
Example of Export to UFF Dialog

- The table contains the measurement points of the current selected group and measurement. **All meas. Point in group** can be checked to enable export of all the measurement points. Alternatively, check only the desired points within the table and uncheck those that should not be included.
- With the desired selections made, click **Export**. The UFF file is generated.

Working with capture plots

Right-click on a plot in the overview to open the context menu.

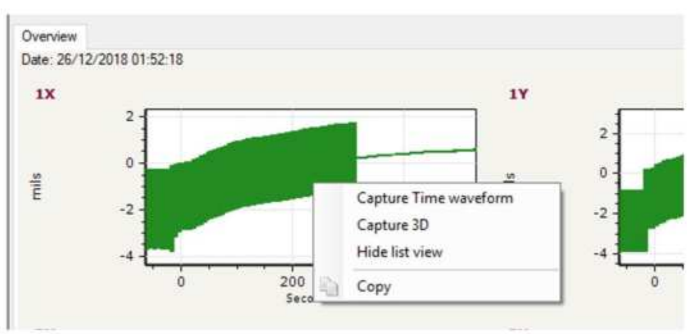


Figure 5 - 56
Example Capture Context Menu

The menu options include:

Capture Time Waveform displays a more detailed window with the waveform of the long, time signal.

Capture 3D displays a 3D plot spectrum for the entire time waveform or a selection of it. The complete capture or any part of it, can be analysed.

Hide list view hides the captures list section at the top of the workspace to provide more viewing space.

Copy creates a screenshot of the graph and copies it to the clipboard.

The window for the capture contains three parts, as shown below:

A. The complete or long, time waveform capture

B. A spectrum part

C. A zoomed version

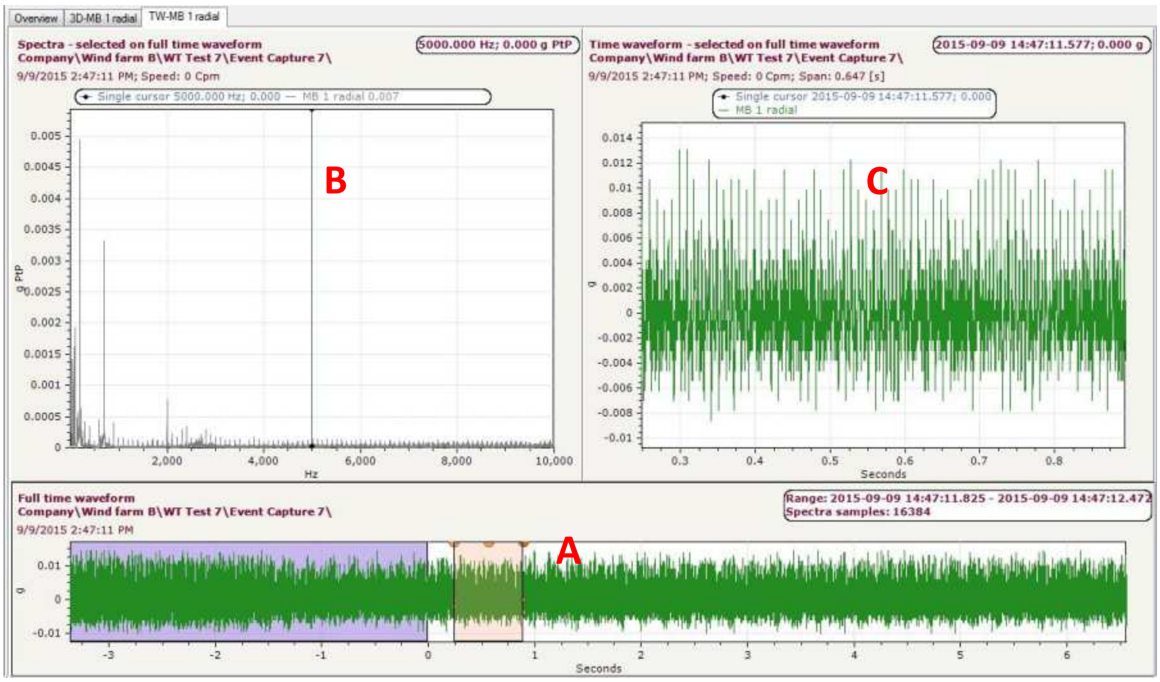


Figure 5 - 57
Example of the Capture Time Waveform View

The following rules apply to the complete or long, time waveform capture (A):

- The occurrence of an event capture could be an alarm or manual storage.
- The date list of the captures, if not hidden, shows the reason that storage took place.
- One band marker is always visible and cannot be removed from the graph.
- The band marker controls both the length of the zoomed in time waveform and which values the spectrum is going to be calculated on. The band in the full time waveform display is initially located at “0”, which for an event capture is the time the event occurred. The band can be adjusted to change the zoomed time waveform as the spectrum is recalculated.
- The X scale on the long, time waveform has zero time at the occurrence of the event capture storage. All time values before that are negative and positive after. The graph displays a different background colour for negative and positive time.

The following rules apply to the spectrum (B):

- Single cursors can be added to the spectrum.

- The DiagX tool can be applied to the active single cursor.
- The spectrum shows the fault frequencies calculated from the machine parts.

The **Capture 3D** plot window displays the 3D plot and a capture time waveform plot. The 3D plot shows spectrum graphs taken from successive measurement values in the selected continuous time waveform capture. The z-axis represents time intervals in the capture from which spectrum graphs were generated. The lower time waveform plot shows the time range over which the data was captured and indicates the range of data currently being displayed in the capture 3D view.

The lower time waveform graph provides control points on a colorband cursor. Modifying the colorband cursor will cause the number of spectra being displayed to vary. Control points can be used to specify which part of the time waveform information displays its spectrum characteristics in the capture 3D plot.

When opening a capture 3D plot and moving the selected area on the long time waveform all the way to the right, there may be some data beyond the selected area that cannot be selected (shown as a grey band). This occurs because a sequence of spectra is calculated from the long time waveform. Depending on the number of samples required per spectrum, there may not be enough data to fill exactly each spectrum all the way to the end of the data. The display presents the areas of the long time waveform that are being used for spectrum data. Any data leftover cannot be selected. See **Spectrum Settings** below for ways to expand the area of selectable data.

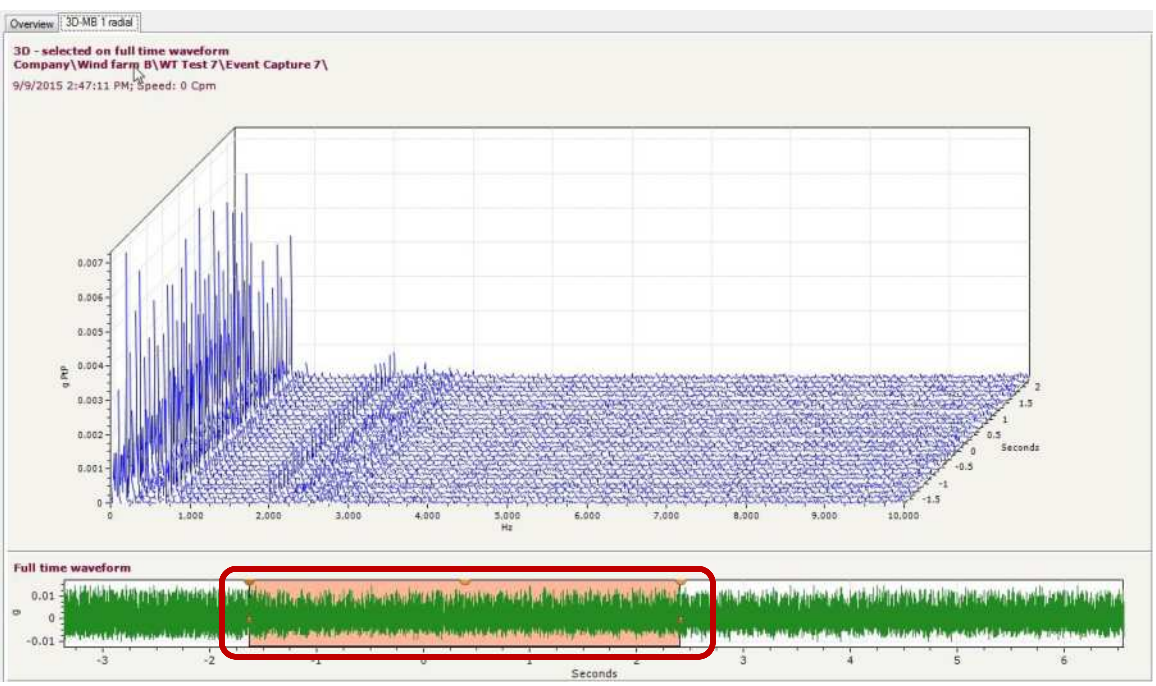


Figure 5 - 58
Example of Capture 3D Plot

Options Menu

The Option Menu is displayed when right-clicking on the plots. Relevant options differ in the capture 3D plot and the capture time waveform plot.

Right-click on the capture 3D plot to open the following context menu.

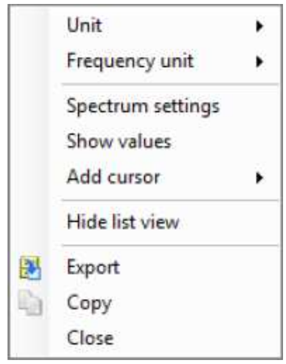


Figure 5 - 59
Example of Capture 3D Plot Context Menu

Unit is the measurement unit of the data displayed. Changes can be made between velocity, acceleration and displacement. The original measurement point units are restored when that particular graph is closed.

Frequency unit switches the frequency unit between *Hz and cpm.*

Spectrum Settings opens a dialog that controls how the spectrum graphs are displayed in the capture 3D plot.

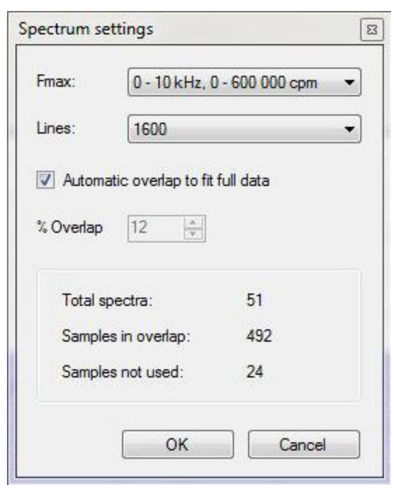


Figure 5 - 60
Spectrum Settings Dialog

Change the **Fmax** by choosing from the available selection of Fmax settings. The Fmax can only be modified to a smaller value than that used for the capture. For example, if the capture was measured with an Fmax of 1 kHz, the selection list will display only those choices that are 1 kHz or smaller.

Change the number of **Lines** shown in the spectrum graphs by choosing from the drop-down.

- This may affect the total number of spectra that are generated from the capture data.

The checkbox **Automatic overlap to fit full data**, is enabled by default. The system calculates the percentage of overlap that maximises the selectable spectrum information. The results of the automatic calculation display below: **Total spectra**, **Samples in overlap**, **Samples not used**.

Clearing the checkbox **Automatic overlap to fit full data**, allows manual adjustments to the **%Overlap** value to be made. **Total spectra**, **Samples in overlap**, **Samples not used** are recalculated and updated accordingly.

After making changes, click **OK**. New spectrum information is generated, and the plot is redrawn to fit the new parameters.

Show values displays the values in 3D plots.

Add cursor adds available cursors (markers) one at a time in the graph temporarily.

Hide list view hides the captures list section at the top of the workspace to provide more viewing space.

Close To close a tab, right-click on the tab label and a small pop-up option to **Close** the tab displays. Or, use the context menu **Close** command.

Right-click on a capture time waveform graph to open the following context menu:

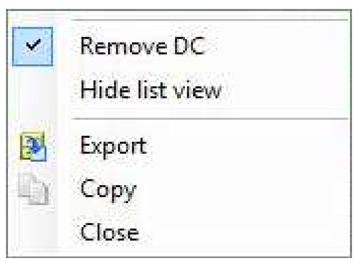


Figure 5 - 61
Example of Capture Time Waveform Context Menu

Remove DC provides the option to exclude the DC part of the signal. Often when showing time waveform data, the DC part is removed, leaving just the AC signal content.

Buffer

 Buffer is used to control and filter what data is retrieved from the database for display and analysis, any system standard or saved buffer settings can be accessed from the drop-down. Date ranges, filter parameters and source buffer type, can all be specified from within the dialog.

Usage

When changing a standard set of settings from within the dialog, the name of the buffer will change to ‘<Custom>’. If closing using the **Save** button, the user will then be prompted to give it an appropriate name so that it can be saved for later re-use.

When editing an existing custom buffer setting, the **Save** button allows updating/overwriting of the existing or naming of a new custom setting ('save-as' functionality).

Custom setting management: when a custom setting is opened in the dialog, the delete control adjacent to the **Name** field is enabled, (white 'x' on a red, circular background).

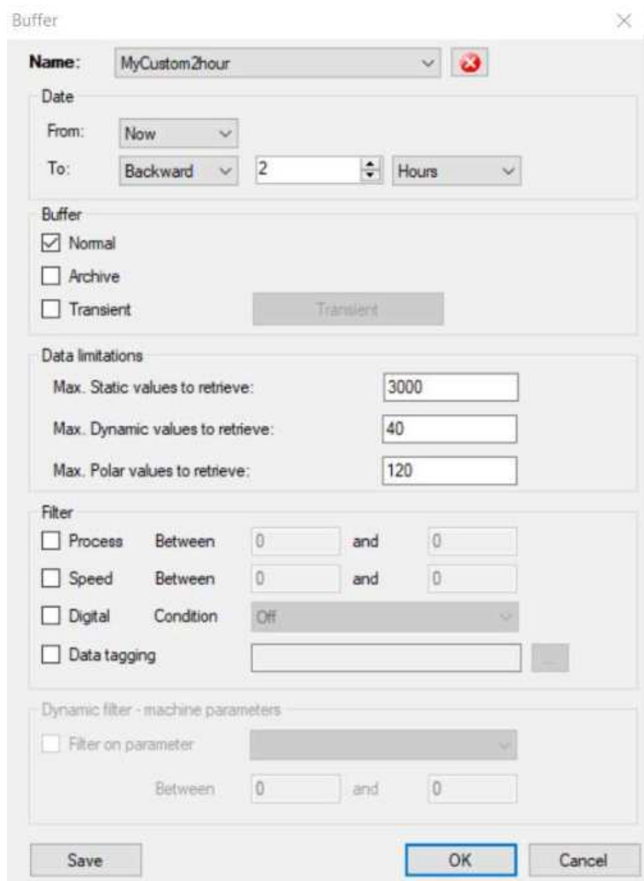


Figure 5 - 62
Example of Buffer Settings

Name identifies this particular setting of the buffer interface.

Date

Select a time or date from the predefined list to be used with *Backward* or *Forward* value for the end date range.

From specifies the start date and time.

To specifies the range of end date and time.

None

Now: specifies the current date and time for the end range.

Time: a specific time to define the end range.

Backward: specifies a date range backward in time relative to the start time. The predefined dates may be used for this option.

Forward: specifies a date range forward in time relative to the start time.

Buffer

It specifies from which buffer to collect the data.

Normal: refers to the data stored in the rolling buffers. The type of data and the storage interval are set in Operating and Storage Conditions Tab settings when creating a measurement point.

Archive: refers to the trend data stored in an archive buffer that has fixed capacity and storage rate. When this buffer is enabled and if data is available, it will store one trend measurement value every 10 minutes. At that rate, the 80 000 measurement values it can hold would represent data collected over 1½ years.

Transient: refers to the data captured during transient. Therefore, for this type of buffer, a specific transient of a measurement group must be selected.

Data limitations

Data limitations allow the user to enter the maximum number of values (Static, Dynamic and Polar) that should be retrieved.

Filter

Process allows filtering by process readings such as temperature and load. This is only applicable if the measurement point had an associated process point configured.

Speed allows filtering by speed readings. This is only applicable if the measurement point had an associated speed point configured.

Digital allows filtering by digital input on or off and filtering by the operating classes. This is applicable if the measurement point had an associated digital point configured.

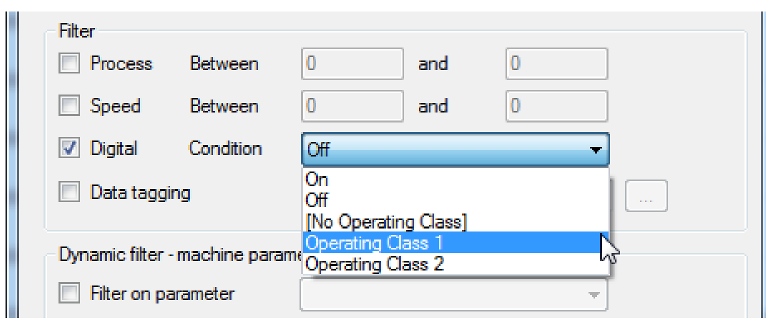


Figure 5 - 63
Example of Buffer Settings for Digital Condition

Data tagging allows for the filtering of data that is marked with a specific tag. Data can be tagged manually with a Software data tagging point or automatically by OPC data tagging points.

Dynamic filter – machine parameters

Filter on parameter enables, when selected (checked), the filtering of dynamic measurements in all relevant plot types based on the range set for one selected machine parameter. Make a selection from the **Filter on parameter** list. The list contains the available machine parameters that are associated with the parent machine. Use the **Between, and** fields to set minimum and maximum values for the filter. A value in at least one field must be entered. Upon clicking Enter, the plot will redraw using the new filter ranges specified by the parameters.

- If a box has no value, the filtering will have no limit in one direction. For example, if there is nothing in the minimum box then there is no lower limit on the filter.
- Unchecking the checkbox will clear the filtering and redraw the plot, but any values entered are still visible.

Notes

A note is defined as an observation or action taken, related to a machine. Typical notes relate to maintenance activities and visual inspections.

To get to the **Notes** screen, select a machine then perform one of the following actions:

- Click on  **Notes** icon on the toolbar.
- Click **Edit** from the tool bar menu options, then select **Notes**.

The notes window displays the notes for the selected object in the hierarchy. Although a note is a machine-specific object, if an object of machine level or above is selected, then all notes under that object will be displayed.

It is possible to filter out specific notes based on date and title of notes. If a hyperlink is specified along with the note, then it can be opened by clicking the hyperlink for the selected note in the notes window.

Use **New**, **Edit** or **Delete** options to configure notes.

Configuring a Note

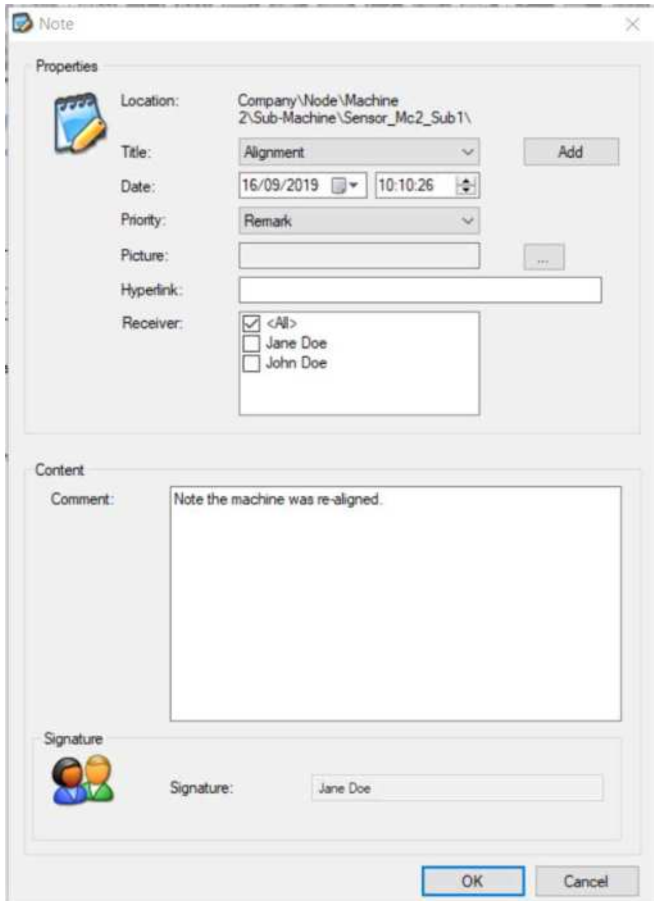


Figure 5 - 64
Example of Notes Settings

Location indicates for which machine or measurement point the note is being configured.

Title enables categorisation of notes based on their type. To add a new title to the system click **Add** next to the title which brings up the new note title screen where a new title can be entered.

Date sets the date and time for the note. When creating a new note, the current date and time is set as default. However, the date and time may be altered to register for example, an historical event.

Priority specifies the severity level to categorise the notes.

Picture is a picture to be associated with the note.

Hyperlink is a document or webpage associated with the note where more information regarding the note can be found. This document or hyperlink can be accessed from the notes list window by clicking the hyperlink of the selected note.

Receiver specifies who will receive the note. The list of potential 'Receivers' for the database and their contact details are managed using the Receivers interface in Database > Libraries.

Comment is the informative text or content of the note.

Signature is the user ID that created the note.

Event Cases

 Event cases can be created in Observer to keep track and document reports, information and history regarding a specific event tied to a specific machine.

New event cases can be created on machine level:

- Right-click on a machine from the hierarchy view then choose **Add Event case**.
- or select a machine, click the **Event cases** icon on the tool bar, then click the **New** button on the Event cases window.

The event cases window displays the event case reports for the selected object in the hierarchy. Although event cases are machine-specific, if an object of machine level or above is selected, then all event case reports under that object will be displayed.

Reports can be created to inform a customer or a department of actions that need to be taken care of regarding the event.

The reports are stored to the event case and can be reviewed and followed-up at a later date. The report is editable until the report is released by setting the status of the report to “released”.

Each report in the event case can produce a document at any time in word or .pdf format which can automatically be sent as an email and/or stored as an attachment on the machine.

A report contains a number of **assessments** which typically are used to inform customers or internal departments of important information by the data analysts in Observer. An assessment consists of an assessment text and a recommendation how to handle the information detected in the assessment.

A severity level can be set in the form of a “classification level” and the assessment can be tied to a specific machine part if desired.

To the assessments, **pictures** can be added which will also be printed in the document that can be produced from a report. These pictures are typically screen shots of graphs in Observer indicating a defect or problem of some kind, but any picture can be added.

Event case report layouts define how the documents should look. For more information, see Report Library.

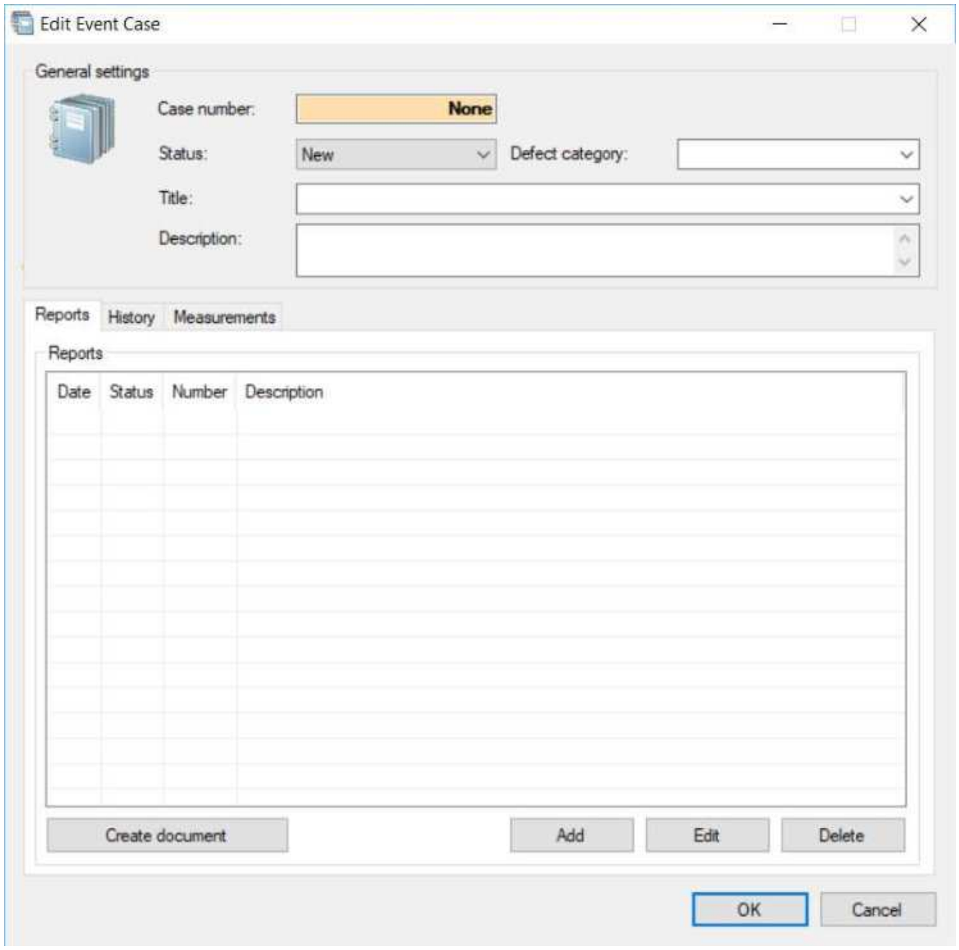


Figure 5 - 65
Example of Edit Event Case

Case number is a unique number that can be used to track this case. The case number consists of a counter and a prefix. The prefix can be set in the options interface. The case number in combination with the report number can be printed on the event case report documents that can be generated.

Status of the report.

Defect category can be used to group this specific case to a specific type of defect.

Title can be used to group this specific case with a specific title.

Description is a custom description that can be entered for the case.

Of all the above information, only the case number will be printed on any document generated from an event case report.

Reports Tab

Existing report(s) can be added, edited or deleted. A document can be generated by selecting a report and clicking **Create document**.

History Tab

It lists all the related history of the selected event case report. New history can be added, or existing history can be edited or deleted.

Measurements Tab

Any measurements related to the selected event case report can be added, edited or deleted.

Editing an Existing Event Case Report

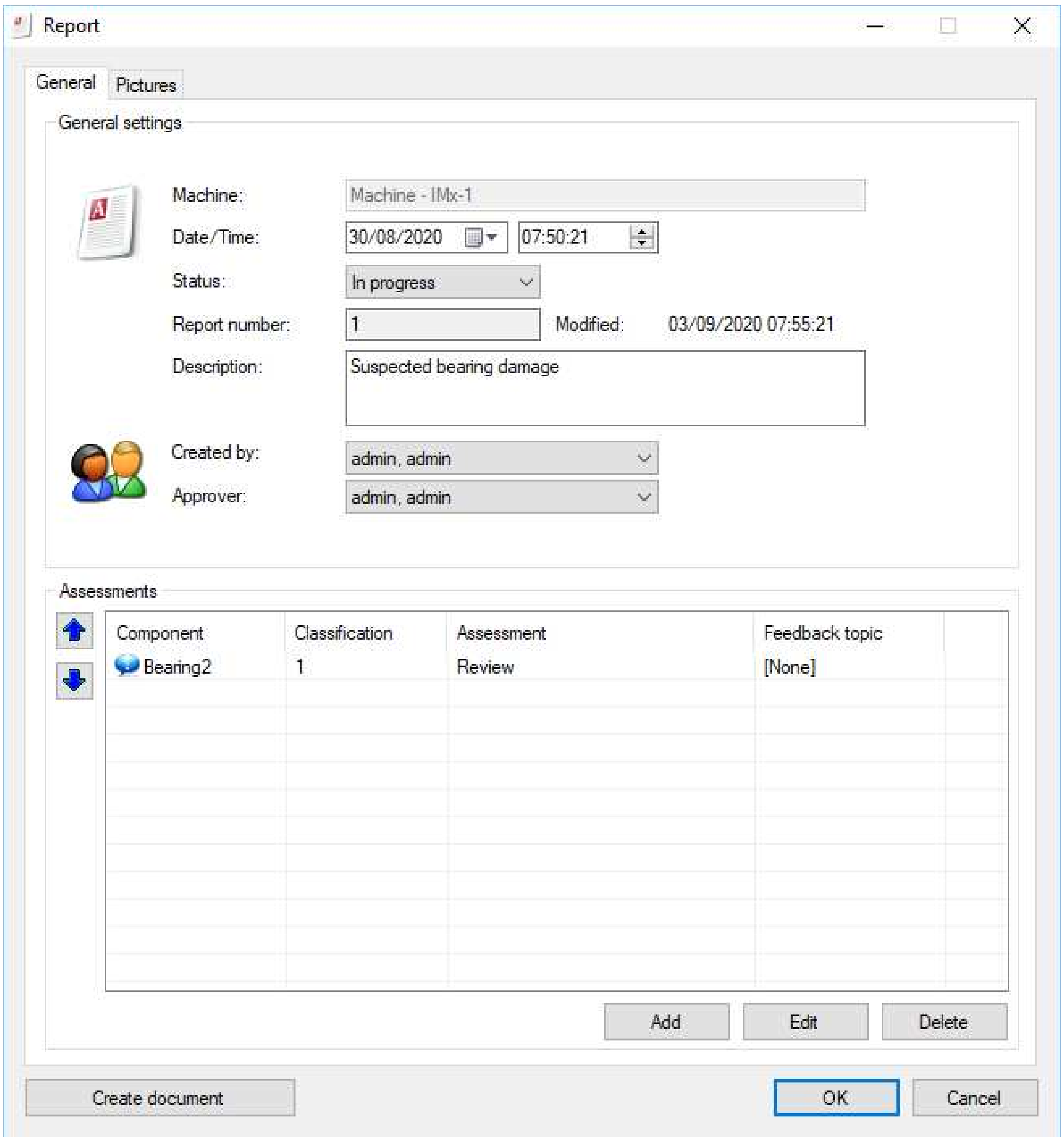


Figure 5 - 66
Example of Report

Machine displays the machine for which this event case report was created.

Date/Time sets the creation date and time of the report.

Status indicates the status of the report. Options are *In progress*, *To be approved*, *Rejected* and *Released*. When a report status is set to *Released*, the report cannot be edited any more.

Report number is an automatic number incremented by 1 each time a new report is created for the specific event case.

Description is a custom description that can be entered for the report.

Assessments lists all assessments created for the report. A new assessment can be added. Existing assessments can be edited or deleted.

Click **Add** or **Edit** to open the **Assessment** dialog.

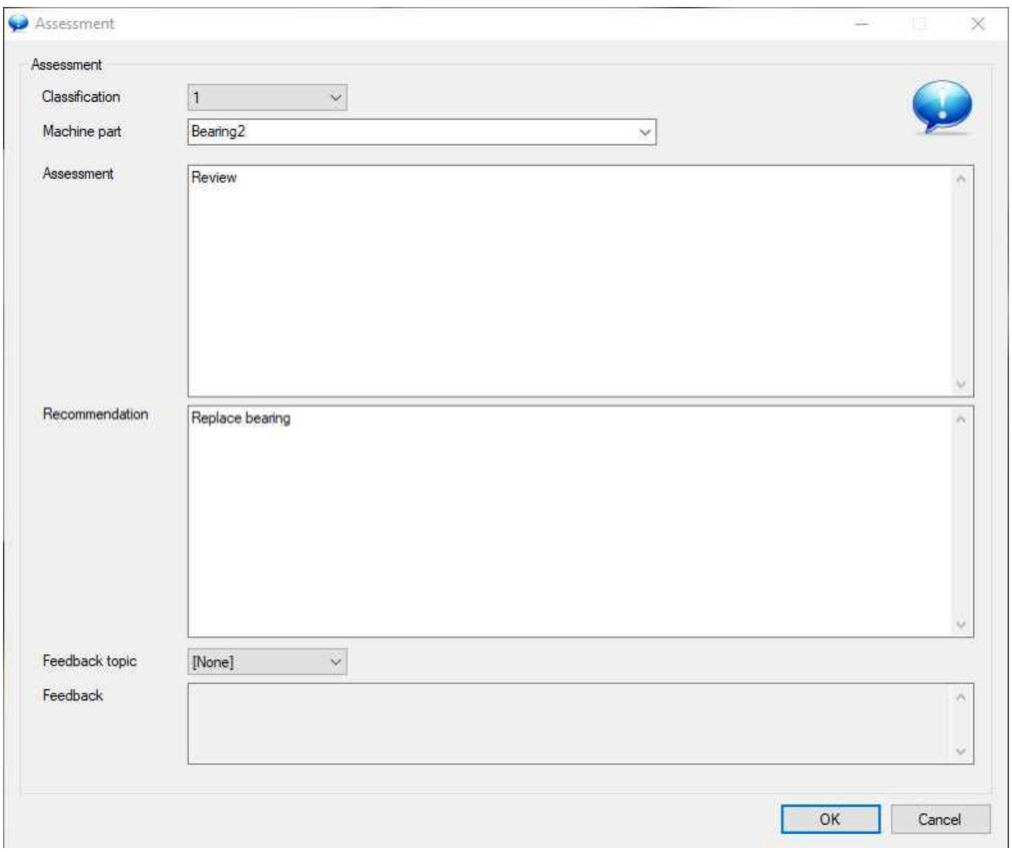


Figure 5 - 67
Example of Assessment

Classification is used to classify the severity assessment in a scale from one to ten, where ten is worst/highest priority.

Machine part can be selected from the existing machine parts of the machine if this assessment applies to a machine part. It is also possible to enter a free text machine part.

Assessment is the data analysis detected or description of the event.

Recommendation of actions that need to be taken in response to the assessment.

Feedback topic specifies for which category the feedback has been provided (not editable).

Feedback displays the custom feedback (not editable).

Maintenance Planner

The **Maintenance planner** interface is for configuring maintenance tasks such as lubrication, replacements, scheduled maintenance, etc. by keeping track of machine running hours or calendar time.

To get to the **Maintenance planner** screen, perform one of the following options:

- Right-click on a machine from the hierarchy view or workspace then select **Maintenance planner**.
- Select a machine, then click  **Maintenance planner** icon on the toolbar.

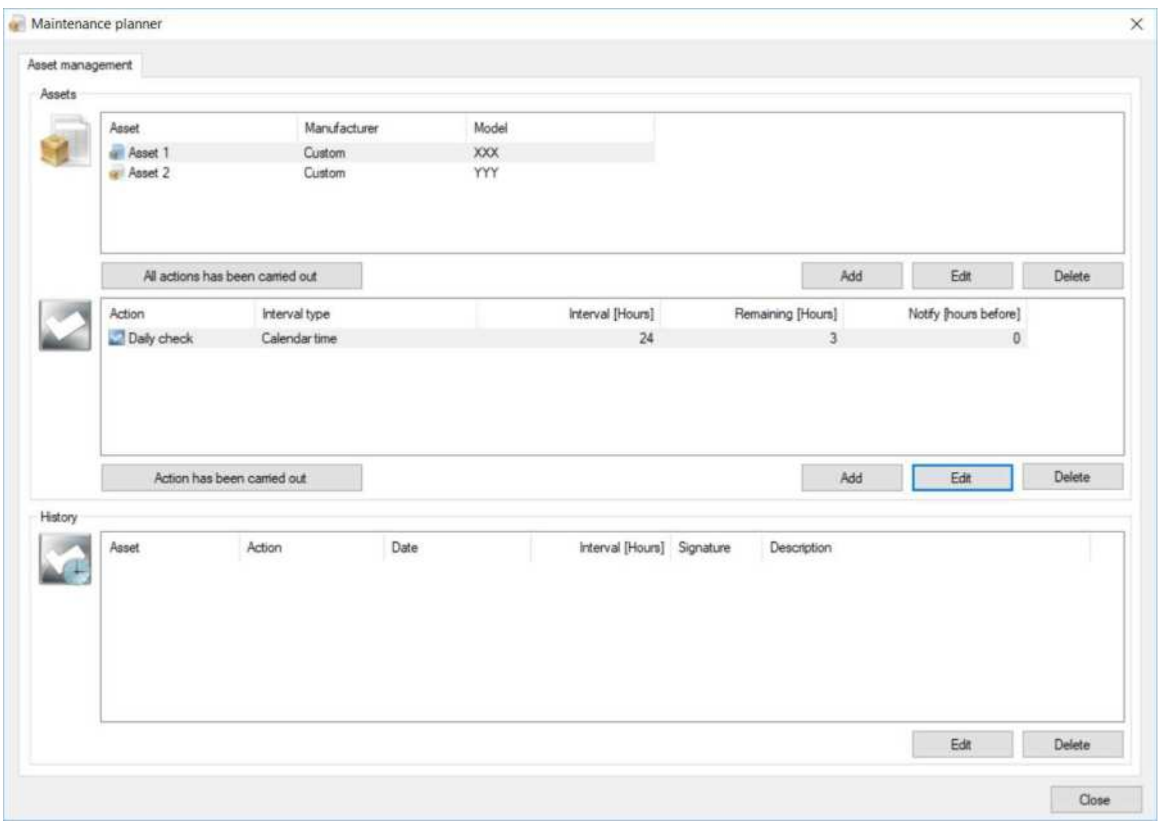


Figure 5 - 68
Example of Maintenance planner

Asset management allows a user to add, edit or delete assets along with asset maintenance task actions. Note that an asset must be assigned first before a maintenance task action can be added, edited or deleted.

History displays the past maintenance tasks for the selected asset. History items can be edited or deleted.

Measurement Date

Measurement date interface lists the measurement date of the selected measurement point. It configures the storage information of the selected measurement data from the list.

To open the **Meas. Date** interface, select a machine > select a measurement point > then click the Meas. date tool in the toolbar.

Measurements list displays data information. Keep forever means that the selected measurement is set as a reference forever until it is edited otherwise.

Edit can change the date, time, option to keep forever or not, option to exclude from diagnosis, speed and process data.

Delete deletes the selected measurement data from the database.

Add can add specific data tagging information, Software data tagging points only.

Export ODS* data exports measurements to a universal file format (UFF) which can then be imported into a software for machine movement animation such as ME'scope. Multi-select within the list is allowed. *ODS: Operational Deflection Shape.

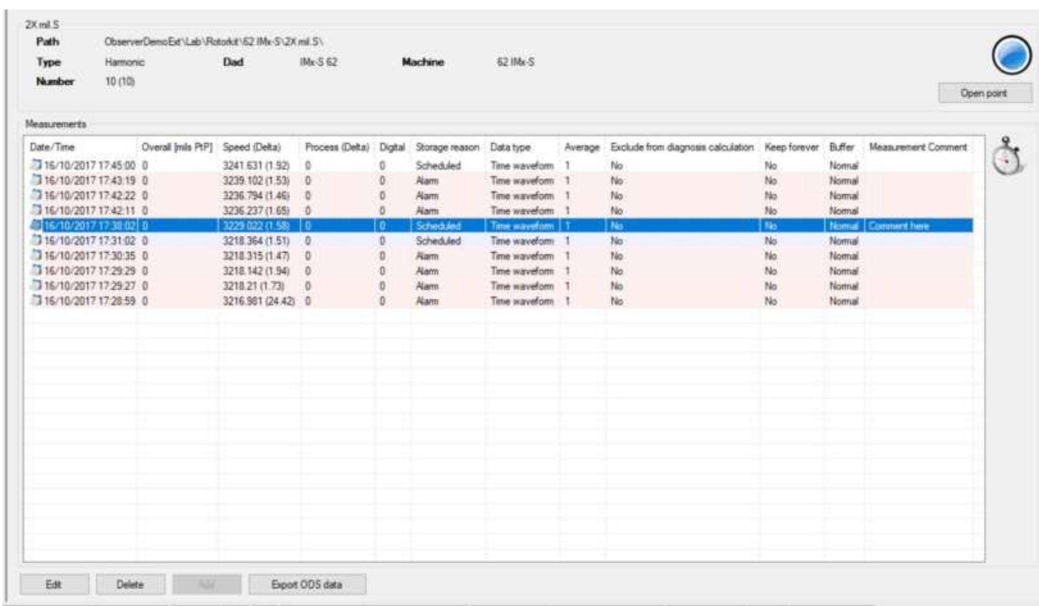


Figure 5 - 69
Example of the Meas. Date Window with Measurement Comments

- Note that the Buffer can be used to control and filter what data is retrieved from the database into the **Meas. Date** window.

A Note about Measurement Comments and Status Codes

The final column is **Measurement Comment**. The comments displayed can provide additional information to aid analysis, for example, IEC status codes. These IEC status codes can be requested and stored if the license module “IEC 61850” is installed. This license module applies only to the following devices: IMx-W, IMx-C, IMx-S, IMx-T, IMx-B, IMx-8/IMx-8Plus and IMx-16/IMx-16Plus.

The contents of the **Measurement Comment** column will display when that measurement is opened in any graph and are also visible in printouts.

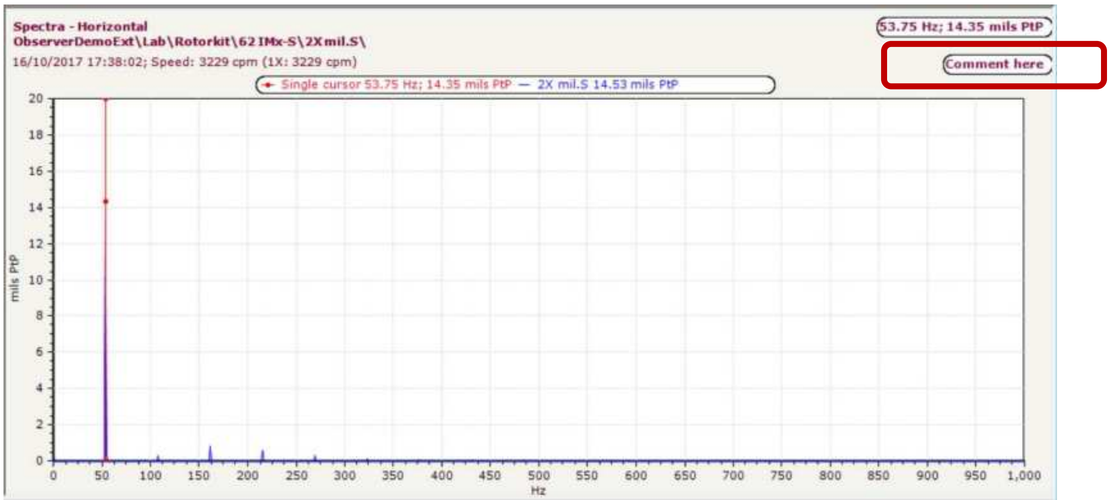


Figure 5 - 70
Example of a Spectrum plot with comment displayed

6
Menu Items

The following menu items are available in @ptitude Observer.

Main Menu	Sub Menu	Sub Menu	Sub Menu
File			Manage databases
Edit		Multiple point update wizard	Add external database
Show	Tree view	Workspace	Remove external database
	Filter	Copy node (Ctrl+C)	Report
	Hierarchy	Paste (Ctrl+V)	Log off
	System	Notes	Exit
	Workspace	Event cases	
	Diagram View	User preferences	
	Alarm list	Properties	
	System alarm		
	Maintenance Overview		
	Message Center		
	Refresh		
	DASHBOARD		
	Sub Menu	Sub Menu	Sub Menu
Database			Security roles
On-line		IMx/MasCon devices	Users
Portables	Microlog Analyzer	OPC Servers	Database information
	Coded notes	Monitor Service Viewer	System log
		E. C. IMx-1 System View	Pictures
		Direct Modbus devices	Diagnosis
		Firmware	Libraries
		Balancing	Export
		Event log	Import
			Alarm group
			Measurement groups
			Options
			Delete data
			Data miner
	Sub Menu	Sub Menu	
Window		Cascade	
Help	Contents (F1)	Tile Vertically	
	Search	Tile Horizontally	
	Enter new license key	Close all	
	News in Observer	[List of open windows]	
	SKF Online Repository		
	SKF CMC Homepage		
	SKF Reliability Forum		
	About		

File

File Sub Menu	Function
Manage databases	Add, edit, remove or change the default database.
Add external database	Add an external database.
Remove external database	Remove an external database.
Report	Report generation, template management - Data selection, General, Diagram sub tabs.
Log off	Log Off.
Exit	Exit.

Manage Databases

Manage databases interface provides the ability to connect to a database or jump from one database to another within @ptitude Observer without leaving the current log-on session. This is an important feature when data spread over several databases must be analysed. It is possible to add a new database and edit or remove an existing database.

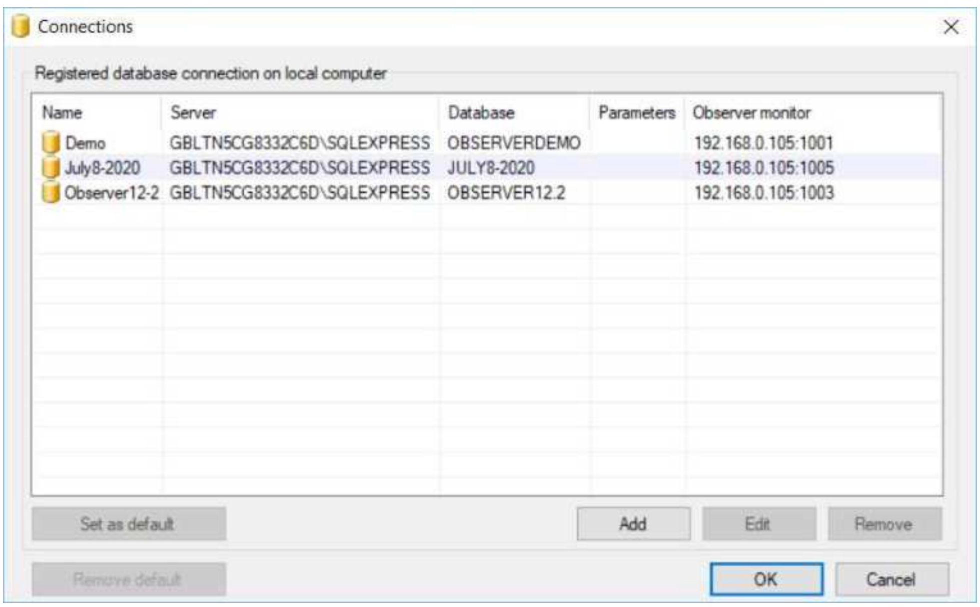


Figure 6 - 1
Example of Database Connections

Set as default sets a database as a default database with which the system starts.

Remove default removes the default database setting.

Adding/Editing a Database

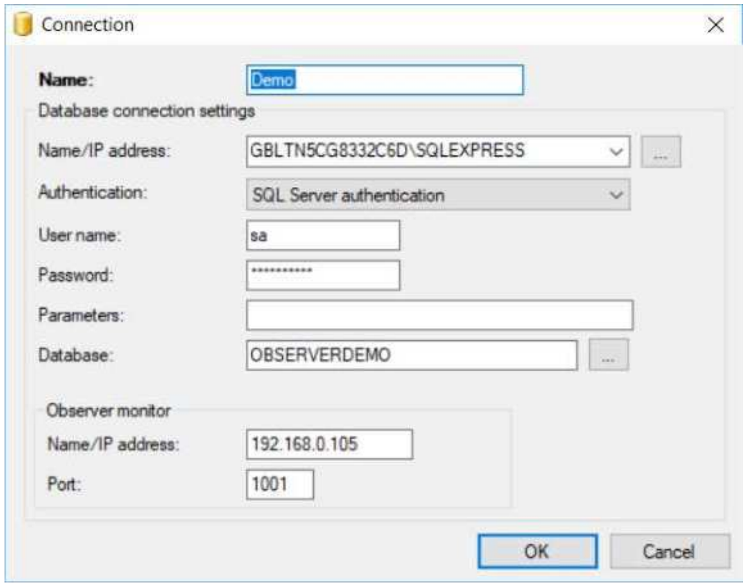


Figure 6 - 2
Example of Database Connection settings

Name identifies the registered database connection on local computer.

Name/IP Address is the server name/IP address entered or selected from the list of detected servers. An entry of “local” refers to the computer on which @ptitude Observer is currently running.

Authentication is a choice between *Windows authentication* and *SQL Server authentication*.

> *Windows authentication* is applicable if connecting to an SQL server in the same domain as this computer with a common domain controller or if the SQL server is installed on the local computer.
>
> *SQL Server authentication* should be used in all other scenarios.

User name is the database user name.

Password is the password for the user.

Parameters allows for any additional parameter to be applied to the database connection. For example, *Network=DBMSSOCN* means that the connection should be forced to use TCP/IP protocol. *Auto translate=false* can resolve DBCS character issues on systems with DBCS languages such as Korean, Japanese and Chinese.

Database specifies which database to use. Select a database from the drop-down list, this list includes all available @ptitude Observer databases on the specific database server.

Observer monitor settings are *Name/IP address* and *Port* of the @ptitude Observer Monitor that is serving the database server. This setting assigns which port the monitor should use to communicate with @ptitude Observer and IMx devices. The port default value is 1000.

The port setting should be the same number as the monitor service has been registered to run with using the "@ptitude Observer Monitor Manager" software.

Add External Database

Add external database interface adds an external database registration to the hierarchy. In an enterprise solution where it is common to work in several databases, it is convenient to add the databases as external databases which then enables access to all databases from the same hierarchy. The external database can be a database on the same database server or it can be on a different server.

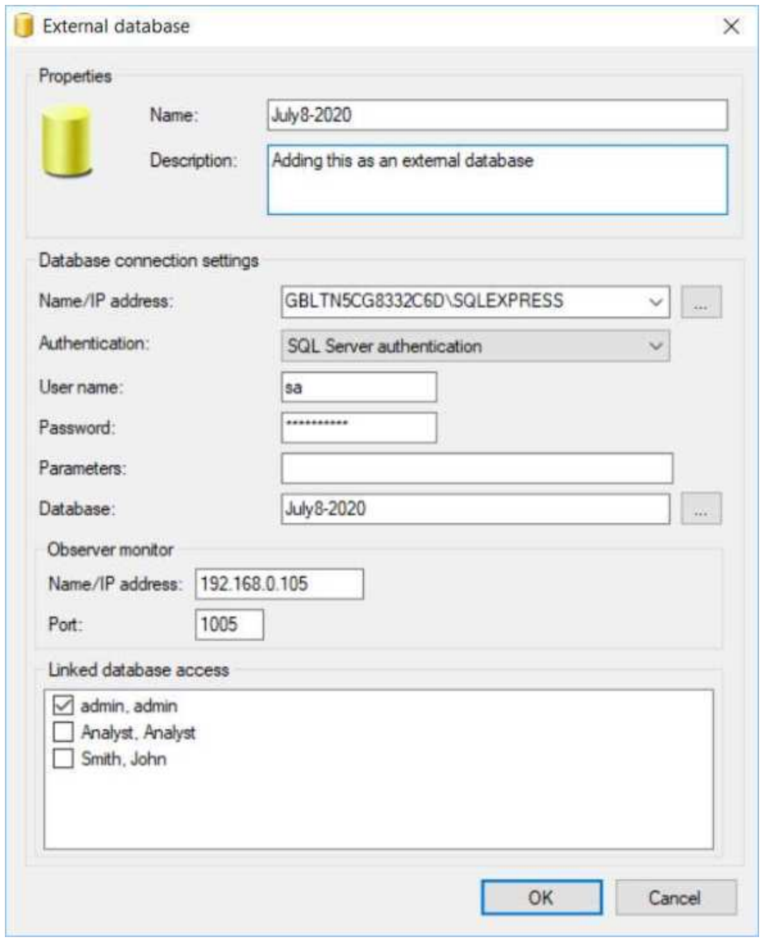


Figure 6 - 3
Example of Add External database

Properties **Name** is what the external database should be called.

Properties **Description** is information about the external database.

The attributes of **Database connection settings** are the same as in Connection interface of Add/Editing a Database under Manage Databases.

Linked database access grants user(s) access to the specified external database.

Remove External Database

Remove external database removes the selected external database from the hierarchy view. Note that it is not possible to select and then remove the main database, as it is not an ‘external’ database.

Report

The Report interface can generate documents that contain text-based information as well as diagrams and pictures of selected data.

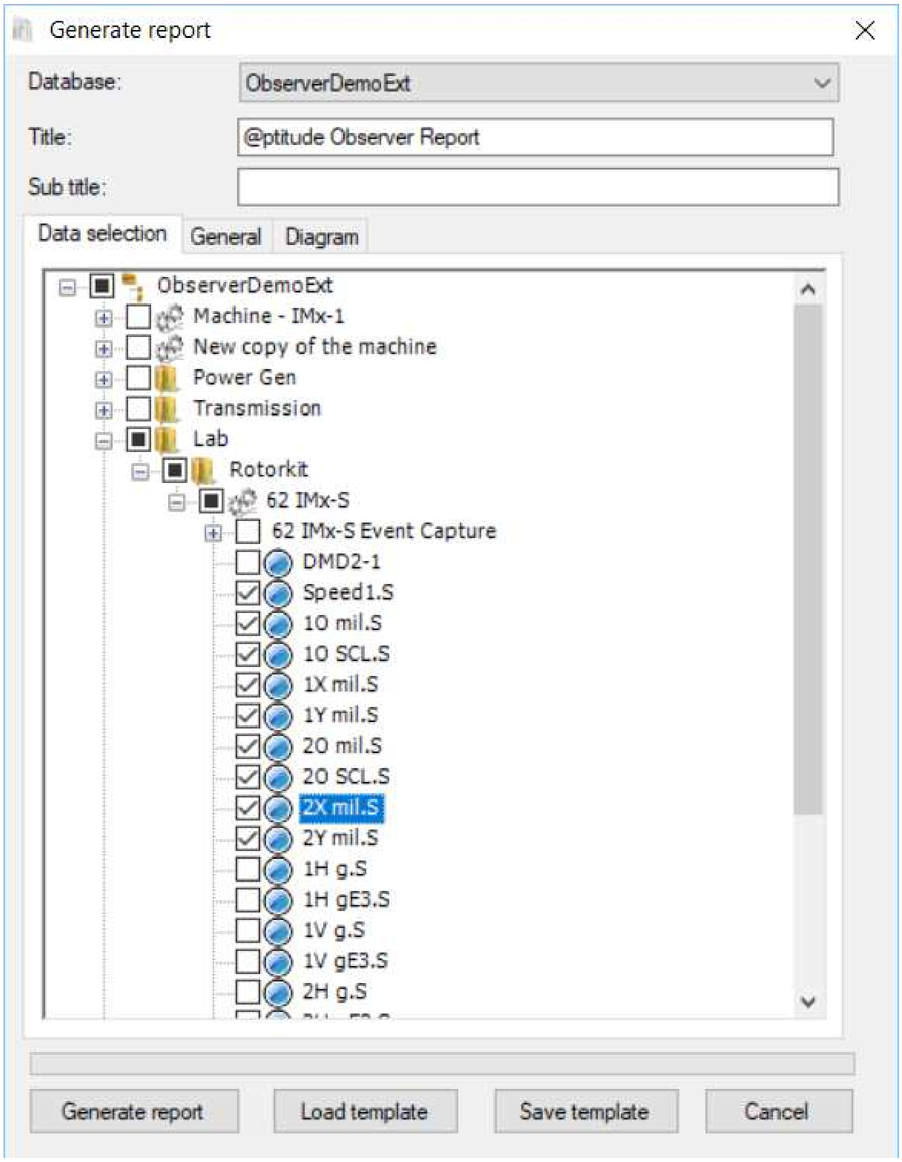


Figure 6 - 4
Example of Select Data for Report

Database is the database from which this report will be generated.

Title is an identifying name given to the report.

Sub title is a secondary, usually explanatory title.

Data Selection Tab

Data selection enables the selection of the machines and measurement points to include in the report.

General Tab

General sets formatting rules for the report and selects types of machine information that should be included. Different types of lists, like alarm lists can also be included.

Content prints the “Table of contents” at the beginning of the report, if checked.

Machine data prints the extended machine information for each machine included in the report, if checked.

Notes includes all the notes related to the selected machines during the date/time range entered, if checked.

Overall level includes the overall value list related to the selected measurement points from the date/time entered, if checked.

Alarm list includes alarm information related to the selected measurement points during the date/time range entered according to the filtering option and status option, if checked.

Page break between machines forces a page break on the printout between machines, if checked.

Show report automatically when generating shows the report in the selected format after the creation of the report has been finished, if checked.

Send report to printer sends the report immediately to a printer after it has been created, if checked.

Keep temporary files keeps all the temporary files required for the creation of the report including pictures, if checked.

Diagram Tab

Diagram allows desired graph settings to be included in the report, to be selected along with date or value range.

Load template loads report settings.

Save template saves current report settings as a template.

Log Off

Log off logs the current user off and allows another user to log on to the system. Note that this option is not available (or visible) when Active directory authorisation is enabled, refer Security Roles.

Exit

Exit stops the current system session.

Edit

Edit Sub Menu	Function
Multiple point update wizard	Multiple point update wizard uses a sequence of four screens.
Workspace	Open, new, edit, remove.
Copy node (Ctrl+C)	Copy node.
Paste (Ctrl+V)	Paste.
Notes	Notes for/under the selected object.
Event cases	Event cases window for the selected object.
User preferences	With General, Diagram, Diagram colors, Toolbar buttons, Process overview sub tabs.
Properties	Properties for the selected object, sub tabs are object dependent.

Multiple Point Update Wizard

Refer to Multiple Point Update Wizard in System Configuration.

Workspace

Workspace interface brings up the workspace manager screen. A workspace is a specific part of the hierarchy that should be grouped together. For example, a workspace can be grouped by a user's responsibility. The workspace manager keeps track of all the workspaces in a database and can create new workspaces or edit existing ones. For portable data collectors, a workspace can be used as a way to define certain machines that the user needs to keep track of.

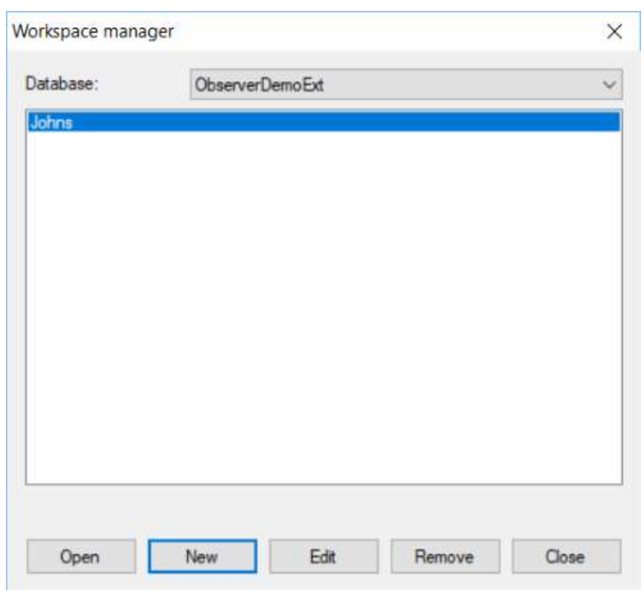


Figure 6 - 5
Example of Workspace manager

Database is where the workspace resides.

Open displays the selected workspace from the workspace manager screen in the workspace view of the tree view window. Only one workspace can be open at any one time so where there are multiple workspaces defined, this control selects which is the 'active' workspace, that is displayed.

New creates a new workspace.

Edit changes the currently selected workspace.

Remove can delete the workspace from the database.

Close the workspace manager window.

Editing a Workspace

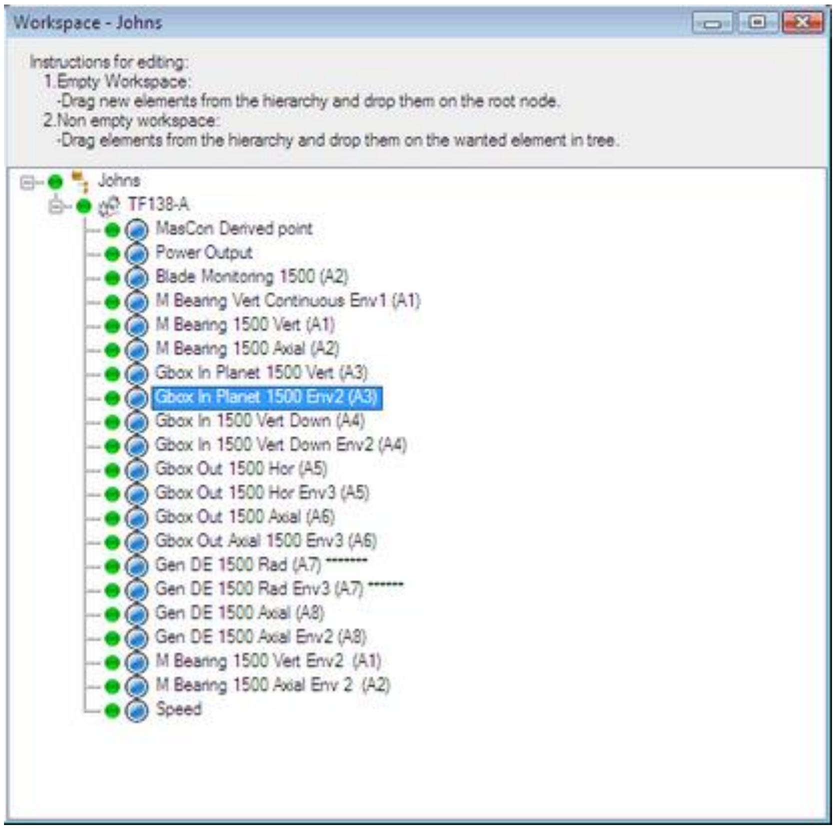


Figure 6 - 6
Example of Workspace

To configure the workspace contents, drag an element from the hierarchy view to the workspace on the location where the node should be positioned then drop it.

Available interfaces for different level of nodes are the same as in Hierarchy View.

Copy Node

Copy node (Ctrl+C) copies the selected node. If a machine or a sub machine is selected, the machine copy wizard will start and guide the copying process. Refer to Machine Copy Wizard in System Configuration.

Paste

Paste (Ctrl+V) pastes the copied node to the selected location in the hierarchy view.

Notes

This displays a list of notes for the selected object in the hierarchy. Refer to Notes in System Operation.

Event Cases

Event cases can be created in Observer to keep track and document reports, information and history regarding a specific event tied to a specific machine. Refer to Event Cases in System Operation section.

User Preferences

User preferences interface is where all the customised settings for the individual users are set.

General Tab

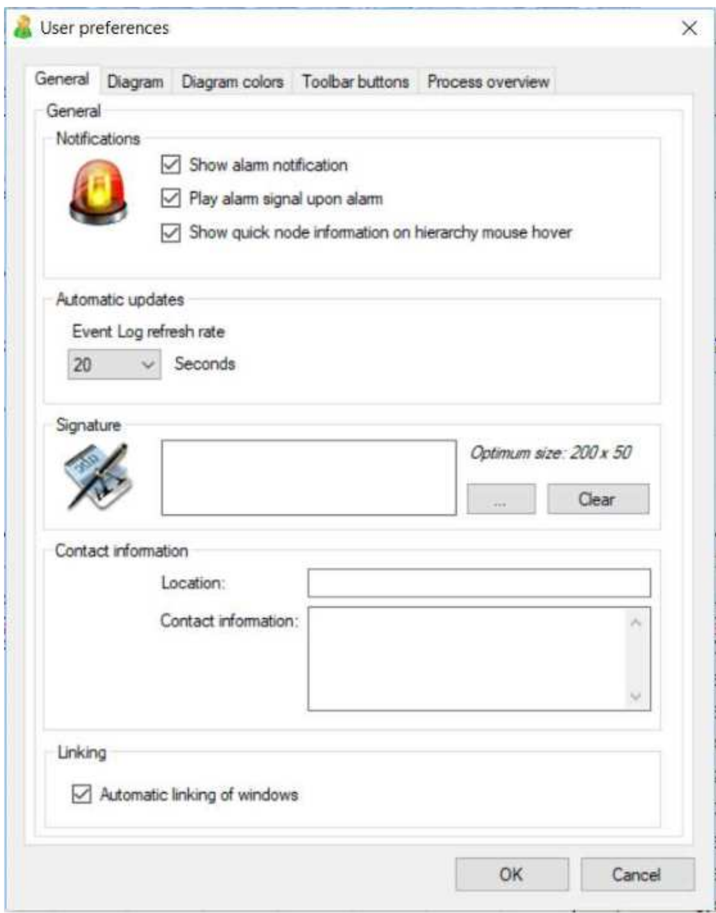


Figure 6 - 7
Example of User Preferences Settings, General Tab

Show alarm notification controls whether alarm notifications are enabled or not. When enabled an alarm event will trigger a new alarm or new system alarm pop-up to the lower right of the @ptitude Observer window and a flashing alarm icon on the top right.

Play alarm signal upon alarm triggers the sound through the speakers of the computer upon alarm, if this field is checked.

Show quick node information on hierarchy mouse hover enables the quick node pop-up information when hovering the mouse over a node in the normal hierarchy.

Event Log refresh rate is the rate at which the Event Log window is refreshed if it is open and the Auto refresh function is enabled. **NOTE**: If this setting is set too low, then it will cause tremendous stress to the application as well as database.

Signature allows an image of a handwritten signature to be added. This signature can be automatically added to event case report printouts.

Contact information sets the contact information for the user.

Linking, Automatic linking of windows is enabled by default and ensures that when any plots or linkable windows are opened they open linked to the hierarchy.

All plots and many other windows such as Notes, Alarm list, System alarm, Event cases and Maintenance overview are linkable so that whilst moving around the hierarchy the information displayed in the window remains relevant to the newly selected object. This includes maintaining plot cursors and cursor positions when moving between measurement points. Refer to the Link to hierarchy toolbar button for further information on enabling or disabling this functionality for the active or all open windows. When linked, this is indicated by including an indicative keyword or a path in the window name, example: *[Notes (Linked)]*.

Diagram Tab

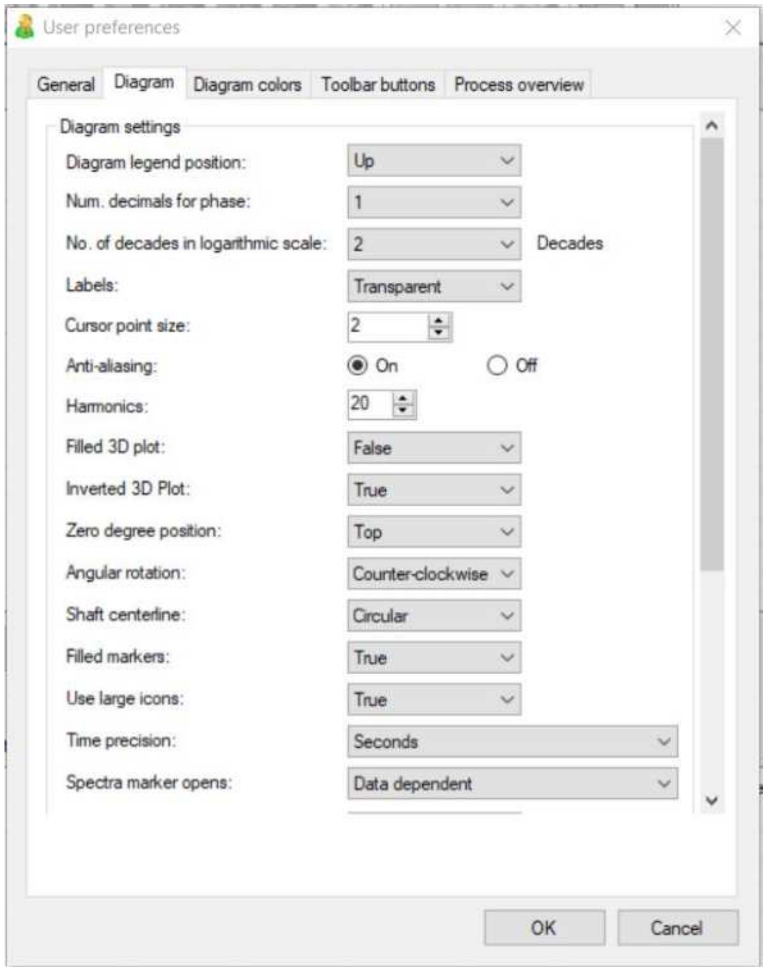


Figure 6 - 8
User Preferences, Diagram Tab

Diagram legend position sets the preferred position of the legend available in most graphs. Note that different legend positions are available for different types of graphs. If the specified position is not available for a particular graph then the software will choose and appropriately position it, automatically.

Num. decimals for phase sets the number of decimals to display for phase in the Trend, Polar and Trend List graphic displays.

No. of decades in logarithmic scale changes the way the logarithmic scale works for graphs. It can be between 2 and 5 decades.

Labels determines how to display labels in graphs. Labels can be set to be displayed as transparent as well.

Cursor point size sets the size of the cursor points for single cursors and other tools mostly for the phase spectrum and time waveform graphs.

Anti-aliasing determines if graphs should be displayed with smoothing (anti-aliasing) *On* or *Off*. Some users prefer to display graphics in any application as antialiased. However, in order to analyse data sometimes it is easier to detect a problem with anti-aliasing off.

Harmonics sets the number of harmonics for the harmonic cursor. It can be between 10 and 200.

Filled 3D plot

True fills the spectrum area as shown in the 3D plot graph display.

False makes the areas transparent.

Inverted 3D Plot inverts the depth scale of the 3D plot.

Zero degree position is the position of 0° in Polar type plots.

Angular rotation determines which direction of the angle increase in Polar type plots.

Shaft centerline determines if the shaft centerline plot should be visualized in circular or square format.

Filled markers shows the point markers as filled or transparent in some diagrams

True shows the point markers as filled, in some graphic displays.

False shows the point markers transparent, in some graphic displays.

Use large icons shows bigger icons if checked True. Otherwise, the system displays small icons.

Time precision sets the precision of the time displayed in the plots.

Spectra marker opens sets the preferred plot type to open when the user clicks the left mouse button on a ‘diamond’ marker in the trend plot. If the specific measurement does not contain enough information to render the preferred plot, the software will automatically choose the most appropriate plot. Right-clicking on the ‘diamond’ spectra marker in a trend plot allows the user to pick from a selection of plots to open.

Full spectrum sets the preferred spectrum mode when displaying spectra in the application. If set to ‘true’, the plot will open in Full Spectrum mode if the measurement and measurement point support it.

Background specifies a background image to be used for the graph or plot areas within diagrams.

Graph settings applies to sets the preferred scope of the graph setting changes. The default is *Everyone,* which shares the graph settings with all users. If set to *Just me*, then the graph settings are private and saved only for the current user.

Diagram colors Tab

Here are all the available colour options for the graph. All can be changed: from the background colour of the graph to the colour of tools.

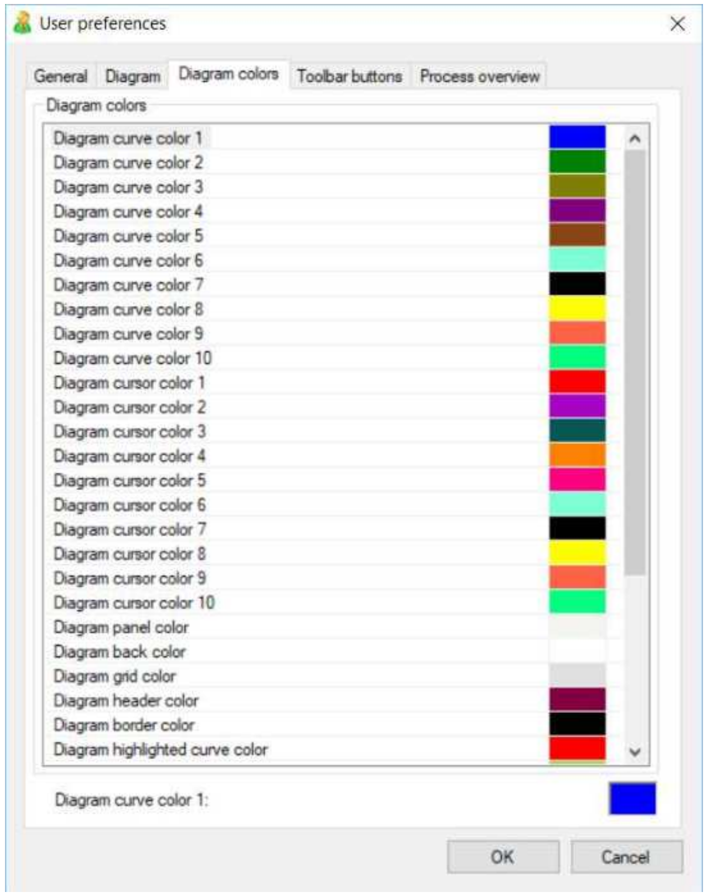


Figure 6 - 9
User Preferences, Diagram colors tab

6 - 14

Toolbar buttons Tab

This tab determines the toolbar buttons to be displayed.

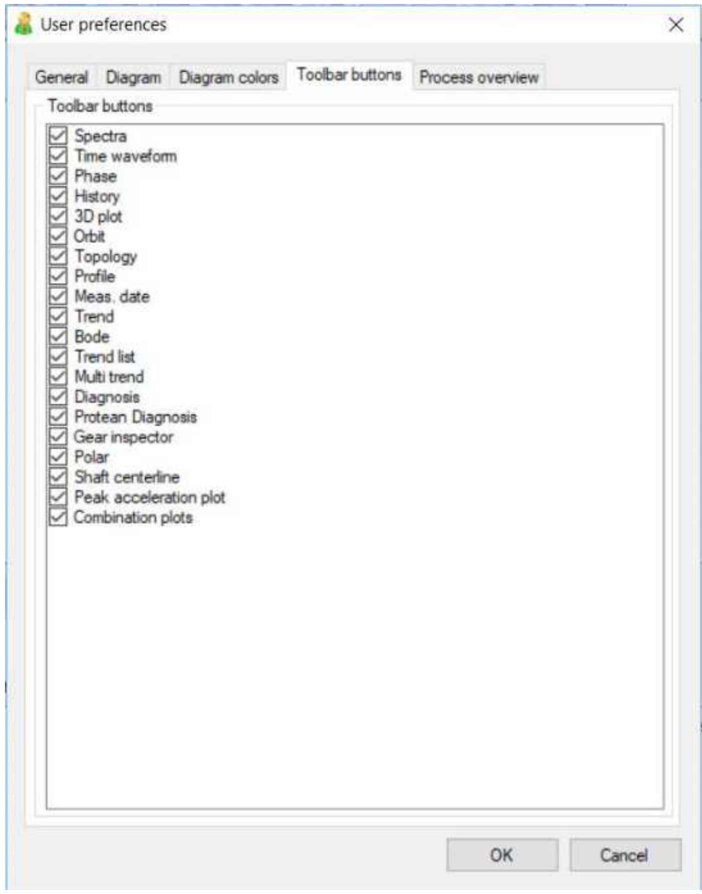


Figure 6 - 10
User Preferences, Toolbar Buttons Tab

Process overview Tab

Some of the Process Overview user preference settings can be customised, to enhance viewing the Process Overview. For example: by selecting to enlarge the icons, setting the update rate and changing the colours of the background and text. **User preferences** can be accessed from either **Edit > User preferences** or by right-clicking in the Process overview and selecting **User preferences**.

To customise the Process overview settings:

- In the **User preferences** dialog, click the **Process overview** tab to open it.

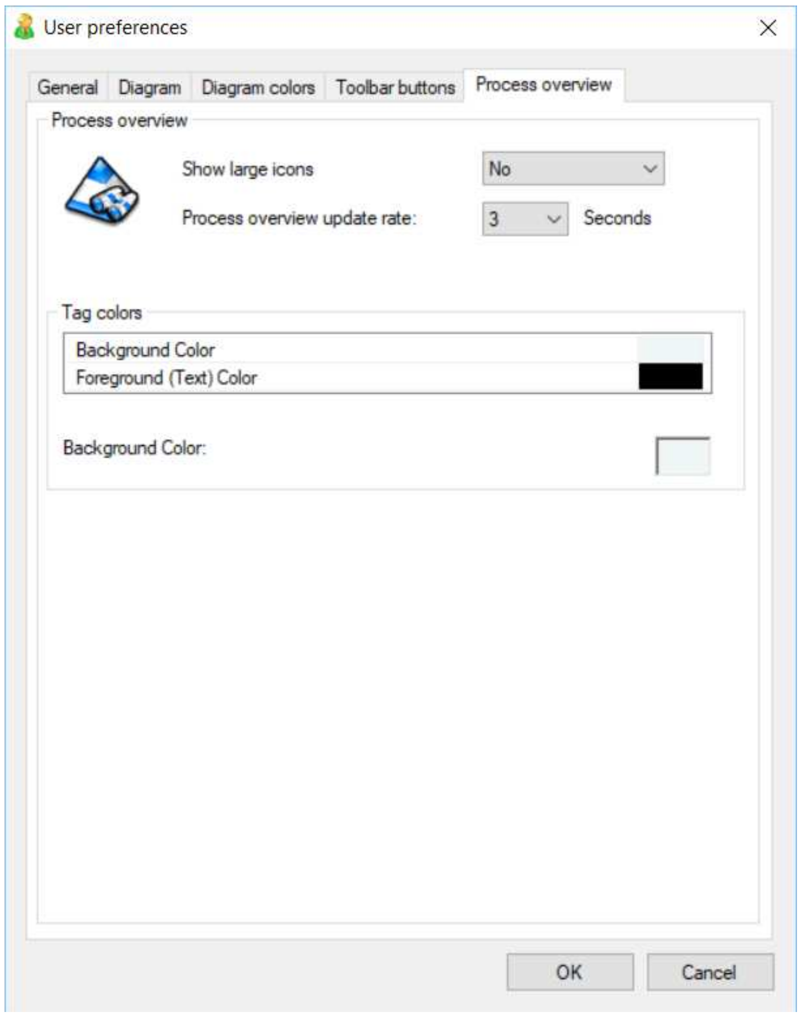


Figure 6 - 11
User Preferences, Process overview tab – changing text colour

- Selecting **Yes** for **Show large Icons**, will maximise the status icons. With this option, the status icons expand in size proportional to the overall size of the tag (details are presented below). If **No** is selected, the status icons remain normal size.
    - Note that the maximum size of a status icon is 100x100 pixels.

- **Process overview update rate** can be set between 1 and 30 seconds. This controls how often the data values in the process overview, are updated/refreshed.

WARNING! If this value is set too low, it will cause tremendous stress to the application as well as the database.

In the **Tag colors** section, the background colour or foreground text colour can be changed.

- Click on the text portion of the label **Background Color**. Notice that the label below for the picture box will then also say **Background Color**.
- Click on the picture box to open the **Color** control dialog.

Figure 6 - 12
Color control dialog

- Select the desired background colour and then click **OK** in the dialog. The colour in the picture box and in the color box of the **Background Color** row update to the selected colour.

Change the text colour in the same way:

- Click on the text portion of the label **Foreground (Text) Color**. Notice that the label below for the picture box will then also say **Foreground (Text) Color**.
- Click on the picture box to open the **Color** control dialog.
- Select the desired text colour and then click **OK** in the dialog. The colour in the picture box and in the color box of the **Foreground (Text) Color** row update to the selected colour.
- Click **OK** to save the new **Process overview** user preferences.

Back in the workspace, the tags will reflect the new background and text colour selections.

To manually enlarge the tags:

- If **Show large Icons** is set to **Yes**, select a tag and catch the corner(s) to manually enlarge it. Catch the lower right corner (a diagonal arrow appears) to enlarge the tag both vertically and horizontally. When an arrow appears at the bottom edge, the tag can only be stretched vertically and when an arrow appears at the right edge, the tag can only be stretched horizontally.
    - ➢ The maximum size of a status icon is 100x100 pixels.

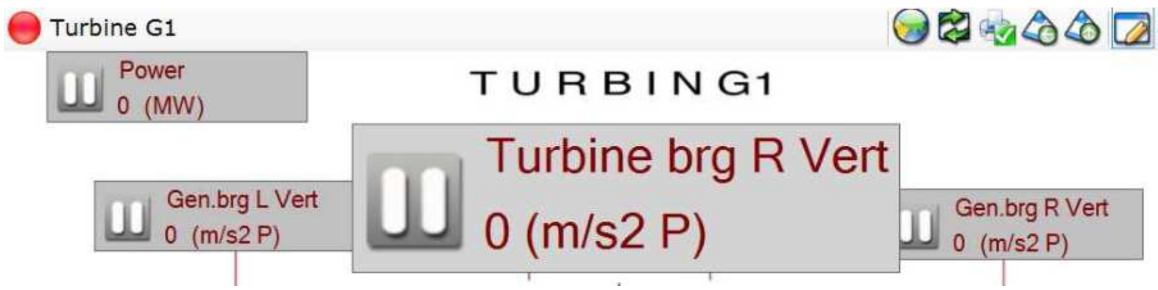


Figure 6 - 13
Example of an Enlarged Process Overview Icon/Tag

Properties

This interface provides properties of the selected item in the hierarchy view, system view or workspace view.

For measurement point properties refer to Setting up Measurement Points and Alarms in System Configuration.

For machine properties refer to Machine Properties in System Configuration.

For node properties refer to Node under Building a Hierarchy View in System Configuration.

For database properties refer to Add External Database under File in Menu Items.

Show

Show Sub Menu	Function
Tree view	Tree view shows or hides the tree view window.
Filter	Hierarchy view point filter.
Hierarchy	Hierarchy brings up the hierarchy view in the tree view window.
System	System brings up the system view in the tree view window.
Workspace	Workspace brings up the workspace in the tree view window.
Diagram View	Brings up a view of saved diagram boxes in the tree view window.
Alarm list	Alarm list.
System alarm	System Alarm.
Maintenance overview	Scheduled Maintenance tasks.
Message Center	Inter user communication.
Refresh	Refresh the current view.
DASHBOARD	Dashboard.

Tree View

Tree view shows or hides the tree view window containing, for example, the hierarchy, system, workspace and diagram views. Refer to Tree View in System Operation. Hiding the tree view window provides more area available for graphs on the screen.

This interface can also be accessed by clicking on the **Show tree view** icon on the toolbar.

Filter

This interface filters the hierarchy view according to the specified rules.

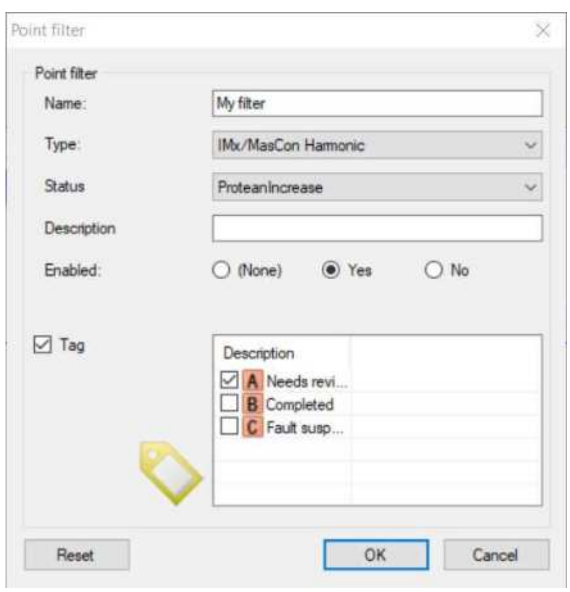


Figure 6 - 14
Point Filter

Name is the name of the filter.

Type is the type of points to be included, selected from the drop-down list.

Status is the status of points to be included, selected from the drop-down list.

Description is a description for the points included.

Enabled is used to filter based on the point's enabled state.

None displays all the points regardless of their enabled state.

Yes displays only the points that are enabled.

No displays only the points that are disabled.

Tag is used to filter by the selected tag(s).

Reset sets filter settings back to the system generated settings.

Alarm List

Alarm list interface brings up the alarm list for the selected item in the hierarchy view and displays all the alarms under this item and sub-items in the alarm list. The alarm list can also be opened by clicking on  **Alarm list** icon on the toolbar.

Filter

List filtering by acknowledge status and time range:

Not acknowledged: the alarms that have not been recognized and not analysed by any user yet.

Acknowledged: the alarms that have been acknowledged by any user.

All: all alarms regardless of the acknowledgement status.

Interval

A time range selection with these options available on a drop-down:

All, *Last day*, *Last week*, *Last month*, *Last year*.

Print prints the alarm list.

Export allows the list to be saved in a spreadsheet format.

Acknowledge

Acknowledge related button functionality is described below but all acknowledge buttons include both a button and drop down functionality. In each the drop-down allows for an 'Acknowledge with comment' function where the user may add a free text comment of up to 500 characters to associate with the acknowledge action.

Acknowledge all acknowledges all the alarms. This button is disabled if the list is empty or the *Acknowledged* filter is being used.

Acknowledge acknowledges only the selected alarm(s). This button is disabled if the list is empty or the *Acknowledged* filter is being used.

To reload the alarm list, click the **Refresh** icon on the toolbar or use Show > Refresh from the menu bar.

The **Alarm list** can be sorted by any column.

Note that to avoid 'information overload' when alarms of the same type but different severity occur at the same time, with the same time stamp, then only the highest severity is stored. For example, a coincident Alarm and Warning would exclude the warning.

System Alarm

The System alarm interface shows measurements out of range and system related alarms such as defective sensors, cables, etc. In addition, the @ptitude Observer Monitor start-ups, IMx-1 system issues and a loss of contact between an IMx/MasCon device and the @ptitude Observer Monitor are registered as well. This is a good place to start for troubleshooting a hardware error but be aware that if Linking is enabled certain types of system alarm, not having a relationship to a specific location in the hierarchy, will only be visible when the top level node of the database is selected.

System alarms are categorised into 'Normal' system alarms and 'critical' system alarms. The critical system alarms are more severe and require more urgent attention from the user than normal system alarms. If a critical system alarm is registered in the system, the system alarm icon in the toolbar will start blinking to attract attention.

Upon opening the system alarm list, two separate lists are displayed: at the top **Critical system alarms** and below **System alarm**. Each can be sorted by any column.

The attributes of the controls on the system alarm screen are the same as in the Alarm List above but noting that **Critical system alarms** can only be acknowledged individually.

Maintenance Overview

 Maintenance overview interface enables review of the maintenance tasks scheduled in the future. Maintenance tasks can be reviewed irrespective of whether they have been notified but not yet actioned or they are overdue. A description of how to set maintenance tasks is found in Maintenance Planner under System Operation section.

Message Center

Message Center interface enables the user to send/receive messages to/from other users within Observer. This can be a helpful tool for those who work in the same database to notify and communicate with each other.

Refresh

This interface forces a refresh of the hierarchy view, system view or workspace view. Refresh can also be accessed by clicking the **Refresh** icon on the toolbar.

DASHBOARD

"DASHBOARD" screen provides Notifications, News Feed and Message Center interfaces which can be navigated by clicking on icons in the upper right-hand corner of the dashboard screen.

Notifications displays any notifications that the user should be aware of.

News Feed informs users of new features in the currently released version. It is also accessible via News in Observer under Help menu tab.

Message Center enables the user to send/receive messages to/from other users within Observer. It is also accessible via Message Center under Show menu tab.

First time access to Dashboard displays Notifications.

The subsequent access to Dashboard displays one of three above interfaces that has been accessed most recently.

Database

Database Sub Menu	Function
Security roles	Predefined and custom security roles.
Users	Add, edit, delete users and access session logs and User, notifications subtabs.
Database information	Database information.
System log	View/print a list of configuration changes.
Pictures	Add, edit, remove and export pictures.
Diagnosis	Manage Diagnoses.
Libraries	Manage various types of libraries.
Export	Export data or structure from the database.
Import	Import data or structure to the database.
Alarm group	Create new, edit or delete an alarm group.
Measurement groups	Simultaneous, transient, event capture, run cycle capture & scheduled capture groups.
Options	Settings sub tabs for General, Data, E-mail, Monitor service, Backup, Alarms and Device.
Delete data	Delete measurement data based on certain criteria or filter settings.
Data miner	Data mining from the Observer database.

Security Roles

Security roles are configured groupings of user rights. User rights are privileges of the user. Privileges are/should be assigned according to the role. The following security roles are available in @ptitude Observer and are listed here by their Active directory ranking or priority:

Table 6-1.
Security roles

Rank	Name	Comment
1	{Administrator}	Full administrative rights: highest ranking/priority
2	{Asset Owner}	Total system view including status and alarms
3	{Analyst}	Full analysis and measurement configuration rights
4	{Machine operator Level 1}	Process overview only
5	{Machine operator Level 2}	Process overview, view data and acknowledge alarms
6	{Machine Data Collector}	View data, acknowledge alarms, data transfer to/from portables
7	{Maintenance Engineer}	Full analysis and measurement configuration rights
8	{Maintenance Manager}	Full administrative rights
9	{Rail Track Monitoring Web View}	Rail Track Monitoring view rights via Phoenix web API
10	{Rail Track Monitoring Web Edit}	Rail Track Monitoring edit rights via Phoenix web API
11	'Custom' – user provided name	Custom roles are distinguished by the name given to them, not being enclosed in brackets: {}.

In the **Security roles** dialog, select a Security Role **Name** from the list of available roles to view the allocated rights and use the dialog's **Edit**, **Delete**, **Copy** or **Add** buttons to manage the security roles.

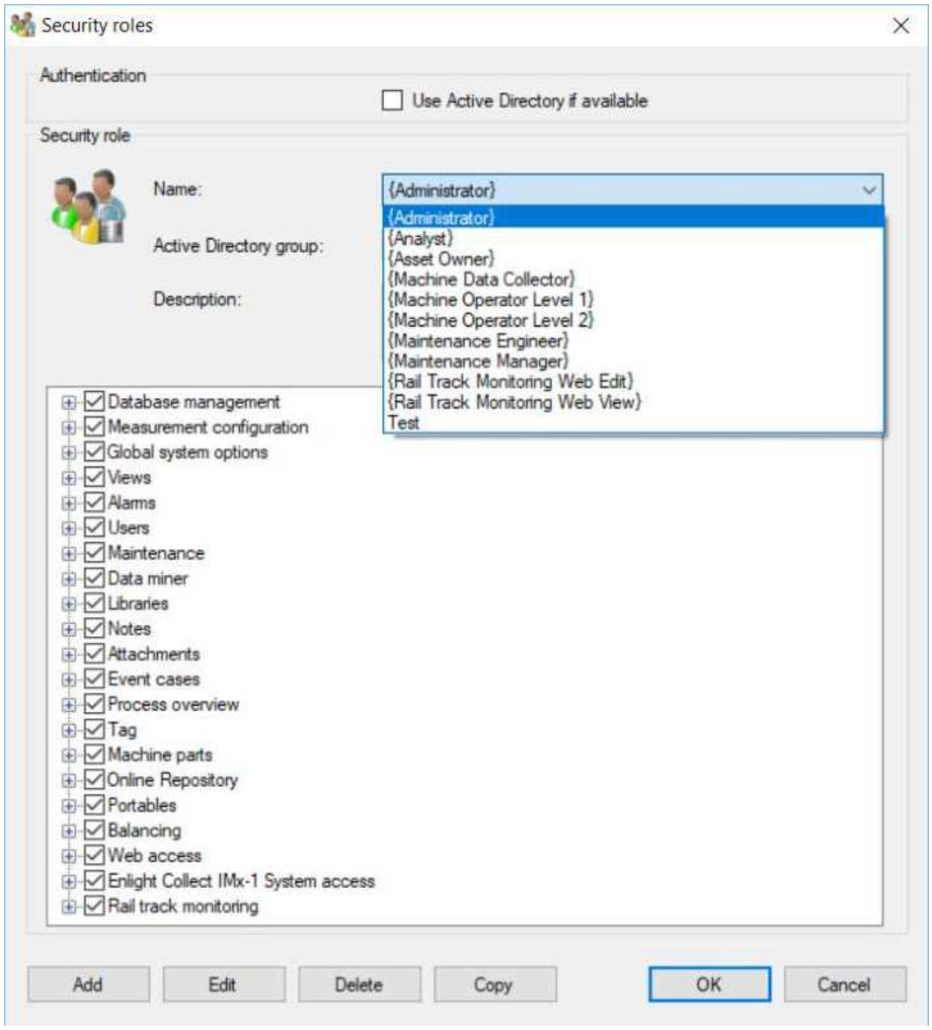


Figure 6 - 15
Security Roles Dialog

- Every user must be assigned to a security role to access the system, see Configuring a User.
- Security roles that are predefined in @ptitude Observer cannot be edited except for **Active directory group** naming. Predefined roles are designated by the role name being enclosed in brackets { }.

  In the example above notice that 'Test' is a custom role and therefore can be edited.

When selecting or configuring a security role consideration should be given to the complete package of user rights. For example, the role "Machine Operator Level 2" has the "Enlight Collect IMx-1 System access" right but otherwise the role has very limited rights. This would make it suitable for someone carrying out IMx-1 system commissioning with the app but not IMx-1 system configuration and maintenance, within @ptitude Observer.

For an explanation of the controls provided in the dialog to support Active directory authentication and the differences between @ptitude Observer internal and active directory user authentication refer Logon.

Users

This menu item brings up the Users dialog:

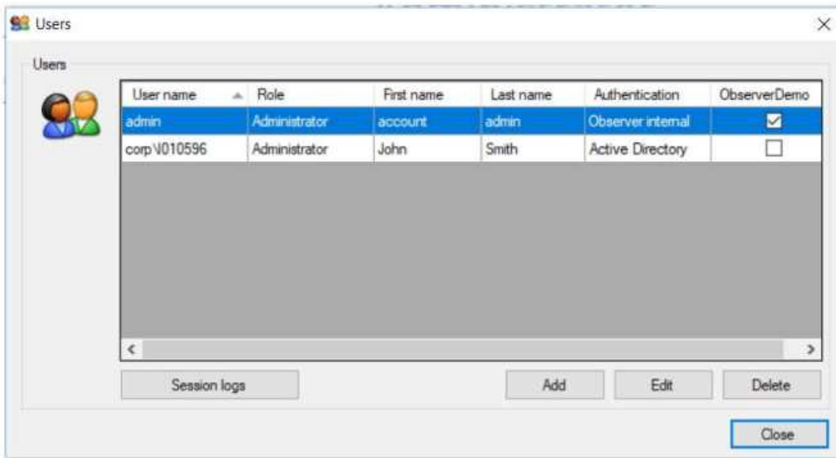


Figure 6 - 16
Example of Users Dialog

This displays existing users and via **Session logs**, the session history for each user and which users are currently logged in. Those with rights to configure users, will also be able to **Add** new and **Edit** or **Delete** existing, Observer internal authenticated, users. Note that individual 'Active Directory' authenticated users are not managed within @ptitude Observer, as these entries just reflect the active directory information read by @ptitude Observer at start-up, refer User authentication using Active Directory groups. It is possible however to edit Notifications tab settings for any user, whatever the authentication method.

The last column in the figure above, headed in this instance 'ObserverDemo', is visible because that is the name of an external database that has been added. The column is indicating which of the users also have access to that database, refer also Configuring a User.

Viewing Session Logs and Current Users

Click the **Session logs** button to view the session history. This provides a quick overview of who was on the system and when.

- Only users of the default database are included; the users of external databases are not listed.

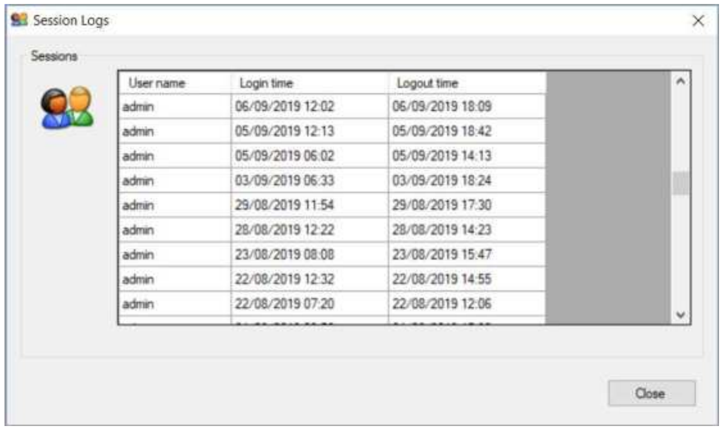


Figure 6 - 17
Example of Session Logs Dialog

The **Session Logs** dialog contains a read-only list of all the sessions (User name, Login time, Logout time, if any) for all users of the default database - even users who may have been deleted. It is sorted by **User name** (ascending) and **Login time** (descending). Note that if the **Logout time** is blank, then the user is considered to be logged in. If the user does not logout, via a session log out or normally exiting the program, the Logout time will be blank. This will occur if the application closes abnormally.

To see a list of users who are currently logged into the default database, click **Current users** on the right of the, lower window edge, toolbar strip.

Figure 6 - 18
Current Users on the Toolbar Strip

The **Current users** dialog opens:

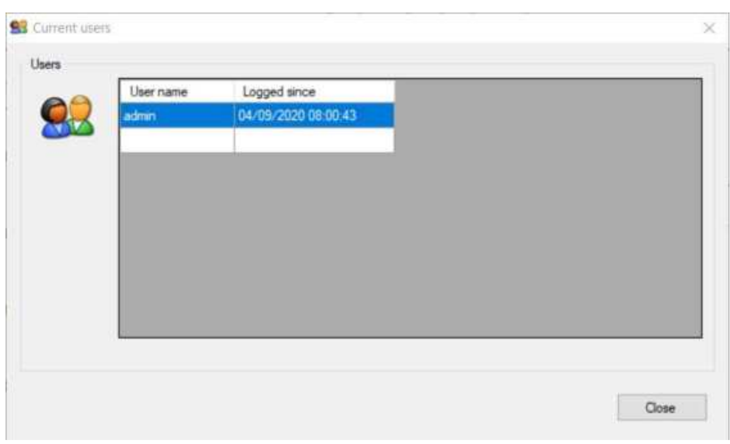


Figure 6 - 19
Example of Current Users Dialog

The **Current users** dialog displays a list of all the users who are currently logged in to the default database and when they logged in.

Configuring a User

Figure 6 - 20
Example of User Configuration

Note that this applies only to @ptitude Observer internally authenticated users. In the case of active directory authenticated users no configuration of the **User** tab is possible and all fields are read only.

User Details

User name is the login name of the user.

Password sets the password. User passwords are case sensitive.

Security role specifies the security role of the user.

First name is the user’s real first name.

Last name is the user’s real last name.

E-mail is the email address that will be used for notifications and/or status information selected.

External database is used to also grant access to the selected external database(s).

Notifications Tab

Send Alarm notifications lets the user receive periodic emails about alarms whenever alarms are available at a system configurable interval. The alarm report interval is set at E-mail settings tab within Options interface under Database.

Send System alarm notifications lets the user receive periodic emails about system alarms whenever system alarms are available at a system configurable interval. The alarm report interval is set at E-mail settings tab within Options interface under Database.

Send Monitor service status information lets the user receive periodic emails about the condition and status of the monitor service in addition to database condition. The status report interval is set at E-mail settings tab within Options interface under Database.

Format offers three different types:

HTML can be used if the email provider supports displaying HTML emails.

Plain sends the email as plain text completely unformatted.

Truncated minimises the size of the email (it also contains less detail). This is especially useful if the emails are being forwarded to a mobile phone as SMS.

Use Custom Topic is a specific topic which will be used whenever the system delivers the selected notification(s) to the user. This is useful when a user has an email provider who offers a phone number recognition as the topic, for example "+46 070 XXXX XXXX". In such a case, if the user sets the Custom Topic to "+46 070 XXXX XXXX", the email notification(s) will be automatically forwarded to the specified number as SMS.

Database Information

Database information provides detail information on the SQL server database status.

To get to the database information screen:

- Click on **Database** on the toolbar, then select **Database information**.

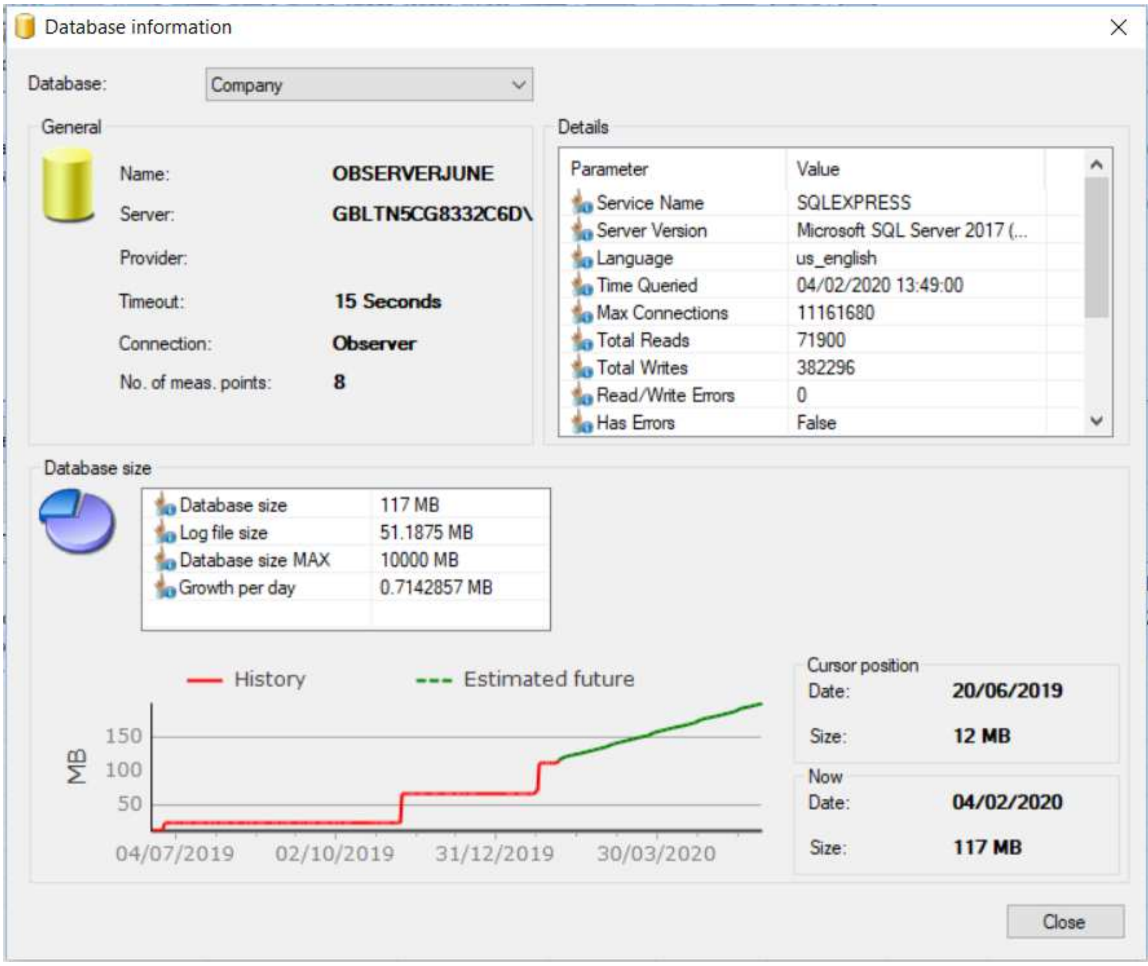


Figure 6 - 21
Example of Database Information

The database information displays the following:

- Current database situation of the selected database.
- Historical database growth trend with a predictive future trend if using on-line systems with @ptitude Observer Monitor.
- In-depth information about the SQL server operations.
- Memory information about the local computer.
- The total number of measurement points in the database.

System Log

The system log provides a list of the configuration changes made to the system. It includes changes to all types of measurement points, channels and IMx/MasCon, Direct Modbus or Enlight Collect IMx-1 devices. The list can be filtered by database, object type and (change) type. When selecting a list entry, the lower **Description** area will ‘echo’ the description column.

Many of the dialogs related to measurement point or device properties incorporate a **System log** button. Clicking on this will directly launch a system log window pre-filtered for that particular measurement point, IMx-1 measurement cluster, IMx/MasCon, Direct Modbus or Enlight Collect gateway device. For an IMx-1 System note the following:

- The IMx-1 sensor is categorised as a Data Acquisition Device ‘DAD’, it has a cluster of measurement points and gateways have their own object type.
- Renaming the sensor will not generate a ‘DAD’ change but will spawn 4 changes in the measurement point naming.
- Opening the system log from the, hierarchy, IMx-1 sensor and measurement properties dialog sets the filter to Meas. point so no ‘DAD’ changes will be visible unless that is changed.
- Opening the system log from the IMx-1 system view, IMx-1 sensor properties dialog sets the filter to ‘DAD’ so no ‘Meas. point’ changes will be visible unless that is changed.

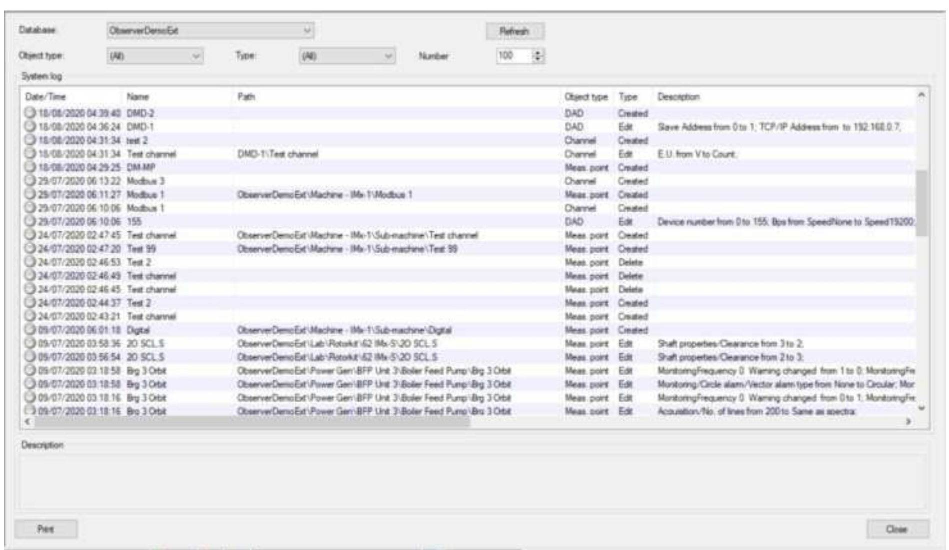


Figure 6 - 22
Example of System Log

Pictures

Pictures interface provides the capability to manage the pictures stored in the database. Pictures can then be used to support notes, provide process overview and graph display backgrounds.

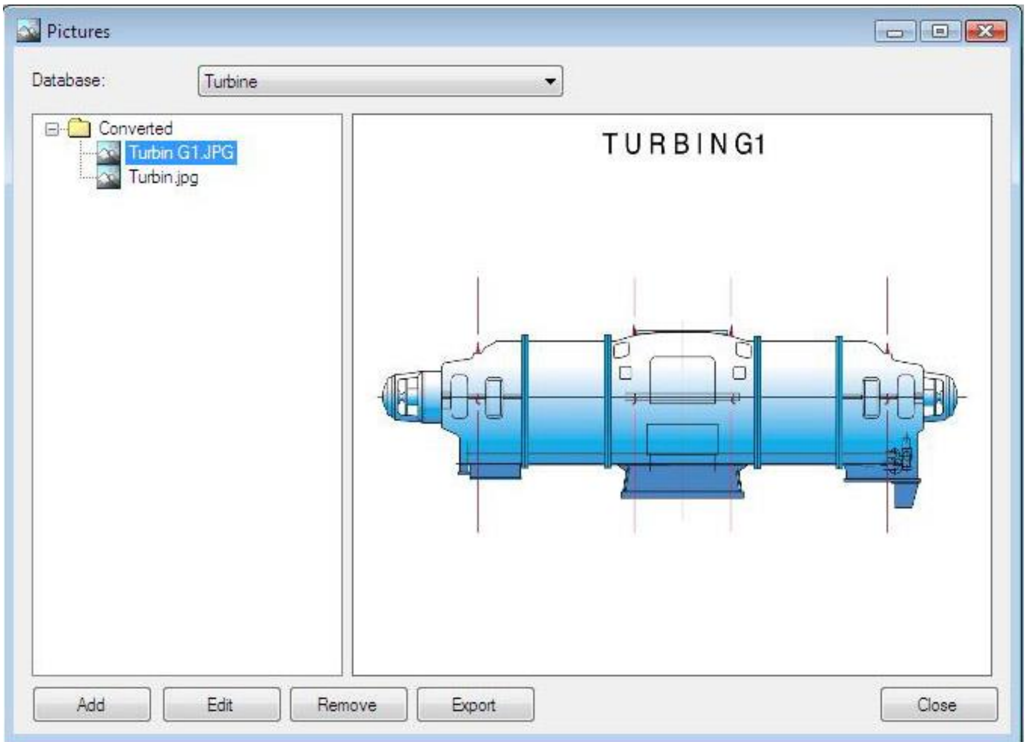


Figure 6 - 23
Example of Pictures Interface

Database is where the pictures reside.

Add allows adding pictures to the database to be used for display purposes.

Edit replaces the current picture by another one.

Remove allows removing the selected picture from the database.

Export allows exporting the selected picture to a selected path. It can be used to transfer pictures between databases.

Diagnosis

Diagnosis rules

When manually analysing spectrum data, it can be difficult to identify which machine part causes a particular frequency of vibration. To make this analysis easier, the system supports ready-made formulas which link frequencies and harmonics to the machine part and underlying cause of the vibration. In @ptitude Observer these formulas can be associated to a machine, via the Machine Properties > Diagnosis or Protean Diagnoses tabs and they allow the system to automatically and intelligently diagnose machines and machine parts for possible fault modes.

The machine diagnostics are built from a specific set of rules called ***Diagnosis rules***. There are three types of diagnosis rule:

Standard defined by SKF and used for Diagnosis

Protean defined by SKF and used for Protean Diagnoses

Custom that are user defined and can be either 'Standard' or 'Protean'

These are managed independently for each **Database**, selected via the drop-down.

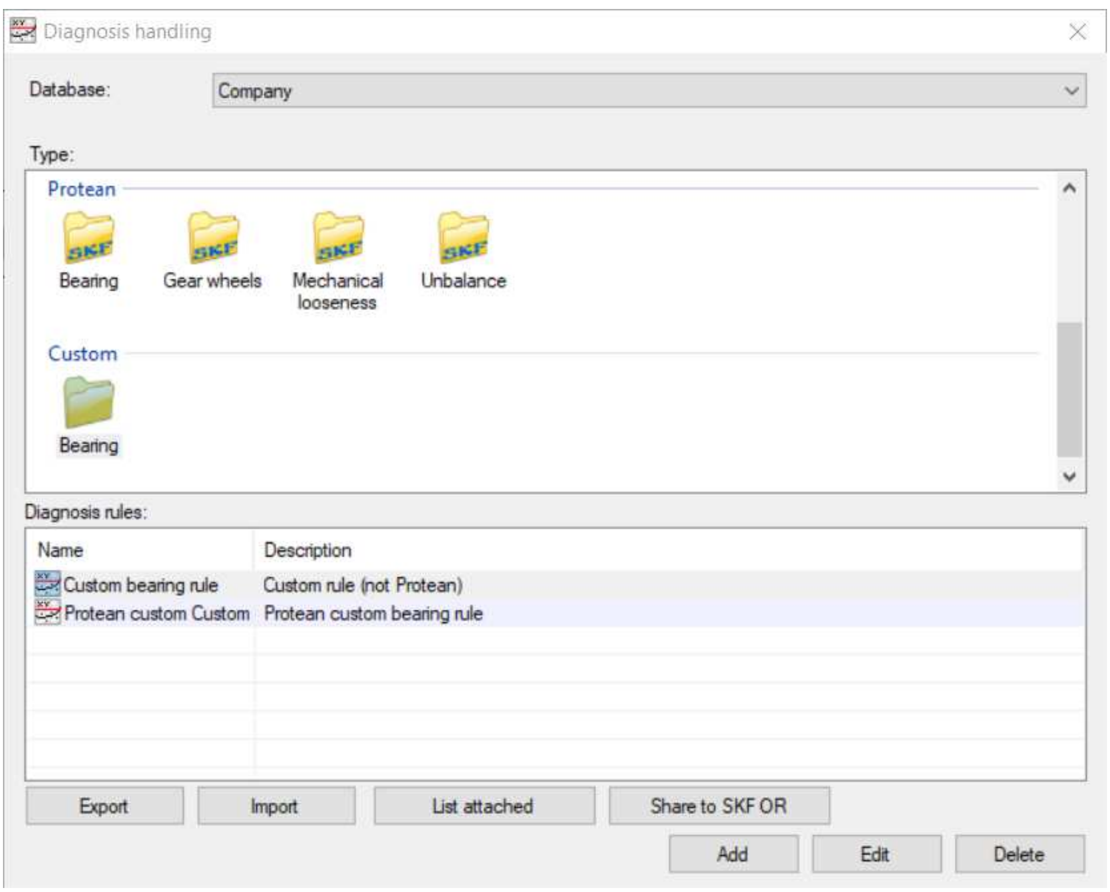


Figure 6 - 24
Example of Diagnosis rules

Export saves the selected rule to a local file. Only custom rules can be exported.

Import imports a rule to the **Custom** folder. The type of file that can be imported is .omdef, Observer Machine Diagnose Export Format.

List attached displays a list of any attached diagnosis in the system built from the selected rule, excluding any made **Private**.

Share to SKF OR is for sharing the selected rule with SKF Online Repository users. Only custom diagnosis rules can be shared.

Add / Edit / Delete provides access to create / change configuration / delete a custom rule.

Creating a custom rule

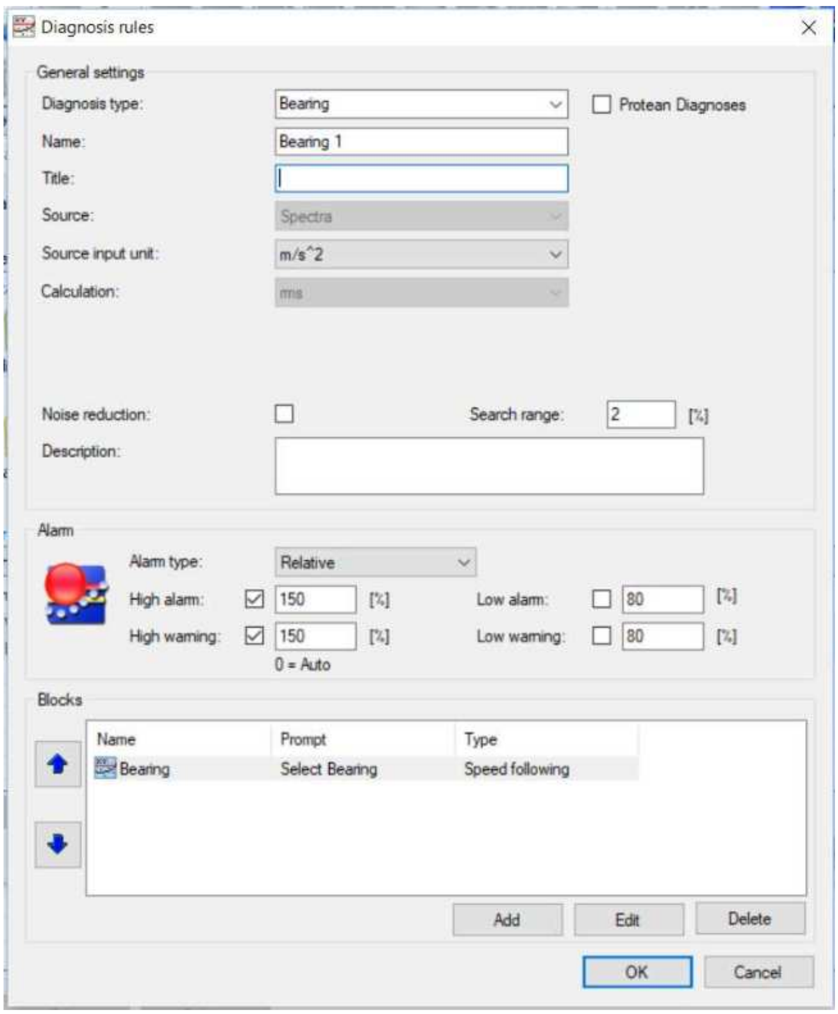


Figure 6 - 25
Example of Creating Custom Diagnosis Rule – Calculation type rms

Diagnosis type is the categorisation type (the fault type or machine part it is commonly applied to).

Protean Diagnoses tick box selects whether this is to be a custom Standard or custom Protean diagnosis rule.

Name is a user defined name to use for this rule.

Title is displayed for all measurement points that implement this particular diagnosis.

Source Input Unit defines the units in which this diagnosis should be trended.

Type selects a type of data upon which the calculation is based.

Calculation:

rms calculates the RMS value for the selected frequencies.

Sum calculates the sum of the selected frequencies.

SumRSS is as Sum but when selecting the peaks and calculating their values three spectral lines, rather than a single line, are taken. The additional two lines are the ones immediately above and below the peak.

% of Overall calculates the RMS of the selected frequencies and divides it by the overall.

% band takes the value calculated from Blocks, described below, and divides it by the value calculated for the selected band, showing the result in percent.

% speed following manual band takes the Block calculation result and divides it by the calculated value to get the relative percentage value.

% speed following automatic band differs from 'manual' in that the frequency range used to calculate the divisor value is automatically set at 5% below the lowest frequency used by the rule to 5% above the highest.

Peak counter counts the number of peaks in the selected frequencies.

Frequency finder finds the highest peak and trends its frequency.

Examples for two of the calculation types are shown in the figures below:

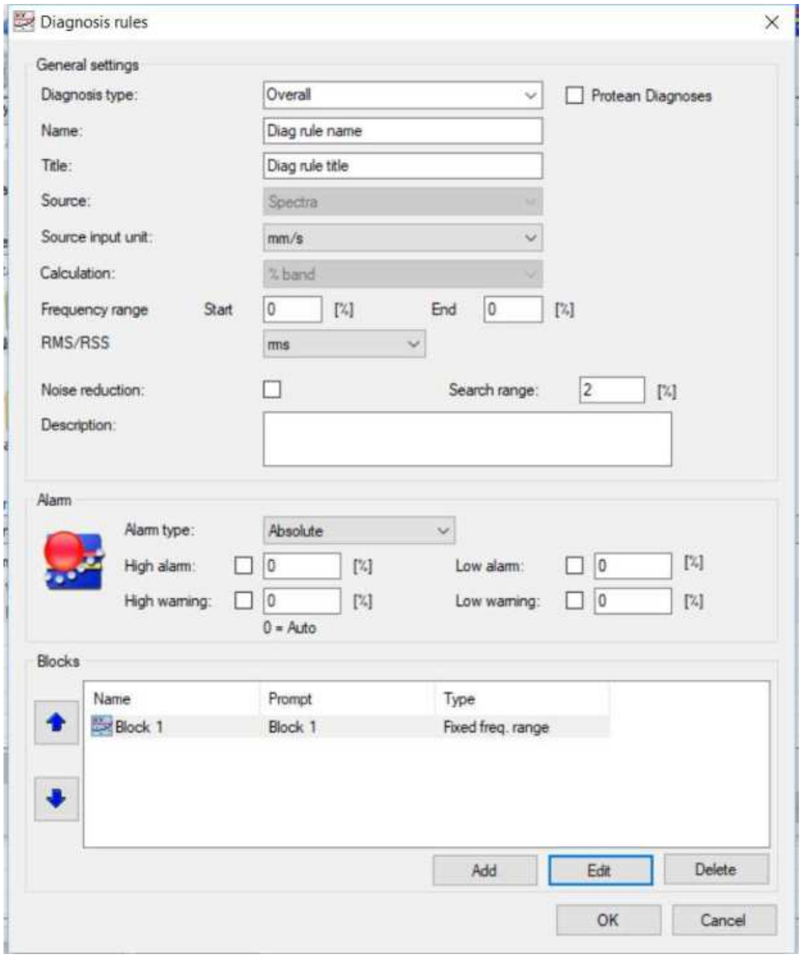


Figure 6 - 26
Diagnosis Rule Setup for % Band

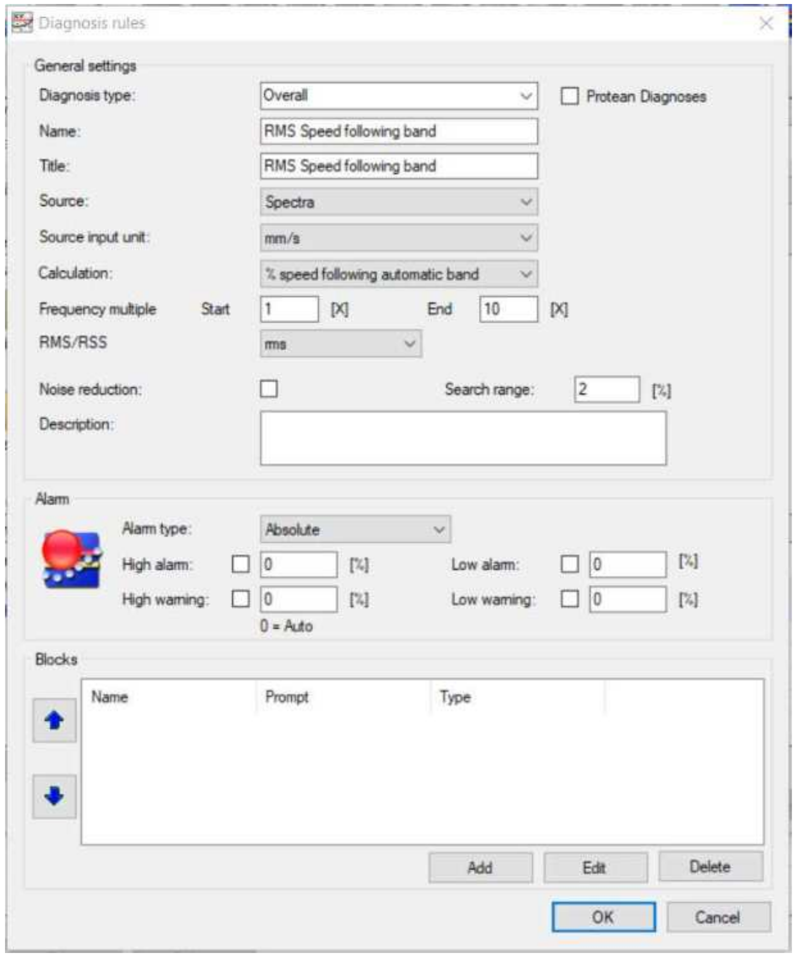


Figure 6 - 27
Diagnosis Rule Setup for % Speed Following Band ('automatic' band shown)

Frequency range for the calculation must also be set when using *% band overall* or a type of *% speed following band*. For *% speed following band* (choice of two types manual and automatic), the frequency range is entered as a multiple of the speed.

RMS/RSS specifies the calculation type to use with % band overall or % speed following band. All added Blocks are calculated using either the selected RMS (root mean squared) or RSS (root sum squared) method. Both methods use the same RMS formula, but the RMS method uses one spectrum line for the peaks in the Block, where the RSS method calculates peaks with spectra lines line -1 to line +1 around the peak so that three spectra lines are used.

Noise reduction applies a filter that removes the noise from the spectra before the calculation begins, if checked.

Search range performs a search for maximum amplitudes within this range.

Description briefly describes the diagnosis. It is recommended but not mandatory when creating customised diagnosis rules.

Alarm type sets the alarm for the diagnosis. Note that the **Alarm** settings area is not used for Protean Diagnoses rules.

Absolute means that the alarm values are set in engineering units.

Relative means that the alarm levels are set in percent of a baseline level. The baseline level is calculated based on a number of historical values.

Alarm/Warning sets the default alarm/warning levels. Setting the alarm/warning levels to zero enables automatic alarm/warning settings and @ptitude Observer will adjust the alarm/warning levels when new data arrives. After five measurements have been taken, @ptitude Observer will save the alarm/warning levels.

Blocks are different types of frequencies used in the calculation. Use the arrow buttons on the left side to rearrange the order of the blocks. Blocks can be added, edited or deleted.

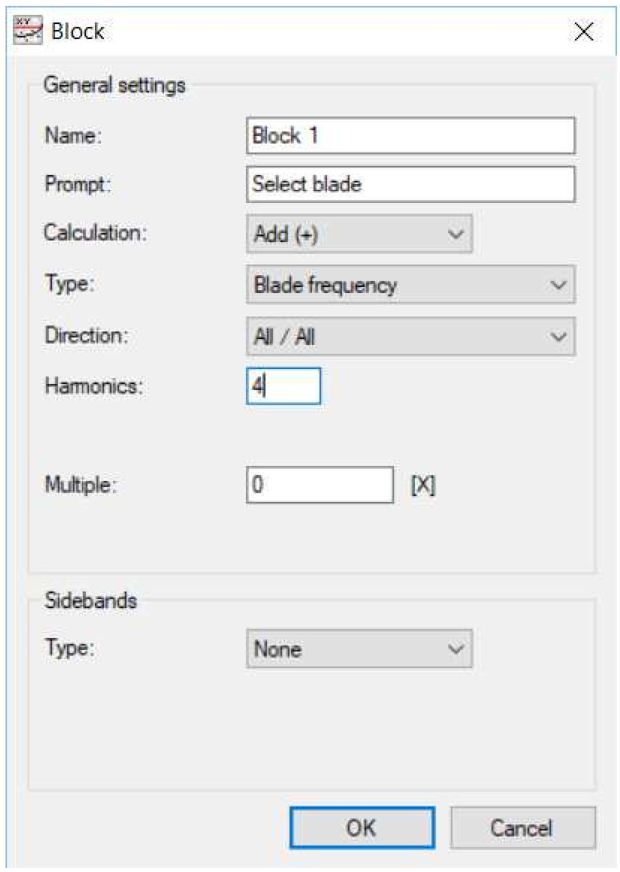


Figure 6 - 28
Example of Diagnosis Block settings

Name is the name of the block.

Prompt is what to ask the user when attaching the diagnosis. If *prompt* is the same on the other blocks the user will only be asked once.

Calculation can add and subtract frequencies from the calculation or zero out by setting the amplitude for the selected frequency to zero.

Type is the type of frequency or which frequency to use. Based on the selection made, different parameters appear.

Direction specifies in which direction the data should be calculated.

Harmonics specifies the number of harmonics that should be included in the calculation.

Multiple is the number to multiply the frequency. Default is 1.

Frequency specifies the frequency in cpm (cycles per minute) that should be monitored.

Sidebands Type selects the sidebands type.

Note: to select which *diagnosis rules* to attach to a specific machine as a diagnosis or Protean diagnoses, refer to Machine Properties.

List diagnoses that need attention

This option lists all attached diagnoses that are incorrectly configured for the entire database. There are a few reasons why this could happen and one of the most common reasons is that a machine part that a specific diagnostic is using for its calculation, has been deleted or removed from the machine. The system does not know how to calculate the diagnostics and now it is flagged as a diagnosis that needs attention by the user. Click on the edit button to reconfigure any diagnosis that needs attention.

Libraries

Libraries Sub Menu	Function
Bearing library	Manage the bearing library within an @ptitude Observer database.
Report library	The report library contains standard layouts for event case reports.
Receivers	This maintains a list of potential receivers and their contact details.
Tag library	Manages customised tags.
Data tagging group	Allows a user to create, edit or delete a data tagging group.
Machine template library	Manages the machine template library.
Create machine template	Adds a new template to the machine template library.

Bearing library

Bearing library manages and allows access to the information held on any of the listed bearings. When building machine parts, the system only allows for the selection of a bearing available within a database. However, user defined bearings can be added to the system.

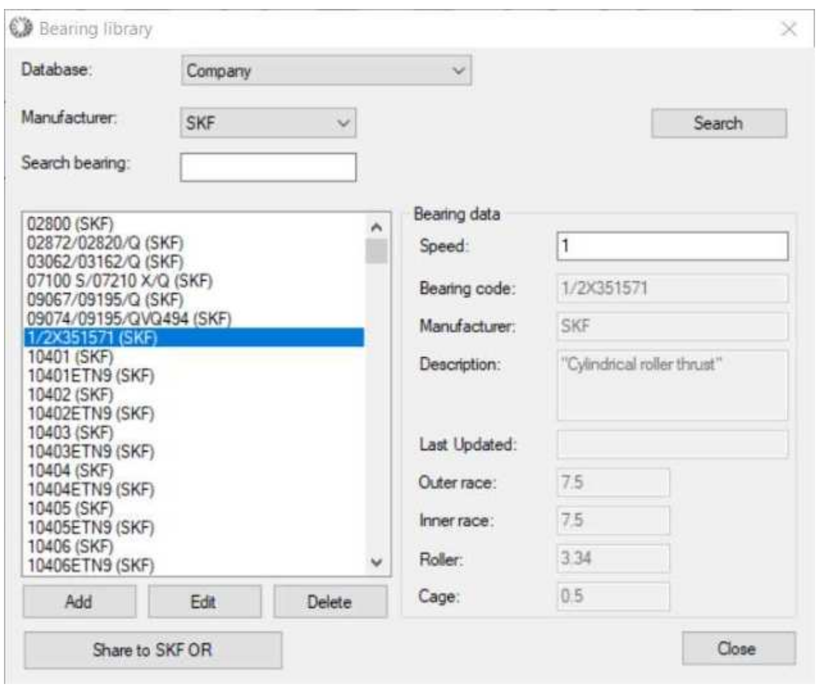


Figure 6 - 29
Example of Bearing library

A bearing library contains the bearing data used in diagnosis and frequency calculations in @ptitude Observer. This makes it easy to identify and detect bearing defects and damage. As part of the descriptive data, 'Last Updated' information is available. Note, as shown above, this field will be blank when no new date is available for a specific bearing in the library.

Report library

The report library contains standard layouts for event case reports. New layouts for event case reporting can be added and existing layouts can be edited or deleted.

New layouts for use in the event case reporting interface are designed with crystal reports software: this is available for purchase at many software vendors.

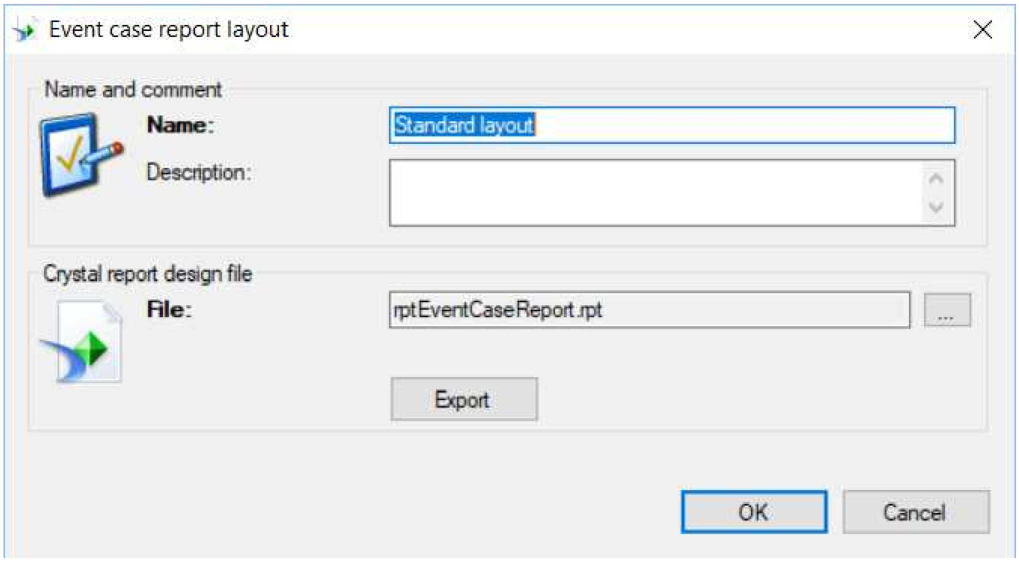


Figure 6 - 30
Example of Event case report layout

Name for the layout.

Description for the layout.

File is the Crystal report, design, file (.rpt) to use for the layout.

Export allows the that file to be saved to a user chosen location.

Receivers

The Receivers dialog is used to manage a list of potential receivers for the selected database. This list is available when selecting a receiver for Notes, when setting a contact person for a machine in its Extended information tab etc.

Tag library

In Observer it is possible to “tag” measurement points or machines with specific customised tags. These tags are configured in the tag library. There can be several tags configured in the library, ranging from A to Z. When configuring a tag, a letter (A to Z) that should be used as a graphical identifier of the icon and the colour of the icon, can be chosen.

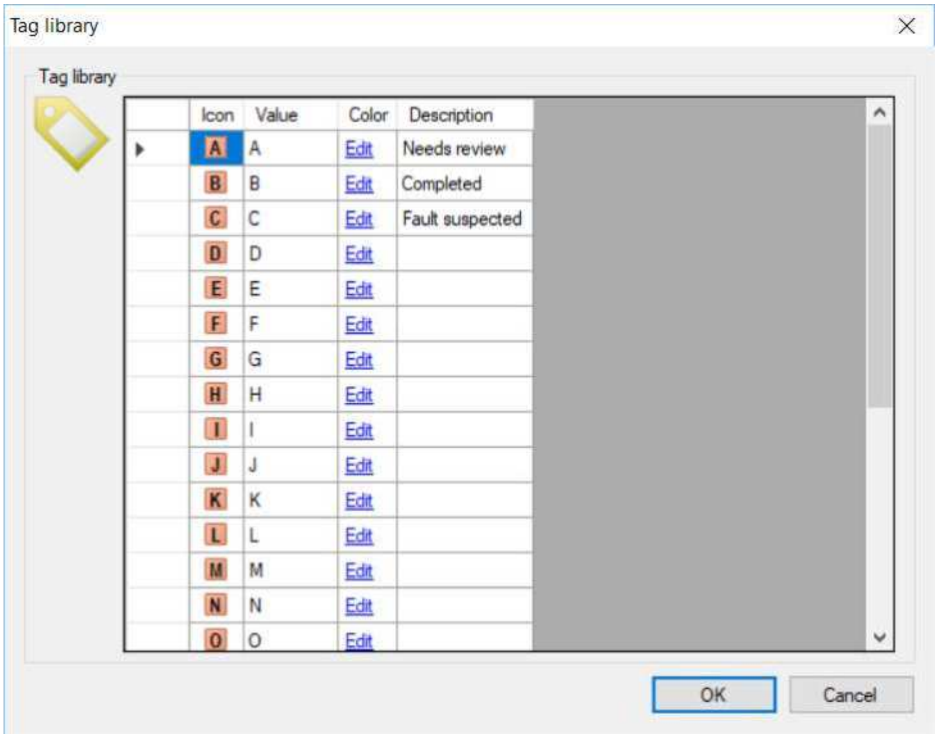


Figure 6 - 31
Example of Tag library

Set the colour of the icon by clicking on the edit text in the ‘Color’ column. Set the description of the tag by clicking in the description column and entering the description of the tag.

Once a tag has been created in the library, the tag can be used to tag measurement points or machines. Tagged measurement points and machines will be marked with a tag after the name of the node as illustrated in Figure 6 - 32, below.

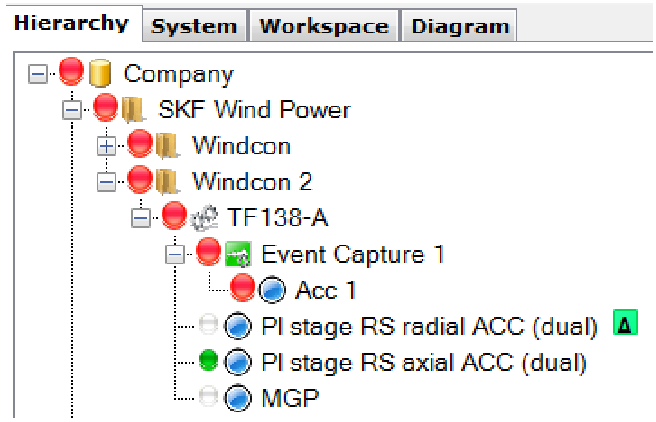


Figure 6 - 32
Example of Hierarchy View with a Tag

To tag a specific measurement point or machine, open its properties and click the tag icon to launch a dialog where the active tags for the item can be managed:

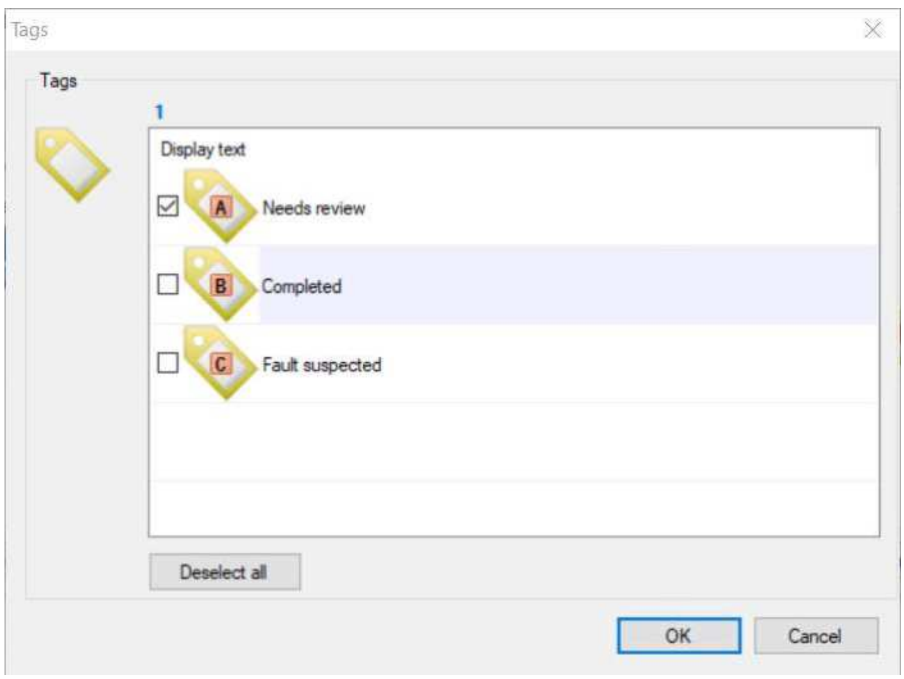


Figure 6 - 33
Example of managing tags for a point or machine

Select one or more tags to set on the selected measurement point or machine.

Data tagging group

Allows a user to create, edit or delete a data tagging group. Note that to be able to create a data tagging measurement point, there must be an existing data tagging group.

Machine template library

It displays machine templates and performs the following actions:

Delete deletes a template from the machine template library.

Export exports a machine template to a file with the file extension of *.omt*.

Import imports a machine template from a file into the machine template library.

Create machine template

A machine template can be created based on a selected machine from the hierarchy view. It will then reside in the machine template library.

Note that to create a machine template, the source machine must be configured with all the properties and measurement points.

As IMx 1 measurements are somewhat different to those performed by other IMx devices it is important to be able to easily distinguish 'IMx-1' templates.

To achieve this, it is recommended that users adopt the following naming taxonomy for all machine templates:

DAD_Asset Class_Asset Type_Manufacturer Name_Manufacturer Model

Example IMx1_Turbine_Wind_Company_V99

- DAD (Data Acquisition Device): IMx1
- Asset Class: Turbine
- Asset Type: Wind
- Manufacturer Name: Company
- Manufacturer Model: V99

Export

Export exports structure/data from the database. Hierarchical elements are stored as an .xme file and, if selected, measurement data is stored in a similarly named .xmd file.

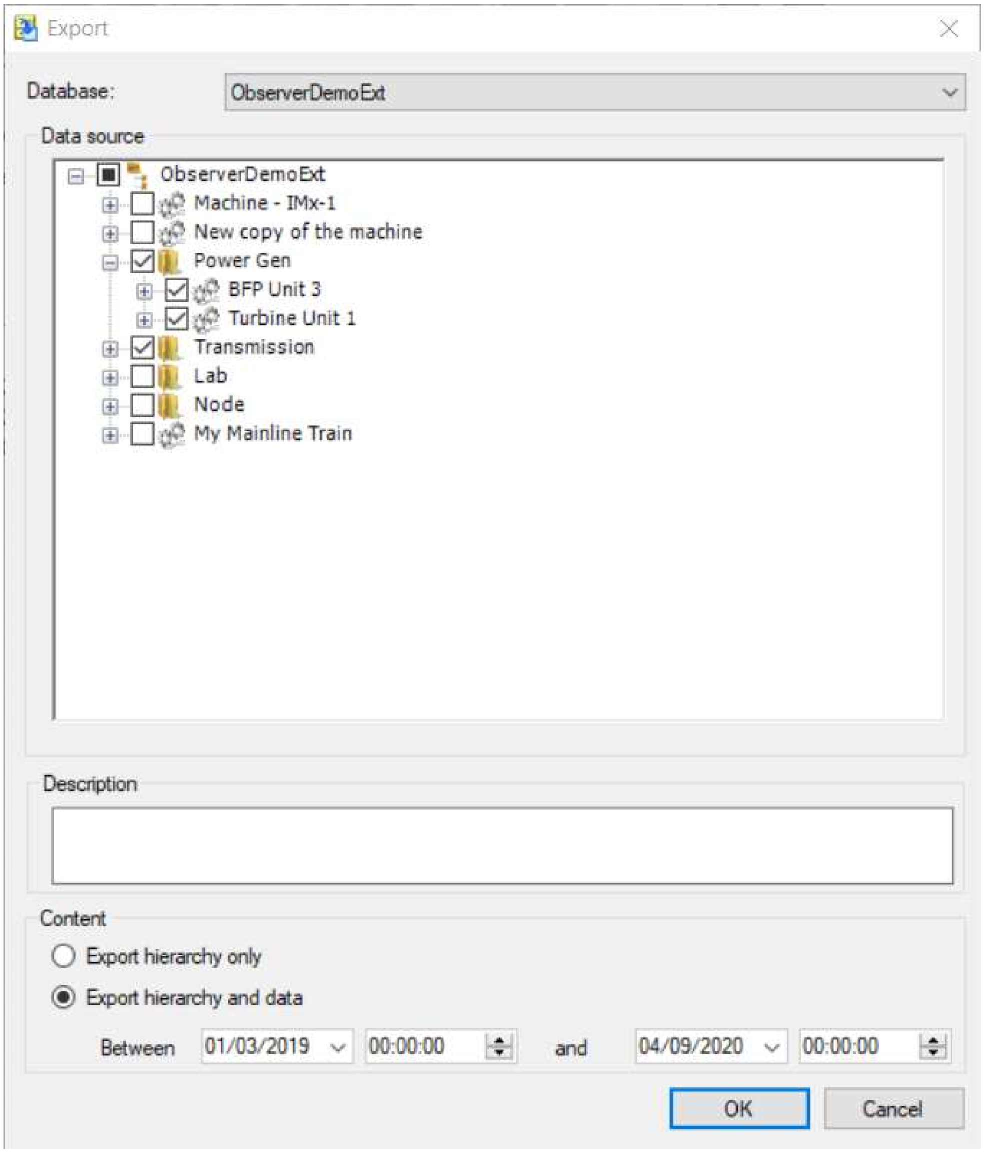


Figure 6 - 34
Example of Export Structure/Data

Database is where the structure/data to be exported, resides.

Data source is the node(s) that should be included in the export process.

Description is a custom description about the export file which will be displayed to the user when importing the data.

Content is the export content which can be only the structure of the hierarchy or the structure of the hierarchy along with measurement data from the specified date and time.

Import

The Import interface enables the importing of .xme and .xmd export files generated by @ptitude Observer.

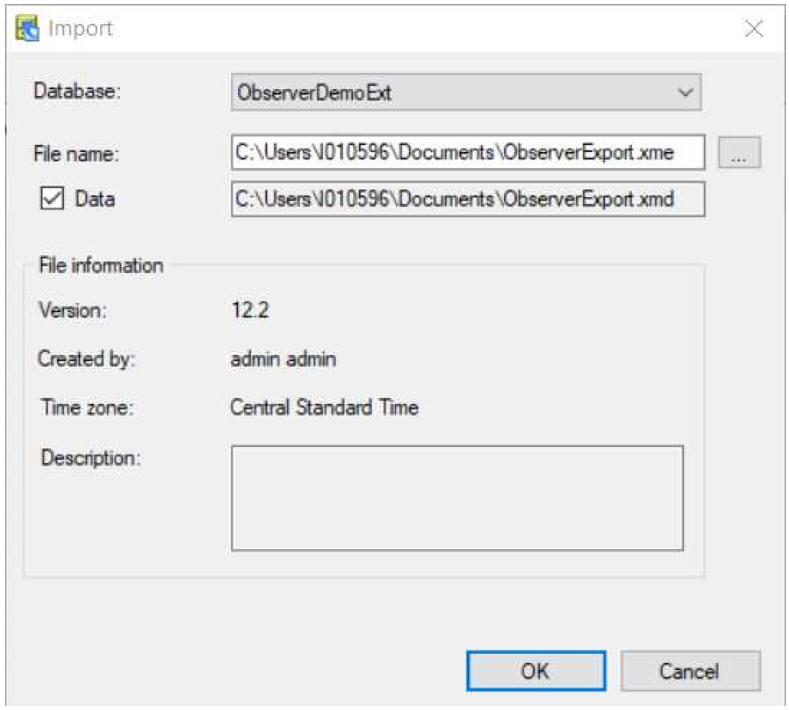


Figure 6 - 35
Example of Import Data

Click the browse (ellipsis) button to navigate to and select the (.xme) file required. The companion .xmd file will be automatically loaded into the dialog if it exists. If that measurement data is to be imported as well, then ensure **Data** is ticked. If a machine included in the import file has been imported before, the system automatically merges the data into the existing hierarchy.

- Note that the hierarchy and data import processes are separate and if a lot of data is being imported the latter may take some time to complete. During the import, the status of both processes is reported on the right of the, lower window edge, toolbar strip.

Important - The export and import interfaces should be used only to export or import minor parts of the database in order to get the same measurement hierarchy as in other database or to send small pieces of data for someone external to analyse them. It should not be used under any circumstances, to transfer data between databases.

Alarm Group

Alarm groups are used where it would be useful in investigating alarm events to have data available from a number of related measurements, even if these did not reach an alarm state. For example, by creating an alarm group with six measurement points, an alarm on any one of the six measurement points will force the storage of data for all six measurement points of the alarm group and can also be used to trigger subsequent data storage for all these points at their alarm intervals.

Figure 6 – 36 below, shows an alarm group and the measurement points belonging to that group.

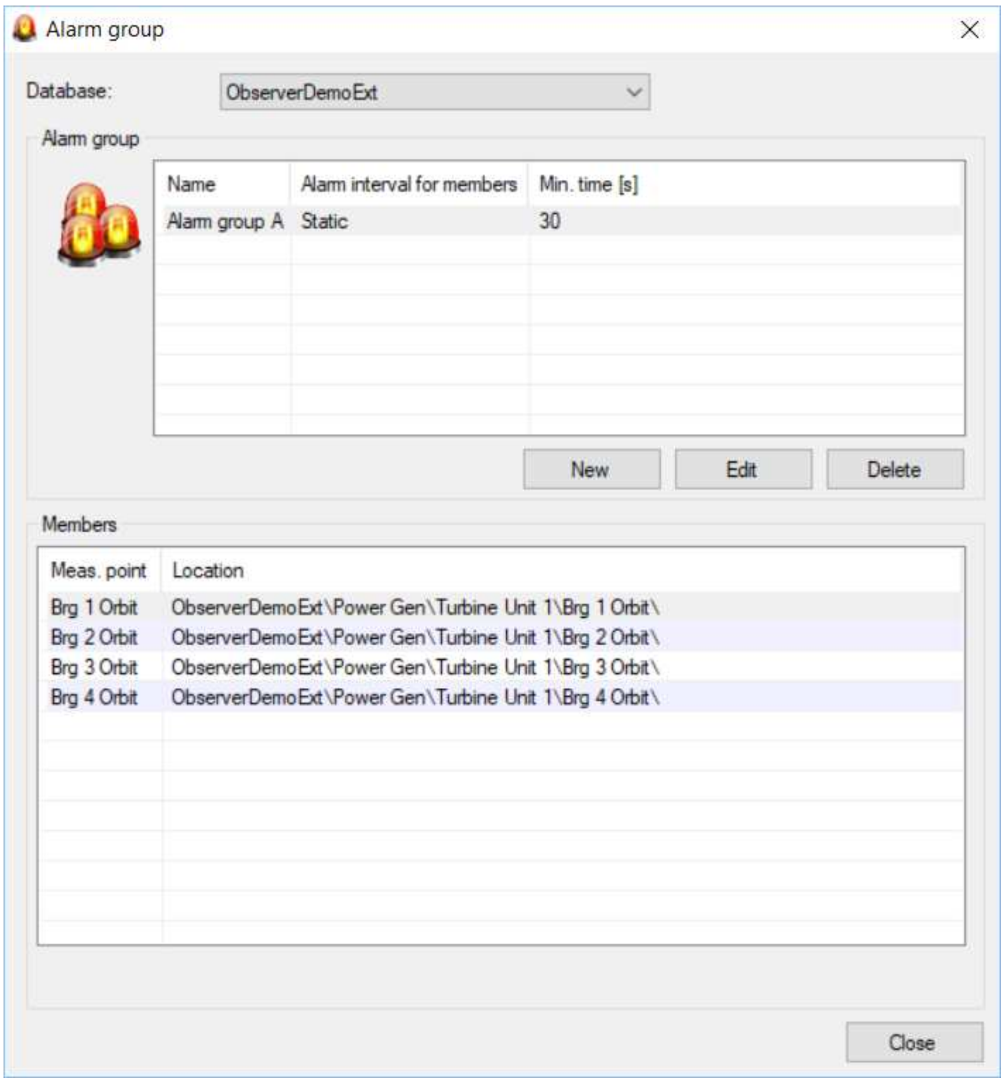


Figure 6 - 36
Example of Alarm group

In this dialog, a new alarm group can be created, and an existing alarm group can be edited or deleted. Select an Alarm group to display its Members but note that group membership is set at the individual measurement point level: point properties, Monitoring tab where a drop-down will allow a choice from any existing alarm groups in the database.

Creating a New / Editing an Alarm group

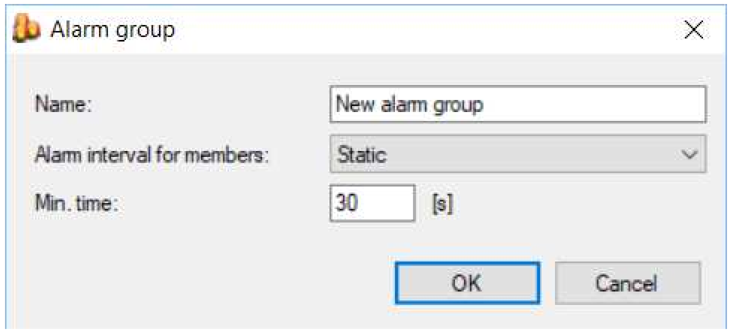


Figure 6 - 37
Example of Alarm group – Edit/create

Name is the name of the Alarm group to be created or edited.

Alarm interval for members dictates whether scheduled storage settings for all group members should be switched to their alarm intervals, (those intervals are configured in the Operating and Storage Conditions Tab under Setting up Measurement Points and Alarms in System Configuration).

None retains the normal scheduled storage setting for measurement points not directly in alarm but does cause both a trend and a dynamic record to be stored, for all members, at the alarm event.

Static applies the alarm scheduled storage setting on all measurement points in the group to store static values at alarm intervals, when an alarm event on any group member is detected.

Static and Dynamic similarly applies the alarm scheduled storage settings on all measurement points in the group but to store both static and dynamic values at alarm intervals.

Min. time is used to prevent multiple alarm group triggers being generated by essentially the same event. It is the minimum time in seconds without any new alarm before a new alarm can trigger the alarm group. The default recommended minimum time is 30 seconds.

Measurement Groups

A measurement group is a logical grouping of measurement points associated with the same IMx/MasCon device that will collect a specific type of data for a particular purpose; for example, at the same time and synchronously.

Different types of measurement groups can be created: *Simultaneous, Transient*, *Event capture, Run cycle capture* and *Scheduled capture*. Note that the type and frequency type of the measurement group cannot be changed after the group has been created.

The following constraints apply to the use of measurement groups**:**

- The maximum number of active measurement groups per IMx is five, including transient (T), simultaneous (S) and any type of capture (C) group.

- The limit for capture group types is one per IMx. For example, the maximum of five groups may consist of: 1C+2T+2S or 1C+4T or 5T or 5S, etc.
    - When trying to add a second capture type group to an IMx, it will not be possible to enter the **Device** and save the group.
- Measurement groups may (or inherently do) utilise a pre- and post-event data capture function. For transient and simultaneous groups note that this can consist of a number of static and dynamic data records pre and post an alarm event, multiple groups of these types may be configured to use this functionality. A capture group will however use all of the associated resources so one or more transient or simultaneous groups actively using pre- and post-event (alarm) data on that IMx will prevent any type of capture group being created. Similarly, although transient or simultaneous groups can be added to an IMx where there is already a capture group, the Pre/Post Event data tab functionality will then be disabled.
- A specific device channel can only be used once within any measurement group (that is, two measurement points using the same device channel cannot be part of the same group).
- Measurement groups do not support the point type Dynamic, Envelope.
- Capture groups have fixed frequency acquisition and no order tracking.

Go to **Database** > **Measurement groups** to open the dialog.

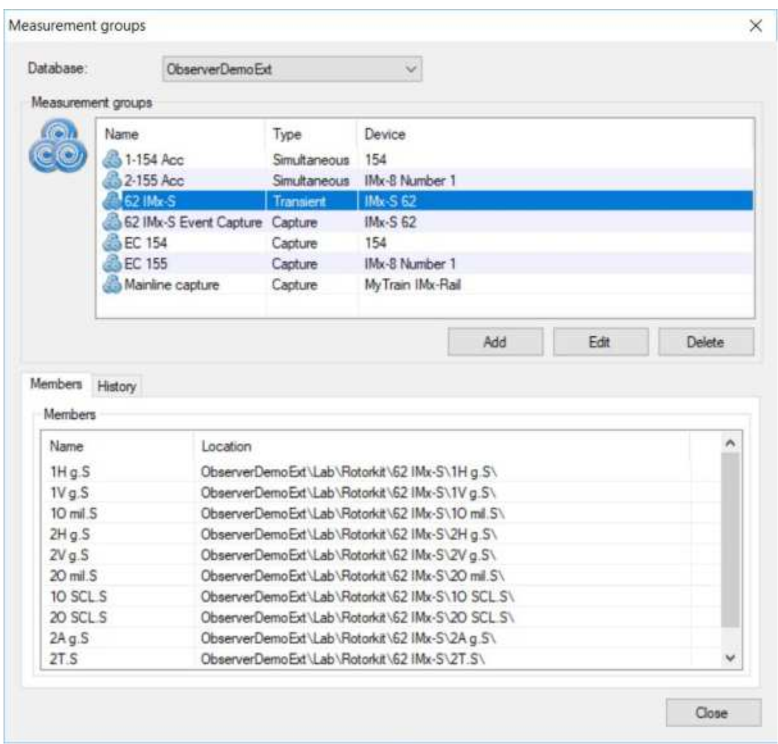


Figure 6 - 38
Example of Measurement groups dialog (Transient group selected)

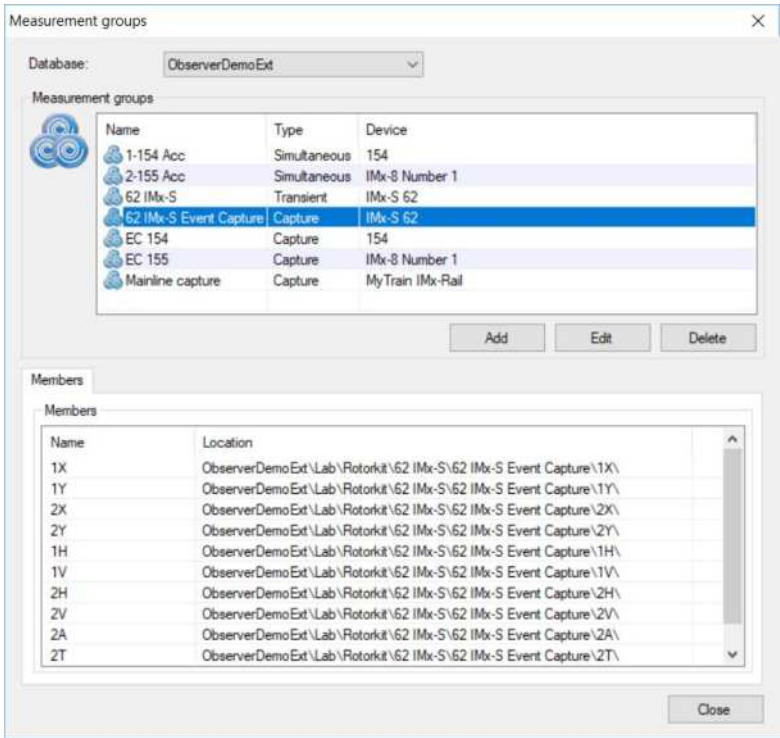


Figure 6 - 39
Example of Measurement groups dialog (Event Capture group selected)

Measurement groups in the selected **Database** are listed. **Type** indicates the measurement group type and **Device** shows the data acquisition device (DAD) specified for the measurement group.

Members tab is a list of the measurement points assigned to the highlighted measurement group.

History tab is a list of the historical run-ups and coast-downs currently stored in the database for a transient measurement group. They can be edited, deleted or set as a reference transient. The list shows the **From** and **To** dates, **Type**, **Keep forever** status and **Comment**.

To add a Measurement Group:

Click **Database** > **Measurement groups** > **Add**.

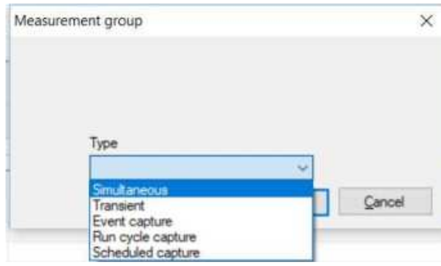


Figure 6 - 40
Example of Measurement Group Types

Type is the measurement group type:

Simultaneous: the purpose of the simultaneous measurement group is to start measuring all the channels in the measurement group at exactly the same time. This group configuration can also set pre- and post-alarm data collection, for the group members.

Transient: the purpose of the transient group is to group measurement points that will collect data typically during a turbine run-up or coast-down. This group configuration can also set pre- and post-alarm data collection, for the group members.

Event capture: supports the event capture feature: time waveform points encompassing pre- to post-event, data capture. The captured time waveforms enable detailed analysis of both very low frequency mechanical and very high frequency electrical or generator related oscillations. Useful for wind turbines and lower speed rotating machinery.

Run cycle capture: supports the run cycle capture feature: this is the functionality used in SKF Rail Track Monitoring, to automatically capture track vibration data between stations.

Scheduled capture: provides the IMx with the possibility to collect long time signals on a scheduled basis, for example once per day.

Notes:

The type of measurement group selected will dictate the group properties that are user configurable and the tabs that are shown:

Table 6-2.
Measurement group Properties Tabs

Tab name	Applies to these group types
General	All types
Acquisition	All types
Operating and Storage Conditions	All except Run cycle and Scheduled, capture types
Monitoring	Event capture type only
Pre/Post Event data	Simultaneous and Transient types only
Transient setup	Transient type only

Layout and content of the tabs may also vary as appropriate to the specific type of measurement group.

Whilst the Run cycle and Scheduled, capture groups do not have an **Operating and Storage Conditions** tab, for these group types the **Acquisition** tab > **Capture settings** area includes:

- ➢ Controls to configure capture gating based on the selected **Associated measurements**.

For a Scheduled capture group, the controls on the **Acquisition** tab > **Capture settings** area are also extended to configure the schedule:

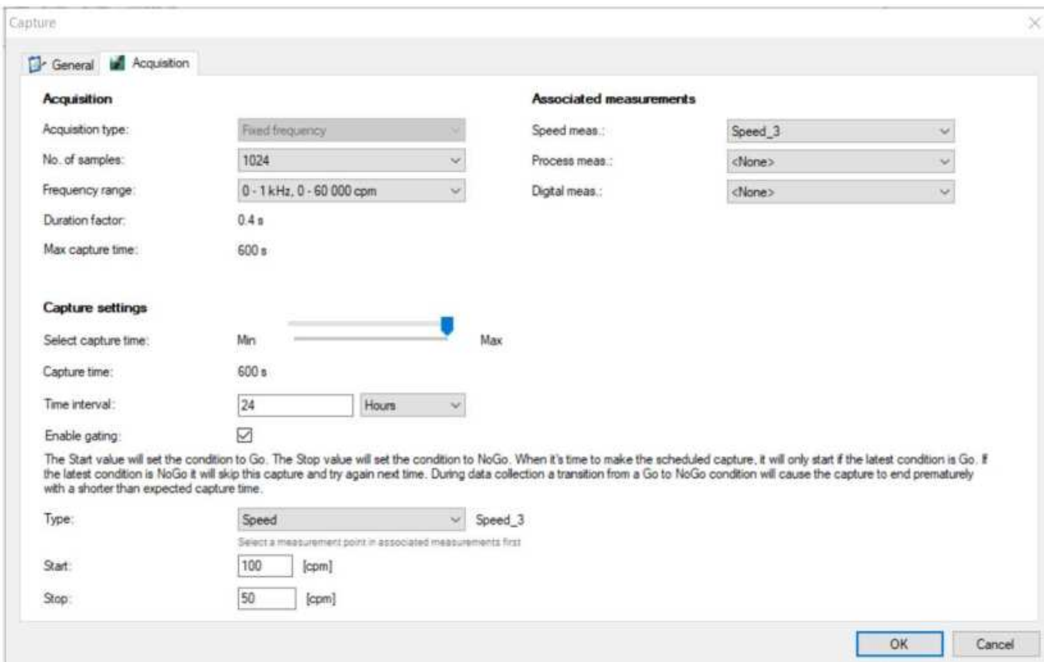


Figure 6 - 41
Example of Scheduled Capture Group Acquisition tab

- ➢ In addition to a slider to **Select capture time** there is a **Time interval** configurable in Hours or Days.

- ➢ **Enable gating** to set an associated measurement **Type** and the **Start** and **Stop** values. When the scheduled capture is due, if the latest state is **Start**, the capture will proceed for either the **Capture time** or if it happens mid-capture, until the **Stop** condition is fulfilled. If the initial state is **Stop**, the capture is skipped until the next scheduled attempt.

The gating behaviour for Scheduled capture groups can be illustrated diagrammatically as follows:

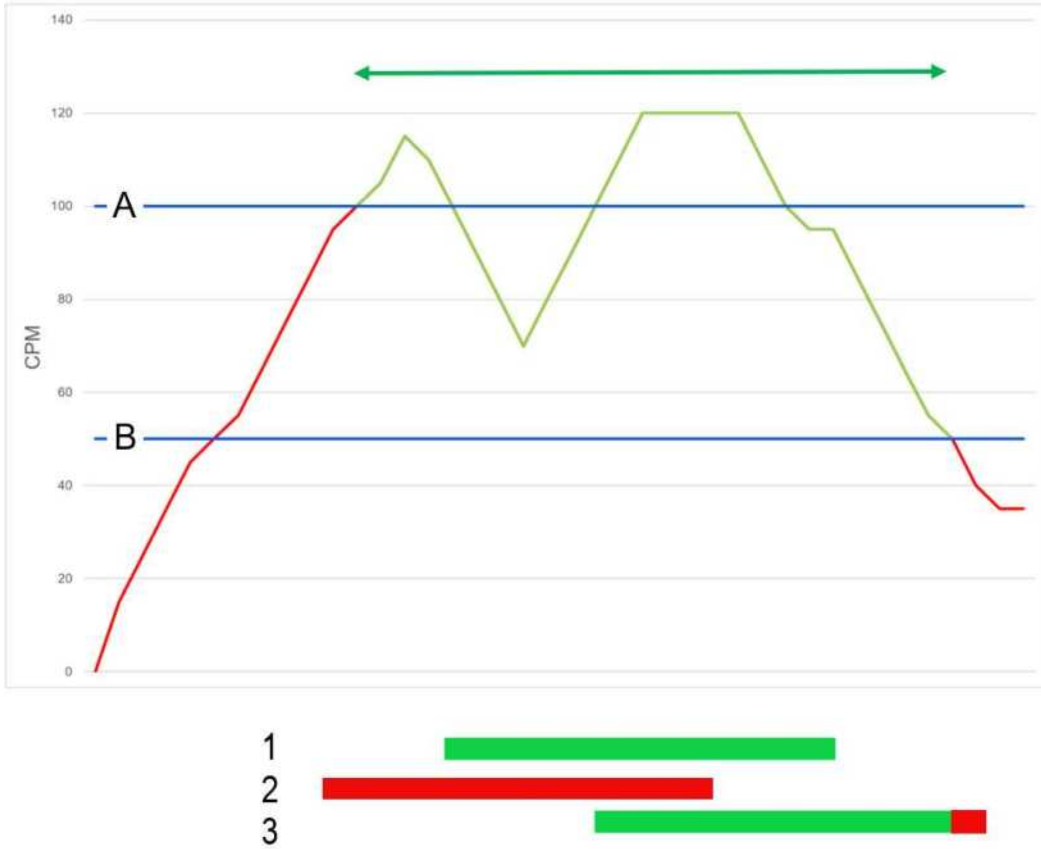


Figure 6 - 42
Example of Scheduled Capture Speed Gating

The above figure shows a graph of speed against time where Scheduled capture gating has been configured with a **Start** threshold of 100 cpm (A) and a **Stop** threshold of 50 cpm (B) and includes three illustrative examples of the expected behaviour.

When the scheduled interval expires and the capture is due, if the speed is in the start state (anywhere coloured green) the Scheduled capture will start, examples 1 and 3. If however, the speed is in the stop state (anywhere coloured red) the capture will be skipped, example 2. Where a Scheduled capture starts it will either continue for the complete **Capture time**, example 1 or end prematurely if the stop state is reached first, example 3.

More detailed examples for Transient and Event capture groups follow and Run cycle capture groups are described in Run cycle capture group, *Appendix D*.

As an alternative when adding any type of capture group, the creation process can be directly initiated from the hierarchy by right clicking on the appropriate machine (or 'train') and selecting the desired group type from the context menu, *Add > Capture group* options.

Configure a Transient Measurement Group

Once a measurement point has been added to a measurement group, some point properties are not available on the measurement point screen and the input controls for them are disabled. These properties are now configured on the measurement group.

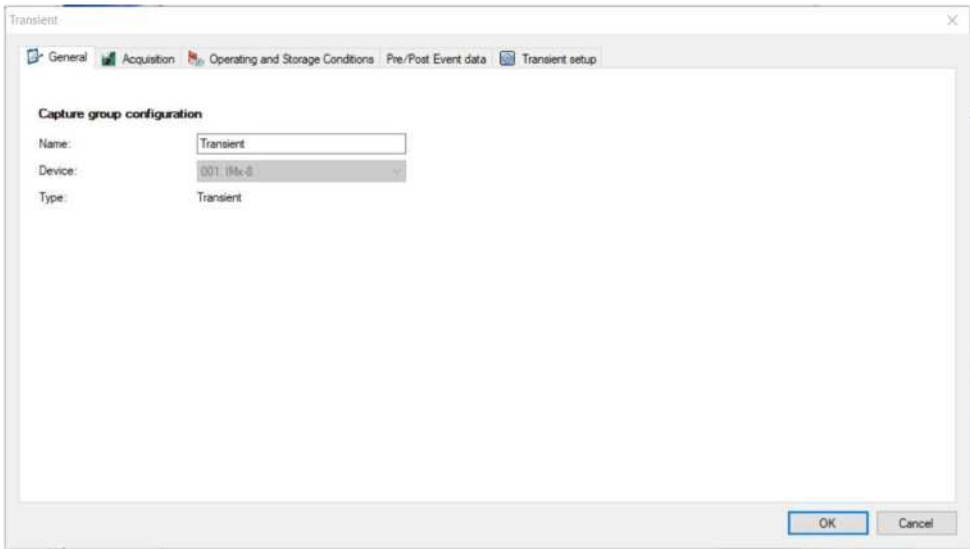


Figure 6 - 43
Example of Measurement Group Configuration

Although the layout and total number of available attributes may be slightly different, the descriptions and explanations in Setting up Measurement Points and Alarms, apply to the attributes found in the first three tabs here.

General Tab

Refer to General Tab under Setting up Measurement Points and Alarms in System Configuration.

Acquisition Tab

Refer to Acquisition Tab under Setting up Measurement Points and Alarms in System Configuration.

Operating and Storage Condition Tab

Refer to Operating and Storage Conditions Tab under Setting up Measurement Points and Alarms in System Configuration.

Pre/Post Event data Tab

If there is no Event capture, Run cycle capture or Scheduled capture group configured on the IMx then a Transient (or Simultaneous) group can make use of the facilities provided by the Pre/Post Event data tab:

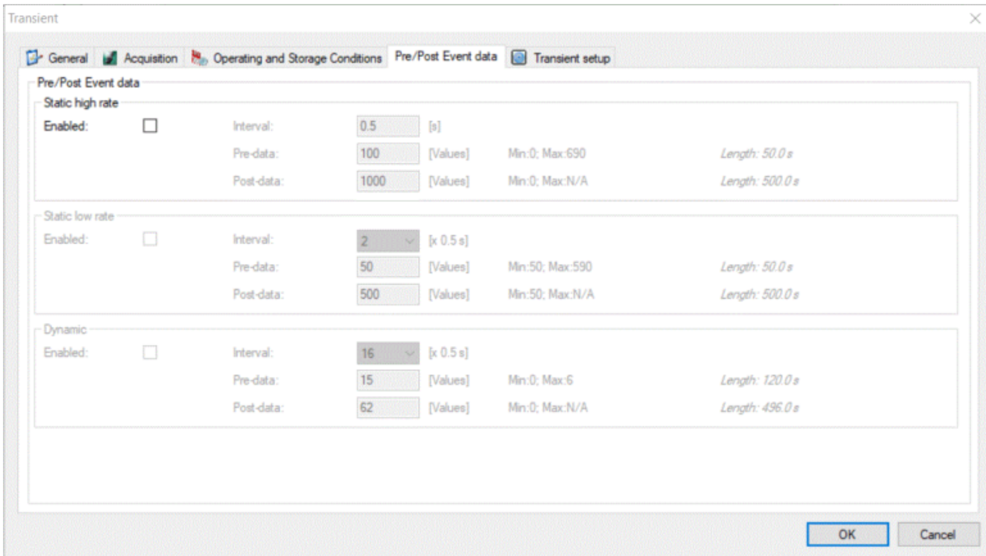


Figure 6 - 44
Example of Pre/Post Event data tab (Transient or Simultaneous groups)

Key points relating to the configuring of Pre/Post Event data:

- The configuration on this tab does not actually relate to the transient event, rather it is a means of configuring pre- and post-alarm data sets for the Transient group. These data sets comprise high rate static (overall) values and optionally low rate static and dynamic data from around the alarm event. The same tab and functionality is available when configuring a Simultaneous group.
- An active transient will prevent this initiating and detection of a transient event will stop/override a post-alarm data capture phase.
- If this capability is to be used, as a minimum, static high rate collection must be enabled as its configured interval will be the basic interval of data collection of which the other intervals are 'power of two' multiples.

As the dialog validation will not accept illegal combinations, whilst configuring, it can be useful to have an appreciation of the overall philosophy used:

- Pre data requires storage so pre-data has absolute limits applied: a total of 690 static records (split between high and low rate) and an absolute limit on the dynamic records that is typically 30 but which is dependent on the number of samples/lines configured. At the extreme settings the limit may be as low as 1 or as high as 60.
- The scheme relies on having an underlying period with all data taken at integer multiples of this (the static high rate interval defined in seconds and then the static low rate and dynamic interval multipliers provide this automatically). For this reason, if any data storage is enabled this must always include the static high rate.
- In addition to the mandatory static high rate, a static low rate and/or dynamic can also be enabled if required.
- When enabled, the static low rate must extend furthest from the alarm event in both pre and post directions, that is, the static high rate and dynamic captures

must be within that time frame so their lengths cannot be greater that the respective pre or post static low rate length.

- If only the static high rate and dynamic are enabled, similarly the dynamic lengths cannot be greater that the respective pre or post static high rate length.
- The configuration should be such that dynamic data is always stored alongside static data, not at a different time. When the length of dynamic doesn't exceed the length of static high rate then this automatically complies. Where it does exceed it, the requirement is still met so long as it is no greater than the static low rate length AND the dynamic interval is no smaller than the static low rate interval.

Transient Setup Tab - Simple configuration mode is available only when creating a new Transient Measurement Group.

Speed ranges for the run-up can define different stages of the run-up/coast-down.

Static data storage

Delta CPM is the setting for maximum speed change before storing static values.

Delta time is the setting for maximum time before storing static values.

Dynamic data storage

Delta CPM is the setting for maximum speed change before storing dynamic values.

Delta time is the setting for maximum time before storing dynamic values.

Transient state timeout specifies how long Monitor should continue to apply the transient data storage settings, after a steady state or slow roll speed has been reached. The use of a Transient state timeout is optional.

Transient closure time is the added time for Monitor to remain in the transient state after the last transient data has been received. When the closure time expires the transient is closed and a final type/classification is set.

Transient Setup Tab - Advanced configuration mode is available only when creating a new Transient Measurement Group.

Transient state timeout and Transient closure time are as described above, noting that in this mode there is no enable control for Transient state timeout although a value of zero can be entered.

Rpm min (cpm) indicates the lower rpm (revolutions per minute) limit for each range.

Rpm max (cpm) indicates the higher rpm (revolutions per minute) limit for each range.

State defines whether this is a steady state or a run-up/down state.

Delta Trend (cpm) indicates the number of cycles per minute between storage of trend values. If this parameter is not reached within one minute, a trend will be stored.

Mean harm. (No. revolutions) indicates the number of revolutions of the shaft on which the mean value of the presented trend is based.

Max. time (s) is the maximum time between the storage of trend values.

Delta FFT (cpm) indicates the required change in speed between each spectra storage.

Max. time FFT (s) is the maximum time between the storage of FFT values.

Classification of Transients When Opening a Transient:

When transient data arrives at the monitor service, it will check if there is an active transient in progress for that measurement point. If not, a new transient is started and classified as following:

- If the speed reading is in a transient range that has no other ranges above it, it is classified as “Overspeed in progress”.
- If the reading is in another transient range and in the lower half of that range, it is classified as “Run-up in progress”.
- If the reading is in another transient range and in the higher half of that range, it is classified as “Coast-down in progress”.

Note: if an existing/in progress transient has not yet reached its closure time then Monitor will store the new transient data as part of the ongoing transient, not in a new one.

Classification of Transients When Closing a Transient

After the “Transient closure time” has elapsed without new transient values the transient will be closed. The state of the transient is then changed as:

- If it was classified as “Overspeed in progress” and the last reading stored also was in the overspeed range the classification is changed to “Overspeed”.
- If it was classified as “Overspeed in progress” and the last reading stored was outside of the overspeed range the classification is changed to “Overspeed – Coast-down”.
- If it was classified as “Run-up in progress” and the last speed reading was in the upper half of its speed range it is classified as “Run-up”.
- If it was classified as “Run-up in progress” and the last speed reading was in the lower half of its speed range it is classified as “Run-up aborted”.
- If it was classified as “Coast-down in progress” and the last speed reading was in the upper half of its speed range it is classified as “Coast-down aborted”.
- If it was classified as “Coast-down in progress” and the last speed reading was in the lower half of its speed range it is classified as “Coast-down”.

To add a measurement point to a transient measurement group:

1. Select a measurement point in the hierarchy view.
2. Go to General tab settings screen of Measurement point via **Properties** command. For help accessing the screen, refer to: To edit a measurement point in Setting up Measurement Points and Alarms.
3. Select the **IMx/MasCon device** to which this point is assigned.
4. Select a **Measurement group** to use from the drop-down list of measurement groups.

Optimal Settings for Transient Group

The following recommendations are to optimise the performance of a transient group.

- Use only vibration measurement points of Harmonic type.
- Do not use other dynamic measurement points in the same IMx device regardless of whether they are on different channels or not. Unrelated "slow points" should be in a separate IMx device.
- In dynamic data setting, select Save Time waveform only. Spectra is calculated from the waveform automatically. The setting applies for all dynamic data (for example, alarm/delta) but is placed in the "scheduled dynamic data storage" box.
- When using order-tracking, keep number of revolutions and maximum frequency to the minimum required.
- With non order-tracked harmonic measurement points, the harmonic calculation in transient should be done using an average of 2 revolutions unless the speed is sufficiently high. For high speed, configure the number of revolutions to correspond to approximately 0,1 seconds.
- With order-tracked harmonic measurement points in transient, 2 measurements/sec are expected with 16 channels (16 single channel points or 8 dual channel points) up to 25x and 8 revs average.
- Points used as simultaneous speed and process parameters should not be in the group. These parameters are stored anyway together with the points in the group. By keeping them outside they will also be stored when below the low speed cut-off. In case of missing data, it is useful to have something like speed always being stored to help determine whether the IMx has been online without speed input or the data acquisition has been unavailable.

Note: There might be issues with using a laptop when testing, especially with a mechanical drive (not an SSD) getting enough SQL Server performance. Lots of small file access like running a backup software on the same disk should be avoided.

Configuring an Event Capture Group

Click first **Database** from the menu bar and then select **Measurement groups**. In the **Measurement groups** dialog, click **Add**. From the pop-up dialog select the **Type** as *Event capture.*

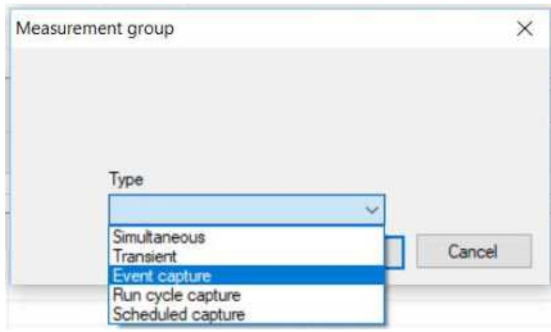


Figure 6 - 45
Example of Measurement group Type, Event capture

The **Capture** dialog opens.

OR

In the hierarchy, right-click the machine to which the event capture group is to be added. Select **Add** and then click **Event capture** from the **Capture Group** sub-section.

Figure 6 - 46
Example of Machine > Add > Capture Group > Event capture

The **Capture** dialog opens with the **General** tab:

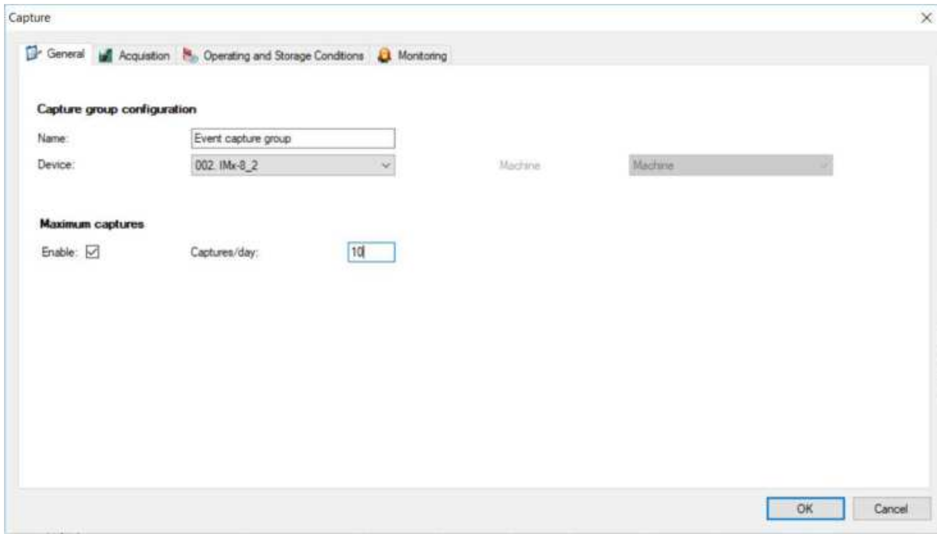


Figure 6 - 47
Example of Capture dialog, General tab

- Enter the group's **Name**, select a **Device** and a **Machine (**default values may appear where for example, the group has been directly added to a machine).
- **Maximum captures** defaults to unselected and 0 (hidden whilst not enabled but meaning unlimited). If the **Enable** checkbox is selected, the **Captures/day** counts all alarm-based event captures with status "Done". The value can be set up to 99 999. When the maximum captures stored per day is reached, an alarm will be generated each time the system tries to store another event capture.
    - ➢ It is always possible to store a manual capture, even after the maximum number of event captures has been reached. Storing an event capture manually will not generate a system alarm even if the maximum number of captures per day has been reached.
- Open the **Acquisition** tab:

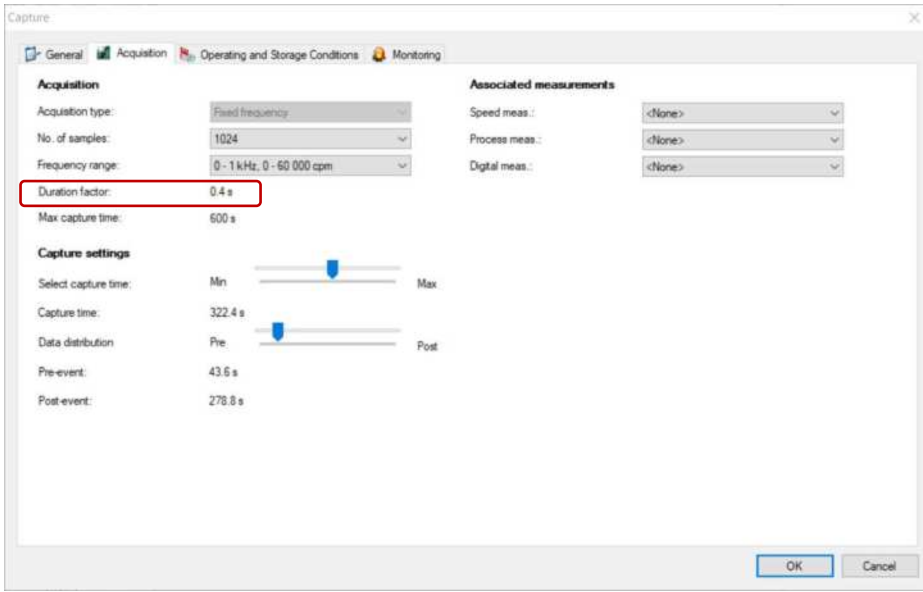


Figure 6 - 48
Example of Capture dialog, Acquisition tab

- **Acquisition Type** is locked to *Fixed Frequency*.
- Select the **No. of samples** (choice: 1024, 2048, 4096, 8192 or 16384).
- Select the **Frequency range**.

The **Duration factor** is calculated as shown in the following table.

Table 6-3.
Duration Factor Calculations.

Fmax	Sample Rate	1024 Samples	2048 Samples	8192 Samples	16384 Samples
1000	2560	0.4 s	0.8 s	3.2 s	6.4 s
2000	5120	0.2 s	0.4 s	1.6 s	3.2 s
5000	12800	0.08 s	0.16 s	0.64 s	1.28 s
10000	256000	0.04 s	0.08 s	0.32 s	0.64 s

The calculated **Duration factor** must be more than 0.16 seconds. If the **Duration factor** is too small to capture an event, an error is displayed, Figure 6 - 49. The user can increase the number of samples, or potentially reduce the Fmax and associated sample rate, to correct this.

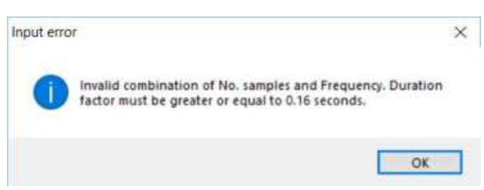


Figure 6 - 49
Example of Input error message

- Set up the desired associated measurements.

The acquisition settings will dictate a **Max capture time**. Use then the slider controls in the **Capture settings** area to **Select capture time** and to allocate how that is apportioned to pre- and post-event data using the **Data distribution** slider. A read back of the overall **Capture time**, **Pre-** and **Post-event** capture times is provided.

Note that certain configurations may trigger an information message in the lower frame of the Capture dialog indicating an 'IMx-8' (meaning any IMx-8 or IMx-16 variant) or other IMx with a CPU version of 1.48 or higher is required.

Open the **Operating and Storage Conditions** tab:

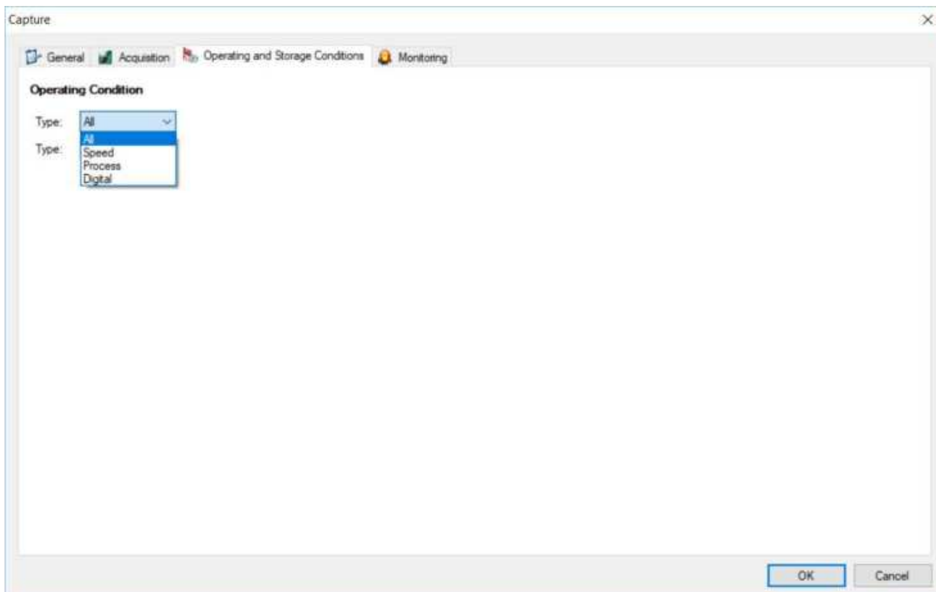


Figure 6 - 50
Example of Capture dialog, Operating and Storage Conditions tab

- Select the desired Operating Condition **Type** values for the group to be stored. This could be based on *Speed*, *Process* or *Digital* conditions.
- Note that if both conditions are actively used AND logic is applied: both conditions are required to be true.

Open the **Monitoring** tab:

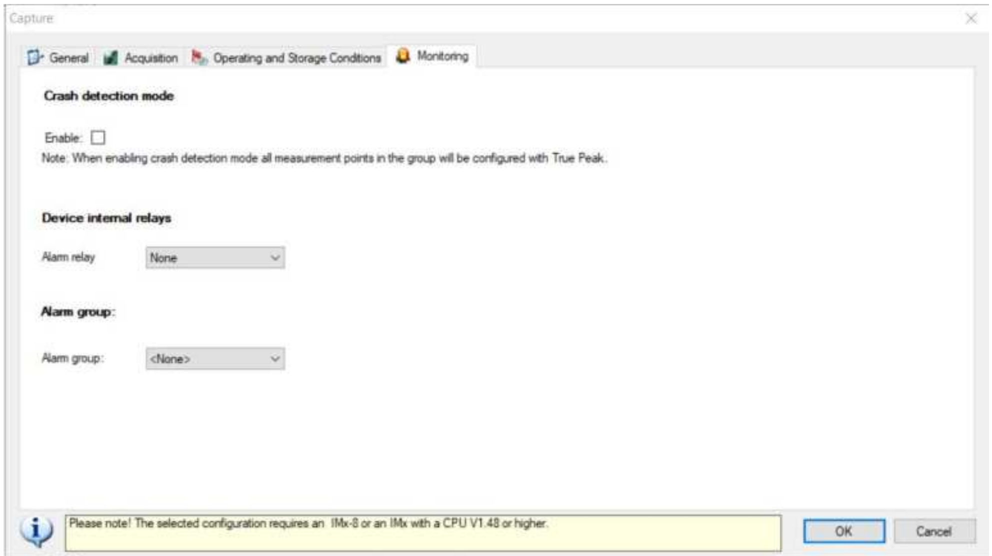


Figure 6 - 51
Example of Capture dialog, Monitoring tab

- Enable/disable crash detection mode. When crash detection mode is enabled, the IMx device is put in a very responsive state to quickly detect machine tool crashes based on vibration events and, if required, shut the machine down to avoid severe damage (shut down requires the use of relay outputs). Crash detection mode applies specific settings, such as the high pass filter cut-off frequency, to all measurement points that belong to the event capture group.
- Select the **Alarm relay** and any **Alarm group** that the event capture group will use.

Click **OK** to create and save the new event capture group. The event capture group will display as the first node beneath the machine. Drag and drop functionality allows the group to be moved only within the same machine. Event capture points may be re-ordered only within the group.

To add an event capture measurement point to an event capture group:

- Right-click the event capture group in the hierarchy and select **Add** > **Meas. point** from the resulting menu. The **Meas. point** dialog opens.

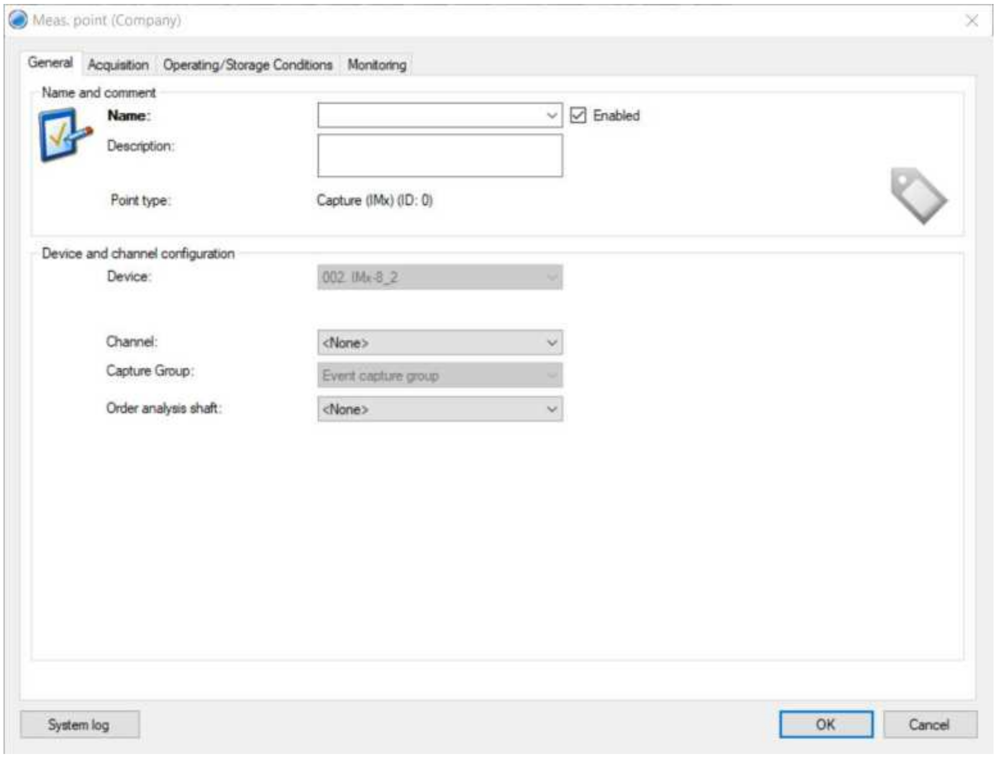


Figure 6 - 52
Example of Event Capture Measurement Point, General tab

One point per channel can be added up to the device channel limit. The maximum frequency per channel is 10 kHz up to 12 channels, for more than 12 channels, the limit is 5 kHz per channel.

- In the **General** tab enter a **Name** for the point.
- Check the **Enabled** box to activate the event capture point.
- The **Device** and **Event capture group** are populated.
- Select a **Channel**.
- Select the **Order analysis shaft** if machine part shafts were specified. The order analysis shaft is the shaft on the machine that is the basis for analysing the orders of running speed.
- Go to the **Acquisition** tab**.**

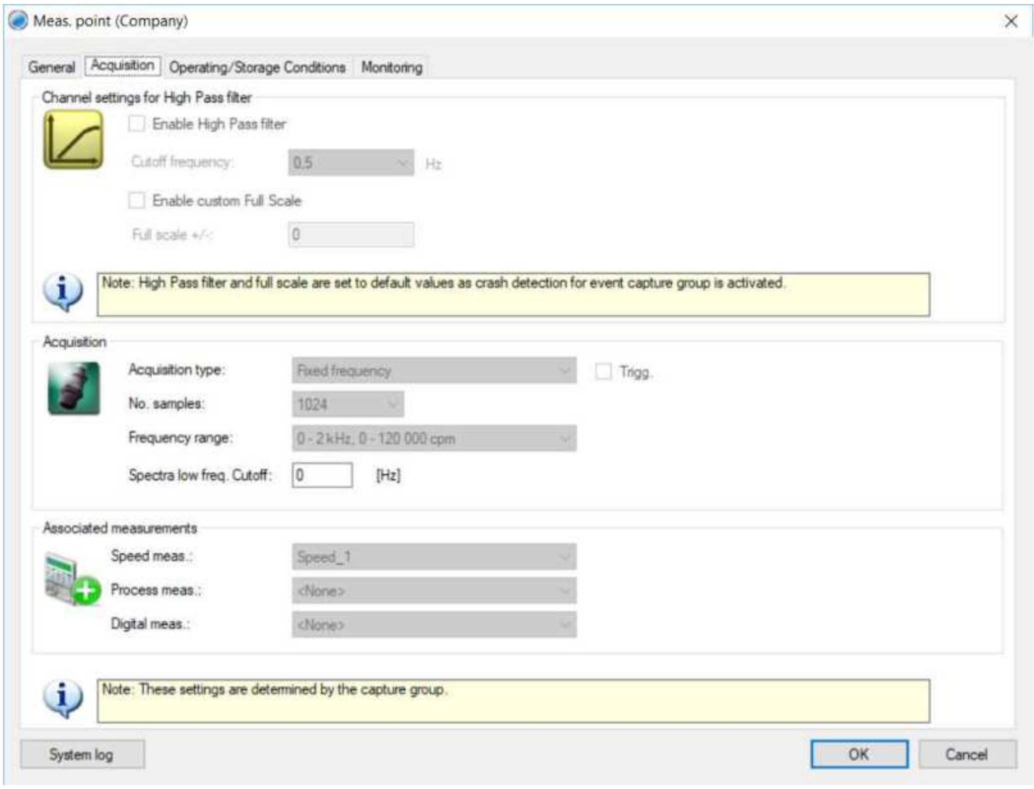


Figure 6 - 53
Example of Event Capture measurement point, Acquisition tab with crash detection mode enabled

Channel settings for High Pass Filter are locked and uneditable on all measurement points belonging to an event capture group that has crash detection mode enabled. When crash detection mode is enabled:

- High pass filtering is also always enabled. The **Cutoff frequency** defaults to 0.5 Hz.
- Full scale is also always enabled. Full scale is the range that corresponds to 6 V input on the channel.

When crash detection mode is disabled on an event capture group:

- High pass filtering can be enabled, and the **Cut-off frequency** can be set to either 0.0625, 0.125, 0.25 or 0.5 Hz.
- Custom full scale can also be enabled when high-pass filtering is enabled. The value 0 corresponds to the full range of channel. Full scale can be set from between 0.8% to 94% of the maximum range of the channel.

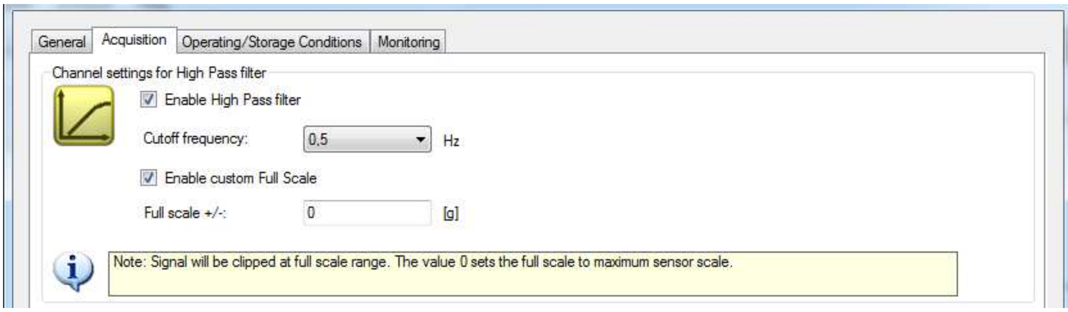


Figure 6 - 54
Example of Event Capture measurement point, Acquisition tab with crash detection mode disabled

- **Acquisition type**, **No. samples** and **Frequency range** are read only. These settings are determined by the event capture group. Enter the Spectra **low freq.** Cutoff value in Hz. The low frequency cutoff is used as a filter to limit unwanted peaks or "ski slopes" at the start of the FFT. For example, setting this value to 5 will zero out all values between 0 and 5 Hz in the FFT.
    - ➢ The **Operating/Storage Conditions** tab settings are also determined by the event capture group.
- Go to the **Monitoring** tab.

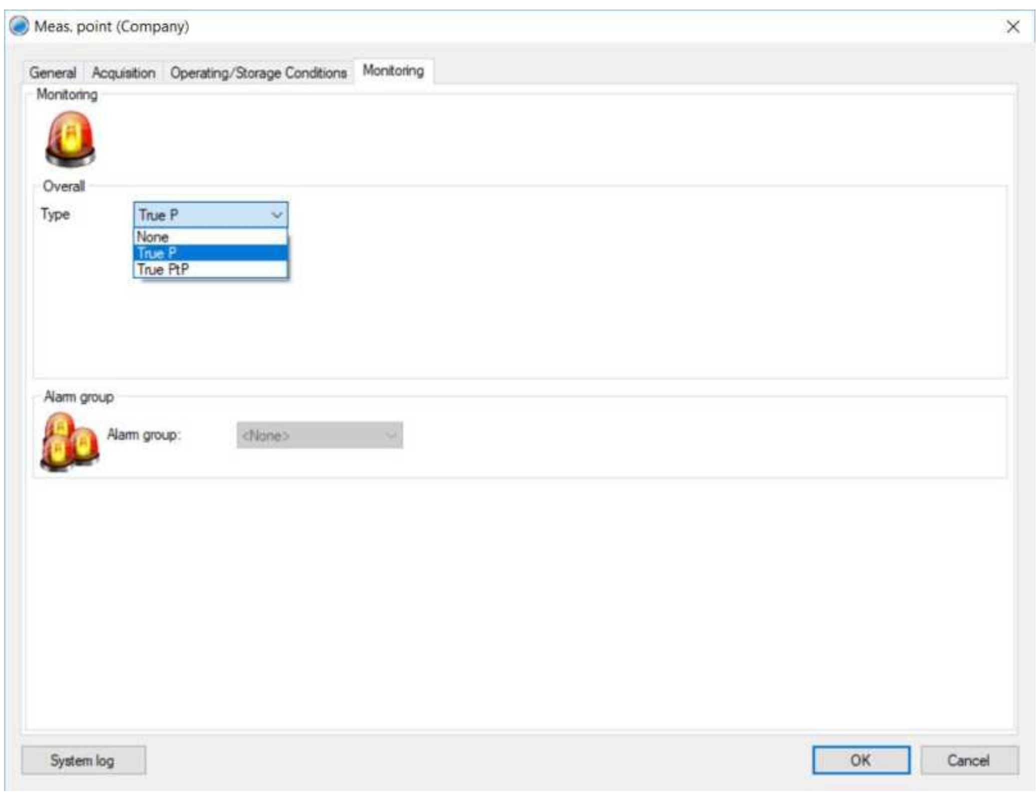


Figure 6 - 55
Example of Event Capture measurement point, Monitoring tab

- **Type** *True P* (True peak) and *True PtP* (True Peak to Peak) are supported. True Peak is only selectable when high-pass filtering is used.

- When crash detection mode is enabled on the event capture group, **Type** is locked to True Peak.
- When crash detection mode is disabled on the group, but high pass filtering is enabled on the measuring point, True Peak can be selected.

When True Peak or True Peak to Peak is selected, additional fields appear in the Alarm section:

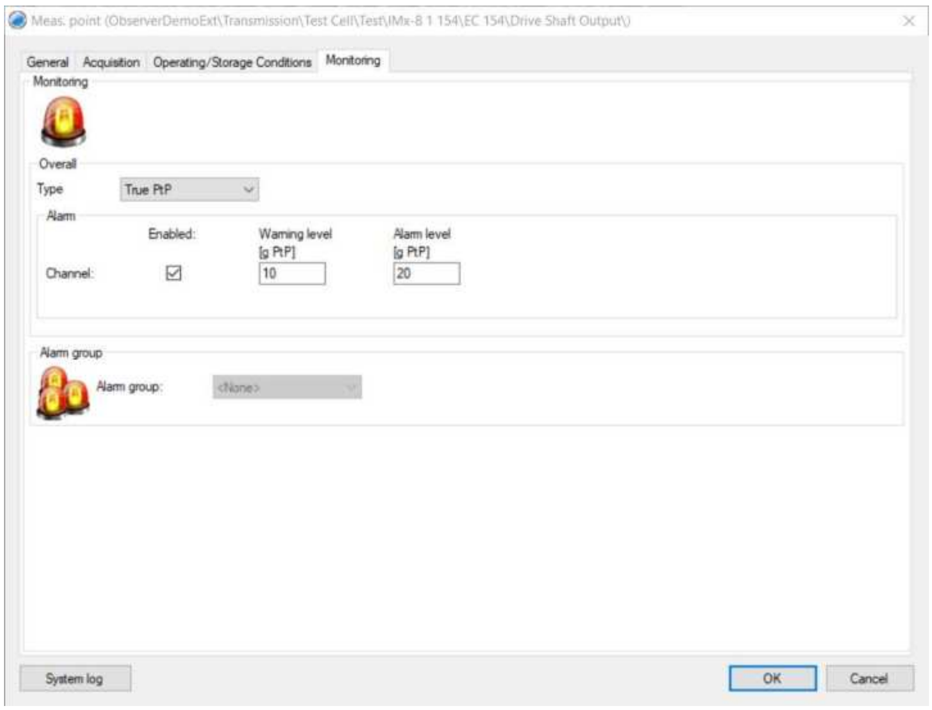


Figure 6 - 56
Example of Event Capture measurement point, Monitoring tab, Alarm section

- Check the **Enabled** checkbox to trigger storage of an event capture for the channels in the group.
- Set the **Alarm** level and **Warning** level. If the point is in an alarm group, event captures from all channels in the group will be taken upon alarm. Warning and Alarm should not use levels above 90 % of configured Full Scale.
    - When the point's signal drops below the specified alarm threshold, there is a one-minute delay before the event capture trigger is armed. This delay prevents the system from initiating a capture at every reboot when a point is above the alarm threshold.
- Select an **Alarm group**.
- Click **OK** to create the measurement point.

The Trend plot function is enabled for event capture measurement points which have alarms enabled. Select the event capture measurement point in the hierarchy view and then click the Trend icon to display the plot.

Options

The Options interface offers different system settings for the @ptitude Observer application and database. These range from new measurement point settings to backup settings and are typically applied to all users in the database.

Database is the database to which the general settings of options are to be applied. Select a database from the drop-down list.

- ➢ From any tab within the Options interface, click the **Default settings** button to restore the system default values for the settings on that tab.

General Settings Tab

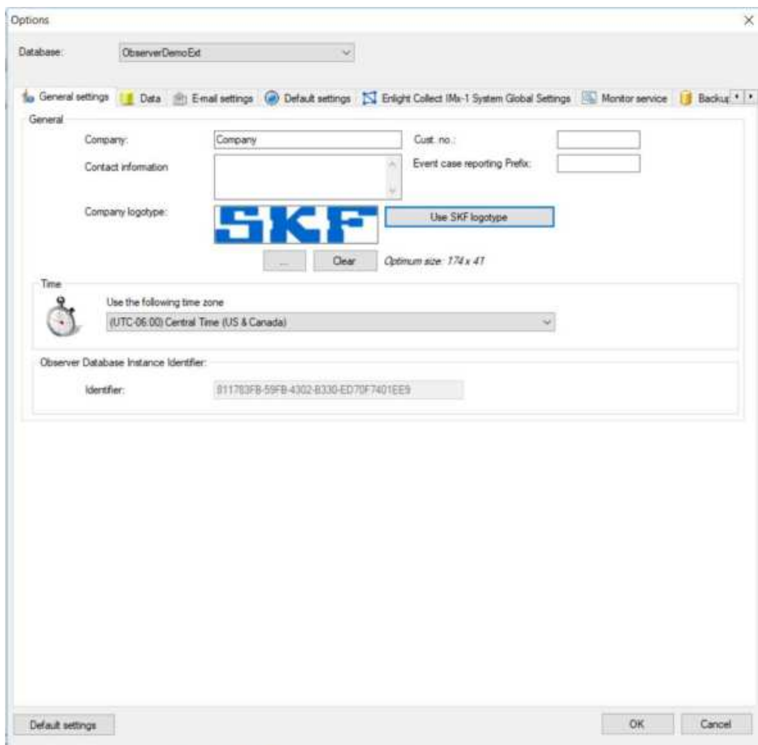


Figure 6 - 57
Example of Options General settings

Company name to which the selected database belongs.

Contact information is for the company. It should normally contain the name and the address of the company.

Cust. no. is an optional text field for a customer number.

Event case reporting Prefix is a prefix text that is applied to the case number when creating event cases and reports. If using multiple databases, the prefix should be different for each database in order to create completely unique event case numbers.

Company logo is used in event case reporting. The SKF or own company logo may be used.

Time zone enables the selection of any time zone available on the computer where the database is created. This can only be changed by users with system configuration rights. Observer will use this time zone for all time date stamps in the database.

Observer Database Instance Identifier is assigned to all new databases and those existing databases upgraded to 12.1 or later. It provides a fully (world) unique identifier for that specific database. It has been introduced as an enabler for future functionality/traceability.

Data Tab

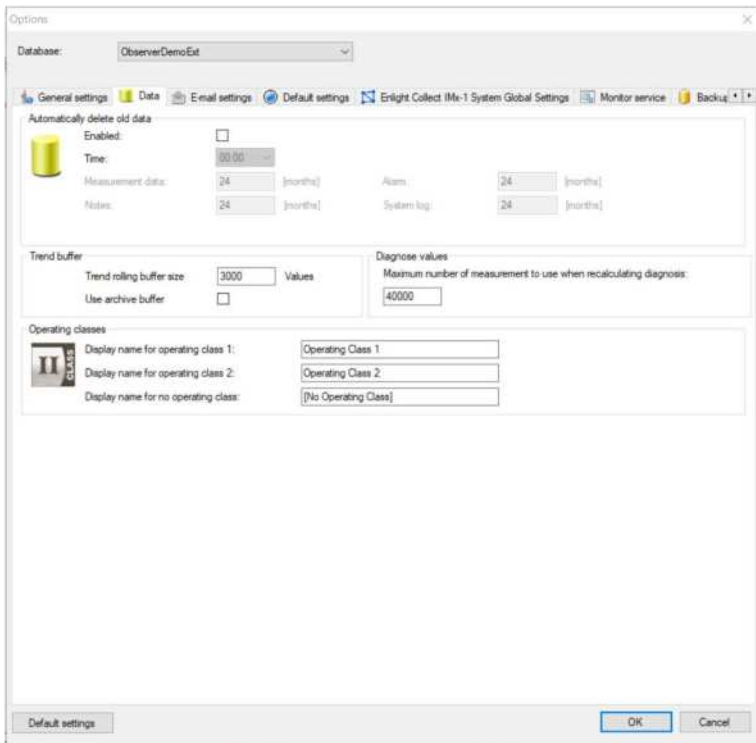


Figure 6 - 58
Example of Options Data settings

Automatically delete old data will cause the monitor service to remove old data from the database once data is older than the specified range, if **Enabled** is checked. Specified ranges can differ for different types of data.

Time specifies at which time of the day the removal will take place. Removing a large amount of data from the database can be time consuming. In such case, it is recommended to set the time to a non-office hour.

Trend rolling buffer size determines the size, number of values, of the built-in trend rolling buffers. The default size is 3 000, the minimum value that can be entered is 800.

Use archive buffer turns the archive buffer on (if checked) or off (if not checked). The archive buffer can store up to 80 000 values for each measurement point.

Diagnose values allows control over the maximum number of values used in a Diagnosis calculation or recalculation. The default setting is 40 000 values.

Operating Classes are different operating conditions in which a machine normally operates. With the use of multiple gating measurement points, different alarm levels can be set depending on which operating class a machine is in. @ptitude Observer supports two operating classes for use with IMx devices.

Display name for operating class 1 and **2** – Enter the text to display in the user interface (for example in the Process Overview) when the machine is operating in either of the two operating classes.

Display name for no operating class – Enter the text to display when the machine is not operating in either of the two operating classes.

- Only individuals with “Config System” rights can change the operating class display names.

E-mail Settings Tab

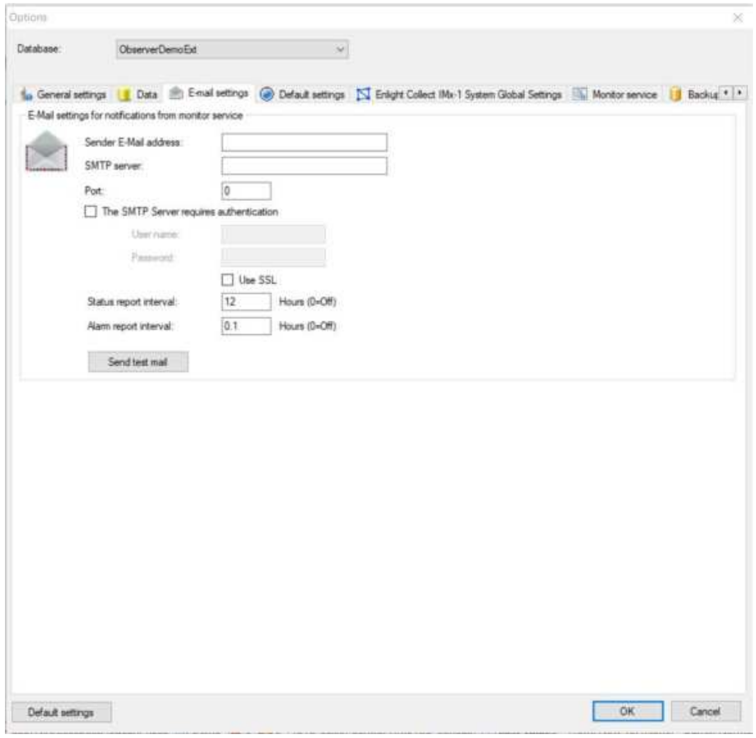


Figure 6 - 59
Example of Options E-mail settings

Sender E-Mail address is the email address to which the monitor service will send notifications.

SMTP Server is the SMTP server that should be used for sending e-mail messages from the monitor service.

Port needs to be set to the port of the SMTP Server.

The SMTP Server requires authentication must be checked if the SMTP Server requires that a user name and a password is supplied.

User name is then the user name for the SMTP Server

Password is then the password for the SMTP Server

Use SSL must be checked if the SMTP Server requires communication through SSL (Secure sockets layer)

Status report interval sets how often status reports from the monitor service should be sent by email. The status report of the monitor service contains a number of parameters about the system, including database size and condition.

Alarm report interval sets how often alarm reports from the monitor service should be sent by email. The alarm report of the monitor service contains alarm information for alarms that have occurred since the last alarm report.

Send test mail sends out a test mail which can be used to confirm that the email settings are correct.

Default Settings Tab

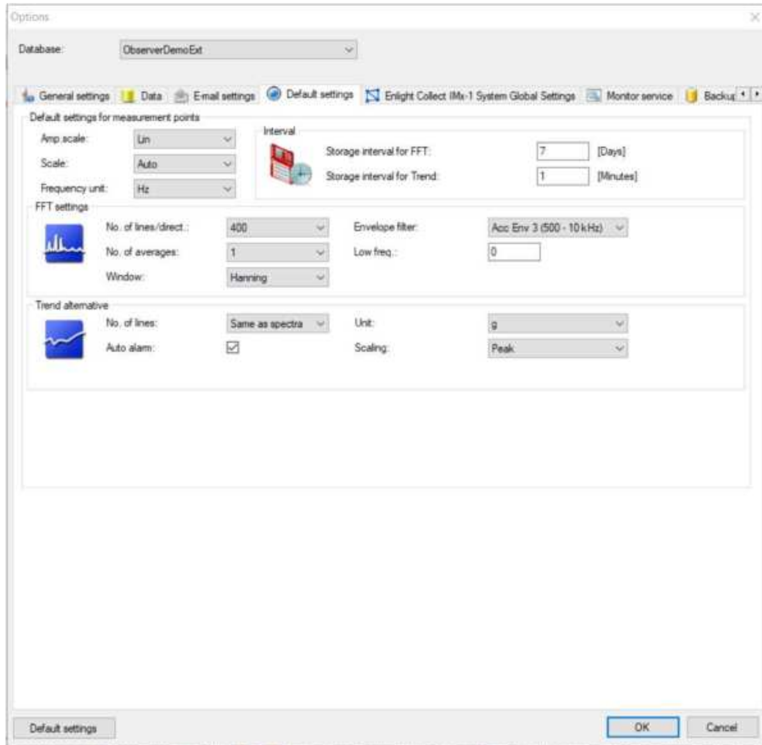


Figure 6 - 60
Example of Options Default settings

The Default settings tab allows the default settings for new measurement points of the selected database, to be configured. When a new measurement point is created, these settings will be automatically selected for the new measurement point on the measurement point screen. For more information refer to Setting up Measurement Points and Alarms in System Configuration.

Note the **Default settings** button, lower left, restores the settings on this tab to their system default values.

Enlight Collect IMx-1 System Global Settings Tab

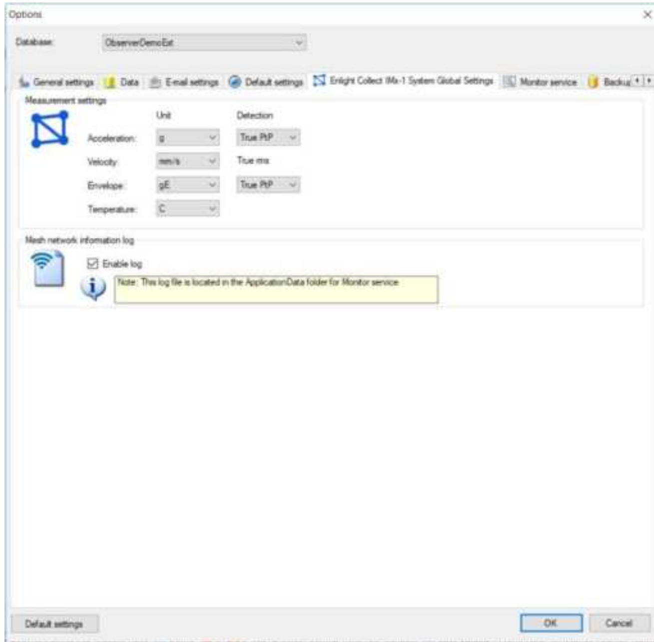


Figure 6 - 61
Example of Enlight Collect IMx-1 System Global Settings

Where the licensing includes the SKF Enlight Collect IMx-1 System, this tab will be visible and is where the engineering units for each of the four IMx-1 sensor measurements is configured. The choices for each are as follows:

- Acceleration: ***g*** or *m/s^2*
- Velocity: ***mm/s*** or *ips*
- Envelope: ***gE*** or *m/s^2E*
- Temperature: ***C*** or *F*

Vibration measurement detection for Acceleration and Envelope measurements is configurable as either ***True PtP*** or *True PtP/2* (half the true peak to peak value).

Being global settings, these apply to all IMx-1 sensors in the database and also to the units used for the gateway, internal temperature measurement. Pressing **Default settings** selects the choices in bold, above.

In addition, in the lower part of this dialog is where the user can enable the 'Mesh network information log'. The log will be created in the application folder for the monitor service and will be named <MonitorName>IMx1SensorMeshInformation.log, i.e. prefixed by the actual name of the monitor service.

The Mesh network Information log is a human readable CSV format file that provides information on sensor mesh, parent-child relationships and performance statistics such as packet loss and transfer time:

- Log time
- Time-stamp from sensor
- Sensor hardware ID
- The last 8-bytes of the sensor address

- The last 8-bytes of the sensor parent address
- Parent link metric
- Packets sent
- Packets lost
- Packets round trip minimum
- Packet round trip maximum
- Packets round trip average
- Network instability flag
- Watchdog reset flag
- Sensor self-diagnostic (see also Status for decoding information)
- Gateway Hardware ID
- The last 8-bytes of the gateway address

Such information can be invaluable when troubleshooting issues with the performance or behaviour of the sensor mesh.

Monitor Service Tab

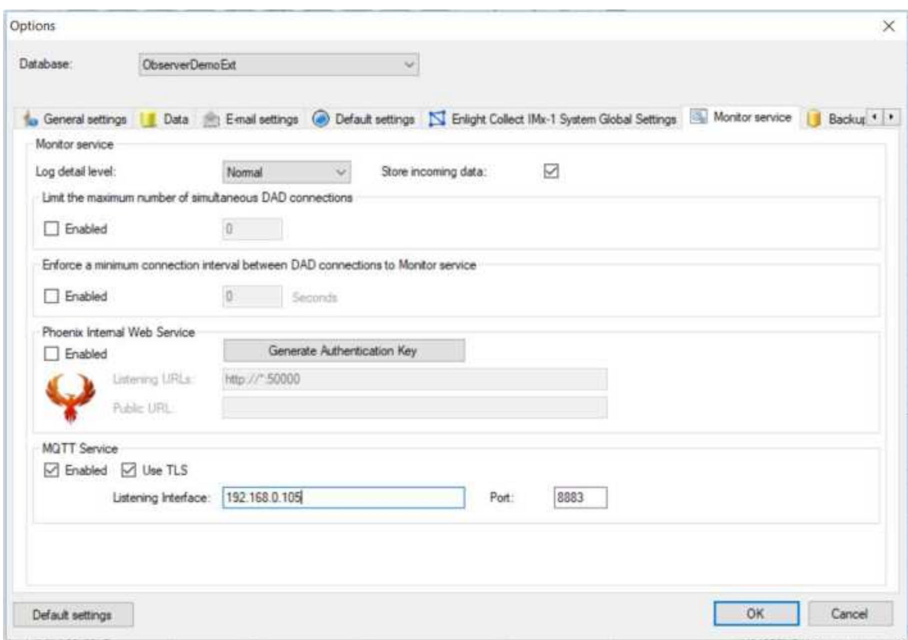


Figure 6 - 62
Example of Options, Monitor service settings

Log detail level determines which type of event(s) are to be stored in the monitor event log. There are five levels to choose from:

None: Nothing is logged in the event log.

Minimal: Only severe errors are logged.

Normal (default): Severe and minor errors are logged.

Detailed: Store events (and severe and minor errors) are logged.

Full: All events that occur are logged. This setting can be used for error tracking.

Store incoming data can turn on and off the data storage in the database. This checkbox should normally always be checked. Under certain circumstances such as during service or during commissioning this can be unchecked to avoid storing invalid data.

Limit the maximum number of simultaneous DAD connections can be used to prevent all data acquisition devices in the system from connecting at the very same time to upload the collected data to the database. This can be useful when having a system setup where the DADs connect on a regular interval, for example once per day to upload their data and then disconnect again.

Enforce a minimum connection interval between DAD connections to monitor service can be used to spread out the workload of the monitor service on sensitive computers.

Phoenix Internal Web service – the internal web service can be used to retrieve data from the Observer database through a web service API. The SKF @ptitude Observer Phoenix Data Service API is a HTTP-based RESTful API that uses OAuth 2.0 for authorization. API request and response bodies are formatted in JSON (**J**ava**S**cript **O**bject **N**otation).

The REST interface is provided by the Observer Monitor Service. To use the REST interface the Monitor service must be installed, started and configured.

Select **Enabled** to enable the REST endpoint.

Click the button **Generate Authentication Key** to generate a permanent encryption key used for authentication. If no permanent key is generated a temporary is generated when monitor starts.

Add **Listening URLs** to specify on which protocol, address and port the REST endpoint should listen for incoming requests. This is a list separated by a comma sign (“,”).

Examples:

https://localhost:14050 will listen on the https protocol on the host only interface “loopback” on port 14050.

https://10.11.12.13:8080 will listen on the https protocol on the network interface 10.11.12.13 on port 8080.

https://computer.dns.name:8080 will listen on the https protocol on the network interface allocated to DNS name computer.dns.name on port 8080.

https://computer.dns.name:8080,https://10.11.12.13:8080, https://localhost:14050 combines all the earlier examples.

URLs are built up of <**protocol**>://<**IP address or hostname**>:<**port number**>.

Protocol: The recommended protocol is https which is encrypted communication. Protocol http is also supported but not recommended since sensitive information is exchanged, like username and password. Please note that using https requires some additional configuration of the windows machine hosting Observer monitor.

IP address or hostname: Specify on which network interface the REST service should listen for incoming requests. Typically, this is represented by a physical

Network Interface Card (NIC) for connection between a computer and a private or public network. However, it can also take the form of a software-only component such as the loopback interface or Virtual Private Network (VPN) interface.

Examples: loopback, computername.companyname.com, 192.168.1.10

There is a special interface called '*' which should be used with care since it's the wildcard interface, which means all interfaces.

Port: The Port where the REST interface should listen for incoming requests. The default is 14050, but any non-allocated port can be used. Double check the firewall to identify which ports are blocked for incoming requests.

Public URL: For cloud scenarios in combination with SKF Rail Track Monitoring the Public URL denotes the URL where the service is reached from outside of the cloud. The cloud provider will map a public IP address or DNS name to the IaaS instance.

On changing the Phoenix configuration and clicking **OK**, the Observer Monitor will react within seconds and open the REST interface. This can be verified in the Observer Monitor log file.

If the port configured is already in use by another process on the computer, Observer monitor will indicate this in the log file. Select another free port or terminate the process that already is using it.

MQTT service for SKF Enlight Collect IMx-1 systems

For utilisation of the MQTT service, four controls are available:

MQTT service – enabling this service is necessary for Monitor to communicate with SKF Enlight Collect IMx-1 systems.

Use TLS – enabling Transport Layer Security ensures the SKF Enlight Collect IMx-1 system including the SKF Enlight Collect Manager app can verify it is connecting to the legitimate @ptitude Observer Monitor server and facilitates encrypted data exchange between them. This is enabled by default on new databases or on those upgraded from @ptitude Observer 12.0 or earlier, when used, a TLS certificate needs to be added to the Monitor service via the Monitor Manager tool.

Listening interface: This is the network interface that Monitor will listen on for MQTT messages. The interface is specified by its IP-address, noting that the address entered here should always be the internal or private IP address for the Monitor server and not its public IP address.

Port: The port Monitor will listen to. By default, this is set to the standard TLS, MQTT port 8883. Ensure that incoming MQTT, TCP connections to the designated port are not blocked by a firewall and that where multiple Monitor services are listening on that IP address, unique ports are used for each.

The app to @ptitude Observer software and the gateway to @ptitude Observer software (back-end) interfaces both support Transport Layer Security using a server certificate and a Certificate Authority (CA) certificate stored in the back-end. The server certificate is used when setting up the TLS connection. The CA certificate contains information about the issuer of the server certificate and is used to ensure that the CA can be trusted.

The server certificate can be a:

- self-signed certificate

- certificate provided by the customer's IT department

A description of how to generate a self-signed certificate is included in the Observer Installation manual, part number 32170700, revision Q or later.

To protect against "man-in-the-middle" attacks, the CA certificate is sent to the gateway at gateway commissioning, via the app. This CA certificate is used by the gateway when connecting to the back-end, to verify that the server certificate is signed by an official CA and can be trusted.

Where the MQTT service is enabled and Transport Layer Security is being used an appropriate security certificate must be associated with the Monitor service so that the server identity can be verified, the connection trusted and the MQTT exchanges encrypted. A server certificate is added using @ptitude Observer Monitor Manager, for general guidance on using this particular software tool refer to the SKF @ptitude Observer Installation manual, part number 32170700.

In Monitor Manager, right click the monitor service to which the certificate is to be added and click "properties" or select it then use Action > Properties from the menu or just double click it:

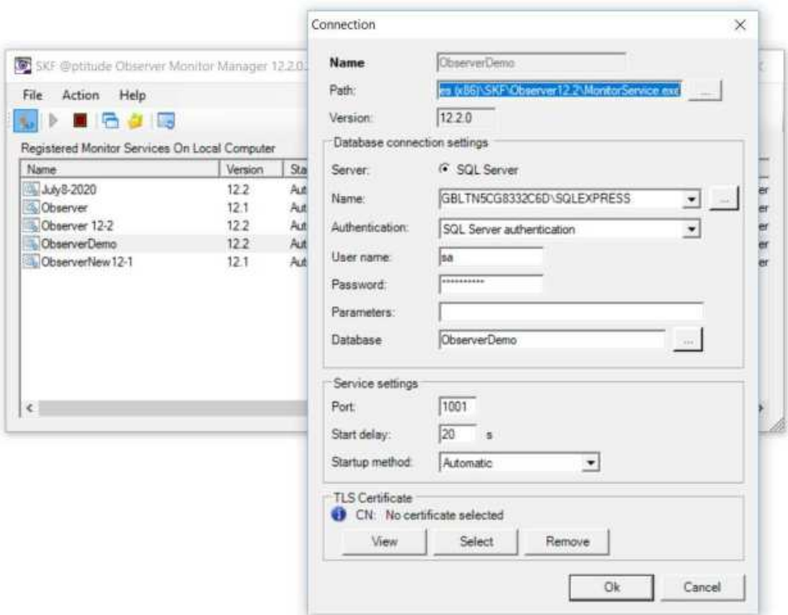


Figure 6 - 63
Using Monitor Manager to add a TLS certificate

There, at the bottom of the Properties/Connection dialog, the user can **Select** a certificate from its windows certificate store, **View** a selected certificate or **Remove** a certificate.

CN: The Common Name of the selected certificate is shown here. The blue information icon triggers tool tip text to remind users to ensure that the Common Name matches the Monitor address the gateway/app have, as a mismatch will prevent them connecting to @ptitude Observer Monitor.

Those responsible for administering the system should ensure an appropriate, in date certificate is always selected. To assist with this, within @ptitude Observer an expiring certificate (one with less than 30-days validity) will generate a system alarm each day and an expired or missing certificate will cause a critical system alarm. Note that whilst an expired or missing certificate will not immediately cause the connection between the gateway and @ptitude Observer Monitor to stop, if that connection is closed for any reason (Monitor or MQTT restart, TCP disconnection) they will be unable to reconnect until the certificate issue is resolved.

Backup Tab

Backup automates daily backups for SQL Server. The backups are done by the @ptitude Observer Monitor service at the specified interval. Therefore, @ptitude Observer Monitor must be running for the backups to be created

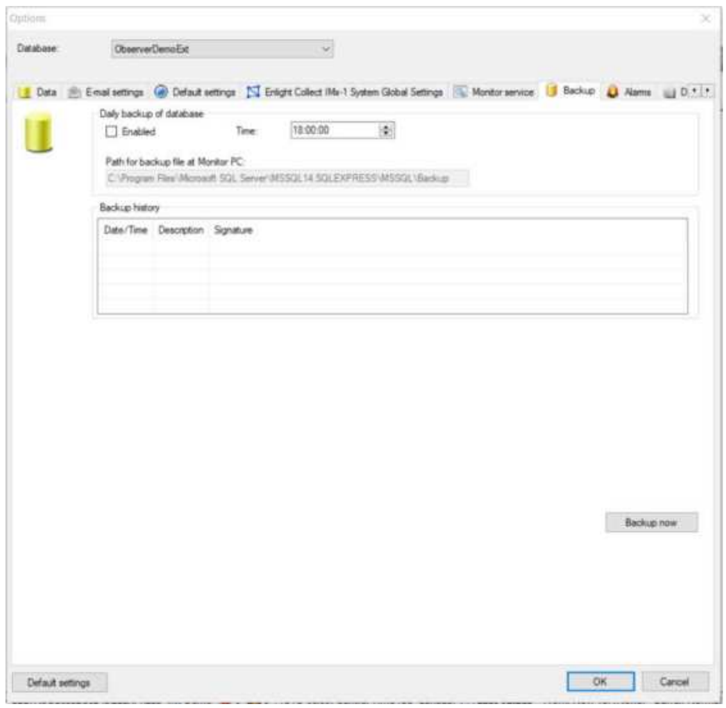


Figure 6 - 64
Example of Options Backup settings

Database is the database to which backup options are to be applied.

Enabled causes daily backup of the database.

Time indicates when the backup job should be actioned.

Path for backup at Monitor PC shows the location on the monitor computer where the backup files will be saved.

- All backups are written to the same filename and location so only the most recent backup file persists. If a depth of more than one file is required then backups should be copied to another location before they are over-written.

Backup history displays the history of backups done.

Backup now causes an immediate backup.

Note that with SQL Server Express, this is the only way to automate backups of @ptitude Observer databases.

Alarms Tab

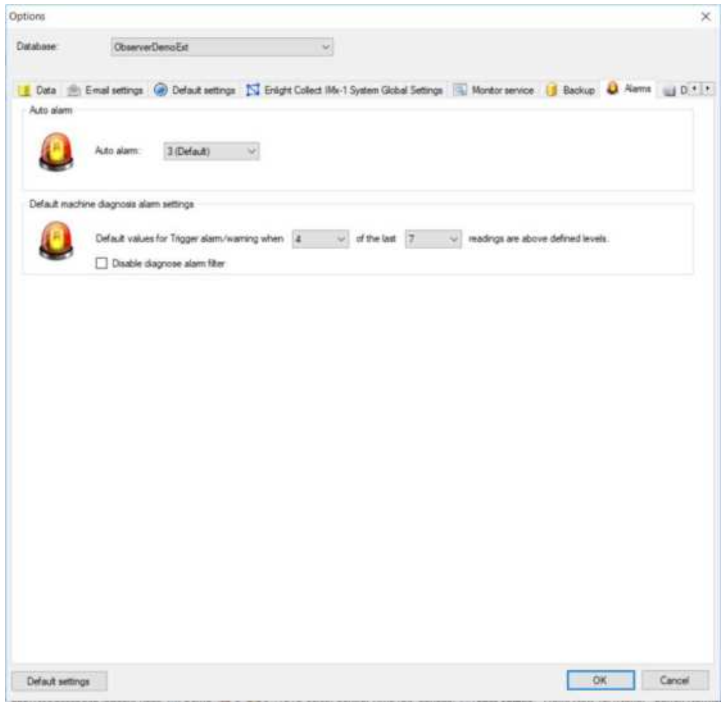


Figure 6 - 65
Example of Alarms settings

Auto alarm value is the setting for the diagnosis auto alarm. It controls how close to current levels the alarm level is set, configurable in the range 0 to 10, where:

0 (Aggressive) sets the auto alarm level very close to previous measurements.

3 (Default) sets the auto alarm level fairly close to previous measurements.

10 (Conservative) sets the auto alarm level high (compared to previous data).

Default machine diagnosis alarm settings sets the alarm hysteresis default values for calculating and triggering an alarm/warning. The method is to set the "Default values for Trigger alarm/warning when *m* (1 to 30) of the last *n* (1 to 30) readings are above defined levels". The default values are *4* and *7*.

Disable diagnose alarm filter relates to an alarm filter that prevents multiple alarm events being generated due to successive measurements being in alarm.

With the filter enabled (default), an alarm is generated the first time the alarm conditions are met but further alarms from subsequent measurements are not generated unless that initial alarm is acknowledged. If acknowledged, the next measurements meeting the alarm criteria generate an alarm and the filtering process repeats.

With the filter disabled (checked), alarms are generated every time measurements exceed the alarm criteria. This corresponds to the default behaviour in @ptitude Observer 10.2 and earlier.

Device Settings Tab

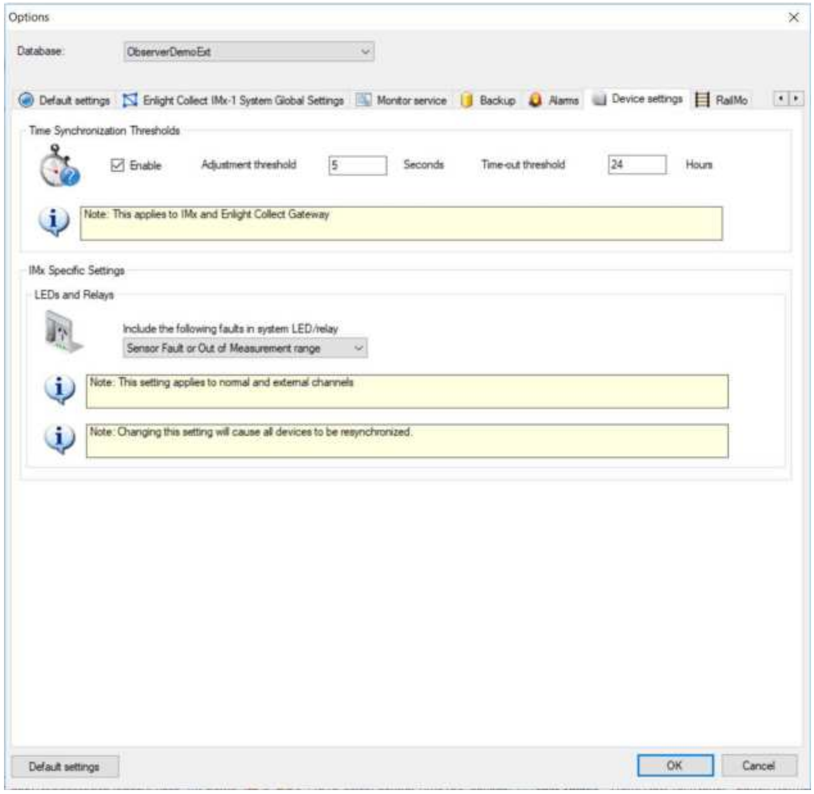


Figure 6 - 66
Example of Device settings tab

This tab has two areas, one for **Time Synchronization Thresholds** that applies to IMx devices and any Enlight Collect gateways, and a second that applies to the system LED/relay on IMx devices.

Time Synchronization Thresholds: are enabled by default with settings of 5 seconds and 24 hours so as to generate critical system alarms if time synchronization is lost.

To configure the time synchronization thresholds:

- If not already enabled, select the **Enable** checkbox.
- Enter the desired number of seconds for the **Adjustment threshold (seconds)**, the default setting is 5 seconds. The adjustment period is the difference between the time of the NTP client and the time of the NTP server. If the time difference exceeds the Adjustment threshold specified, the alarm is created. The alarm states: “The time difference between the device (name) and the NTP server has exceeded the threshold."
- Enter the desired number of hours for the **Time-out threshold (hours)**, the default setting is 24 hours. The NTP client tries to communicate with the NTP server at specific intervals to get the current time. If the time period the NTP client cannot communicate with the NTP server exceeds the Time-out threshold specified, the alarm is created. The alarm states: "Device (name) has not been able to synchronize with the NTP server."

Include the following faults in system LED/relay applies to all IMx multi-channel devices. This setting is written to the IMx configuration file upon synchronization.

- *None* is the default setting for new and upgraded databases (if the setting wasn't previously available).
- *Sensor Fault* includes only the channel sensor fault condition.
- *Sensor fault or Out of Measurement Range* includes both channel sensor fault and a measurement point out of range as potential triggering events.
    - ➢ If this setting is changed, then all IMx devices in the database will be synchronized automatically by the Monitor service.

RailMo Tab

Where the licensing includes SKF Rail Track Monitoring and the application is for a *Metro* system, the user will also make use of the RailMo tab. The settings available there are described in RailMo tab and Peak severity settings and storage limitations.

Delete Data

Delete data interface can delete measurement data based on certain criteria or filter settings for the selected database.

Data Miner

The data miner allows for complex data mining from the Observer database with the results available in three different formats; table, trend and bar.

This interface makes it possible to compare measurement points, machines or even specific diagnoses.

Expert users can also design custom statistical views and, if approved, these can be shared with other Observer users around the world through the SKF Online Repository (SKF OR).

Note that to create custom statistical views, a very good understanding of the Observer database structure is required.

On-line

On-line Sub Menu	Function
IMx/MasCon devices	Set up and edit IMx/MasCon devices.
OPC servers	OPC configuration, options for **Internal OPC server** and **External OPC servers**.
Monitor Service Viewer	Monitor Service Viewer.
Enlight Collect IMx-1 System View	Manage Enlight Collect IMx-1 system components.
Direct Modbus devices	Manage Direct Modbus devices, their channels and write functionality.
Firmware	Manage the on-line device firmware available in @ptitude Observer.
Balancing	Multi-plane balancing of rotors.
Event log	The Event log displays system level events.

IMx/MasCon devices

This interface brings up the IMx/MasCon devices screen. Refer to Managing IMx/MasCon Devices and Channels in System Configuration.

OPC Servers

OPC server configuration, with options for **Internal OPC server** and **External OPC servers**. Refer to Creating OPC Servers and Channels in System Configuration.

Monitor Service Viewer

The monitor service viewer can be used to view the interface of the monitor service remotely from Observer. It is possible to view all events occurring in the service as well as database status, device status, OPC status and the number of clients currently connected. As it is the Monitor service that receives the data from an IMx-1 system, it can contain relevant information regarding the system's performance.

When reviewing events in the monitor service viewer, if the description column contains a lot of text and is difficult to read without excessive scrolling, for easier viewing click on a row to open that event entry in a separate window.

Enlight Collect IMx-1 System View

The SKF Enlight Collect gateways and IMx-1 sensor hardware are maintained via this view, for more information refer IMx-1 System view.

Direct Modbus devices

This menu option opens the Direct Modbus devices, view:

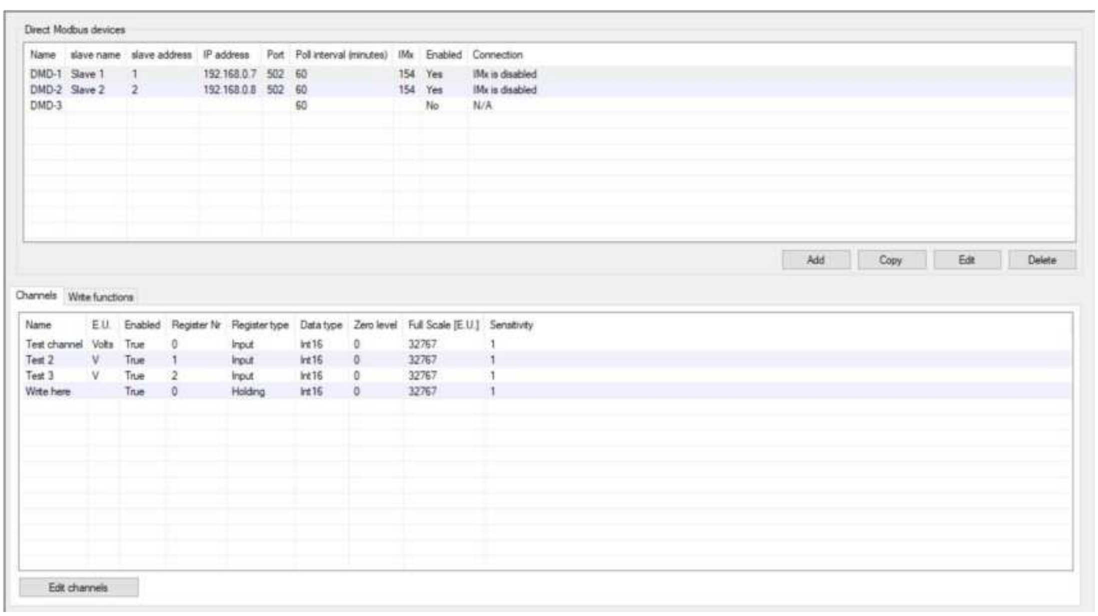


Figure 6 - 67
Direct Modbus devices view

Direct Modbus devices are a means of adding Modbus TCP slave sensors 'directly' to an @ptitude Observer system. Whilst requiring an associated IMx to route the communications and therefore using up one of its (four) Modbus connection possibilities, this Direct Modbus device method does not use any of the IMx's 32 external channel capability nor impact its overall channel count. The data returned 'directly' from a Direct Modbus device is therefore associated not with an IMx point type but with a software measurement point type called a Direct Modbus Point.

- To take advantage of latest functionality, users should always ensure that the system is updated with the latest available IMx firmware.
- If the IMx reports that it is unable to contact the Direct Modbus device, the associated measurement points will be set to a Sensor fault status.
- Whilst ownership of the TCP slave device resides with the IMx, that IMx is not responsible for polling for Direct Modbus data. A consequence of this is that if @ptitude Observer Monitor were to lose connection to the IMx, Direct Modbus data would potentially be lost as it is not being locally buffered by an IMx. In case of such a connection loss, the affected Direct Modbus points will be set to a Not measured status.
- If required, it remains possible to configure the IMx to fetch Modbus data from a TCP slave even if that same slave is being used as a Direct Modbus device.
- Again, if required, a single TCP slave device can be the basis of multiple Direct Modbus devices.

The process of integrating Direct Modbus device data into @ptitude Observer can be summarised as follows:

1. On the associated IMx that will provide the communications 'conduit', configure the IMx as a TCP master and create a Modbus TCP slave for the sensor. Only the basic slave definition is required (name, slave address, IP address, Port and data Byte order). Refer Modbus Communication.
2. Open the Direct Modbus devices view and **Add** a Direct Modbus device referencing the appropriate IMx and its Modbus TCP slave. Then Direct Modbus device **Channels** can be defined based on slave registers where the desired data can be read and, if needed, write functionality can be defined so that command data can be written to the device from @ptitude Observer (for example this might be used to reset the particle counts of an Oil Debris Monitor device).
3. Then in the @ptitude Observer hierarchy add as required, Direct Modbus Points and configure them to the appropriate Direct Modbus device and channel.

Direct Modbus devices view

Direct Modbus devices and their channels are maintained in this view. It shows the status of Direct Modbus devices and is where additional devices and their channels are created and configured. It opens in the main window area as used by the DASHBOARD and analysis diagrams.

To open the view:

- Click **On-line** on the toolbar and then select **Direct Modbus devices**.
- Alternatively, if the view is already open, but just hidden beneath another, select **Window** and then **Direct Modbus devices** from the numbered list of open views.

Figure 6 - 67 above, is an example of a **Direct Modbus devices** view.

In this view the upper area is a table of all **Direct Modbus device**s in the database (with device **Add**, **Copy**, **Edit** and **Delete** controls). The lower area (the first tab: **Channels**) lists all channels configured on the Direct Modbus device selected in the upper area and has a single **Edit channels** control. Having already configured the appropriate IMx as a TCP master and created a Modbus TCP slave entry for the sensor, it can be added to the table:

Figure 6 - 68
Add a Direct Modbus device

For each device added the following aspects are configured:

Enable: Tick to enable the device.

- A warning may be shown to remind that the device cannot be enabled unless an **IMx** and a **Slave** have been selected.

Name: Name given to the Direct Modbus device.

IMx: Select an IMx device from the drop-down.

- Only IMx devices configured as a Modbus TCP master will be listed.

Slave: Select a Modbus TCP slave device from the drop-down populated with the TCP slaves on the selected **IMx** device.

Poll interval: Enter the time period between successive data requests. Note the adjacent drop-down that allows the interval to be specified in *Minutes*, *Hours* or *Days*.

- Once the Direct Modbus device is configured, @ptitude Observer Monitor will have the task of requesting data from the device at this interval. Minimum interval between successive polls is 1 minute.

Once the device configuration has been completed, **Save** those settings or **Cancel** to close without saving. Note that this dialog also includes a button to link to the **System log,** which will open that dialog pre-filtered for Object type 'DAD' – the appropriate level for a Direct Modbus device and once the new device has been created further filtered for the specific device.

Closing the Device configuration dialog will cause the main Direct Modbus device table to update. The columns there mainly reflect the settings made in the device configuration with the addition of a final column:

Connection: Current connection status for the Direct Modbus device.

Channels tab

The first tab in the lower area (**Channels**) lists all channels configured on the selected device (and has a single **Edit channels** control). All channels to be used should be configured here irrespective of whether these relate to where data is being read (Input or Holding registers) or where data may on occasion be written back to the device (Holding registers only).

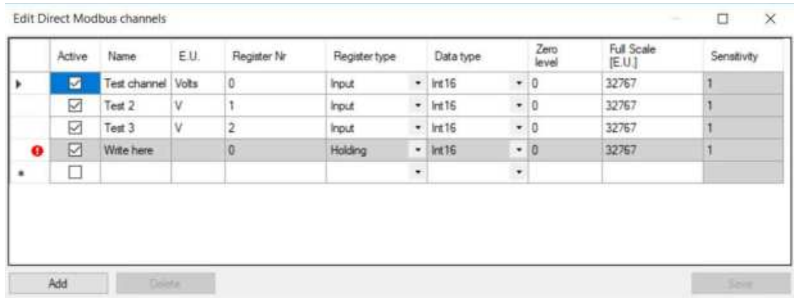


Figure 6 - 69
Edit channels – Edit Direct Modbus channels

- ➢ In the figure above, the Holding register example was not editable because it has already been allocated to a write function (greyed cells and warning icon refer). If that were not the case, the editable cells would be the same as the rows shown above it.

The **Edit channels** dialog contains a channel table with controls to **Add** or **Delete** a channel and to **Save** changes. The 'X' control is used to exit without saving changes and will generate a warning/reminder whenever there are pending changes, to save.

For all channels being configured select or enter the following:

Active: Tick to enable, make the channel active.

Name: Name given to the Direct Modbus device, channel.

EU: The engineering unit label/descriptor for the data.

Register Nr, **Register type** and **Data Type**: All need to be appropriately set for the data that the Direct Modbus device will make available or that it will expect. The combination of **Register Nr** and **Register type** will determine what register is actually accessed, for example '*0*' and *Holding* will be understood to be register number 40001 on the Modbus slave device. The **Data Type** column can be configured for *Int16*, *Int32*, *Uint16*, *Uint32* or *Float*.

In combination the **Zero level**, **Full scale [E.U.]** and the read only **Sensitivity** fields are used where scaled values are being transmitted, to correct or compensate for a known/expected offset in the received value and/or scale the result.

- ➢ If the data type *Float* is selected, all these three fields become read only, as *Float* is not a scaled data type.

Full scale [E.U.] and a read only **Sensitivity**: Will be initially automatically set to reflect the range imposed/implied by the **Data type** selection, for example:

Int16: 32767 and a sensitivity of 1

UInt16: 65535 and a sensitivity of 1

Any changes made to the **Full scale [E.U.]** field will be proportionately (and inversely) reflected in the **Sensitivity** field, for example:

Int16: 3276 results in a sensitivity of just over 10 (10.002)

Closing the **Edit Direct Modbus channels** dialog will cause the table on the **Channels** tab to update. The columns there reflect the settings made in the configuration dialog.

Write functions tab

The second tab in the lower area (**Write functions**) lists all configured write functions and has controls for **Add**, **Edit**, **Delete** and **Send** write functions:

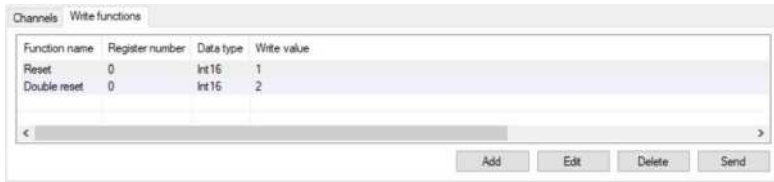


Figure 6 - 70
Write functions tab

- ➢ Again, note that the information displayed in the lower area is filtered by the Direct Modbus device selected in the upper **Direct Modbus devices** area.
- ➢ If data will only ever be read from the Direct Modbus device (nothing written to it), no configuration is needed here.
- ➢ If a write function is required, ensure that the target register on the Direct Modbus device is already configured on the **Channels** tab.

Adding or editing a write function launches the Configure Write function dialog:

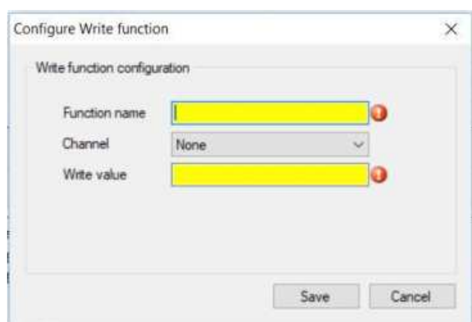


Figure 6 - 71
Configure Write function

Function name: give the function a name, ideally one that will clearly communicate its purpose.

Channel: Select a channel from the drop-down.

- ➢ Only channels that have already been configured as Holding registers on the Channels tab will be shown. To aid identification the entries are of the form: Register Nr", "Channel name.
- ➢ As illustrated, warnings may be shown to remind that configuration entries have not yet been completed.

Write value: Enter the value that should be written to the register on the Direct Modbus device.

Click **Save** to save the configuration and close the dialog, the table on the **Write functions** tab will update. The columns there reflect the key data for the write functions.

Repeat to add further write functions for different data values to that register or indeed for other registers that may need to be written to. Whereas the read function is a scheduled event the write function is only ever user initiated, one write at a time. This is accomplished by selecting the Write function table row corresponding to the function to be written and then pressing **Send**:

Figure 6 - 72
Send function command

The dialog confirms where and what data is being sent so that the user can confirm that this is as expected.

- An entry in the comment field is mandatory before the command data can be sent.

Click **Send** to have the command sent, an error message will display if either the IMx or the slave Modbus device is unreachable, a timeout occurs because @ptitude Observer Monitor is not running etc. A successful send will cause the **Function name** and the user entered **Comment** field text to be automatically added as a note, to the relevant machine(s) in @ptitude Observer. This note will also be visible in the associated measurement trend plots.

Direct Modbus Points

The data received from Direct Modbus devices is stored in Direct Modbus Points. These are added to the @ptitude Observer hierarchy, as/where required. A Direct Modbus Point is a type of Software, trend based measurement point and is available both in the New meas. point dialog and as a dedicated entry in the hierarchy right click menu at machine or sub-machine level:

Figure 6 - 73
Add - Direct Modbus Point

The advantage of the hierarchy context menu is that whereas the new measurement point dialog opens at a single point properties form this opens a table prepopulated with all configured Direct Modbus devices and their channels:

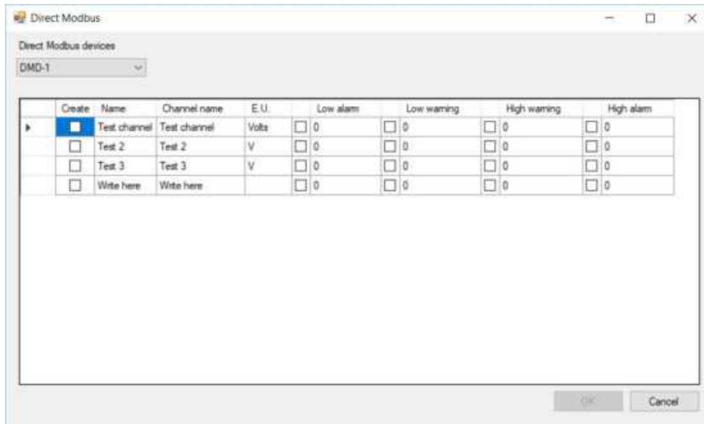


Figure 6 - 74
Add - Direct Modbus Point dialog

Direct Modbus devices: Select from the drop-down the appropriate device name, the table below updates with each Direct Modbus device channel occupying one row.

Create: Tick to create a measurement point from this channel.

Name, **Channel name** and **E.U.**: These initially reflect the channel naming and E.U. label with **Name** being set equal to **Channel name**. The measurement point **Name** and **E.U.** text can be edited here as required.

Direct Modbus Points support four alarm thresholds forming an alarm window: **Low alarm**, **Low warning**, **High warning** and **High alarm**. For each there is a separate enable control and numerical threshold setting.

After making any changes click OK to save and the dialog will close and the hierarchy update.

- Note that the Direct Modbus dialog is for adding Direct Modbus points and doesn't support editing of already created points. Running the process again will simply add more points.

To edit or view an existing Direct Modbus point right click on it or double click on it to open at the properties dialog:

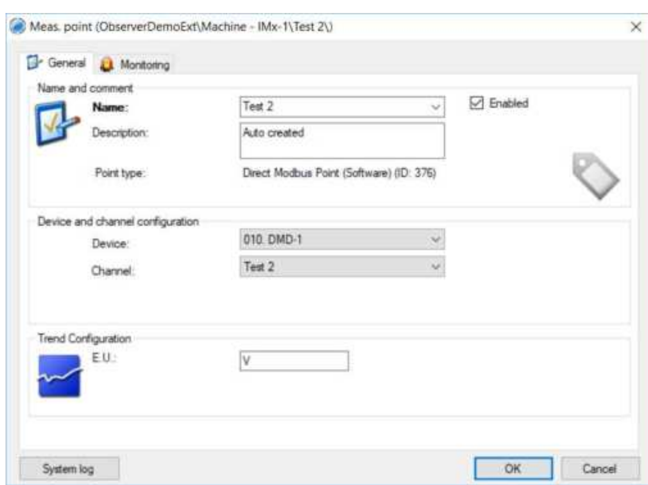


Figure 6 - 75
Direct Modbus Point properties

Two tabs are available, the second **Monitoring** tab holds the alarm configuration and the first **General** tab holds the remainder of the configuration from the point definition table. There is one additional field in the measurement point properties not present in that table, **Description**, which until/unless edited will include the text 'Auto created'.

Direct Modbus Points are supported by the Machine copy wizard, Machine templates, Import and Export of the hierarchy and Point copy and paste.

- Not supported by the Multiple point update wizard.

Firmware

Provides access to the dialog to manage the on-line device firmware currently stored in @ptitude Observer. Also reachable from On-line > IMx/MasCon devices > Firmware button, but in the same firmware dialog all types of on-line device are catered for, including the SKF Enlight Collect IMx-1 system.

Balancing

On-line balancing is a tool for multi-plane balancing designed especially for turbines. However, it is just as useful on smaller machines. The on-line balancing in @ptitude Observer uses IMx, MasCon16 devices harmonic measurement points because of their simultaneous measurement capability. On-line balancing supports a maximum of 15 planes over 5 states with up to 40 measurement points.

For successful balancing, the phase must be stable, and it should be possible to make changes on the actual speed range under run-up/down group. Polar plot can be used to determine if the phase is stable. If the phase is not stable, the problem is not only unbalance but also can be something else. Therefore, in such case further normal analysis of the machine is required. On a horizontal machine with laying shafts, the best balancing direction is the weakest direction.

In order to have an accurate balancing analysis of a machine, it should be certain that the problem lies within the unbalance characteristics. The following are some examples of other problems with characteristics that can be similar to unbalance.

- Bearing problems
- Bearing slip
- Misalignment
- Weak foundation

Balancing interface has the following functions.

- Balance
- ICM (Influence Coefficient Matrix)

Balance

Follow the steps described below in order to have an accurate balancing analysis of a machine.

Step 1: Choose an ICM (influence coefficient matrix) of the selected database. ICMs are created via the ICM interface.

The list of ICMs are shown by names and dates created. ICM contains the necessary information about the machines behaviour needed to eliminate unbalance which is stored in the database for new on-line balancing in the future.

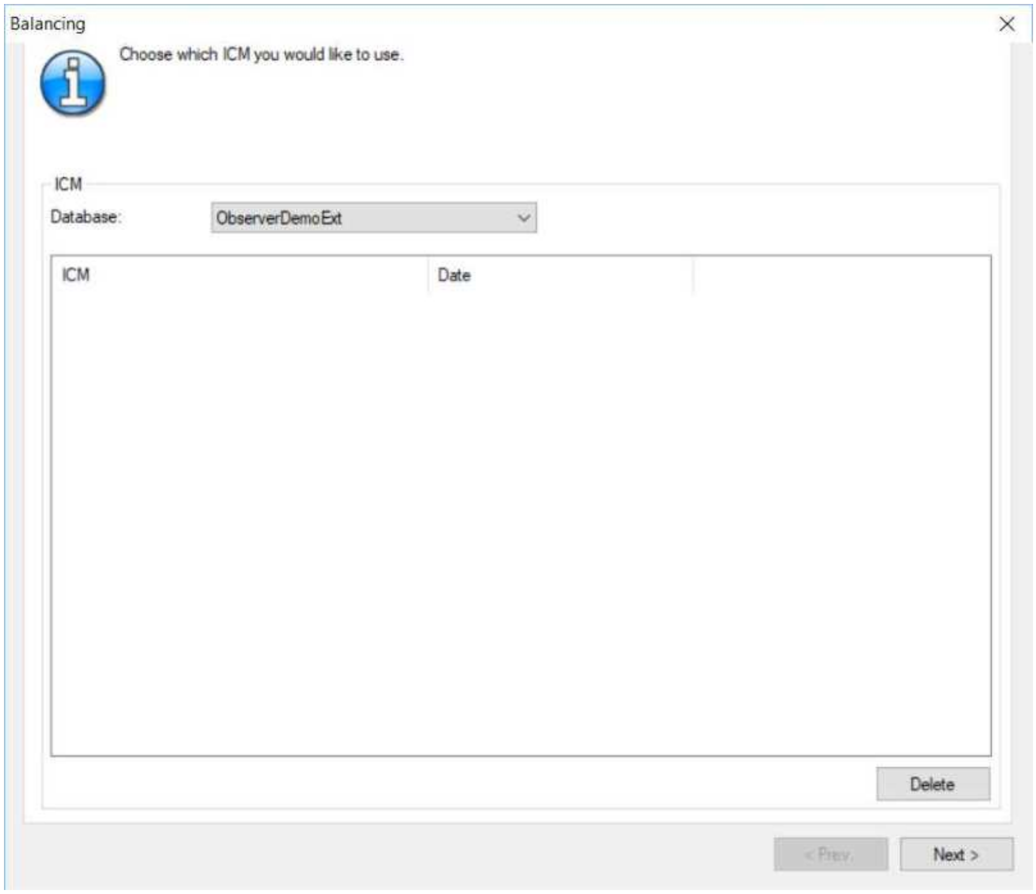


Figure 6 - 76
Example of Select an ICM for Balancing Analysis

Step 2: Choose which points, planes and states that this balance should use. For big machines such as a turbine, it is possible to balance a few of the planes. It is not necessary to balance all the planes, all the time.

Step 3: Choose a measurement point that is sensitive to the balance state, points with higher vibration amplitude have a greater influence on the balance calculation.

Step 4: Choose the data to use, to eliminate unbalance.

Live data display all the measurement points with an amplitude, phase and number of means collected. A phase % is the difference between highest and lowest and calculated over 360 degrees. Between 0 and 5% is a normal range, whereas 5 to 10% is unstable and greater than 10% is an unusable phase. If the phase is unusable, the balancing is most likely going to fail. In such case, go back and perform a normal analysis of the machine and determine what the problem is and remove the problem first. A large number of test weights can also cause an unusable phase.

Step 5: After all the possible combinations have been calculated and optimised, a balancing result is available.

The improvement shows how much of the vibration has been eliminated. The biggest value is 100%.

In order to minimise the mounting weight, one of the combinations may have lesser weight than the others. It is also possible to input own weights to calculate expected deflection. This can be used if there is any plane that could not be mounted for some reason or possibly the weights used don't correspond exactly to the recommendations.

After weights are mounted, it is strongly recommended to go back to the eliminating screen (step 4) and collect some new live data. It is most likely that the elimination of unbalance can continue, in an iterative manner, until only a very small unbalance is left.

ICM

ICM (influence coefficient matrix) interface allows a user to create an ICM for the selected database. Created ICMs are used for further on-line balancing.

Follow the steps below in order to create an ICM.

Step 1: Choose sensors, number of planes and number of states from the machine of the selected database.

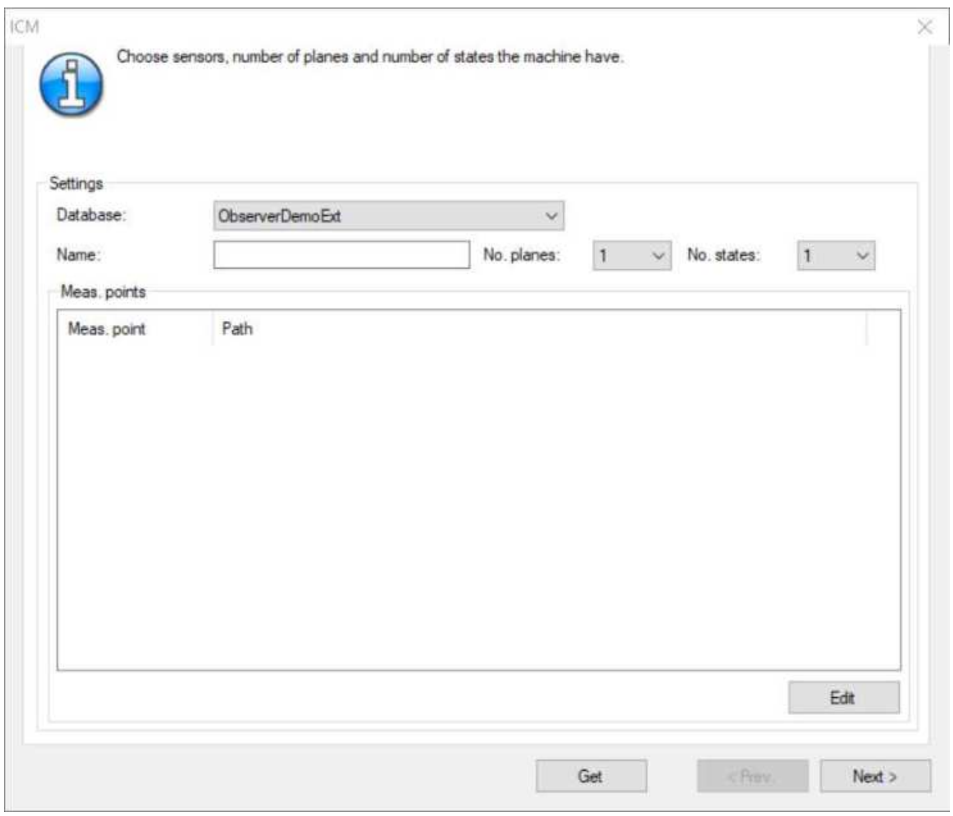


Figure 6 - 77
Example of Create an ICM, settings

Database is the database to which this ICM applies.

Name is the text reference to the ICM.

No. planes is the number of locations that weights can be added.

No. states is the number of defined speed ranges in which a balancing is conducted. For large turbines, it could be more than one. Whereas for regular fans, it probably would be one.

Meas. point is the selected harmonic measurement point.

Path is the particular harmonic measurement point's path.

Edit brings up the hierarchy view. Select a harmonic measurement point by checking a box.

Get lists the existing ICMs of the selected database from which an ICM can be selected.

Next continues to the next screen (step 2).

Step 2: Name the planes, states and define balancing speed range by a centre frequency with a plus/minus delta speed.

Step 3: Now it is time to select data. Data can be collected live as well as read from the database. It is important to input weight and phase of every test weight used.

Step 4: At this stage, verify that the amplitudes or phase has changed between initial run and the test runs. It is possible to see the actual number of mean values collected. If the changes in amplitude and phase were too small, then probably the test weights were too light. This can cause an incorrect ICM which in turn is inappropriate to use for a good balancing.

Step 5: Presentation of the ICM matrix over every defined state is shown. Note that the matrix condition number* should not be greater than 4.

*The matrix condition number is a measure used in numerical analysis/methods to describe how sensitive the result is to changes in the input data, in this case the vibration measurements. A higher condition number indicates small differences or errors in the measurement data could cause significant changes in the balance corrections suggested and should therefore not be used.

Event Log

The Event log displays system level events but whether or not it is enabled depends on the licence key being used. For example, licences that include the IMx-1 software module will have this functionality enabled.

It can display all events from the database but filter controls (Data source, Type, etc.) allow the information presented to be focussed as required. An Export function allows the export of events to an Excel file for further analysis or sharing.

For some device types such as the IMx-R and the IMx-1 an extended range of events are supported. For detailed information, refer to the *IMx-R user manual* for IMx-R devices (part number 32179900) and for the IMx-1, the *Enlight Collect IMx-1 System user manual*, part number 15V-090-00087-100.

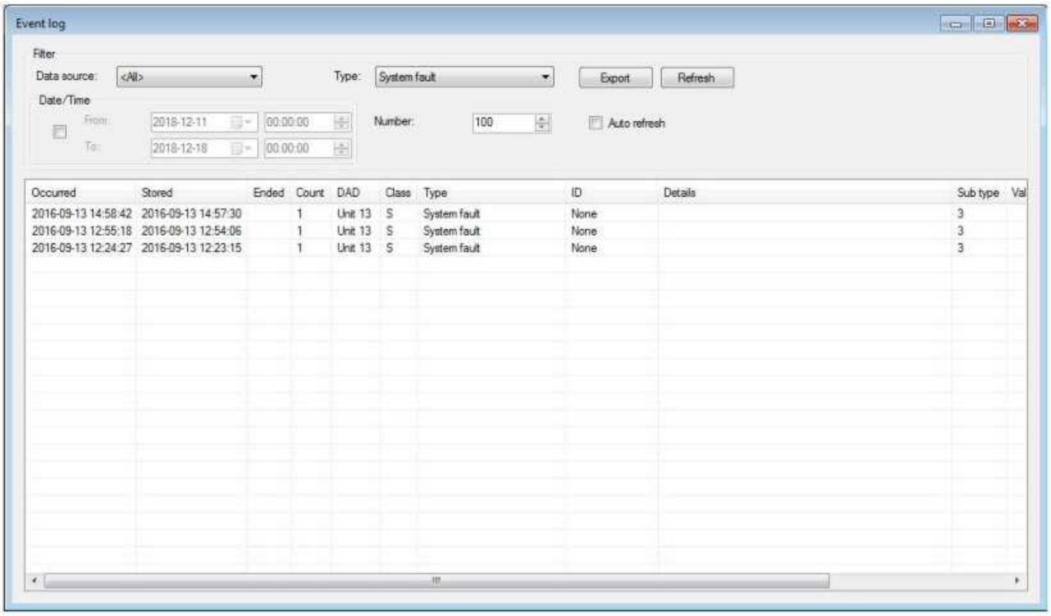


Figure 6 - 78
Example of Event Log

Class: S = CM system fault

A = alarm

If **Auto refresh** is enabled, the event log will be refreshed according to the value set for Event Log refresh rate in User Preferences.

Portables

Portables Sub Menu	Function
Microlog Analyzer	Microlog Analyzer support with Status, Download, Upload and Communication sub tabs.
Coded notes	A coded note is a pre-configured comment available to the Microlog user.

Microlog Analyzer

The Microlog Analyzer interface has four tabs where users can apply different actions. Upon opening the interface, @ptitude Observer automatically tries to get the status of the connected Microlog Analyzer.

Status

This shows information retrieved from the Microlog Analyzer, such as firmware version, current date/time, total number of points stored currently, total amount of free memory, temperature inside the device and battery voltage.

Status retrieves the status from the connected Microlog Analyzer.

Clear removes all routes and data from the memory of the connected Microlog Analyzer.

Reset deletes all the data from the existing routes on the connected Microlog Analyzer. For Microlog Analyzer USB communication only, the clock is set to the PC internal clock.

Download

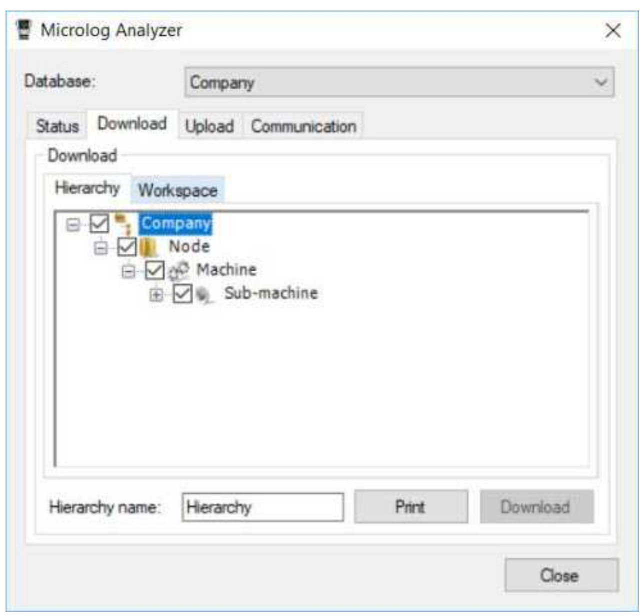


Figure 6 - 79
Example of @ptitude Observer Download Routes to Microlog Analyzer

This is used to download routes to the Microlog Analyzer. It is possible to download a section of the hierarchy as a route or a complete workspace or workspaces as a route.

Hierarchy name specifies a custom name for the route that will be assigned when the selected portion of the hierarchy is downloaded to the Microlog Analyzer. It is available for the hierarchy setting only.

Print prints the selected hierarchy or workspace as a route list.

Download starts the download to the Microlog Analyzer.

Upload

The upload setting is used to transfer the data collected by the Microlog Analyzer and save it in the @ptitude Observer database.

Non route enables the upload of data that is not route-based. Non-route is also known as brute force.

Upload measurement history uploads the history of measurement points for USB communication only.

Reset deletes all data on the specified route but keeps the route information so the route can be measured again.

Remove deletes the specified route and all data on the route. To use the route again, it must be downloaded again to the Microlog Analyzer.

Upload uploads the selected route and stores the data in the @ptitude Observer database.

Communication

The communication settings change the settings used to communicate with the Microlog Analyzer. These settings will be saved until the next time communication settings, is opened.

Type can be *Serial, USB* or *Route Manager*.

Port is required for the serial type only. It specifies which port to use for serial communication.

Baud rate is also only required for the serial type. It specifies the speed of the serial communication. The default is 115200.

Coded Notes

Coded notes interface configures the coded notes that should be sent to the Microlog Analyzer device when downloading routes. A coded note is a pre-configured comment to apply to a certain measurement. All coded noted associated with the database are listed and it is possible to Add, Edit or Delete entries or reorder the list.

Window

Window Sub Menu	Function
Cascade	Cascades all open windows so that they overlap but with the title areas remaining visible.
Tile Vertically	Arranges all open windows vertically (side by side).
Tile Horizontally	Arranges all open windows horizontally (one above the other).
Close all	Closes all the open windows.
	[A numbered list of windows that are currently open, is appended below. The list will also indicate the active window, that is the one on-top or the one that has the focus, and that selection can be changed here.]

Help

Help Sub Menu	Function
Contents (F1)	Opens the help file for @ptitude Observer.
Search	Opens the @ptitude Observer help file in search mode.
Enter new license key	A new license key is required if an upgrade to @ptitude Observer has been purchased.
News in Observer	Information on the new features in the currently released version.
SKF Online Repository	@ptitude Observer SKF Online Repository Settings and Updates.
SKF CMC Homepage	Web link to SKF Condition Monitoring product information.
SKF Reliability Forum	Web link to the SKF Reliability forum.
About	About @ptitude Observer displays the System Info box.

Contents

Contents interface opens the help file for @ptitude Observer.

Search

Search interface opens the @ptitude Observer help file in search mode.

Enter New License Key

A new license key is required if an upgrade to @ptitude Observer has been purchased. The software must be restarted after the registration. Refer to Getting Started.

News in Observer

News in Observer contains information on the new features in the currently released version.

SKF Online Repository

Through the SKF Online Repository (SKF OR) it is possible to share application logic and system design with other @ptitude Observer users.

Currently it is possible to share bearing information, machine templates, data miner views and custom diagnosis rules.

When adding a new bearing to the system, it is possible to share this bearing information to other Observer users. After the submission has been approved, other users will automatically receive a notification the next time they start @ptitude

Observer that a new bearing is available, and they can choose to automatically install in their bearing library.

The same logic applies to machine templates, data miner views and custom diagnosis rules.

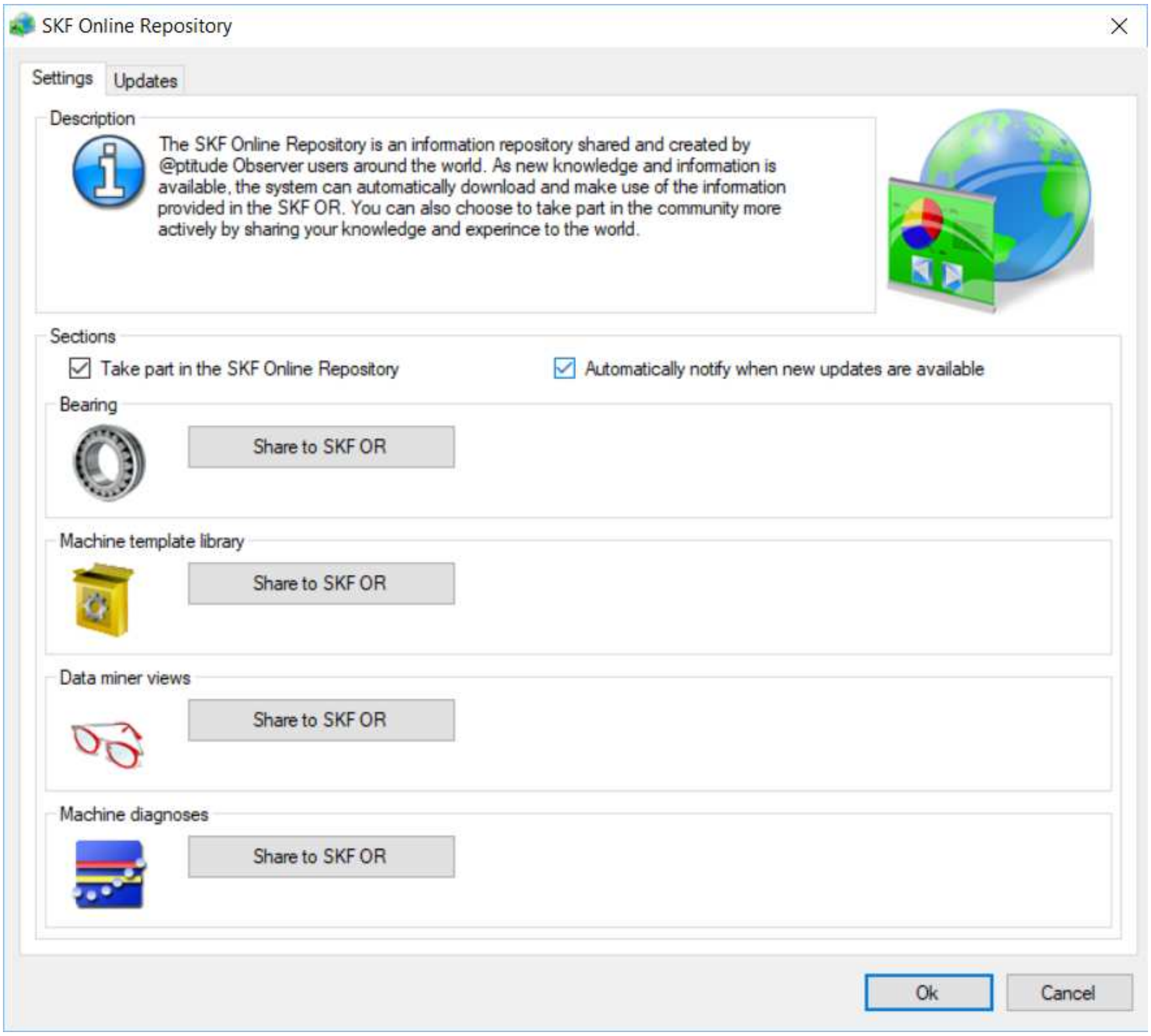


Figure 6 - 80
Example of @ptitude Observer SKF Online Repository Settings

Take part in the SKF Online Repository configures the system to be able to send and receive data from the SKF OR, if checked.

Automatically notify when new updates are available enables the system to automatically check the SKF OR for any new updates available when the @ptitude Observer system starts.

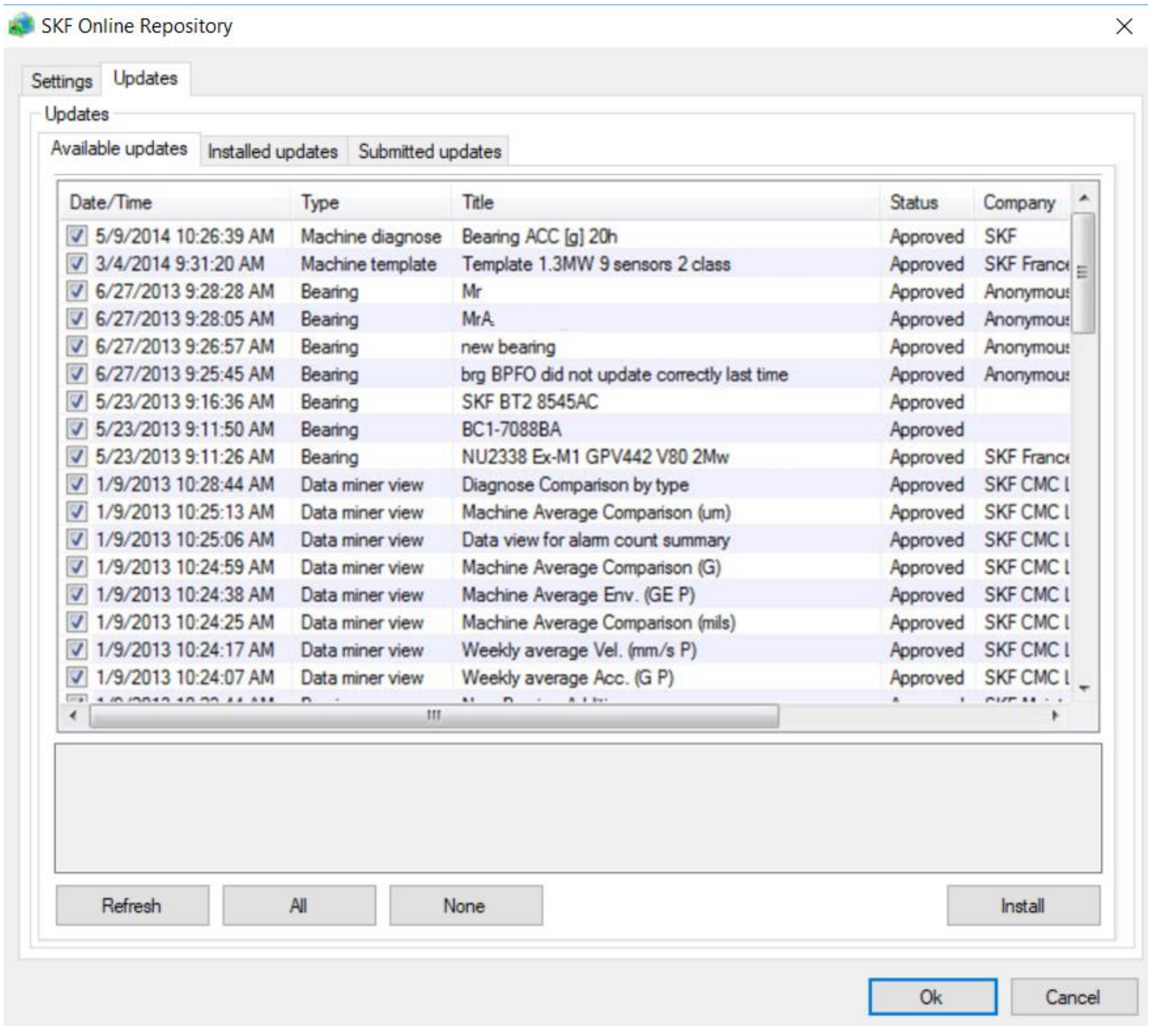


Figure 6 - 81
Example of @ptitude Observer SKF OR Updates

Available updates are updates that are available but have not been downloaded and installed yet.

Installed updates are updates that have been installed through the SKF OR.

Submitted updates are updates that have been submitted but not yet approved.

SKF CMC Homepage

This interface starts the default web browser on the local computer and navigates to SKF Condition Monitoring product information.

SKF Reliability Forum

This interface starts the default web browser on the local computer and navigates to the SKF Reliability forum. A username and password are needed to access the forum.

About

This interface displays version information about the currently installed version of SKF @ptitude Observer.

About @ptitude Observer displays the **System Info** box which lists all the modules that are enabled by the license key (that is, currently installed in the Observer application). Use the scroll bar to view the list if it extends below the window.

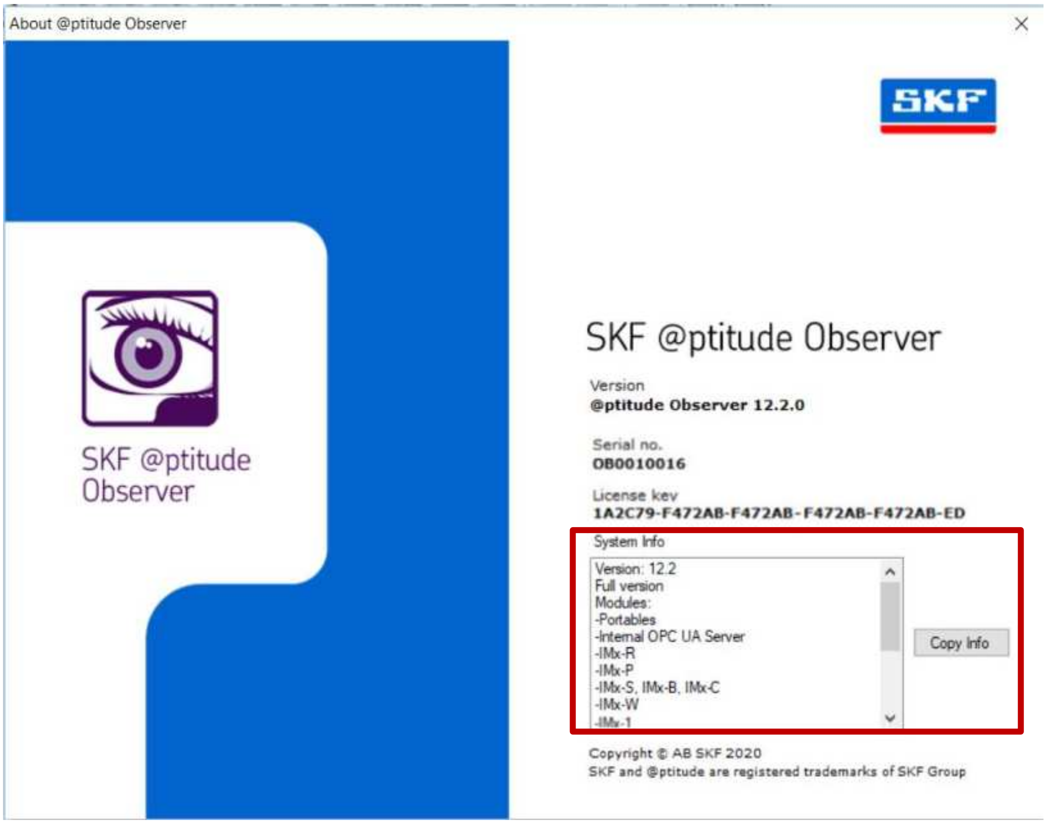


Figure 6 - 82
System Info and Copy Info

This list cannot be edited but it can be copied.

- Click **Copy Info** to copy the contents of the System Info box to the clipboard.
- Paste the contents into an email or other document to keep a record of the licensed modules or to request additional modules.

Appendix A
What to Expect When Using Event Capture

This appendix describes the behaviour of the event capture function under various conditions.

- The manual capture function is not included in the count of maximum captures stored per day. A manual capture is stored even if the limit of captures per day is reached.

Event Capture after an IMx Reboot

There is a minimum 60 second event capture disarm period between an IMx reboot and an event capture triggered by an event capture point in alarm or a manual event capture. During this start-up period, alarm events will not initiate a new event capture. This disarm period is a firmware characteristic that allows the system to avoid unwanted captures at start-up when being in alarm before reconfiguration.

- For example: If a new alarm occurs on an event capture point 30 seconds after an IMx reboot, an event capture will not start. There might, however, be an entry in the alarm list for this alarm.

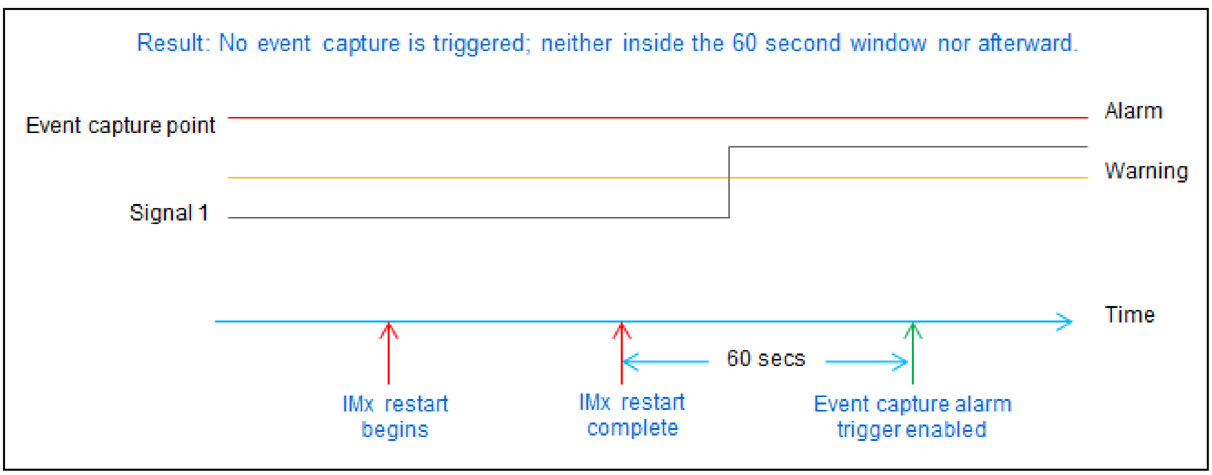


Figure A - 1
No Event Capture Is Triggered

- The pre-data buffer starts filling after the IMx device reboot process is complete.
- A manual capture can be triggered within the disarm time.

Depending on when the alarm is triggered, and the time specified for pre-data, an event capture may contain only the alarm segment and less than expected pre-data.

Incomplete Pre and Post Data

In normal operation, a completed event capture will have pre-and post-data lengths as specified in the event capture group properties. However, under some conditions the capture of pre-data or post-data may be incomplete.

Incomplete Pre Data

If the IMx device did not have sufficient time to fill the pre-data buffer before the event capture is triggered, the captured pre-data returned may have a length less than that specified in the event capture group.

Possible conditions where this might occur include:

- A manual capture is initiated in a time shorter than the pre-data length after another event capture has been completely uploaded.

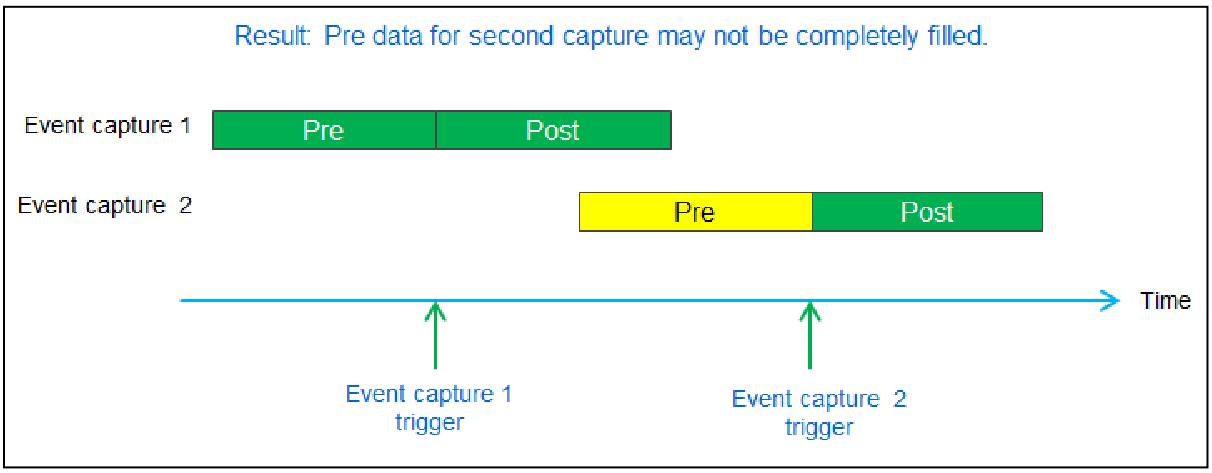


Figure A - 2
Example of Incomplete Pre-Data

- An alarm driven capture is initiated within a time shorter than the pre-data length after another event capture has been completed.
- An event capture is initiated after an IMx reboot within a shorter time than the pre-data length.

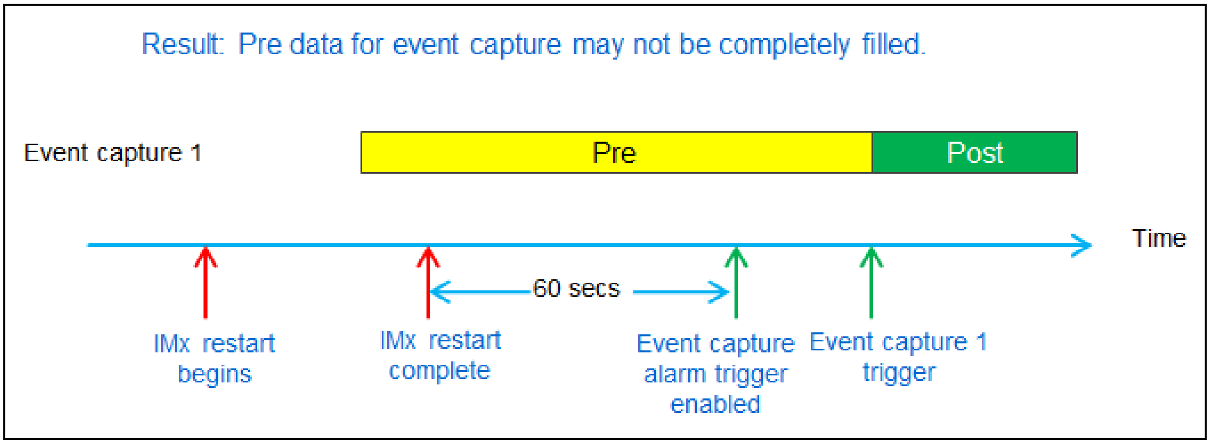


Figure A - 3
Event Capture Triggered Within a Time Shorter than the Pre-Data

Incomplete Post Data

The captured post data returned may have a length less than that specified in the event capture group.

Reasons for the early termination of post data include the following:

- Loss of power to the IMx
- Manual reset by command (**Restart** on the **IMx/MasCon devices** configuration tool)
- Firmware update
- Watchdog reset due to firmware/hardware problem
- System config update (for example, changing device number or network settings)
- Large negative time adjustment (synchronization was not done for weeks or months)

Two results are possible when post data is incomplete.

Power was lost before the alarm containing the event trigger was saved to non-volatile memory.

The Monitor service will never see either the alarm or the end of the event capture and therefore any captured data already received has little value. When closed, the incomplete event capture shows in the capture list, but no plots are available.

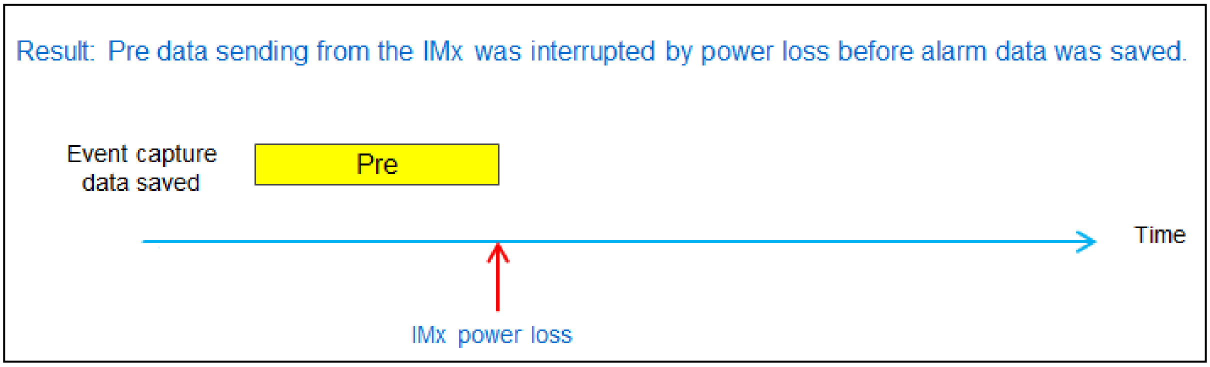


Figure A - 4
Event Capture Interrupted Before the Alarm Is Saved

- If all channels in the capture are missing the alarm data, then the incomplete event capture entry is displayed with the status *Truncated*, but no plots are available.
- If one or more event capture points received a captured alarm while other points in the group did not, only limited, partial data will be visible. Because the display depends on the presence of the alarm to function correctly, many features of the event capture plots will not be fully functional.
  - Channels with alarms will display whatever data was provided from the capture process.
  - Channels without an alarm will not display captured data fully. There will be no band marker in the full time waveform plot, the zoomed time waveform plot will show only a big “X” and the spectrum plot data will not cover the normal zoomed in region of the time waveform.

Power was lost after the alarm data was committed to non-volatile memory

The alarm data will be sent by the IMx once power is restored, but the end data was not saved and will never be received by the Monitor service. When closed, this incomplete event capture entry will be visible, and it can be opened for display even though some post data will be missing.

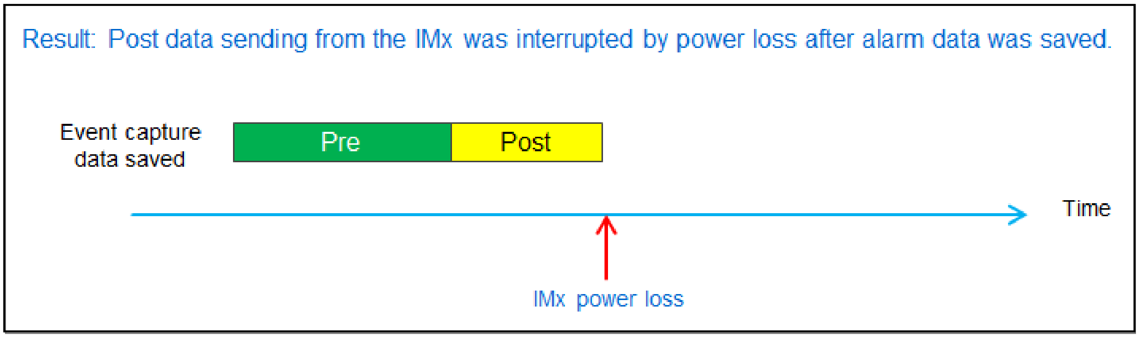


Figure A - 5
Event Capture Interrupted After the Alarm Is Saved

Active Range

If an event capture is started inside an active range and then goes outside the range while the event capture is ongoing, the data will be collected as usual.

If event capture points are in an alarm group and outside active range of the event capture group and another member of the alarm group goes in alarm, the event capture is also stored.

If an IMx device restarts because of reconfiguration during an ongoing event capture, the IMx device will continue sending event capture data until the remaining data has been stored in the non-volatile memory. Then, the device will reboot. After reboot, it will continue sending the remaining data from the interrupted event capture.

Network Interruptions During an Event Capture

If there is an interruption in network communication between the IMx device and the Monitor service during an ongoing event capture, the progress indicator in the Event Capture view window may stop updating and show no further progress.

The event capture will remain in a pending state until one of the following occurs:

- A new alarm-triggered event capture is received from the IMx device. In this case the pending event capture is closed and a new one is opened for the incoming alarm-based capture.
- Once the network problems are resolved, the previously interrupted event capture data transfer from the IMx is resumed and the event capture data transfer finishes normally.
- The pending event in the Event Capture view list is cancelled by the user.
  - ➢ While an event capture remains in a pending state on an IMx, no further manual event captures can be initiated on that IMx device.

Signals Outside Sensor Fault Detection Thresholds

Event capture signal levels that are detected to be outside sensor fault threshold levels will continue to be collected and stored in the event capture data.

- The sensor fault threshold values used for determining the presence of sensor and cable fault issues are those currently stored for the individual IMx channels.

When viewing data in either the capture time waveform plot or capture 3D plot, where any captured measurements have been found to be outside sensor fault threshold limits, a warning message is displayed in the plot indicating a possible problem with the data.

Miscellaneous

If the pre-data received is less than the total quantity of pre-data expected, the status in the Capture list is *Done, Pre data not filled*. This indicates that the Monitor has received all the data the IMx has available to send, but the pre-buffer was not filled when the event capture was triggered due to one of the reasons stated above.

Stopping the Monitor service and restarting it while an event capture is ongoing does not affect the storage of event capture data. The IMx will pick up the data after the Monitor service and the IMx device have reconnected.

The date in the alarm list for the first event capture point in alarm matches the event capture date and the 0 point in the event capture graph. Where there are several event capture points, some might have a slightly later date/time.

Ongoing event capture: IMx device restarts

The IMx device will continue sending event capture data until the remaining data is placed in the non-volatile memory, but then it will reboot. After reboot, the device will continue sending the remaining data from the interrupted event capture.

Manual event capture: Alarm event occurs

If a manual event capture is ongoing, the IMx event capture is locked, meaning that despite an alarm on the event capture point it will continue sending the manual event capture data.

If a manual capture is in progress it will finish, and no other event capture is stored. However, if there is an alarm group in alarm, a second overlapped alarm event capture may be stored.

Alarm event capture: Change in alarm state

If an event capture starts with warning level and the amplitudes increase to alarm level while the event capture is ongoing, only one event capture is stored.

- The alarm list will display dual alarms for both warning and alarm states.

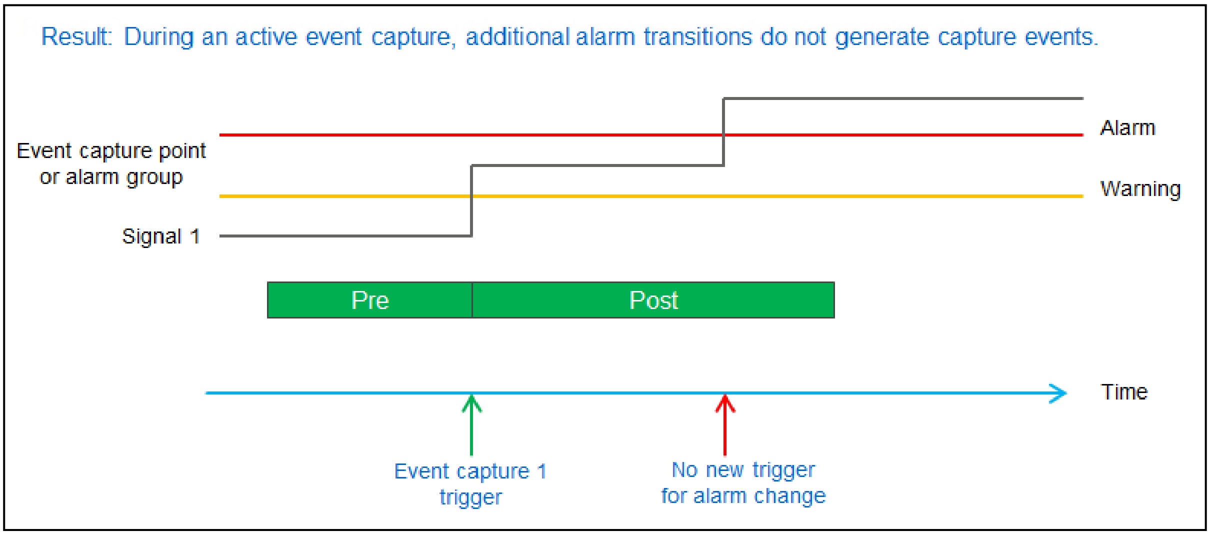


Figure A - 6
Event Capture with Additional Alarm Transitions

Cancel button

The **Cancel** button in the event capture window works as follows:

- Clicking the **Cancel** button stops the IMx device from sending event capture data by forcing a reset.
- Data received before the **Cancel** button is activated is retained.

Alarm leave time

The alarm leave time is calculated to satisfy both a minimum number of 10 measurements and a minimum time of approximately 60 seconds. This means that the IMx needs to see a minimum number of measurement values out of alarm state before enabling the setting of a new alarm state that corresponds to at least 60 seconds of time.

- A transition out of and back into warning state that happens in less time than the alarm leave time does not generate a new event capture.

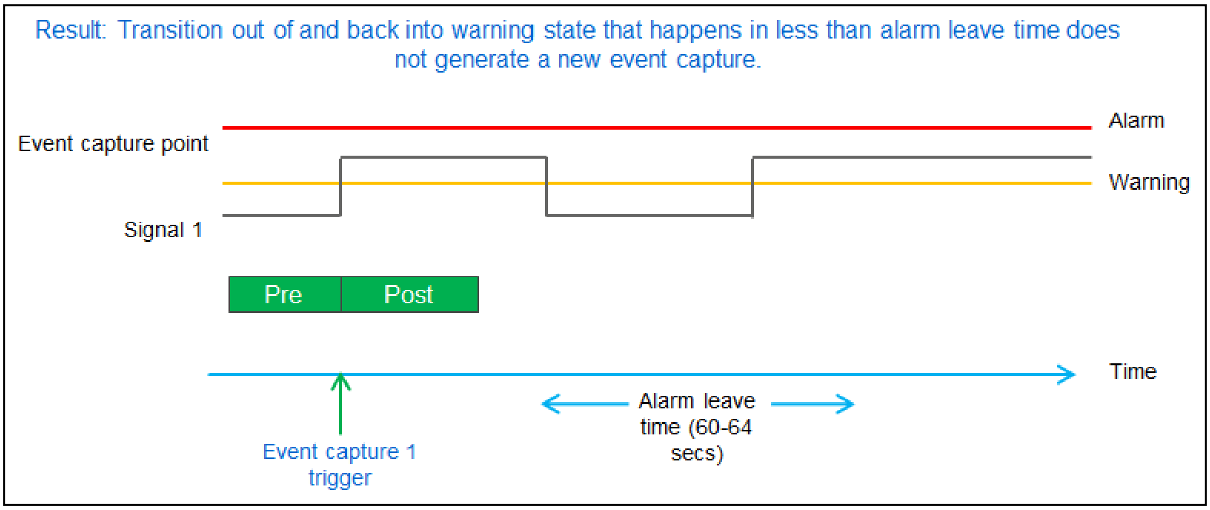


Figure A - 7
Alarm Leave Time Shorter than Warning State Transition

- A transition out of and back into warning state that happens in more time than the alarm leave time does generate a new event capture.

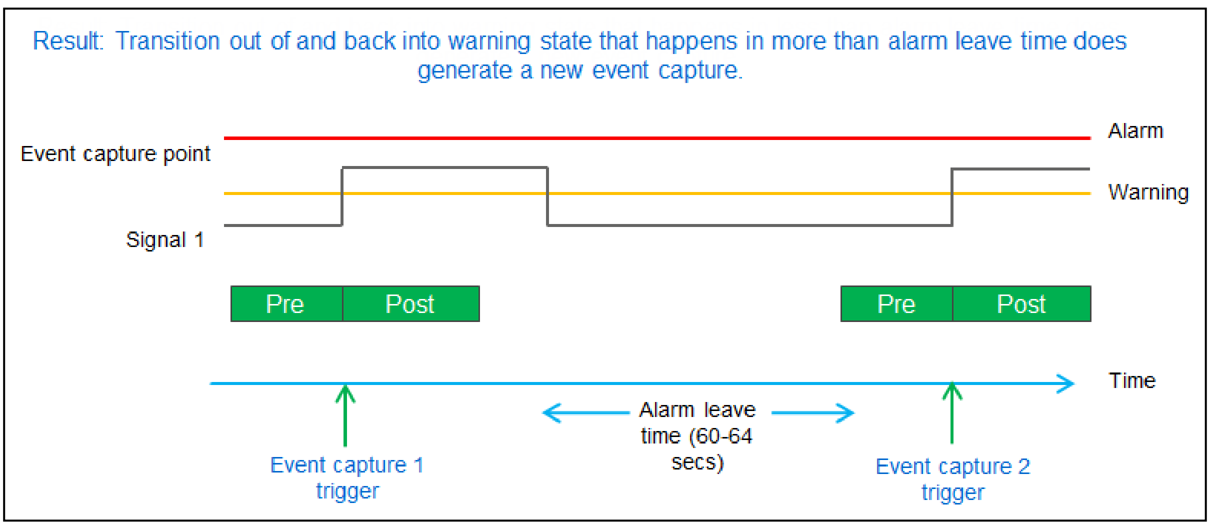


Figure A - 8
Alarm Leave Time Longer than Warning State Transition

No event capture is triggered when the alarm threshold is lowered to below the current vibration level.

Appendix B
Summary of Tools in the Toolbar

Observer Tools

The following images display @ptitude Observer's default toolbars and their toolbar button assignments, along with a brief description.

Primary Toolbar

Copy active window to clipboard - copies the active window to the clipboard. Can be pasted into another application.

Print active window - prints the active window.

Notes – with a machine selected, opens a list of Notes related to the machine. Typical notes are maintenance activities and visual observations. Click New to open the Note dialog. Although a note is a machine-specific object, if an object of machine level or above is selected, then all notes under that object will be displayed.

Event cases – with a machine selected, the tool opens the list of event cases for that machine. Event cases document reports, information and history regarding a specific event tied to a specific machine. Click **New** to open the **Edit Event Case** dialog. Although event cases are machine-specific, if an object of machine level or above is selected in the hierarchy, then all event case reports under that object will be displayed.

Attachments – with a machine selected, opens a list of related attachments. Click **New** to open the **Document** dialog to add a new attachment (a .PDF file, Word report or an MP3 file).

System alarm - opens the system alarm list for the selected hierarchy item, noting that certain types of system alarm will only be visible when the top node of the database is selected. System alarms are raised for measurements out of range and system-related alarms such as defective sensors, cables, etc. The @ptitude Observer Monitor start-ups and any loss of contact between an IMx or MasCon device and Monitor are registered as well.

Alarm list - opens the alarm list for the selected hierarchy item and displays all the alarms under this item and sub-items in the alarm list.

Maintenance overview - opens the list of the maintenance tasks scheduled in the future.

Process overview - illustrates the current status of the machine through bars and process values. Upon opening a machine, all the measurement points on the machine are automatically added. At the top of process overview screen, there is a header displaying the total status of the process overview.

Machine parts – opens the machine parts tool for the creation of models of machines, including shafts, gear boxes, engines, fan casings, blades, generators, etc. The machine parts tool is used to calculate the disturbance frequencies specific to a particular machine, such as gear and bearing frequencies, etc., by using the defined machine data.

Maintenance planner - opens the **Maintenance Planner** dialog to configure maintenance tasks, such as lubrication, replacements, scheduled maintenance, etc.

Data miner – opens the Data Miner dialog. Click **Add** to open the **Data Miner query editor** dialog to set the parameters for complex data mining from the Observer database. Results can be shown in three different formats: table, trend and bar.

Properties – with a machine selected in the hierarchy, opens the **Machine properties** dialog. With a measurement point selected, opens the **Meas. point** dialog.

Capture – with a capture node selected in the hierarchy, this launches the capture view. The capture view displays all points available in the capture. Each capture point reflects a single channel. Two plot types are available:

- Capture Time Waveform - the true peak-peak is calculated from the time waveform.
- Capture 3D – shows spectrum graphs taken from successive measurement values in the selected continuous time waveform capture. The z-axis represents time intervals in the capture from which spectrum graphs were generated.

Meas. Date – select a machine in the hierarchy, then select a measurement point and click the **Meas. date** tool. The interface lists the measurement dates of the selected measurement point.

Navigation Toolbar

Show tree view shows or hides the tree view window containing the hierarchy view, system view, workspace view and diagram view. Hiding the tree view window provides more area for plots on the screen.

Show bottom pane – with a plot in view, opens the bottom pane to show Machine parameters. Click the **Live** tool to begin updating the bottom pane with live data. Clicking the **Show bottom pane** tool again closes the bottom pane.

Link to hierarchy – can act as both a button and as a drop-down. Click on the button to toggle the link state of the active window: if it is currently linked to the hierarchy it will be unlinked and vice versa. Touch the drop-down to gain access to two further alternative actions: *Link all* and *Unlink all*. Using these will apply the action to all open linkable windows, not just the active window. When linked, this is indicated by including an indicative keyword or measurement point path in the window name, example: *[Alarm list (Linked)]*.

Refer to User Preferences for further information on enabling or disabling this **Linking** functionality as a default behaviour.

Show previous measurement point – with a measurement point selected in the hierarchy, moves the selection to the measurement point above it.

Show next measurement point – with a measurement point selected in the hierarchy, moves the selection to the measurement point below it.

Measurements Toolbar

Buffer –control and filter what data is retrieved from the database for display and analysis. Specify date ranges, filter parameters and buffer types.

Refresh - forces the system to refresh or recreate the hierarchy view, system view or workspace view.

Previous measurement - refreshes the graph with the data from the previous measurement.

Select measurement date – opens a calendar, select a date to see the measurements from that date. Double clicking on a date refreshes the graph with the data from the selected date.

Next measurement - refreshes the graph with the data from the next measurement.

Plots Toolbar

For a summary of the plot selection icons available on the Plots Toolbar refer to Graphic Displays and Tools.

Save Settings - saves any changes made to the graph settings, such as the scale settings.

Graph Display Toolbar

Refer Graph Display Toolbar.

Plot Tools Toolbar

Refer Plot Tools Toolbar.

Appendix C
Protean Diagnosis

The Protean Diagnosis system

The Protean Diagnosis system is based on the earlier Machine Diagnostics solution implemented in SKF @ptitude Observer software. Below is a short description of the evolution of this solution.

Earlier Machine Diagnostics Solution

The Machine Diagnostics solution in SKF @ptitude Observer is comprised of the following main areas:

- Machine Parts – In this module the kinematics of the machine being monitored is described. All relevant defect frequencies are being calculated dynamically for each measurement based on the shaft speed measured simultaneously with the vibration data.
- Diagnosis Rules – For each defect a definition of how to calculate a Condition Indicator value is stored. A high-level user can define their own diagnosis rules.
- Diagnosis Trend – A series of Condition Indicator values coming from the processing of historical measurement data.
- Alarm level – A threshold level for the Condition Indicator that defines when an anomaly has been detected. This level is automatically calculated based on historical data and new data.

The Protean Diagnosis Solution

The Protean Diagnosis solution also uses the first 3 points shown in the list above together with some additional features:

- New capabilities in Condition Indicator calculation
- Dynamic alarm setting and smart triggering

A description of each feature follows.

Condition Indicator Calculation

In the Machine Diagnostics solution, it is possible to calculate the Condition Indicator values by adding individual peaks of a frequency spectrum to form an RMS. It is also possible to calculate the Condition Indicator value as a percentage of Overall.

In the Protean solution it is also possible to calculate the Condition Indicator value as a percentage of a speed following band. Its main advantage is that the operating condition influences all peaks in a frequency range, including the ones detecting defects. By then calculating the Condition Indicator value as a percentage of a speed following band, set to a range covering the peaks being used in the Condition Indicator calculation, this will substantially reduce the influence from the running condition of the machine.

Dynamic Threshold Setting

In the Machine Diagnostics solution, it is possible to let the system set the alarm level based on the mean of a group of Condition Indicator values plus a user defined number of standard deviations above that mean. In the Protean solution a new threshold is being calculated automatically when an alarm has been triggered. If the Condition Indicator values decreases significantly the threshold is also recalculated. With this functionality the threshold is always set at a level to detect a significant increase of the Condition Indicator values.

Protean diagram example

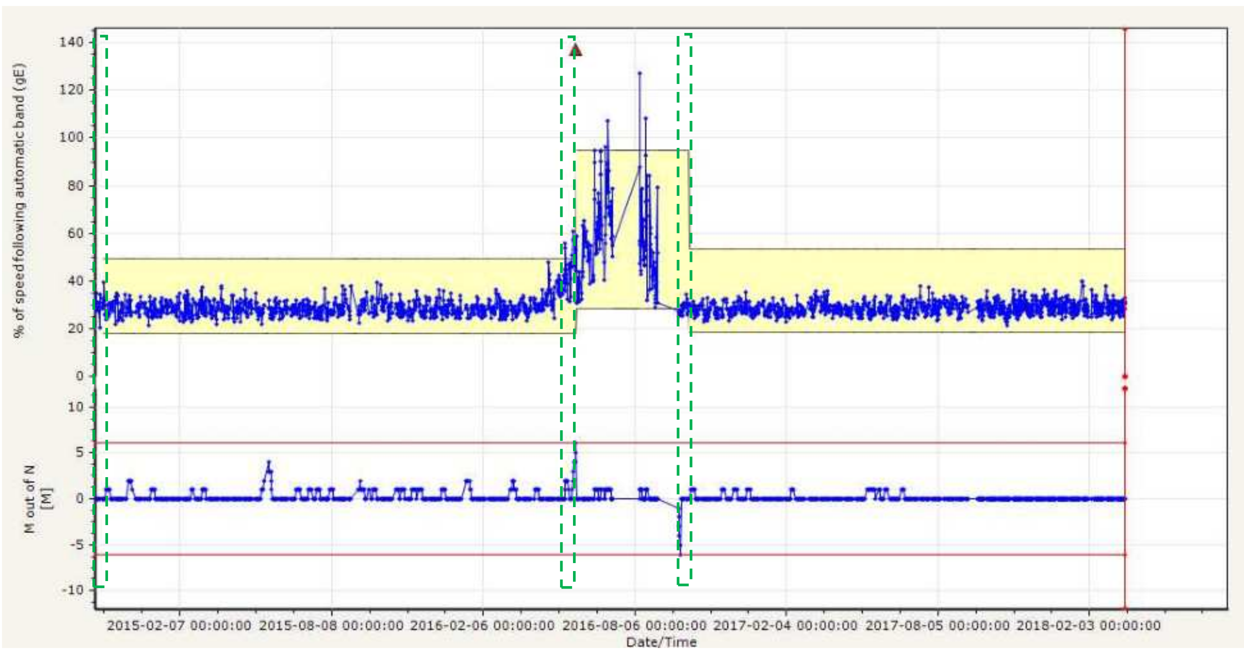


Figure C - 1
Protean Diagnosis diagram showing a bearing defect

In the above figure the corresponding M out of N values have also been shown to illustrate how this triggers the alarm levels to adapt. The green dashed areas indicate where there are periods of 'learning'.

Initially the graph shows how, after a period of learning (20 measurements), the system automatically applies alarm thresholds, the yellow shaded area, to the Condition Indicator value for a bearing defect.

Monitoring continues for some time until, approximately mid-graph, the analysis detects that in this case 6 of the last 7 measurements (M out of N) have exceeded the upper alarm level and a Protean alarm is therefore generated.

This alarm is marked in-graph by the red triangle and an immediate, automatic upward adjustment of the alarm levels is also triggered. No further alarms are then generated but based on the initial alarm, corrective action has been scheduled.

Soon after that corrective action is taken, 6 of the last 7 measurements are detected as being below the lower threshold and an automatic downward adjustment to the Protean alarm thresholds is triggered. Note that to correctly reflect the new situation the new lower, alarm threshold is actually only set after another period of learning is completed.

Appendix D
SKF Rail Track Monitoring

Introduction to SKF Rail Track Monitoring

SKF Rail Track Monitoring uses data from train mounted SKF Multilog IMx-Rail hardware to monitor the rail infrastructure. @ptitude Observer supports two modes for SKF Rail Track Monitoring: *Metro* and *Mainline*:

- **Metro**: In a metropolitan application the infrastructure that the train repetitively traverses is defined in @ptitude Observer by way of Train Stations, Track sections, Routes etc. Data capture starts when the system detects that the train has started moving and continues (subject to a capture time limit) until it is detected as having stopped. Four consecutive sets of such captured data are then matched to the defined infrastructure by checking for correspondence to a known station sequence in a route. By the nature of regular *Metro* services 'up and down' the track, it is expected that data will become available for the entire line. No GPS data is required or used.

  Metro applications make use of analysis graphs within @ptitude Observer and an SKF (or third-party) web app/client. This analysis functionality, the SKF web client for *Metro* applications and the Phoenix configuration for it, are all topics that are included in this user manual.

- **Mainline**: As distances involved in *Mainline* applications are much greater than in metropolitan, it uses a different methodology for track monitoring whereby data is only captured on detection of an exception (high amplitude shock impact detected). In this case GPS data is required to assist with the identification of the locations where high shock impacts are being measured.

  Mainline applications make use of an SKF (*Mainline*) web app/client that uses a Phoenix API call to access the post processed data from @ptitude Observer. The interface for that call and the *Mainline* web client itself are outside the scope of this user manual. Configuration of the IMx-Rail devices and associated @ptitude Observer measurement points necessary to capture and post process the data are included in this user manual.

After some sections describing aspects that are largely the same in both modes, there are further sections where (particularly) the further @ptitude Observer functionality for *Metro* applications is described.

Licensing

If the @ptitude Observer licence key does not include SKF Rail Track Monitoring, then most functionality referred to here will not be visible to that user.

Terminology used

On the Hierarchy tab, Trains (equivalent to Machines in a traditional @ptitude Observer system) can be created with suitable measurement points based on data gathered by appropriately configured IMx-Rail devices. That Train data is then available for processing and analysis.

IMx requirements

For rail track monitoring an installed IMx-Rail device is required and within that, two analogue input channels and two digital channels need to be assigned.

- The analogue channels provide vibration data from the left and right rails.
- The digital channels are used to provide speed, an estimated distance travelled and direction of travel*.

*To provide direction of travel information the two tacho sensors must be slightly offset, circumferentially. For more information refer to the application note: CM3190 Detection of rotation direction of shaft in Observer.

- The maximum pulses/rev that can be used by the time difference point is 96.

Within @ptitude Observer, what would normally be regarded as a 'machine' is designated as a 'train' where the IMx and sensors are installed. Trains are defined with an assigned forward direction and train/sensor left and right are named relative to that direction:

Figure D - 1
Example of train left and right

As shown diagrammatically in Figure D - 1 above, the left and right sensors should be mounted at the same position on the train, but on opposing sides. The blue arrow indicates the assigned forward direction; hence the red side/sensor is left, and the green represents, right. See also Add Trains.

@ptitude Observer measurement points

The focus here is to add configuration data for a train and associate this with an IMx-Rail device. Suitably configured, the IMx-Rail digital channels are used to provide speed channel data and to support a time difference point, used to infer the train's direction of travel.

The two vibration points are assigned as part of a Run cycle capture group, so that whilst the train is moving the vibration, sample level, data can be collected for rail condition analysis.

This level of @ptitude Observer configuration is equivalent to a 'machine' configuration and when completed together with an active, configured IMx-Rail the system can acquire data.

Rail track monitoring configuration

The digital data from the IMx-Rail is also used to estimate distances travelled. For *Mainline* applications this is used to help identify the location of sites registering high amplitude, shock impacts.

In *Metro* applications distances between stops are matched to the infrastructure based on the data entered for station locations, specifically: the distance in metres from the previous station.

Once *Metro* data is matched, it is analysed and checked for anomalies that should be highlighted for corrective action such as track inspection or replacement.

Configuring an IMx-Rail device for Metro or Mainline

On-line Device Configurator

The SKF @ptitude Observer On-Line Device Configurator is a tool used to set the network configuration and identification of IMx hardware, including the IMx-Rail device. For more information, refer to the "On-line Device Configurator User Manual", part number 32170800.

Device and channel configuration

Within the database to be used for rail track monitoring, create a device using Create from the IMx/MasCon Devices screen. In this case set the **Model** as *IMx-Rail*.

The IMx-Rail device will be added to the list of devices in the IMx/MasCon Devices screen. Once a network configuration file has been downloaded (and when the configured Monitor port is open for connection), the reported TCP State of the IMx-Rail device should be 'Connected'. See Figure 4-6, Example of IMx/MasCon Devices Screen.

Create Analogue Channels

Now select that device from the list of IMx/MasCon devices and then click **Create** below the Analogue Channels list (Analogue Channels).

Two analogue channels should be created to allow for measuring the vibration on the left and right side of the train. Both channels should be created by configuring the following fields:

- **Name** – Give an identifying name to the channel: Sensor Left or Right
- **Sensor type** – Example: *Acceleration [g]*
- **Number** – Choose a free channel number
- **Sensor check** – Configure as required
- **Sensitivity** – Set to the sensitivity of the sensor being used, example:10 mV/g

Create Digital Channels

Now select the device again and then click **Create** in the digital channels window (Digital Channels).

Two digital channels should be created to allow for the system to ascertain train speed and direction of travel. Both channels should be created by configuring the following fields:

- **Number** – Choose a free channel number
- **Name** – Give an identifying name to the digital channel
- **Pulses/rev** – Specify the number of pulses per rev
    - ➢ The maximum pulses/rev that can be used is 96

Mainline only

For deployment in *Mainline* applications, the IMx-Rail being used must also be configured for **External communication** with a Modbus slave GPS module.

Configuring @ptitude Observer for *Metro* or Mainline

Introduction to @ptitude Observer configuration

There are several associated, but separate configuration steps required to complete a rail track monitoring, system configuration and (for *Metro* applications) to define the railway network being monitored:

- For the database
  - Set an appropriate Trend buffer size
  - Configure Peak Severity settings (*Metro* only)
  - Configure storage limitations (*Metro* only)
- On the Hierarchy tab:
  - Add Trains with the necessary measurement points and run cycle capture group

Trend (rolling) buffer size

From the **Options** interface, select the appropriate database from the drop-down list and select the **Data** tab. There is a setting for the **Trend rolling buffer size**, which has a default size of 3 000 values, see Data Tab.

The value should be changed to 32 000 000. This number is arrived at based on storing one year of speed signal values when the speed is sampled once every second. (60*60*24*365 = 31536000). Increasing this value as indicated allows the software to reprocess speed data, when/if needed.

Peak severity settings and storage limitations (Metro only)

From the **Options** interface, select the appropriate database from the drop-down list and select the **RailMo** tab. There are settings associated with the Peak severity assessment and below that Storage limitations:

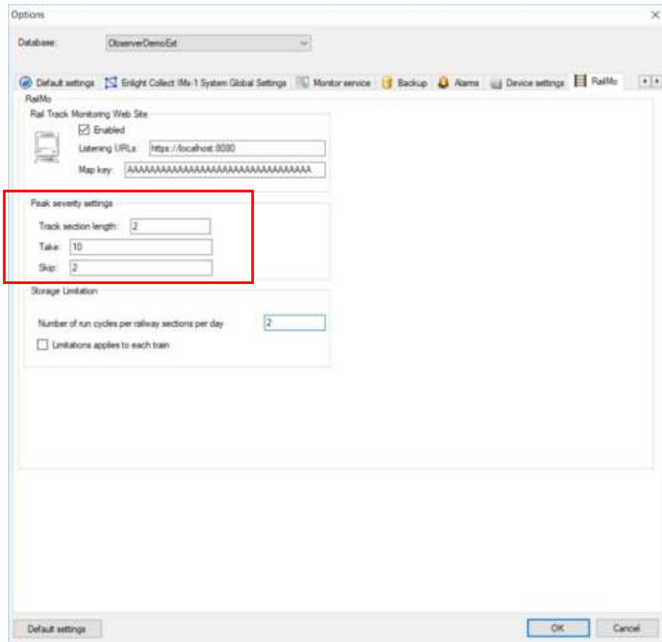


Figure D - 2
Peak severity settings

Peak severity settings are based on a **Track Section length**, **Take** and **Skip** values. They are used, in conjunction with a date range, in the Line Summary table display.

For each length of track, the most recent '**Take**' severity values are collected and sorted and then the '**Skip**' highest results are discarded. The highest remaining severity value becomes the severity value for that length of track. Note that:

- If the number of available measurements in the date range is lower than '**Take**', the analysis will use what data is available.
- If the number of available measurements in the date range is lower than '**Skip**' (or if '**Skip**' is not lower than '**Take**') the severity will default to 0 (OK, green).

The **Track Section length** setting determines how many metres of track, the track sections should be divided into. For every 'x' metre, the highest of the calculated severities (or alarm levels) is used. In the line summary table display, each entry is colour coded with the highest severity remaining after this **Take** and **Skip**, processing.

Storage Limitation settings are configurable and will limit the number of run cycles processed per track section, per day. This includes an option to apply this limit per train. No data is deleted, this limit affects only the processing of the run cycle data.

Add Trains

Trains are defined with an assigned forward direction even though the physical train may not have a uniquely identifiable front or rear.

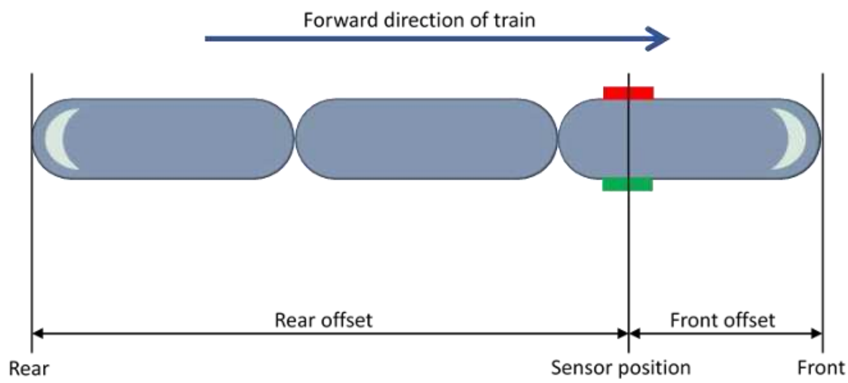


Figure D - 3
Example of train and sensor definition

As shown diagrammatically in Figure D - 3 above, the left and right sensors should be mounted at the same position on the train, but on opposing sides. In this example, the blue arrow indicates the assigned forward direction; hence the red side/sensor is left, and the green represents, right. The front and rear (sensor) offset measurements will also be required when adding the train to @ptitude Observer.

- Since a train can move in both directions it is only during configuration that front and rear need to be chosen. The value from the time difference point will show the direction of the train when measurements are taken.

A train, with associated measurement points, is added to @ptitude Observer as a **Machine** (see Machine).

- The second selection item below (**Track type**) is what differentiates between a *Metro* and a *Mainline* system.

On opening the dialog for Machine properties, first enter an appropriate name in the **General** tab and then select the **RailMo** tab. There, to configure a 'Machine' as a Train:

- Check "**Enable track monitoring**".
- **Track type** – Select either *Metro* or *Mainline.*
- **Wheel Diameter** – Diameter of the wheel that the speed sensors are monitoring.
- **Front** and **Rear Offset** – Distance from the vibration sensors to the front and rear of the train.
- **Distance error threshold** – Threshold used in pattern recognition* for *Metro* systems. For *Mainline* this can be set to zero.
- **Alarms** – For *Metro* systems alarm levels are used for graphs, noting that **Critical level** is only used for the line summary table and web interface. For *Mainline* systems alarm levels can be used for the web client.

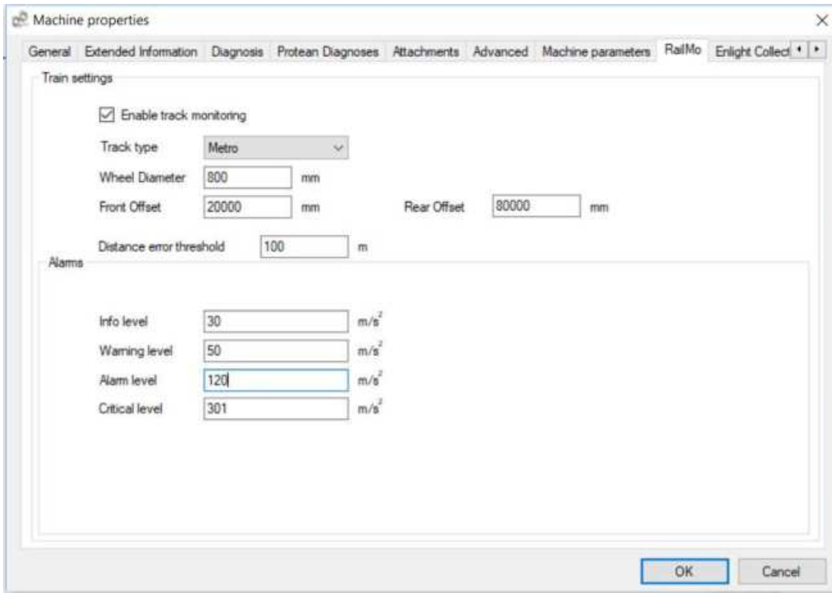


Figure D - 4
Machine properties – RailMo tab

Additional notes for Metro systems:

Data collection (IMx-Rail to a machine/train within the @ptitude Observer database) is independent of the rail track monitoring (Line/Train Station/Route) configuration. A pattern recognition technique is used to match collected data to track sections. Whilst data will be collected for all journeys, the analysis of that data can be limited, refer Peak severity settings and storage limitations.

*In *Metro* systems, the distance error threshold level is the total allowed error in pattern matches for 4 consecutive track sections. If the error when comparing the estimated distance (from IMx speed channel input) to actual (from Train Station configuration) is less than this threshold then a match is allowed. This value might have to be changed depending on the distances involved and variances in the estimated lengths of train runs, between stations.

Create measurement points

A measurement point defines a measurement that should be captured on a machine/train, see Measurement Point.

Any train must be configured with a set of measurement points, as follows:

- Two, speed points (speed data from the two digital inputs)
- One, time difference point (direction of travel from the two digital inputs)
- Two, vibration points (the left and right rail, vibration measurements), created in the run cycle capture group

A *Mainline* train also requires:

- One, IMx derived point where the value is used as a trigger in the run cycle group
- Three or four IMx process points for GPS latitude, longitude, direction (and possibly also GPS velocity)

The process is generally as described in Setting up Measurement Points and Alarms, though noting that the vibration points are added to a run cycle capture group that is triggered by either the train speed data (*Metro* systems) or the IMx derived point (*Mainline* systems).

Create speed points

Setup two speed points, choosing the appropriate IMx-Rail unit for the **Device** and speed channel, for **Channel**:

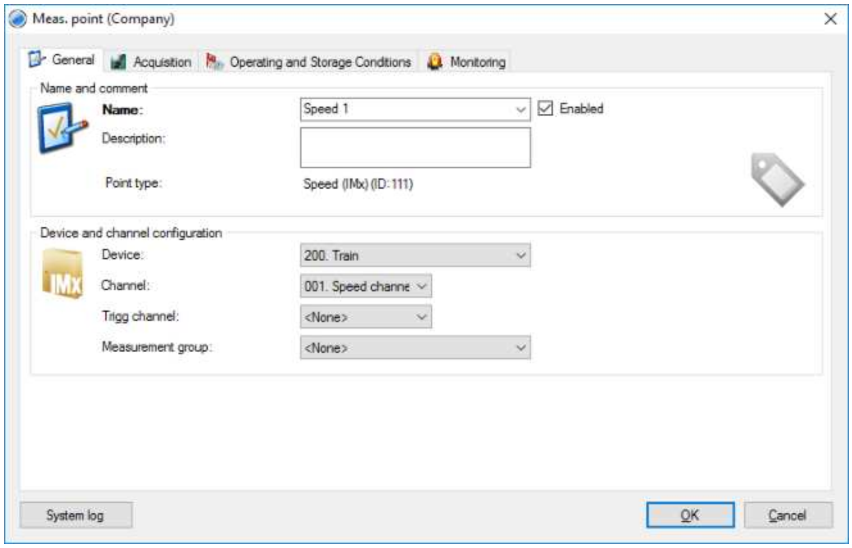


Figure D - 5
IMx-Rail speed point

For one of the speed points, enable and configure the **Scheduled Trend storage** settings on the **Operating and Storage Conditions** tab, as follows:

- Check "**Enabled**"
- Enter 0.01667 (minutes) for the **Interval** and **Interval Alarm**. This recommended setting equates to a sample per second.

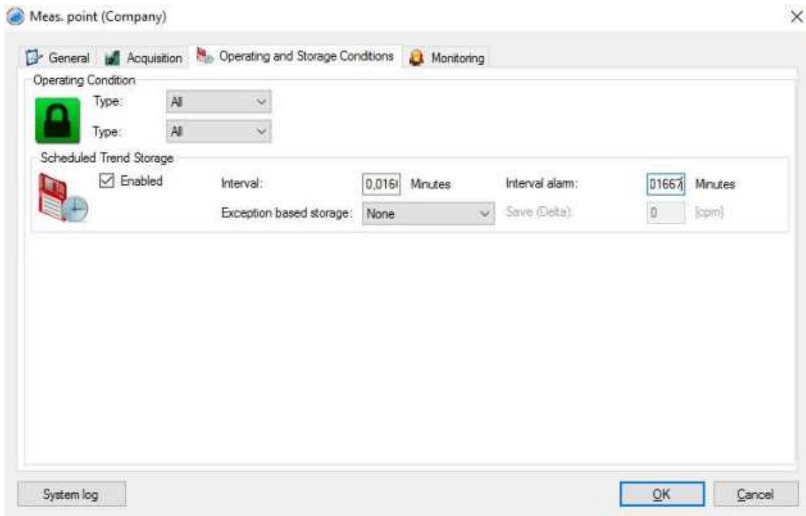


Figure D - 6
One speed point: Scheduled Trend Storage settings

For the other speed point, disable **Scheduled Trend Storage** and for both speed points ensure that in **the Monitoring** tab, **Enable automatic alarms**, is not set.

Create a time difference point

Once the two speed points have been created, add a new measurement point, type: **Time difference**. Choose the appropriate IMx-Rail unit for the **Device** and the two speed channels for the **Channel** entries.

Enable and configure the **Scheduled Trend storage** settings on the **Operating and Storage Conditions** tab, as follows:

- Check "**Enabled**"
- Enter a value in minutes for the **Interval** and **Interval Alarm**

This point is assessing the direction of travel, so a recommended minimum setting is 0.0833, which equates to a sample every 5 seconds. Longer time periods, less frequent checks, may be acceptable for train applications. Set both fields to the same value.

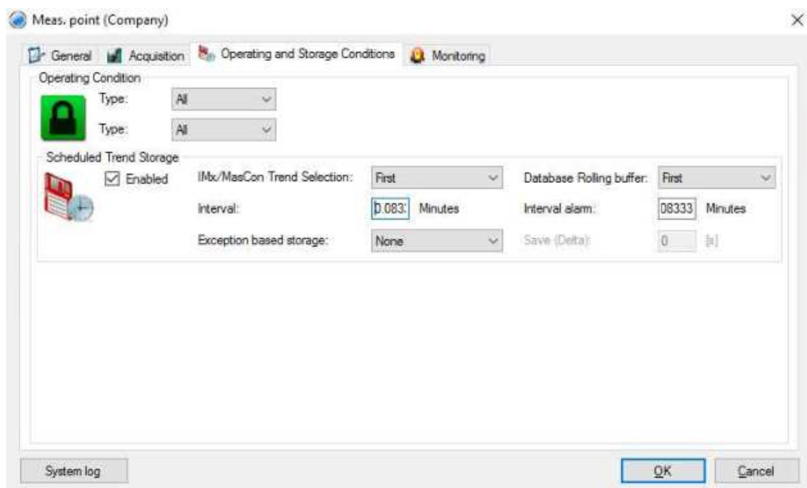


Figure D - 7
Time difference point: Scheduled trend storage

As for the speed points ensure that in the **Monitoring** tab, **Enable automatic alarms**, is not set, for the Time difference point.

IMx derived point and GPS points (Mainline only)

A *Mainline* application will need to use an IMx derived point to trigger the capture. This derived point will however be ultimately based upon a calculation that uses data from two measurements from within that capture group:

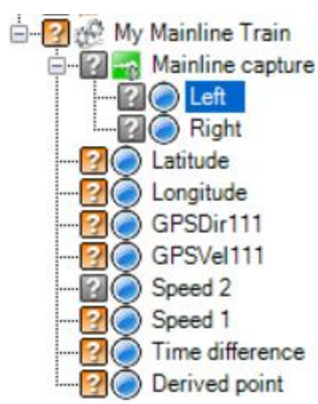


Figure D - 8
Mainline: IMx derived point and Left/Right capture group measurements

- Due to this ‘circularity’, the recommended best practice is to initially create the IMx derived point based on Left and Right **Parameters** of **Type** *Constant* and then after the Run Cycle Capture configuration has been completed return to the derived measurement and change both parameters to *Trend* and relate them to the corresponding Left/Right sources in the capture group, shown above.

On the Acquisition tab of the IMx derived point, use the **Add**, **Parameters** capabilities to add ‘Left’ and ‘Right’ and then use them in this formula:

(((Right*Right)+(Left*Left))/2)^0.5

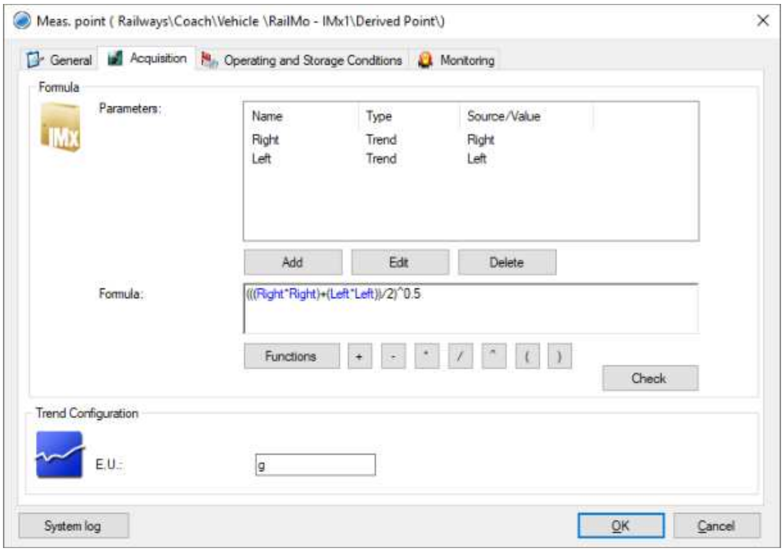


Figure D - 9
IMx derived point: Final configuration of parameter Type and Source

For the GPS data, create IMx Process points at appropriate locations in the hierarchy, selecting the relevant IMx channel number (e.g. 101 for “Latitude”). Repeat for “Longitude”, “GPSDir” and if required “GPSVel”.

Run cycle capture group

The **Run cycle capture** group is used to control that the IMx-Rail only samples data at the appropriate time:

- *Metro* applications: whilst the train is moving
- *Mainline* applications: during a shock impact

To start, add a run cycle capture group to the machine (train) by right clicking on it in the hierarchy and selecting the *Run cycle capture* option from the context menu, *Add* > *Capture groups*.

When the **Capture** properties dialog opens, on the **General** tab, give it an appropriate name and select the relevant IMx-Rail device from the **Device** drop-down.

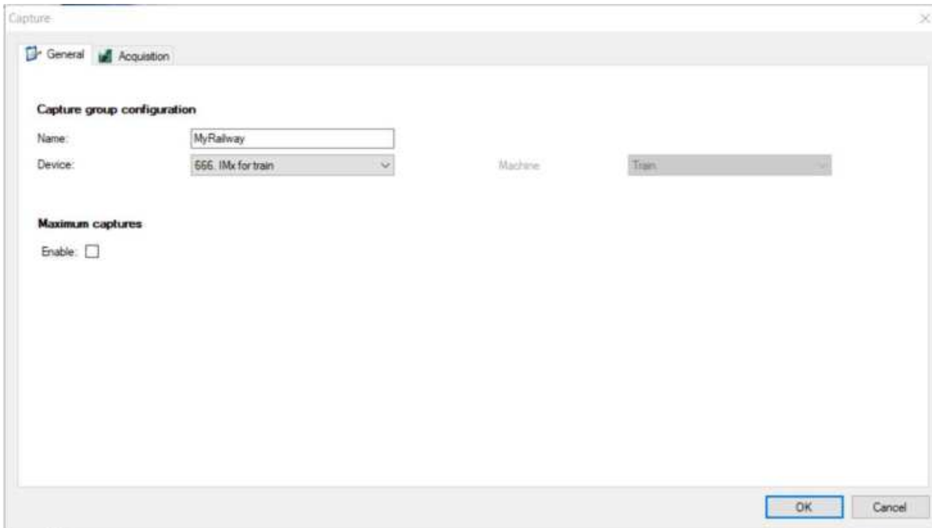


Figure D - 10
Run cycle capture group – General tab

Change to the **Acquisition** tab and in the **Associated measurements** area:

- For *Metro* applications, in **Speed Meas.** select one of the two speed measurements from the drop-down.
- For *Mainline* applications, in **Speed Meas.** select one of the two speed measurements and then also select the IMx derived point in the **Process meas.** drop-down.

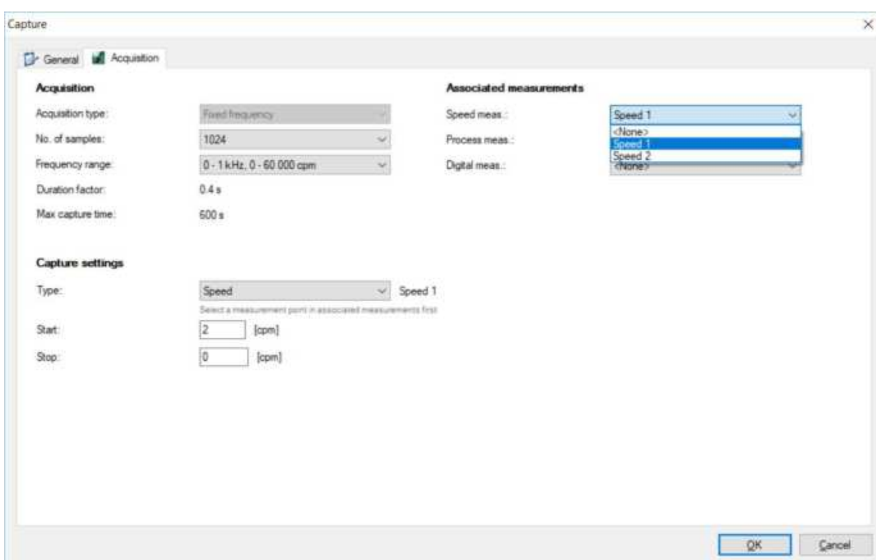


Figure D - 11
Run cycle capture group – Acquisition tab (Metro example)

Then in **Capture settings**, configure appropriately to the application:

- *Metro*: **Type** as *Speed* and enter the **Start** and **Stop** values as 2 and 0 respectively.

- *Mainline*: **Type** as *Process* and enter the **Start** and **Stop** values as 160 and 150 g respectively (or other shock impact values as desired).

Click **OK** to save the run cycle capture group.

The capture behaviour for a Run cycle capture group can be illustrated diagrammatically as follows:

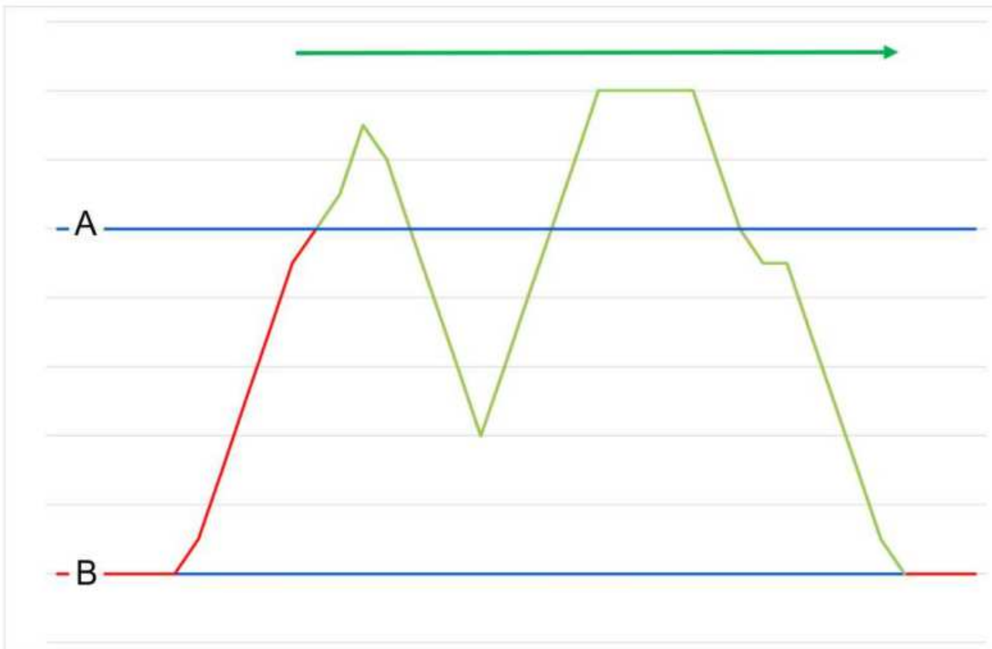


Figure D - 12
Example of Run Cycle Capture Start-Stop Behaviour

The above example shows a graph of the trigger measurement against time where a Run cycle capture has been configured with a **Start** threshold of A and a **Stop** threshold of B. When the measurement value (speed or shock impact) transitions over the start threshold the capture begins. The Run cycle capture will continue until the measurement value transitions below the **Stop** threshold so that the track section data (coloured green on the graph) is captured.

In the general case if the stop state is not reached before the **Max. capture time** ends, further captures will be automatically initiated to cover the entire run cycle.

- For *Metro* rail track monitoring, the current matching and pattern recognition techniques require there to be a start and a stop within the same capture, so time between consecutive stations must be less than the **Max. capture time**.

Create measurement points in the run cycle capture group

Finally, right click on the run cycle capture group to add measurement points, the Measurement point properties dialog opens:

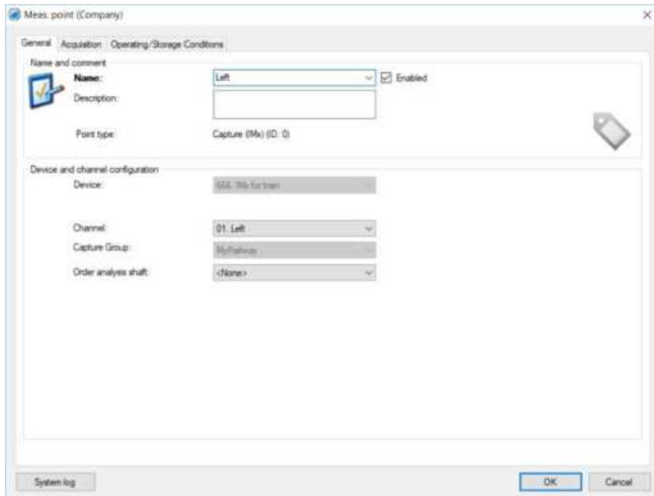


Figure D - 13
Creating a vibration point

Create a measurement point for each of the two vibration channels on the IMx-Rail.

Important note: When naming these points, the use of "Left" and "Right" as point names is mandatory as the system will actively use this naming to determine if the data is arriving from the left or right side of the train.

For vibration measurement points used in SKF Rail Track Monitoring, DC-drift during long captures may be significant. Thus, the recommendation is to:

- Enable High Pass filtering with a **Cut-off frequency** set to 0.5 Hz (default).
- Enable custom Full scale, with a range that corresponds to a ±6 V input change on the channel. For a sensor of sensitivity 10 mV/g, this would be 600 g.

  Custom full scale can be set from between 0.8% to 94% of the maximum range of the channel.

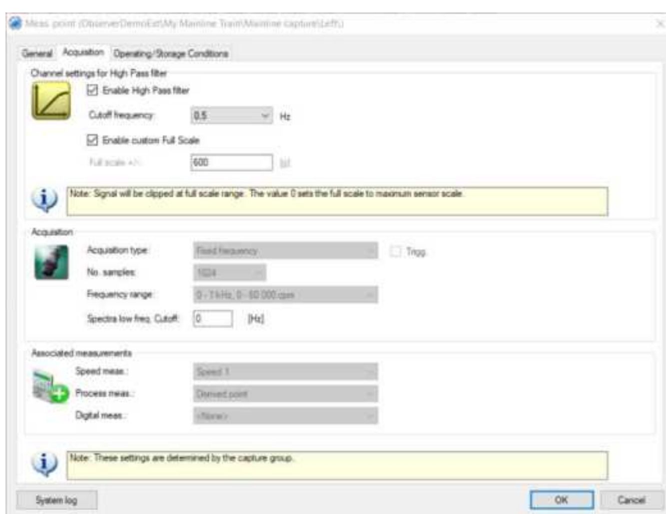


Figure D - 14
Modifying channel settings for high pass filter

- *Mainline* applications: After creating the measurement points Left and Right, return to the IMx derived measurement and change both the Left and Right parameters to **Type** *Trend* and relate them to the corresponding Left/Right sources, just created in this capture group. Example for ‘Left’:

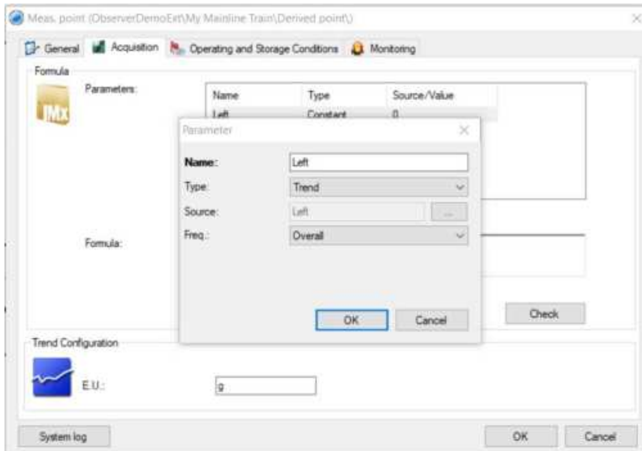


Figure D - 15
Mainline Derived point – change type to Trend

Note that after the IMx has been configured (network/measurement) and the train configuration is done, the IMx/train will start to collect data for storage in the database, just like any other ‘machine’:

- *Mainline* applications: This essentially completes the configuration process as the analysis of the collected data takes place outside of @ptitude Observer.
- *Metro* applications: This configuration process is independent of (does not rely on) the rail track monitoring specific configuration (Lines/Train Stations/Routes). When this latter configuration has been made, software will attempt to match the measured data (based on an estimated distance travelled) to the relevant track sections. This includes any historic data, collected before the rail track monitoring element of the configuration was in place.

Important considerations for the configuration

All measurement points must be created in a certain way to make the system work properly, as the software expects certain naming etc. to recognise and deal with the measurements.

In the run cycle group:

- Left measurement point must be named “Left”
- Right measurement point must be named “Right”

On the train/machine level the measurement points must be as follows:

- One of the speed points will be used for train speed (name not important)
- One time difference point (name not important)
- Latitude process measurement point naming must include “latitude”, the term is not case sensitive

- Longitude process measurement point must include “longitude”, the term is not case sensitive

- Direction process measurement point naming must include “gps_dir” or “gpsdir”, neither term is case sensitive

- If a Velocity process measurement point is used, the name must include “gps_vel” or “gpsvel” , neither term is case sensitive

In case of problems with post processing, try changing the order of speed points in the hierarchy.

Viewing captures

Rail track monitoring data is a type of IMx capture (Run cycle capture) and as such, in a rail track monitoring system, can be viewed in the Capture view.

There, for all rail track monitoring data captures, the storage reason will be ‘Run Cycle’.

For *Metro* applications where @ptitude Observer is attempting to match captures to specific track section by a comparison of distances, rail related information will be provided in the **Track section**, **Calculated distance** and **Additional information** columns. Note that the table will include all captures whether identified, processed or not. Captures not identified or those identified but not processed because of the settings in storage limitations, will have specific **Additional information** text (‘Track section Not identified’ or Outside of post-processing conditions’):

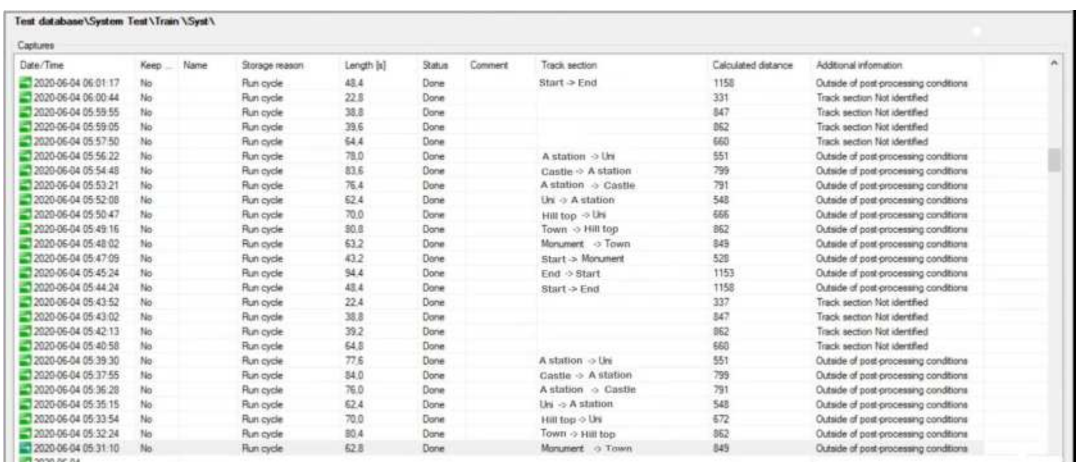


Figure D - 16
Capture view

Post processing of captures (Mainline only)

When a run cycle capture is stored for the train the post processing starts.

Post processing of captures uses a (fixed, internal) software configuration to add information in a post processing database table. A web client using a Phoenix API call can access that post processed data.

- The post processing activity will try to find the last stop the train made by using the speed trend values.

- The algorithm will find the timestamp when the train was at standstill and get the corresponding GPS measurement from that time or earlier.
- The algorithm will calculate the distance back to the shock impact.
- Additional distance calculations made during the capture will also be stored.
- GPS position from the shock impact and the end of the capture will be stored automatically by the IMx-Rail.

Phoenix interface for the API call is described separately in RailMo Web API.

Further @ptitude Observer configuration for Metro

Rail track configuration

Regions and Lines

For *Metro* systems, the configuration needs to define the infrastructure being monitored in terms of Regions, Lines, Train Stations, Features and Train routes, etc. This is achieved by the dedicated RailMo tab, in the tree view window:

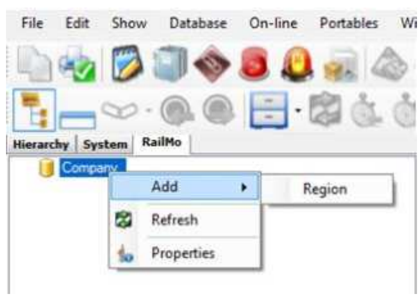


Figure D - 17
Tree view window, RailMo tab, Add

Starting from the database level, the right click context menu provides the possibility to build up a hierarchical structure using the **Add** function to add Regions and to Add Lines to Regions.

- There can be multiple Lines within each Region and multiple regions within a Company. On adding a Line, two directions of travel are automatically created, initially named Bound 1 and Bound 2, and within these the sequential stations are defined.

Rail infrastructure icons, in @ptitude Observer:

Region		**Track section**	
Line		**Incoming connection**	
Bound A		**Outgoing connection**	
Bound B		**Train route**	
Train Station			

Bounds, Train Stations and Track sections

When a line is created, it automatically includes two bounds (directions of travel) and a first station in each bound. The default naming for these bounds and initial stations can be changed via the context menu and properties:

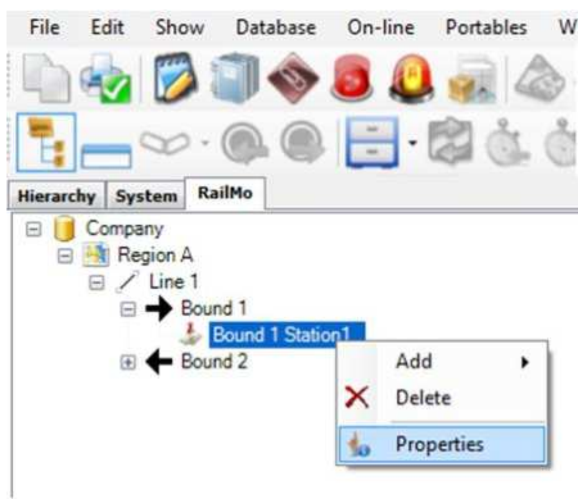


Figure D - 18
Changing Train Station properties

In addition to appropriate naming, it is necessary to set in the Train station properties the **Chainage** and location (**Latitude** and **Longitude**):

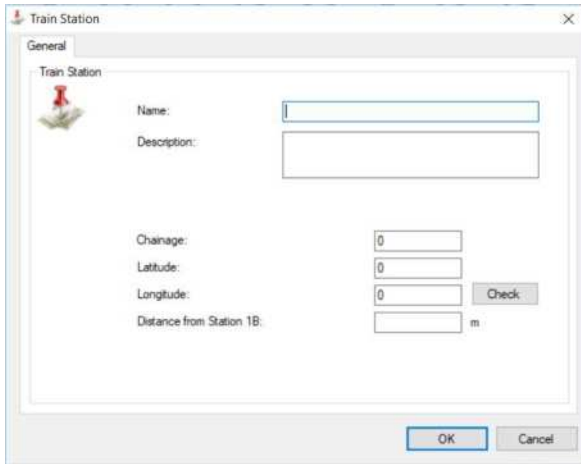


Figure D - 19
Train Station properties

Chainage for the Train Station (or any feature) being its location along the network from a designated origin or zero point.

Check: helps the user to visually verify the **Latitude** and **Longitude** coordinates entered, by opening Google maps at that location.

Note that the '**Distance from**' field is only shown when the Train Station is being created. Thereafter the value entered is used to pre-populate the **Length** attribute of the Track section joining this station to the preceding station. In the figure above the previous station was named 'Station 1B'.

Continue to add further stations, sequentially, in order of their location along the Line, for each bound (direction of travel):

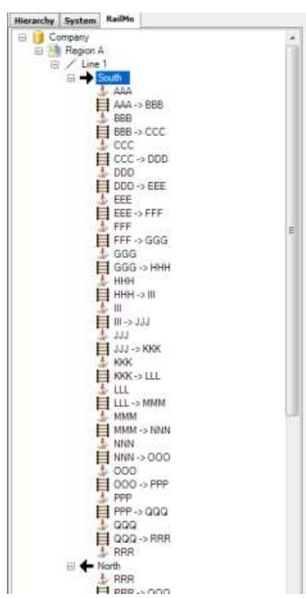


Figure D - 20
Example of a Line, Bound with Train Stations and Track sections

It can be seen from the above figure, that between each station, a track section is automatically created. This provides the basic infrastructure data, to which can then be added, Bifurcations (branches), Track section Features and Routes.

Note that within each track section, the identification of each rail (left or right rail) is made accounting for the direction of travel:

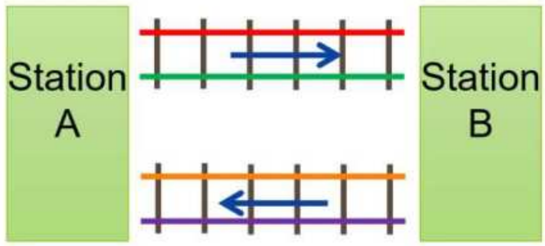


Figure D - 21
Example of Rail identification

From Figure D - 21 above, if Station A is a southernmost station on a Line then travel from A to B may be termed ‘Northbound’. On the northbound Track section there is a left and a right Rail. These are determined taking account of that direction of travel so red is left and green is right.

Considering the southbound case (B to A) the orange rail is now named right, and purple is left.

A bifurcation can be included by selecting a station and choosing to add either an incoming or outgoing connection:

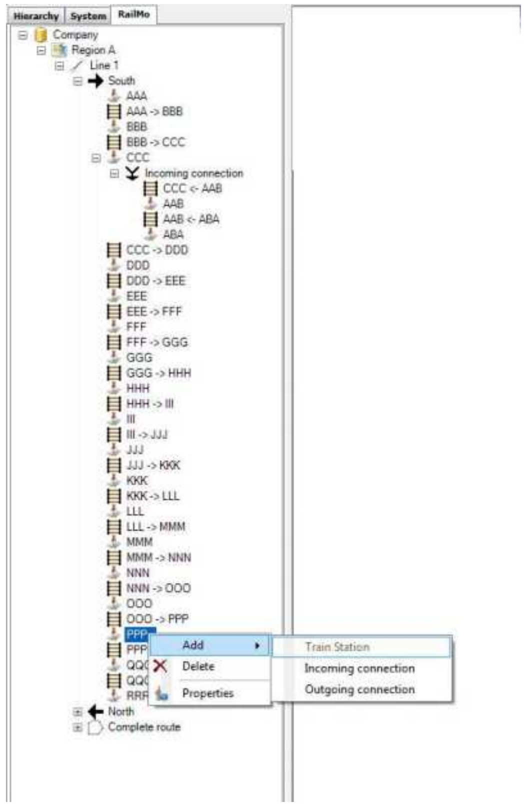


Figure D - 22
Adding an Incoming or Outgoing connection

This launches the same Train Station properties dialog, shown in Figure D-19, so as to add the next station on that connection. An incoming connection on this bound means the trains will be travelling into this line from the connecting station, outgoing would be from this line along the added connection.

Note that adding a Train Station is unavailable above because the selected station being added to, is ‘mid-line’. It is possible to add connections to any station on the line, but a station can only be added to the line, at the end of that line.

Track section features

By right clicking on a **Track section**, its properties can be accessed:

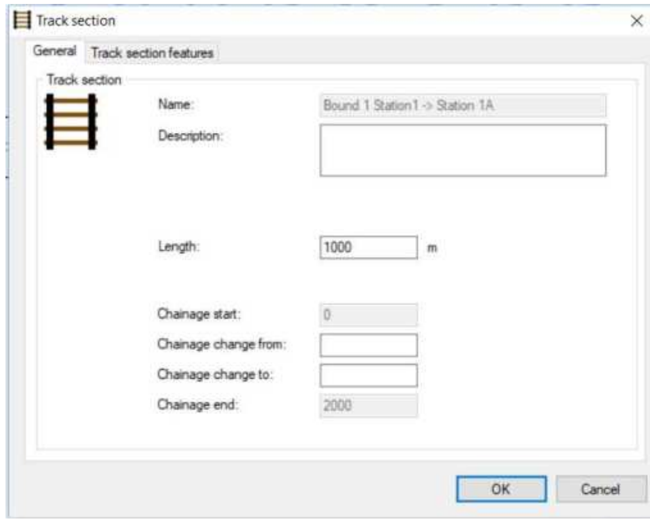


Figure D - 23
Track section General tab

By switching to the **Track section features** tab, it is possible to view, manage and **Add** features that are encountered within this section. An added Track Section Feature can, for example, be of type: *Turnout* (points), *Bridge*, *Tunnel*, *Turn*, *Note* or *Other* feature.

When adding a track section feature it is positionally defined by a **Chainage start** and **end** and if required, an **Alert level offset**. Descriptive text can also be included:

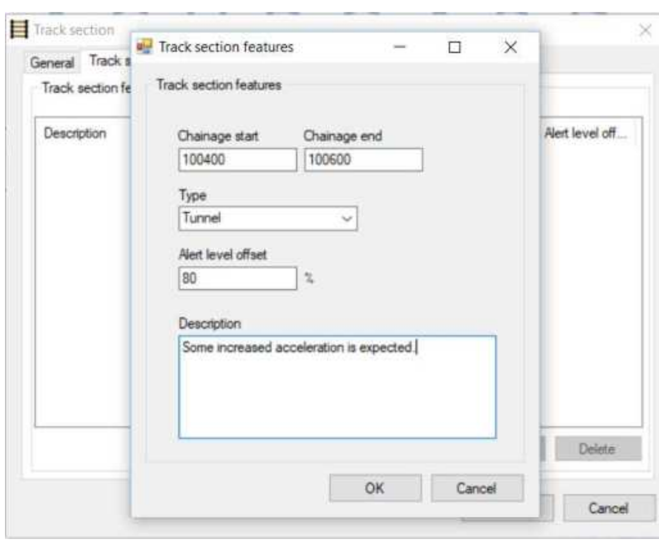


Figure D - 24
Adding a Track section feature

The **Alert level offset** is applied to all thresholds whilst within the specified chainage range. For example, enter 0 to leave these thresholds unchanged or 10 to increase them by 10% from their configured values.

Train Routes

Whilst the Line structure defines how stations are connected, Train routes describe how trains are operated on those lines. They may therefore encompass the whole or just parts of a Line and one Line may have multiple routes.

The Train route data is used by the software to (pattern) match measured data with the correct Track sections. To add a Train route, right click on the Line and use the context menu to **Add** a **Train route**:

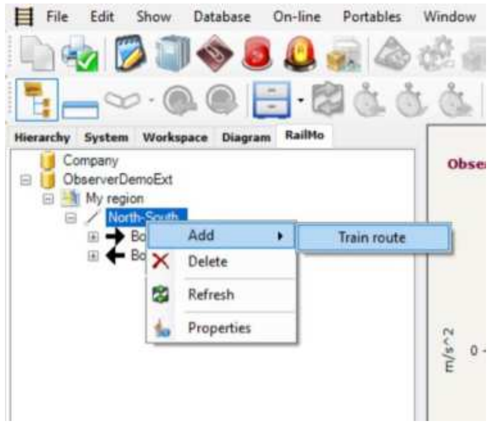


Figure D - 25
Add Train route

Now define the Train route in terms of the start and stop stations for each Bound:

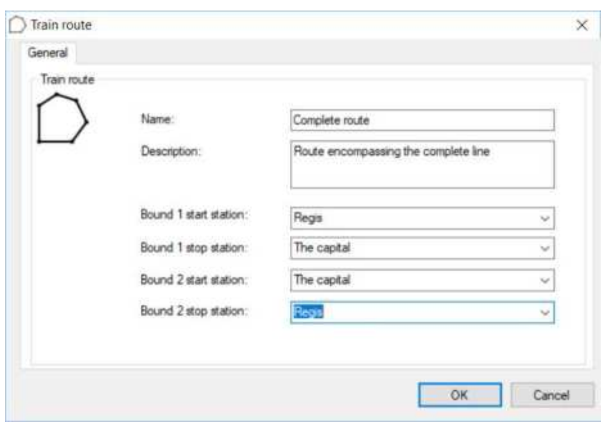


Figure D - 26
Train route properties

Select the appropriate stations from the drop-down list of stations on that line. A name should be given to the route and descriptive text can be added.

The Train route is now visible in the RailMo view, below the two bounds for the line:

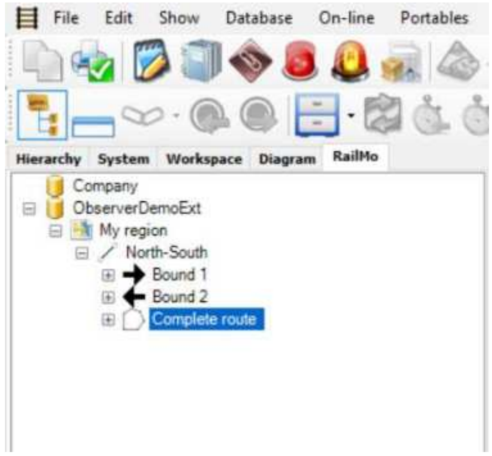


Figure D - 27
Rail track monitoring Train route

Matching and pattern recognition

By appropriately configuring the **Wheel Diameter**, the system can estimate the distance the train has travelled between stops. Every 10 seconds, the system identifies any uploaded train speed data representing a journey between two stops and calculates an estimated distance travelled.

Once that train has accumulated four such, consecutive ‘runs’, the total distance travelled is compared with distance data for the configured routes. The **Distance error threshold** is used when deciding if a match has been found. If multiple sections match within that threshold, the one with the lowest error will be used.

Based on this methodology, there are some limitations that can be identified:

- A route is defined by its start and stop (end) stations, all intermediate stations on the line are included.
- It will not match data where the train stops between stations or where it doesn’t stop at stations configured for this route.
- The pattern matching can include data from both bounds (example: the journey between the penultimate station and the stop/end station can be considered along with data from the return journey).
- Differences between the inter-station distance and train stop and start positions or variations in where the train stops when calling at a station will introduce errors.
- The matching is not designed to cope with a situation where there are multiple 4-section stretches of track, that have equal length.
- The configuration settings (**Front** and **Rear offset**) are specific to a physical, train configuration. Changing that (adding/removing carriages) whilst retaining incorrect offsets will introduce errors.
- There is currently no functionality to remove incorrectly matched data. If however the data remains unmatched, it can be selected and deleted from the capture view, refer Figure D - 16

Configuring @ptitude Observer for the Web app (Metro only)

The required configuration parameters are accessed in @ptitude Observer under **Database**, **Options** and **Database, Security roles**.

RailMo tab

From **Database**, **Options** select the RailMo tab:

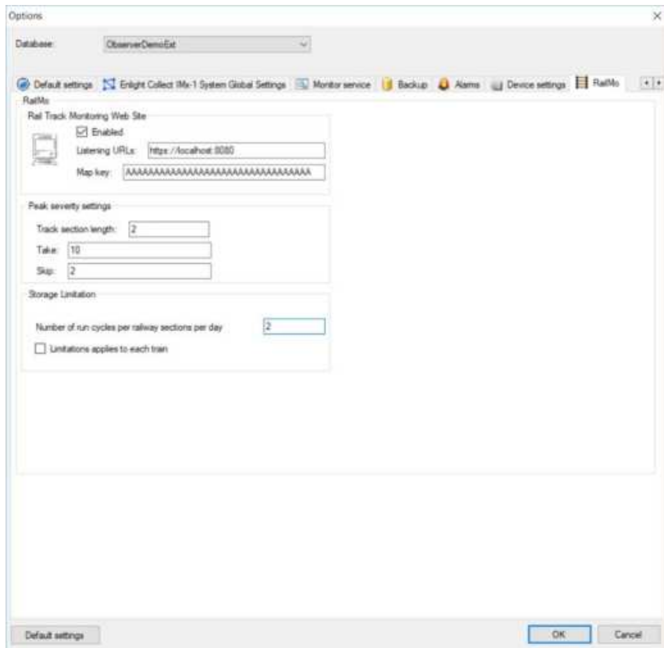


Figure D - 28
Database Options, RailMo tab

- Check, to enable the web application
- Specify a list of URLs, each URL should be separated by a comma.
    - ‘http’ and ‘https’ are supported, ‘https’ protocol is recommended
- Enter a valid Google map API key

Monitor service tab

From **Database**, **Options** select the Monitor service tab:

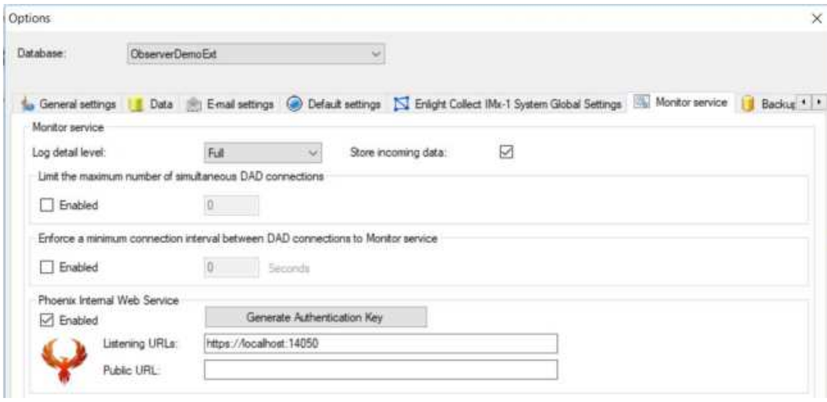


Figure D - 29
Database Options, Monitor service tab

- Check, to enable the Phoenix internal web service
- Specify appropriate URLs, separate multiple entries by a comma
    - ‘http’ and ‘https’ are supported, ‘https’ protocol is recommended
    - Listening URLs
    - Public URL (if cloud based)

Further information on the Phoenix internal web service is available in Options.

Rail track monitoring security roles

Security Roles are configured groupings of user rights or privileges. For rail track monitoring two specific security roles are available with the following underlying rights:

- Rail Track Monitoring Web View
    - Rail Track Monitoring View
    - Event case View
- Rail Track Monitoring Web Edit
    - Rail Track Monitoring View
    - Event case View
    - Rail Track Monitoring Edit
    - Event case Edit

As the name suggests, the role Rail Track Monitoring Web View will permit users with that role to view maps and exceptions. The role Rail Track Monitoring Web Edit has the same view rights but adds the further rights needed to make changes.

An administrator should add such users as are required to access and use the web application.

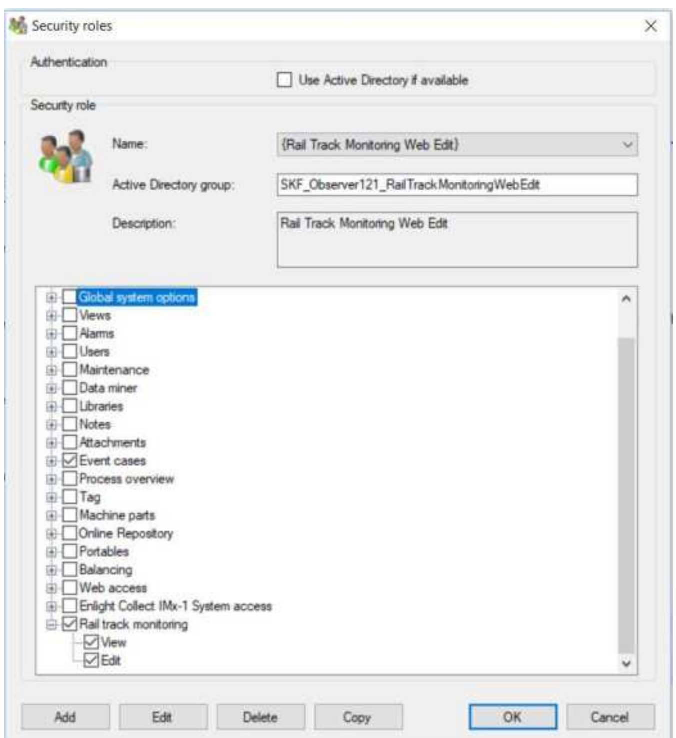


Figure D - 30
Rail Track Monitoring Web Edit – Security role

An appropriate user login is required before the Web App can be accessed.

@ptitude Observer Analysis Tools (Metro only)

Once data has been gathered and matched, an analyst can review the track condition in @ptitude Observer software using the following tools:

- Line Summary table – quickly identify track sections with highest severity events
- Acceleration and speed profile plot – section overview showing separate data for left and right rails
- Acceleration for section plot – combining trend and severity information for a length of track
- Time waveform and spectrum – the vibration data collected from a length of track

Line Summary table

This provides an overview of a railway Line, highlighting the severity index and number of exceptions associated with each Track section:

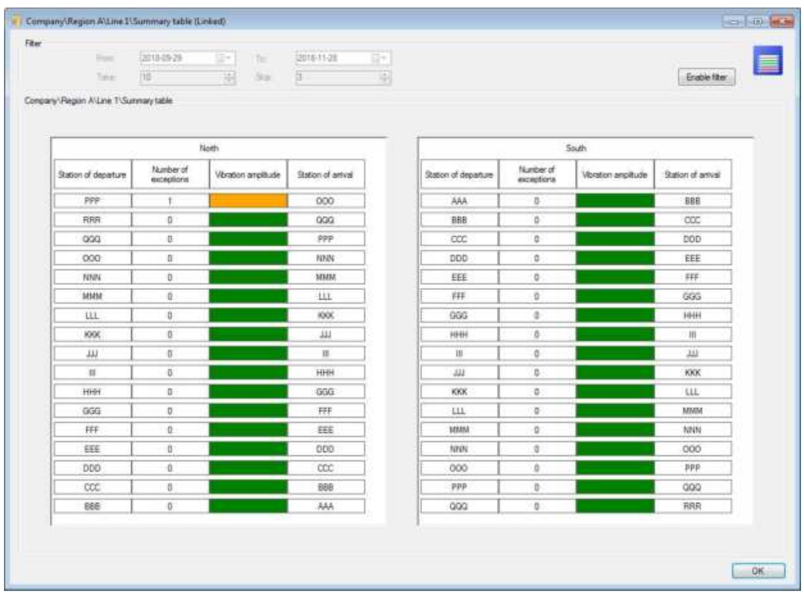


Figure D - 31
Line Summary table, example

- If launched from the Line level, both bounds are shown (in this example named North and South)
- The names of the boundary stations for each track section are shown
- A numeric value for the number of exceptions is displayed
- Track sections are ordered in the table, as follows:
  - First by the number of exceptions
  - Then by the order of the stations along the line

- The severity is colour coded (applies also to Acceleration and speed profile, and Acceleration for section plots)
    - Below info level: Green
    - Info: Yellow
    - Warning: Orange
    - Alarm: Red
    - Critical: Dark red

The user may filter the data by pressing enable filter and setting the date range for the data, in this way historical data can be reprocessed. **Take** and **Skip**, is explained in Peak severity settings.

The colour bars for severity are 'clickable' and will open an Acceleration and speed profile plot for that section, within that bound.

Acceleration and speed profile plot

 The Acceleration and speed profile plot provides an overview of data for a section of a bound:

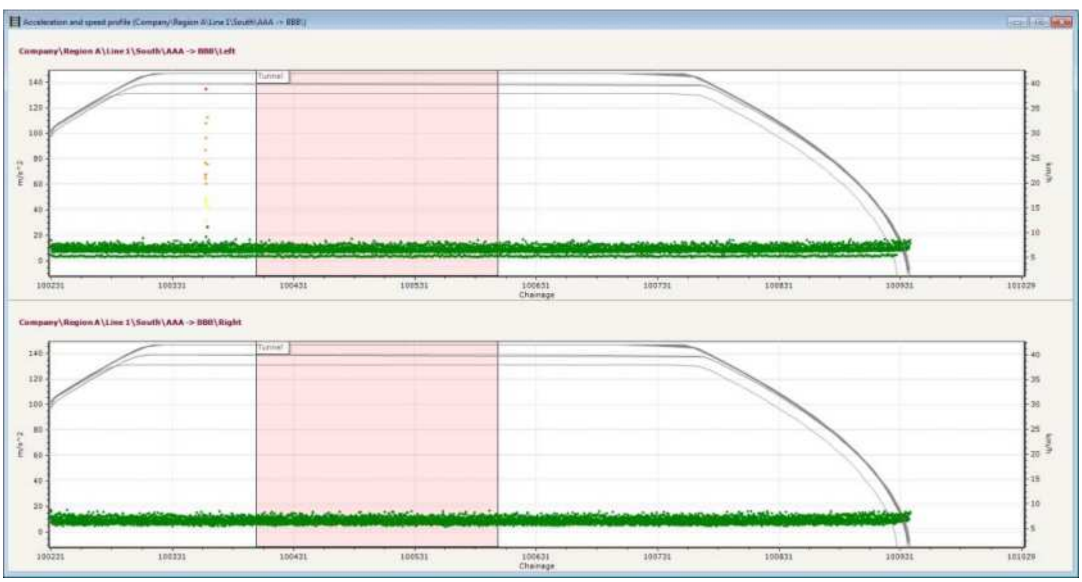


Figure D - 32
Acceleration and speed profile plot, example

- The Left and Right rails are presented separately
- Historical data is over plotted, against track position (chainage)
- The location of features is indicated by a coloured overlay or band
    - Example in the figure above: Tunnel
- Vibration severity is plotted as colour coded dots
    - left hand scale applies
- Measured, train speed profiles for the section are graphed

- right hand scale applies

The plots are auto-scaled, and the same scale is applied to both rails. Click on a severity dot in one of the graphs to open an Acceleration for section graph.

Acceleration for section graph

An Acceleration for section graph is a way of displaying historical severity data for a single rail within a section to highlight trends or changes in the data (worsening damage or damage zone extending).

- Each 'bubble' represents a consolidated (peak acceleration) value for 1 m of rail
- The bubble is sized according to amplitude (and colour coded based on severity)
- The x-axis is location (chainage)
- The y-axis is time (sequential data sets, that have been captured by trains)

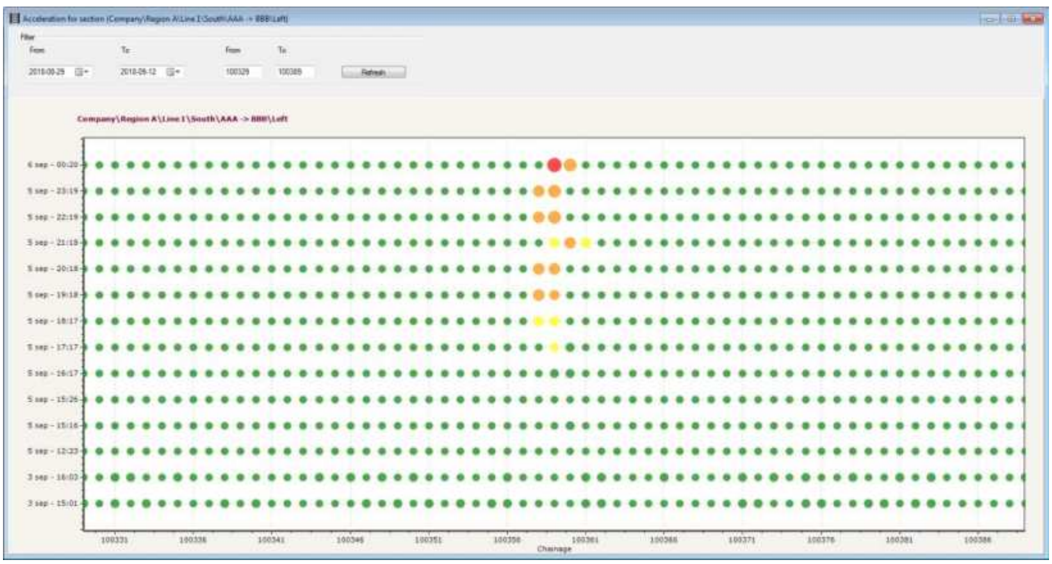


Figure D - 33
Acceleration for section graph, example

The Filter zone above the plot, shows the current data range (date and chainage) and can be adjusted to move the view along and across the available rail severity data.

Click on a bubble to open a time waveform and spectrum display for that data.

Time waveform and spectrum display

The time waveform and spectrum display accesses the 'raw' data for that rail sub section, within the selected dataset:

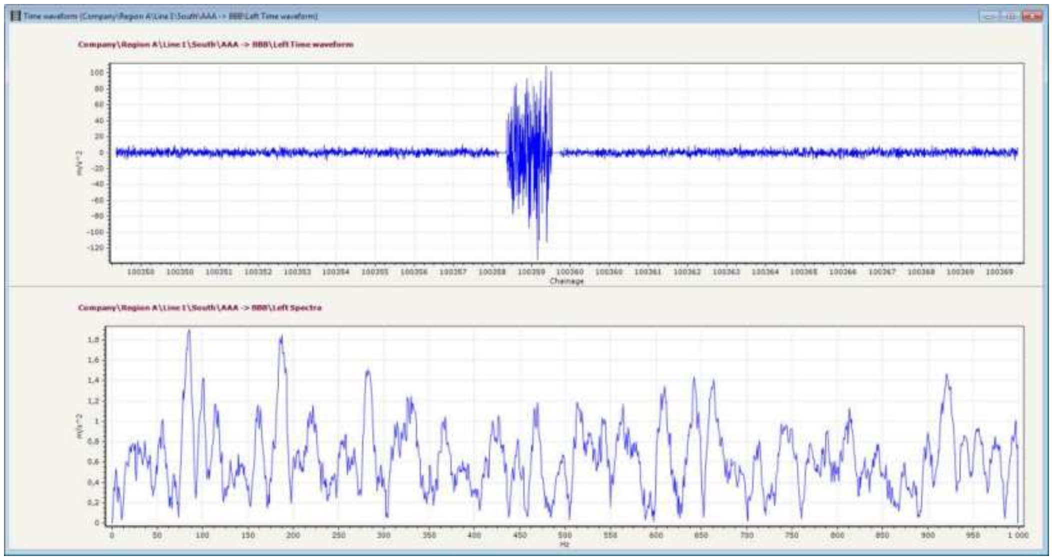


Figure D - 34
Time waveform and spectrum display, example

'Time waveform', in rail track monitoring, plots the vibration waveform against chainage (rather than time) and the spectrum is a conventional acceleration FFT of that data, plotting acceleration amplitude (peak) against frequency.

Event case and Exception workflows (Metro only)

Creating an Exception

In @ptitude Observer an Exception is based on the following:

- An event case, to which is added:
  - A report
    - An assessment
    - Supporting pictures (charts, graphs, etc.)

Further background on event cases, reports and assessments can be found in Event Cases.

To start this process, select the Track section to which the exception will apply and open '**Event cases**':

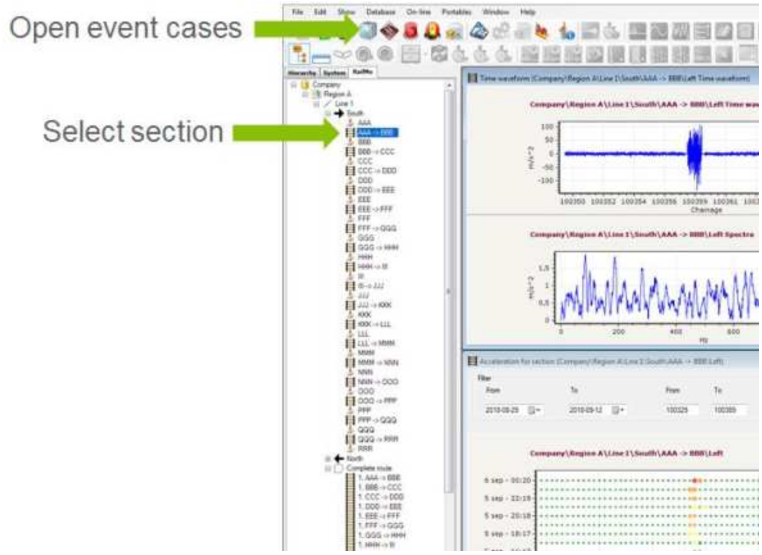


Figure D - 35
Open an Event case

When the event case dialog opens, a list of existing event cases is displayed and the opportunity to create one is provided by the '**New**' button. When the Edit Event case dialog opens, click **Add**, to add a Report*.

*Note that in creating an Event case for rail track monitoring, no user entries are needed in the '**General Settings**' fields of the Edit event case, dialog.

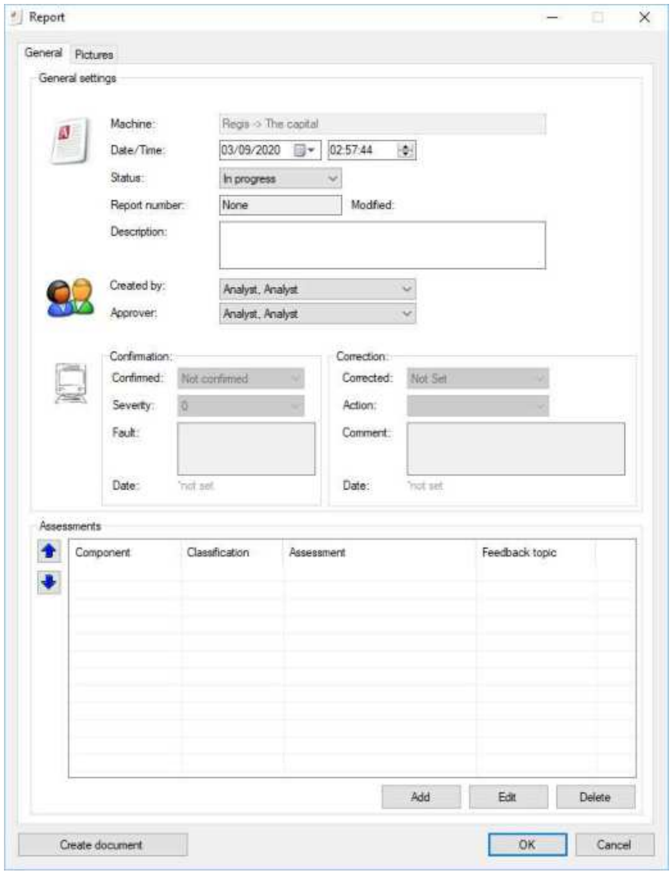


Figure D - 36
Rail track monitoring Report dialog

In the **Report** dialog, shown above:

- In the **Description** text box, add a meaningful description for the report
    - **Created by** and **Approver** fields: select from the drop-downs
    - **Confirmation**/**Correction** fields: will feedback information from the customer
- Now click **Add**, to add an Assessment to the report

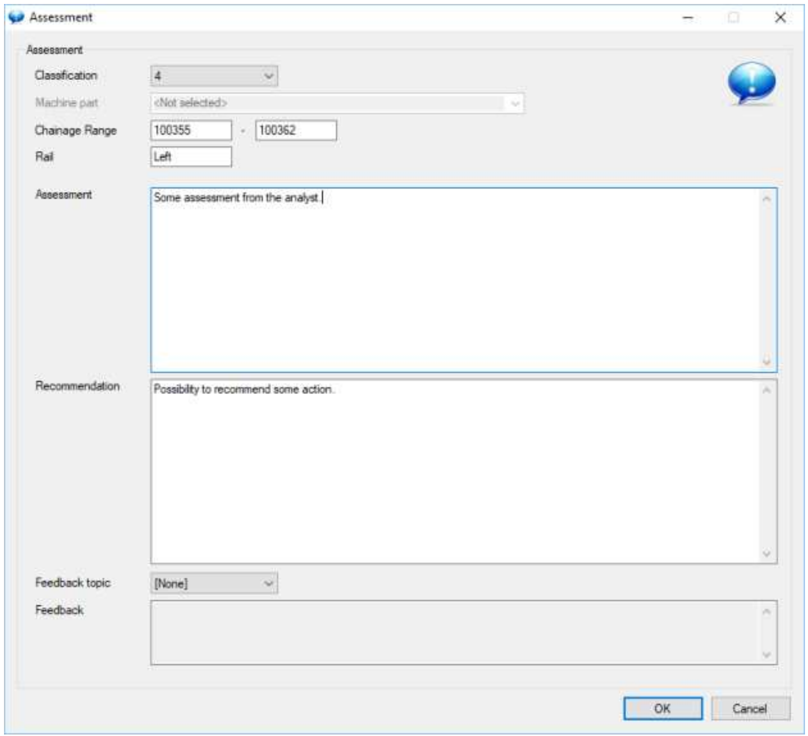


Figure D - 37
Rail track monitoring Assessment dialog

In completing the assessment, the analyst should:

- Enter a **Classification** (range *1* to *10*, where 10 is worst/highest priority)
- Fill-in the **Chainage Range** and the **Rail** ID to which the assessment applies
  - In this case the ID could for example be*: Left*, *Righ*t or *Left+Right*
- Optionally:
  - Enter free text to describe the **Assessment** and any **Recommendation**
  - Note these optional elements are not included in the web display

Having created the assessment, the **Pictures** tab of the **Report** dialog can be used to add supporting images to exceptions (graphs, tables, etc.). Images can be added from either the clipboard or the active window in @ptitude Observer:

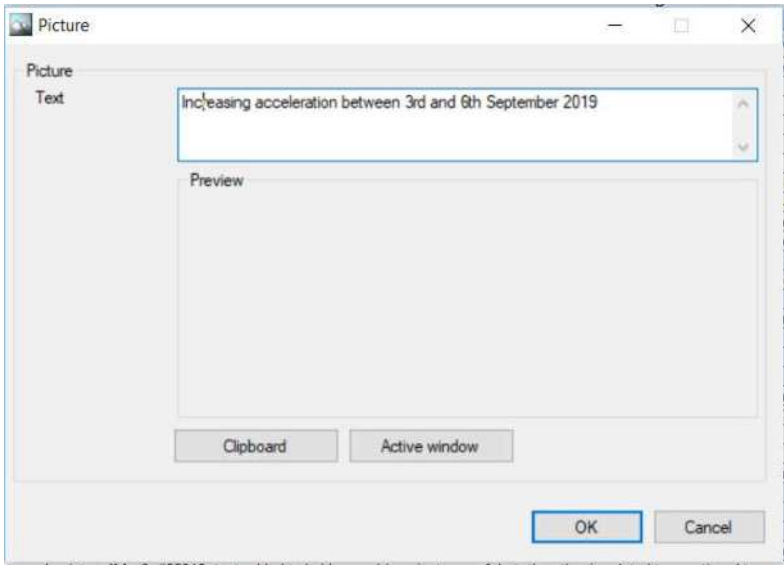


Figure D - 38
Report, Pictures tab, Add Picture

Select the desired image and add a meaningful description in the **Text** box:

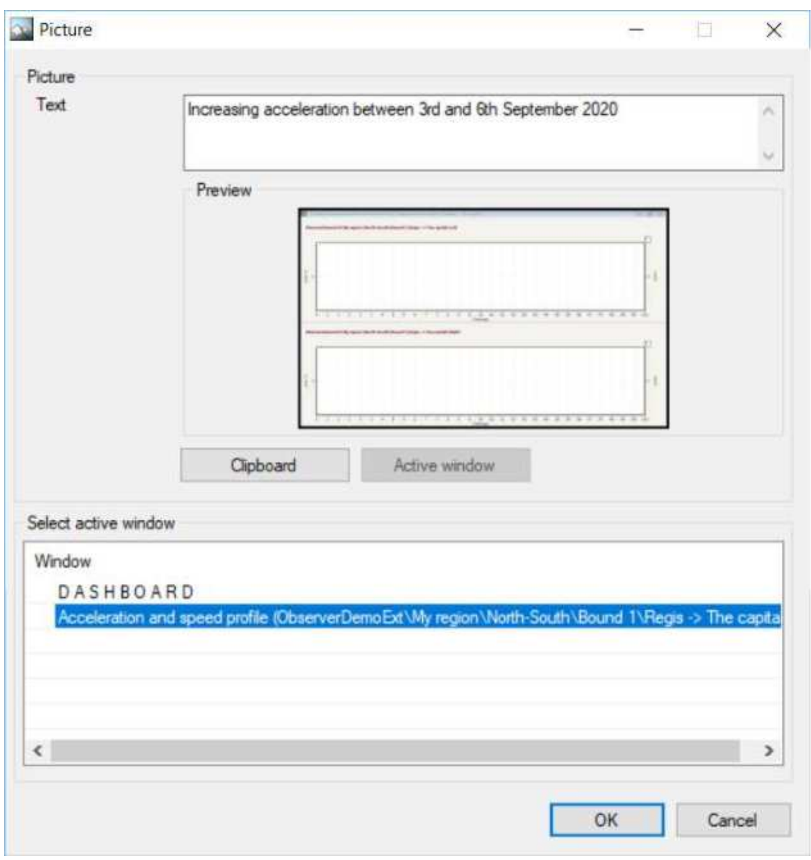


Figure D - 39
Add from active window, example

Exception feedback

When an Exception has been processed by the customer, the report is automatically updated with the **Confirmation** (results of visual inspection) and where appropriate, the **Correction** (corrective actions) applied, refer also Processing and closing exceptions.

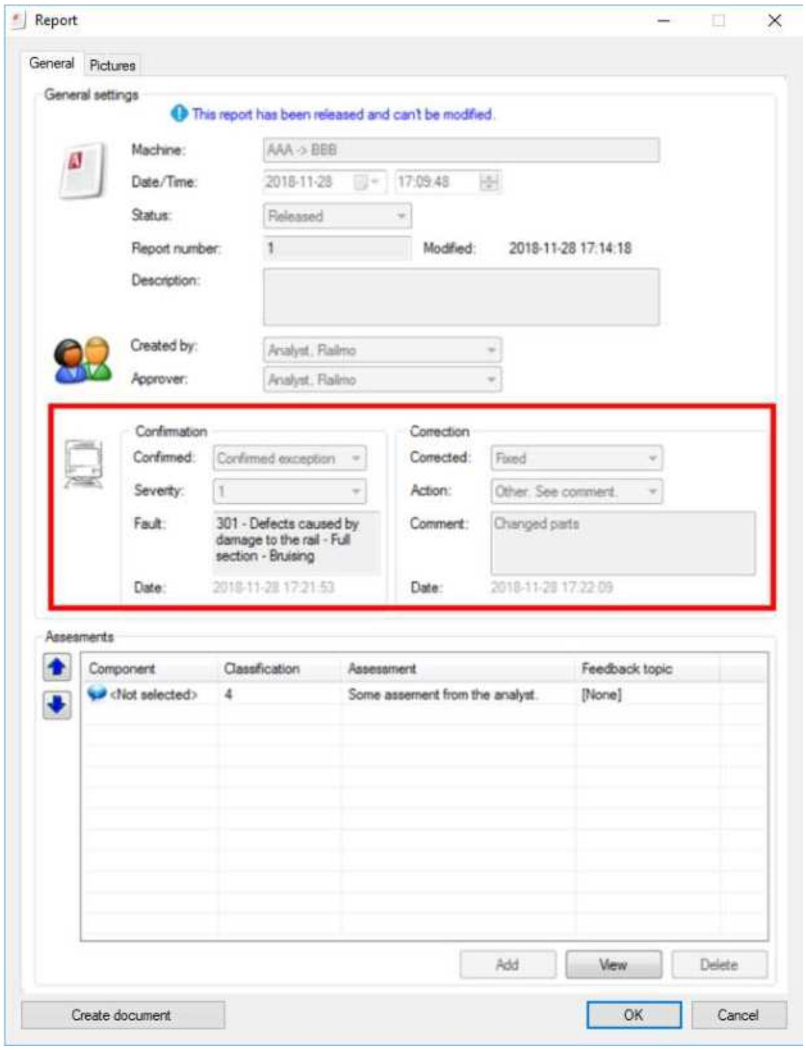


Figure D - 40
Report updated with Exception, feedback

This closes the loop and the Event case status will also be similarly updated (open Event Cases, to view).

Using the Web App (Metro only)

Introduction to the Web application

The web app for *Metro* systems can be hosted on a local network or can be cloud based and provides easily viewed status information for the rail infrastructure. To access the web app, navigate to the configured URL where the login page will be displayed.

Figure D - 41
Login screen

Only users with the appropriate rights and Rail track monitoring security roles can access the system. At first login, it is mandatory to **Accept** the EULA:

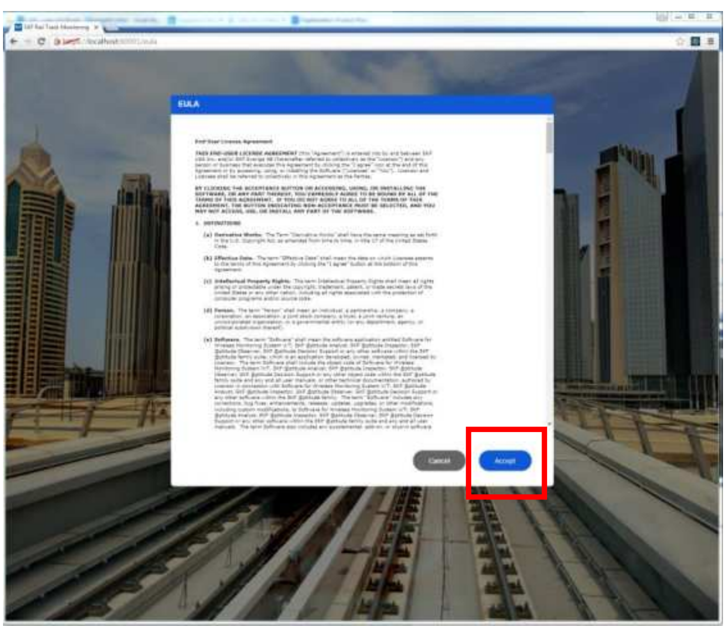


Figure D - 42
EULA

The app displays as a main panel, with a blue navigation bar on the left side:

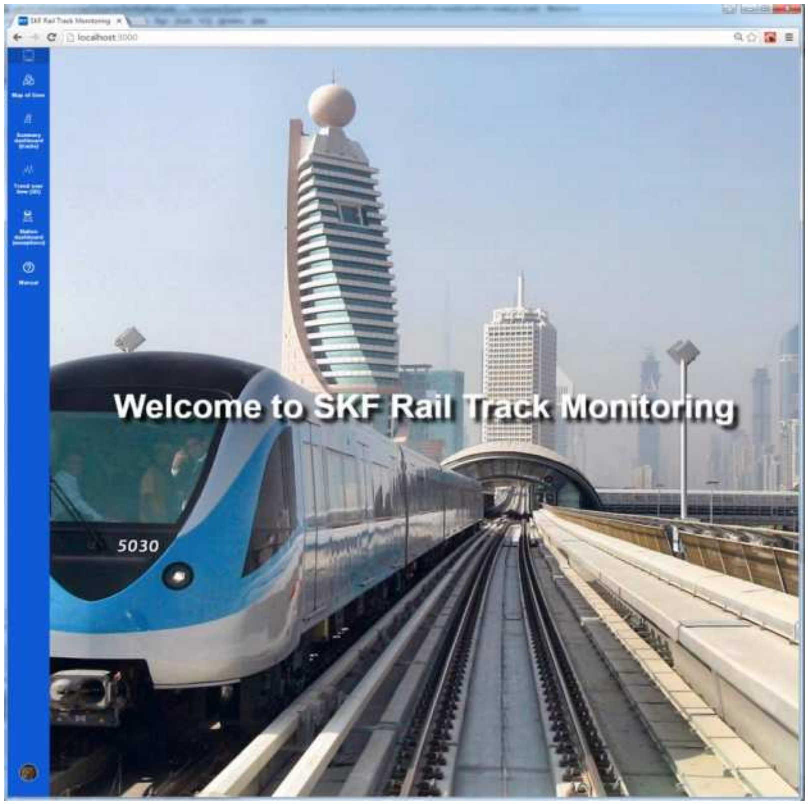


Figure D - 43
Welcome screen

In that navigation bar there are options for:

- Map of lines – to open a map displaying the lines/line information
- Station dashboard (exceptions) – to list recorded exceptions

Map of lines

On selecting the Map of Lines option, the main panel now displays a Google map on which the lines are displayed, each line is coloured by the severity. The lines are drawn based on station locations (not a representation of the actual routing) and is initially zoomed and panned to fit the lines, although it can be further zoomed and/or panned as needed.

Clicking on a line will show additional information:

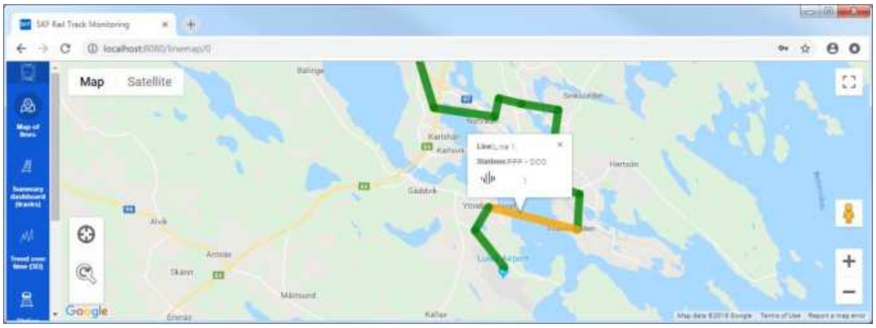


Figure D - 44
Clicking on a line section for further information (zoom 1 example)

In the lower left corner of the map display are two controls to 'recover' the map pan and zoom settings and bring the lines in view:

-  Pan to railway bounds button, pans the map so that the railway is visible in the map.
-  Zoom to railway bounds button, resets to the default zoom and pan, to fit and centre the map for the lines.

At three zoom levels the level of detail, routinely shown, changes:

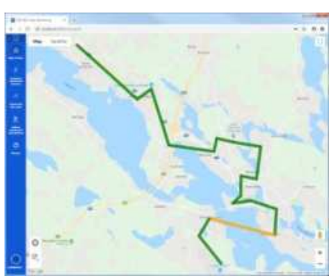
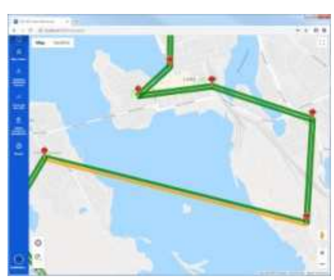
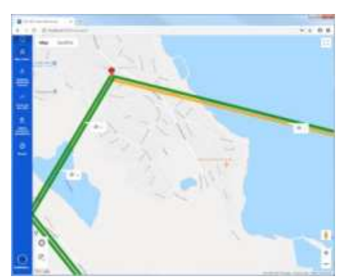
		
Zoom 1	Zoom 2	Zoom 3

Figure D - 45
Line map, zoom

Zoom1

- The Railway Line is drawn as a single line
- Stations are shown as dots

Zoom 2

- As zoom 1 but with:
- The Railway Line drawn as two lines (representing each bound)
- Stations shown by their names (and a location 'pin', coloured red)

Zoom 3

- As zoom 2 but with:
- A 'call-out' on each section and bound, containing the Exception count

Station dashboard

The Station dashboard groups open exceptions by Line, Track section (from station to station) and bound:

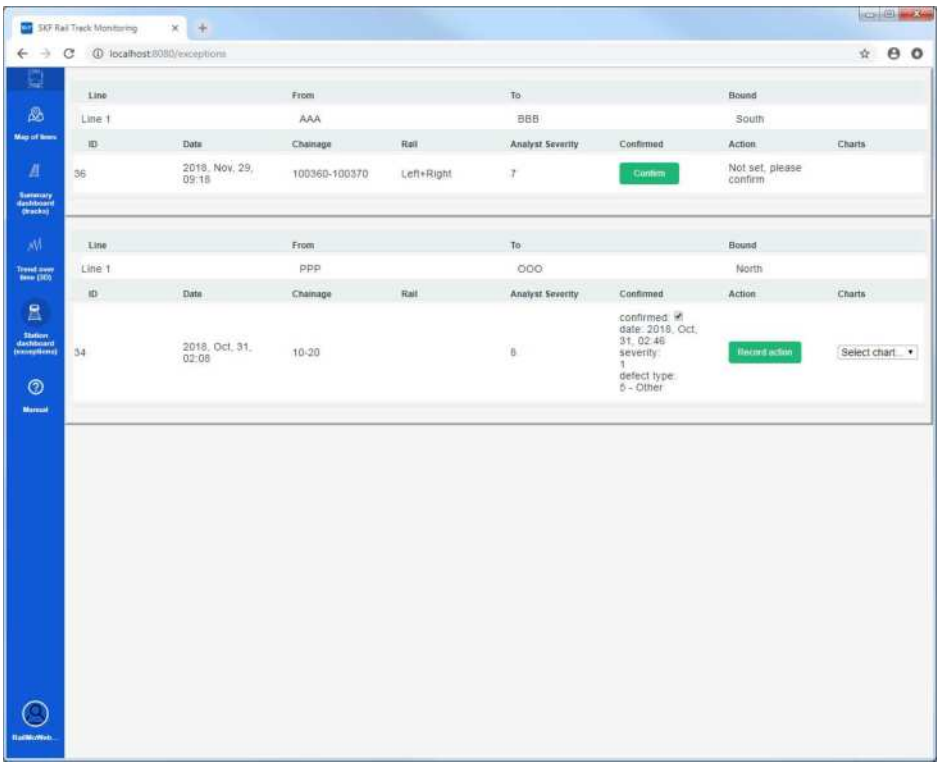


Figure D - 46
Station dashboard, example

Within such a group, all open exceptions are listed together with the following supporting information:

- **ID**
- **Date** of creation
- **Chainage** – identifying the specific length of rail, concerned
- **Rail** – Left, Right or Left+Right
- **Analyst Severity** - as set by the analyst

- **Confirmed** - Confirmation information, if any
- **Action** information, if any
- **Charts** – provides access to any images the analyst has attached

Confirmed and **Action** information are a part of the Exception workflow and record the customers actions and feedback while closing out the exception. Once an exception is closed, it will no longer be visible in the web app.

Processing and closing exceptions

The first stage is normally to visually inspect the region of track against which the exception has been raised. The results of that inspection can be recorded against the exception by pressing the associated **Confirm** button, for that exception. This launches a new dialog:

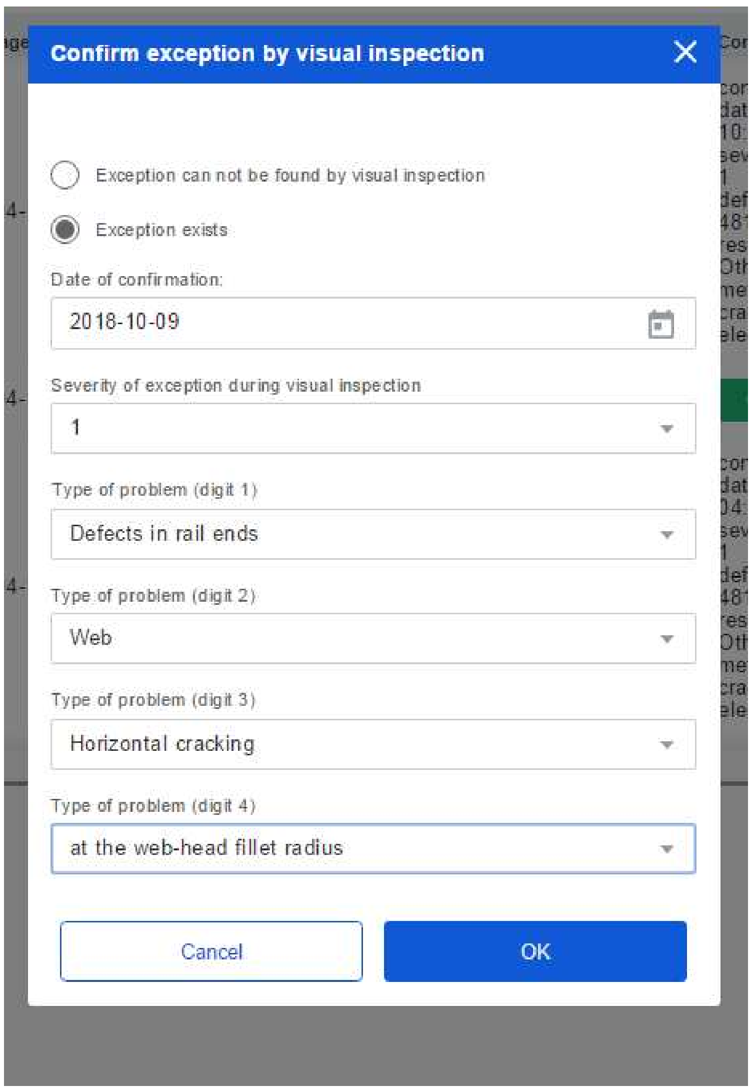


Figure D - 47
Confirm exception dialog

If the exception is confirmed (a defect exists), after entering the date the inspection was performed, the dialog uses a series of drop-downs to classify the findings in terms of the type and severity of the defect seen. Using drop-downs rather than free-text to describe the defect, allows it to be objectively classified.

The numeric coding used to classify defect type is based on the International Railway Solution (IRS) 70712, Rail Defects.

Second stage is to record the corrective action taken (if any). This is achieved by pressing the associated **Record action** button, for that exception. The dialog opens:

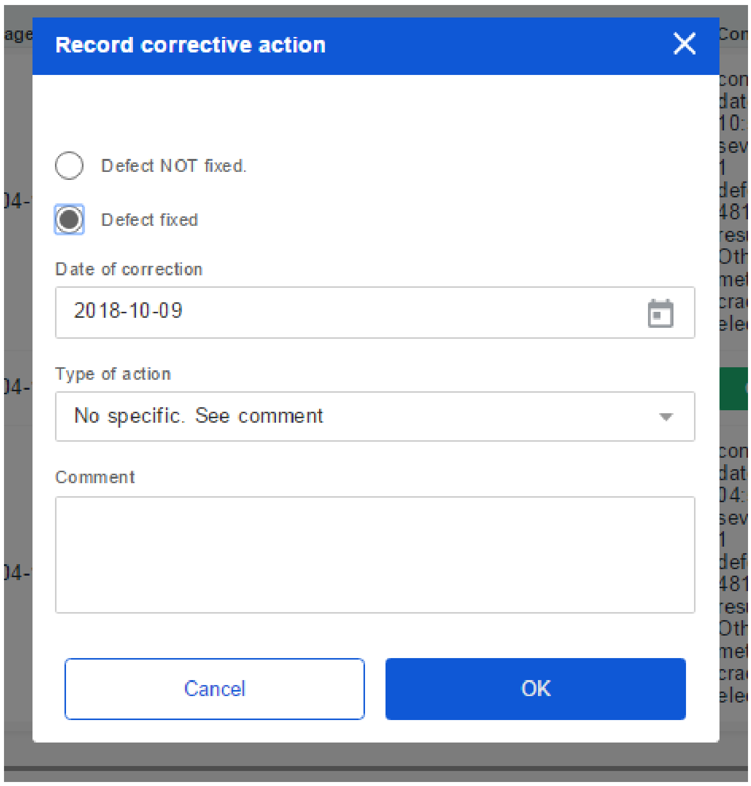


Figure D - 48
Record corrective action, dialog

In this instance a drop-down for the type of action taken (if any) plus a free-text area for further comment, are provided.

When a defect found (or not found) and a fix (or no fix) have been registered, the exception is closed.

Appendix E
End User License Agreement

THIS END-USER LICENSE AGREEMENT (this "Agreement") is entered into by and between SKF USA Inc. and/or SKF Condition Monitoring Center AB (hereinafter referred to collectively as the "Licensor") and any person or business that executes this Agreement by clicking the "I agree" icon at the end of this Agreement or by accessing, using, or installing the Software ("Licensee" or "You"). Licensor and Licensee shall be referred to collectively in this Agreement as the Parties.

BY CLICKING THE ACCEPTANCE BUTTON OR ACCESSING, USING, OR INSTALLING THE SOFTWARE, OR ANY PART THEREOF, YOU EXPRESSLY AGREE TO BE BOUND BY ALL OF THE TERMS OF THIS AGREEMENT. IF YOU DO NOT AGREE TO ALL OF THE TERMS OF THIS AGREEMENT, THE BUTTON INDICATING NON-ACCEPTANCE MUST BE SELECTED, AND YOU MAY NOT ACCESS, USE, OR INSTALL ANY PART OF THE SOFTWARE.

1. DEFINITIONS

(a) Derivative Works. The Term "Derivative Works" shall have the same meaning as set forth in the U.S. Copyright Act, as amended from time to time, in title 17 of the United States Code.

(b) Effective Date. The term "Effective Date" shall mean the date on which Licensee assents to the terms of this Agreement by clicking the "I agree" button at the bottom of this Agreement.

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