

# Modbus for SKF IMx and SKF @ptitude Analyst



User Manual Part No. 32342700-EN  
Revision A



**WARNING!** - Read this manual before using this 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.

## SKF USA Inc.

® SKF is a registered trademark of the SKF Group.  
All other trademarks are the property of their respective owners.  
© SKF 2015

The contents of this publication are the copyright of the publisher and may not be reproduced (even extracts) unless prior written permission is granted. Every care has been taken to ensure the accuracy of the information contained in this publication but no liability can be accepted for any loss or damage whether direct, indirect or consequential arising out of the use of the information contained herein. SKF reserves the right to alter any part of this publication without prior notice.

Patents: US 4,768,380 • US 5,633,811 • US 5,679,900 • US 5,845,230 • US 5,852,351 •  
US 5,854,553 • US 5,854,994 • US 5,870,699 • US 5,907,491 • US 5,992,237 • US 6,006,164 •  
US 6,124,692 • US 6,138,078 • US 6,199,422 • US 6,202,491 • US 6,275,781 • US 6,301,514 •  
US 6,437,692 • US 6,489,884 • US 6,513,386 • US 6,633,822 • US 6,789,025 • US 6,792,360 •  
US 7,103,511 • US 7,697,492 • WO/2003/048714

### Product Support – Contact Information

*Product Support* – To request a [Return Authorization](#), [Product Calibration](#) or a [Product Support Plan](#), use the web page links for direct contact and support.

*Product Sales* – For information on purchasing condition monitoring products, services or customer support, contact your [local SKF sales office](#).

### General Product Information

For general product information (i.e., product data sheet, accessories catalog, etc.), visit the [Condition Monitoring Products](#) page on SKF.com and select the appropriate product link.

### Technical Support Group

Discuss/review issues of specific interest with maintenance and reliability specialists from around the world at the [SKF Knowledge Centre](#).

For technical support on issues like troubleshooting product installation, troubleshooting product performance, etc., use our [technical support](#) web page to contact one of our Technical Support Groups.

### Product Registration

Please take a moment to register your product at [www.skf.com/cm/register](http://www.skf.com/cm/register) to receive exclusive benefits offered only to our registered customers, including receiving technical support, tracking your proof of ownership, and staying informed about upgrades and special offers. (Please visit our website for more details on these benefits.)

### Tell us how we're doing!

It's important that you're satisfied with the quality of our product user manuals. We appreciate your feedback; if you have comments or suggestions for improvement, [please tell us how we're doing!](#)

090915dc

# Table of Contents

<b>Introduction</b>	<b>1-1</b>
Modbus for IMx-S and IMx-T Units .....	1-1
About This User Manual .....	1-1
Important Messages .....	1-2
<b>Modbus (RS 485) Interface</b>	<b>2-1</b>
Terminal Blocks .....	2-1
Transmission Characteristics .....	2-2
RS485 Bus Termination.....	2-2
<b>Modbus and IMx</b>	<b>3-1</b>
The Modbus Protocol .....	3-1
Modbus Register, Modbus Channel and Measured Channel.....	3-2
Bit Representation of Mask.....	3-3
<b>Configuring Modbus Capability for IMx</b>	<b>4-1</b>
Configuration Scenarios.....	4-1
Export Data from IMx Modbus Slave to Generic Modbus Master .....	4-1
Import Data from Generic Modbus Master to IMx Modbus Slave.....	4-2
Import Data from Generic Modbus Slave to IMx Modbus Master.....	4-3
Data Transfer between IMx Units .....	4-3
Configuring IMx Units for Modbus .....	4-5
<b>Modbus Export through SKF @ptitude Analyst</b>	<b>5-1</b>
Configuring the Modbus Export.....	5-1
<b>Modbus Import through SKF @ptitude Analyst</b>	<b>6-1</b>
Configuring the Modbus Import .....	6-1

<b>Setting up a Measurement Point for Modbus</b>	<b>7-1</b>
Measurement Point Scenario .....	7-1
<b>Checking Modbus Interface and Troubleshooting</b>	<b>8-1</b>
Procedure .....	8-1
<b>Example of Database Records and their Mappings</b>	<b>A-1</b>

# 1

## Introduction

### Modbus for IMx-S and IMx-T Units

---

This user manual describes how to use Modbus with IMx-S and IMx-T units. Modbus is a serial communications protocol for connecting industrial electronic devices. The Modbus feature is configured through SKF @ptitude Analyst software.

- Information on how to use Modbus with the Modbus part of IMx-M units is described in "IMx-M User Manual", Rev M or later.

IMx units offer the Modbus protocol over 2-wire RS 485 which can run as a Modbus Master or a Modbus Slave.

The following are common scenarios of when to use Modbus functionalities with IMx:

- To transmit data to a control system
- To receive data from a control system
- To receive data from sensors such as oil particle counters
- To exchange data between IMx units (used only for testing)

This user manual document describes the following:

- How to physically configure Modbus/RTU protocol over RS 485 and cable connections - [Modbus \(RS 485\) Interface](#)
- How to use Modbus capabilities - [Modbus and IMx](#)
- How to configure IMx units through SKF @ptitude Analyst software - [Configuring Modbus Capability for IMx](#)
- [Checking Modbus Interface and Troubleshooting](#)

### About This User Manual

---

This user manual describes how to use Modbus with IMx-S and IMx-T units.

- In writing this manual we assume you are familiar with common Windows® operations. Refer to your Windows guides for information in these areas.

As you use this manual, you'll discover certain conventions used:

**Bold** type is used to indicate text that appears on a menu, window, or dialog.

*Italics* are used to emphasize important information.

- - are used to indicate notes to the reader.

## Related Documentation

Document	Part No.
IMx-S User Manual, Rev R or later	32087700
IMx-T User Manual, Rev G or later	32096300
IMx-M User Manual, Rev M or later	32179800
SKF @ptitude Analyst and SKF Multilog On-Line Systems User Manual	32296700

## Important Messages

---

The following messages are important information which require special care in order to have a safe and reliable IMx-S or IMx-T system.



***Important messages, instructions and information in this manual must be carefully followed. Otherwise, harm might occur to equipment and/or personnel.***



***IMx units contains circuit boards that are static sensitive. Therefore, use appropriate precautions to prevent ElectroStatic Discharge (ESD) when handling circuit boards.***



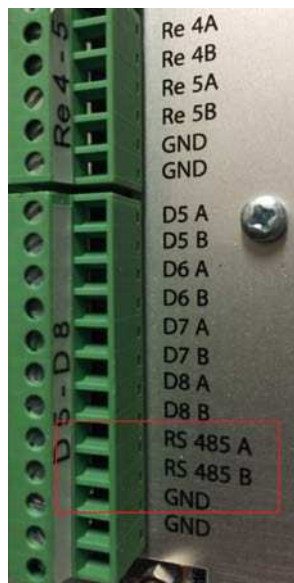
***DIP switch settings must be handled with special care to prevent any damage to IMx unit:***

- ***Do NOT change DIP switch settings while the IMx unit is powered-up, as this may cause damage and void the warranty.***
- ***Before powering up the IMx unit, make sure that DIP switch settings are properly set to match the recommendations for the connected sensors. Incorrect settings may cause permanent damage to the IMx unit.***

## Modbus (RS 485) Interface

### Terminal Blocks

The following are different terminal blocks available on IMx units.



IMx-T RS 485 terminal block



IMx-S RS 485 terminal block

Figure 2 - 1.  
Examples of RS 485 Terminal Blocks.

A = Non-inverting  
B = Inverting  
GND = Reference ground

Note that some RS 485 equipment have the A and B naming reversed. In that case, connect the wires in reverse fashion in order to avoid the communication failure over RS 485.

When connecting IMx to a third party equipment refer to [Notes on Implementation](#) under the chapter, [Modbus and IMx](#), of this User Manual.

## Transmission Characteristics

---

The supported transmission parameters are listed in the table, below. The most commonly used values are in bold.

Any combination of transfer rate, parity and stop bits can be chosen. However, these parameters must match those of other equipment on the network.

Table 2-1.  
Supported RS 485 Transmission Parameters.

RS 485 Transmission Parameter	Supported values
Transfer rate (bps)	9600 / <b>19200</b>
Parity	<b>None</b> / Even / Odd
Stop bits	<b>1</b> / 2

## RS485 Bus Termination

---

IMx units have termination which is controlled manually with a DIP switch.

If an IMx unit is at the end or beginning of the RS485 Bus, activate the built-in termination resistor by setting the DIP switch DIP21 for IMx-S or ANA21 for IMx-T switch number 2 to ON.

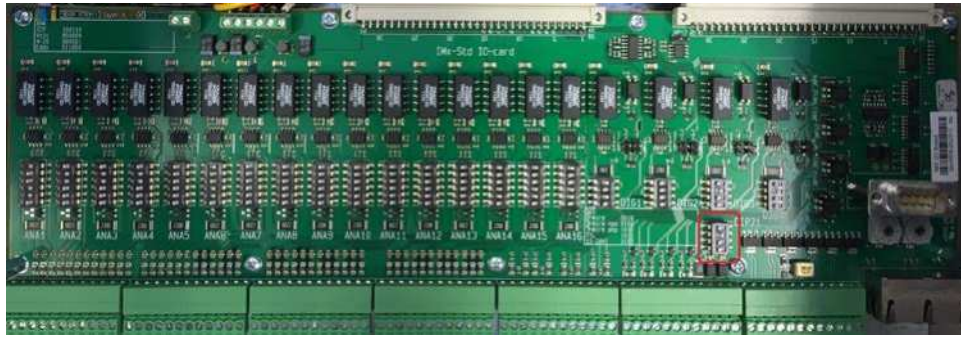
- DIP21 can be accessed after the front panel of the IMx-S has been taken off.
- ANA21 can be accessed after removing the IO board from the IMx-T rack.
- DIP21/ANA21 has four switches in total, of which only switch number 2 has working functionality.

Table 2-2.  
DIP21/ANA21 Switch Number 2 Definition and Functionality.

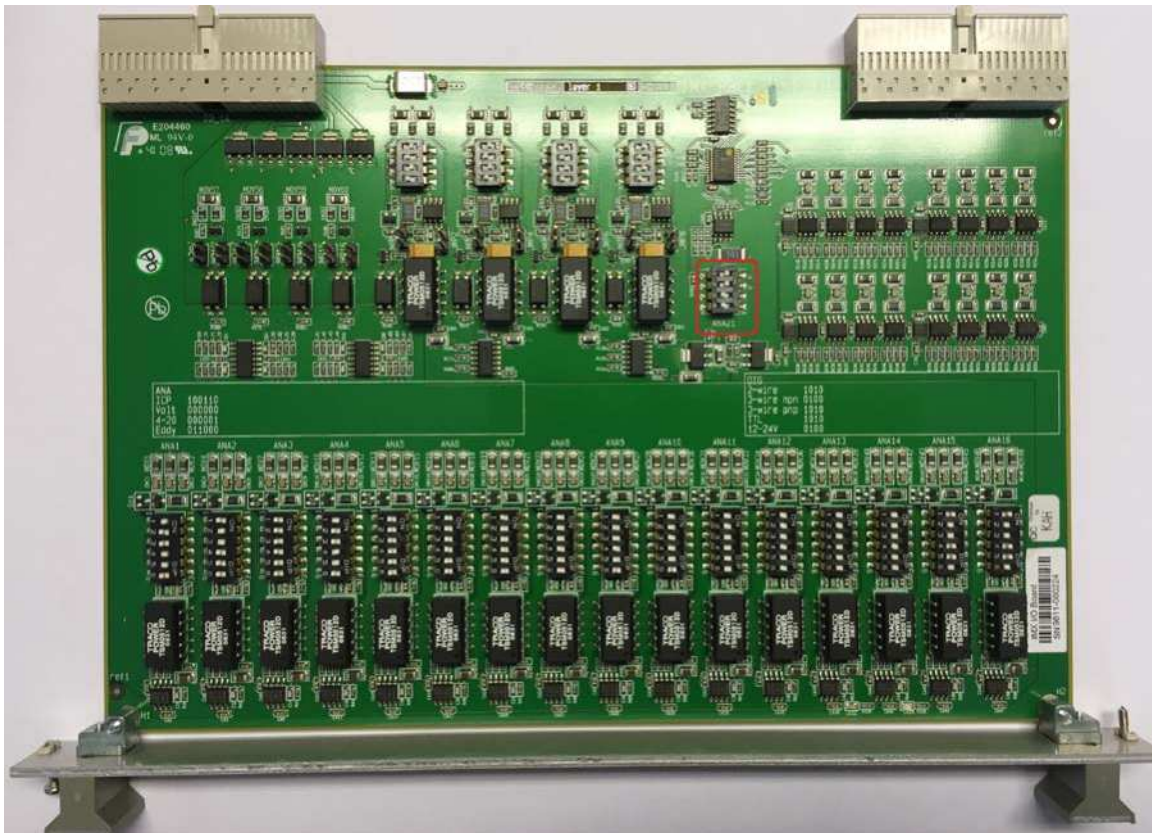
DIP Switch Setting	Definition	Functionality
0	ON	Termination resistor enabled
1	OFF	Termination resistor disabled

- For IMx-S and IMx-T units switch OFF means no termination whereas switch ON means termination (120  $\Omega$ ).





IMx-S Modbus termination DIP switch (DIP21)



IMx-T Modbus termination DIP switch (ANA21)

Figure 2 - 2.  
Modbus Termination DIP Switches.



### The Modbus Protocol

---

The Modbus protocol allows for only one Master, but many Slaves.

#### Modbus Slave

- Modbus Slaves respond to requests from a Modbus Master.
- A Modbus Slave can export values or import values from Modbus registers, following requests of a Modbus Master.
- An IMx Modbus Slave makes all of its measured analogue vibration and digital speed channels available for export at the request of any kind of Modbus Master.

#### Modbus Master

- An IMx Modbus Master can read data from one Modbus Slave device.
- When an IMx Master is appropriately configured, the Modbus registers are read into Modbus channels. Modbus channels are available for analysis and gating in the same way as local measured channels.

#### Notes on Implementation

- IMx Modbus Master only polls for data.
- Master polling rate is about 1 to 2 times per second.
- When used as a Slave, data can both be imported and exported.
- Measurement points translate to exported Modbus registers according to Table 3-1, below.
- Imported Modbus registers translate Modbus channels according to Table 3-2, below.
- The read function code is 0x04.
- The write function code is 0x10.
- The data format is 16-bit signed integers.
- Modbus Slave speed channels are transmitted in cycles per minute (cpm).
- The number of available relay channels varies depending on the type of IMx unit.

#### Register Terminology

- 3xxxx = Input registers (read-only)
- 4xxxx = Holding registers (read/write)

## Modbus Register, Modbus Channel and Measured Channel

---

The correspondence between measurement points and exported Modbus registers are listed in the following table.

Table 3-1.  
Correspondence Between Measurement Points and Exported Modbus Registers.

Exported Modbus Register	Content
30001 to 30016	Freely Configurable*
30017	Speed digital channel 1
30018	Speed digital channel 2
30019	Speed digital channel 3
30020	Speed digital channel 4
30021	Speed digital channel 5
30022	Speed digital channel 6
30023	Speed digital channel 7
30024	Speed digital channel 8
30025	Relay mask **
30026	Alert mask**
30027	Danger mask**
30028	Heartbeat***
30029	Reserved
30030	Reserved
30031 to 30100	Freely Configurable*

\*Any IMx measurement point can be selected and exported via Modbus on these registers.

\*\*Mask is a 16-bit mask which shows conditions of each channel in hex decimal. See Bit Representation of Mask below for detailed information.

\*\*\*Heartbeat register value (One-indexed) will update every read with none zero positive values. To use it, verify that there is a difference between the last and next value.

The correspondence between imported Modbus registers and Modbus channels are listed in the following table.

Table 3-2  
Correspondence Between Imported Modbus Registers and Modbus Channels.

Modbus Channel	Imported Modbus Register When IMx is a Modbus Master	Imported Modbus Register When IMx is a Modbus Slave
1	30001	40001
2	30002	40002
3	30003	40003
4	30004	40004
5	30005	40005
6	30006	40006
7	30007	40007
8	30008	40008
9	30009	40009
10	30010	40010
11	30011	40011
12	30012	40012
13	30013	40013
14	30014	40014
15	30015	40015
16	30016	40016

## Bit Representation of Mask

Bit representations of Relay Mask, Warning Mask and Alarm Mask can be combinations of more than one channel condition. The following table lists those possible combinations in channel numbers.

Table 3-3  
Bit Representation for Relay Mask, Warning Mask and Alarm Mask.

Bit Representation in Hex	Channel Numbers	Bit Representation in Hex	Channel Numbers
0x1000	13	0x0010	5
0x2000	14	0x0020	6
0x3000	14,13	0x0030	6,5
0x4000	15	0x0040	7
0x5000	15,13	0x0050	7,5
0x6000	15,14	0x0060	7,6

Bit Representation in Hex	Channel Numbers	Bit Representation in Hex	Channel Numbers
0x7000	15,14,13	0x0070	7,6,5
0x8000	16	0x0080	8
0x9000	16,13	0x0090	8,5
0xA000	16,14	0x00A0	8,6
0xB000	16,14,13	0x00B0	8,6,5
0xC000	16,15	0x00C0	8,7
0xD000	16,15,13	0x00D0	8,7,5
0xE000	16,15,14	0x00E0	8,7,6
0xF000	16,15,14,13	0x00F0	8,7,6,5
0x0100	9	0x0001	1
0x0200	10	0x0002	2
0x0300	10,9	0x0003	2,1
0x0400	11	0x0004	3
0x0500	11,9	0x0005	3,1
0x0600	11,10	0x0006	3,2
0x0700	11,10,9	0x0007	3,2,1
0x0800	12	0x0008	4
0x0900	12,9	0x0009	4,1
0x0A00	12,10	0x000A	4,2
0x0B00	12,10,9	0x000B	4,2,1
0x0C00	12,11	0x000C	4,3
0x0D00	12,11,9	0x000D	4,3,1
0x0E00	12,11,10	0x000E	4,3,2
0x0F00	12,11,10,9	0x000F	4,3,2,1

As an example, if all channels were in alert other than Channel 11, Register 30026 would read 0xFBFF (binary 1111 1011 1111 1111), if only Channel 11 were in alert, Register 30026 would read 0x0400 (binary 0000 0100 0000 0000).

# Configuring Modbus Capability for IMx

## Configuration Scenarios

---

The configuration of IMx units is done through the SKF @ptitude Analyst software. Refer to SKF @ptitude Analyst and SKF Multilog On-Line Systems User Manual.

There are different procedures for configuring Modbus capabilities depending on the scenario. Select a matching scenario and follow the steps.

- [Export Data from IMx Modbus Slave to Generic Modbus Master](#)
- [Import Data from Generic Modbus Master to IMx Modbus Slave](#)
- [Import Data from Generic Modbus Slave to IMx Modbus Master](#)
- [Data Transfer between IMx Units](#)

Also found in this chapter are the procedures for [Configuring IMx Units for Modbus](#), including configuring the Modbus Slave and Modbus Master.

## Export Data from IMx Modbus Slave to Generic Modbus Master

---

IMx Modbus Slaves can export data to generic Modbus Master via Modbus register:

- All analogue measurement point types of IMx units.
- All digital measured channels of IMx units.

Refer to Table 3-1 for the correspondence between measurement points and exported Modbus register numbers, described in the chapter, [Modbus and IMx](#).

To have an IMx unit perform in this setting, follow the listed steps in order.

1. Determine RS 485 network parameters, such as bps, parity and stop bit, described in [Transmission Characteristics](#) in the chapter, Modbus (RS 485) Interface.
2. Determine a unique Modbus Slave address for the unit to use in the Modbus network.
3. Configure the unit as a Modbus Slave by following the instructions described in the section, [Configuring IMx Units for Modbus](#).
4. Configure the measurement points to be exported according to the section, [Modbus Export Properties](#), in the chapter, Modbus Export through SKF @ptitude Analyst.
5. Check the configuration setup by performing the steps described in the chapter, [Checking Modbus Interface and Troubleshooting](#)
  - Multiple IMx Modbus slaves can be connected to the same Modbus Master under the following conditions:  
There must be sufficient delay from the last response before sending a new request. A delay of 50 ms is adequate. For example, with two

IMx units there must a polling delay for each request; one delay for IMx A and another delay for IMx B. If only one delay is added after polling both IMx A and IMx B, the request for IMx B may be missed).

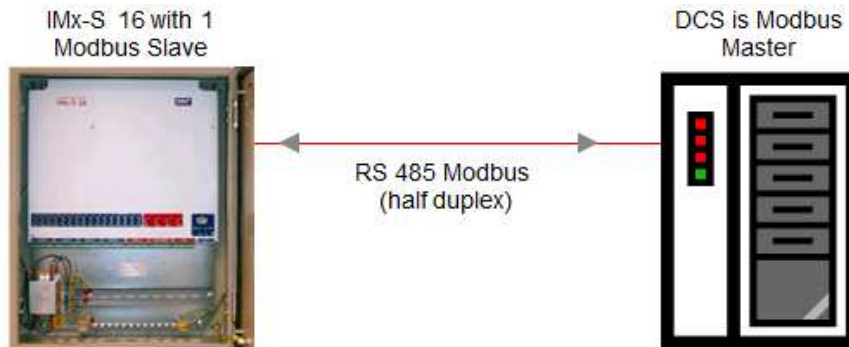


Figure 4 - 1.  
Example of Modbus Slave and Modbus Master.

---

## Import Data from Generic Modbus Master to IMx Modbus Slave

---

IMx Modbus Slaves can import values from generic Modbus Master via Modbus register.

To configure an IMx Slave unit to read values from the Modbus Master, follow the steps below.

1. Decide which Modbus register is of interest to you.
2. Translate the register number according to Table 3-2: Correspondence Between Imported Modbus Registers and Modbus Channels" in [Modbus and IMx](#) to determine which Modbus channel to set up.
3. Determine RS 485 network parameters, such as bps, parity and stop bit described in [Transmission Characteristics](#) in Modbus (RS 485) Interface chapter.
4. Determine a unique Modbus Slave address for the unit to use in the Modbus network.
5. Configure the unit as a Modbus Slave by following the instructions described in the section, [Configuring IMx Units for Modbus](#).
6. Set up a Modbus channel for the IMx Modbus Slave by following the instructions described in the section [Modbus Import Properties](#) in the chapter, Modbus Import through SKF @ptitude Analyst. Use the Modbus analog channel number from step 2.
7. Create the measurement points associated to the Modbus channels. Refer to SKF @ptitude Analyst and SKF Multilog On-line Systems User Manual.
8. Check the configuration setup by performing the steps described in the chapter, [Checking Modbus Interface and Troubleshooting](#).



## Import Data from Generic Modbus Slave to IMx Modbus Master

---

IMx Modbus Master can import data from a generic Modbus Slave via Modbus registers.

To configure an IMx Master unit to read values from the Modbus Slave, follow the steps below.

1. Decide which register is of interest to you.
2. Translate the register number according to "Table 3-2: Correspondence Between Imported Modbus Registers and Modbus Channels" in the chapter, [Modbus and IMx](#), to determine which Modbus channel to set up on the Master.
3. Determine RS 485 network parameters, such as bps, parity and stop bit described in [Transmission Characteristics](#) in Modbus (RS 485) Interface chapter.
4. Find out the Slave address of the generic Modbus Slave with which IMx Modbus Master will communicate.
5. Configure the unit as a Modbus Master by following the instructions described in the chapter, [Configuring IMx Units for Modbus](#). Use the Modbus Slave address from step 4.
6. Set up a Modbus channel for the IMx Modbus Master by following the instructions described in section [Modbus Import Properties](#) in the chapter, Modbus Import through SKF @ptitude Analyst. Use the Modbus analog channel number from step 2.
7. Set up an appropriate measurement point on the channel created in step 6.
8. Check the configuration setup by performing the steps described in the chapter, [Checking Modbus Interface and Troubleshooting](#).

## Data Transfer between IMx Units

---

A transfer of measurement data from an IMx unit to another IMx unit is normally used for test only.

To have data transfer between two IMx units, follow the listed steps in order.

1. Decide which unit is to export data and which unit is to import data:
  - The unit which is to export data has to be configured as a Modbus Slave.
  - The other unit which is to import data has to be configured as a Modbus Master.
2. Decide which register is of interest to you.
3. Translate the register number according to "Table 3-1: Correspondence Between Measurement Points and Export Register Number" and "Table 3-2 Correspondence Between Imported Modbus Registers and Modbus Channels" in the chapter, [Modbus and IMx](#).
  - The corresponding Modbus channel number is used when setting up a channel on the Master.
  - The corresponding measurement point and export register number is used when setting up a channel on the Slave.

4. Determine RS 485 network parameters, such as bps, parity and stop bit for both units. Refer to [Transmission Characteristics](#) in Modbus (RS 485) Interface chapter.
5. For the unit that is to export data (Modbus Slave):
  - Configure a Modbus Slave with a unique Slave address on the export unit by following instructions described in the chapter, [Configuring IMx Units for Modbus](#).
  - Set up a channel (refer to SKF @ptitude Analyst and SKF Multilog On-Line System User Manual).  
Use the corresponding measured channel number from step 3.
  - Set up a measurement point channel (refer to SKF @ptitude Analyst and SKF Multilog On-Line System User Manual).
6. For the unit that is to import data (Modbus Master):
  - Configure a Modbus Master with the Slave address from step 5 to create a Modbus Master-Slave pair. Follow the instructions described in [Configuring IMx Units for Modbus](#).
  - Set up a Modbus channel by following the instructions described the section [Modbus Import Properties](#) in the chapter, Modbus Import through SKF @ptitude Analyst.  
Use the corresponding Protection channel number from step 3.
  - Set up a measurement point (refer to SKF @ptitude Analyst and SKF Multilog On-Line System User Manual).
7. Check the configuration setup by performing the steps described in the chapter, [Checking Modbus Interface and Troubleshooting](#).

## Configuring IMx Units for Modbus

The configuration of Modbus for IMx units is done through @ptitude Analyst software.

1. First start the SKF @ptitude Analyst software located in the SKF @ptitude Monitoring Suite. For more detailed information about @ptitude Analyst software, refer to "@ptitude Analyst User Manual".

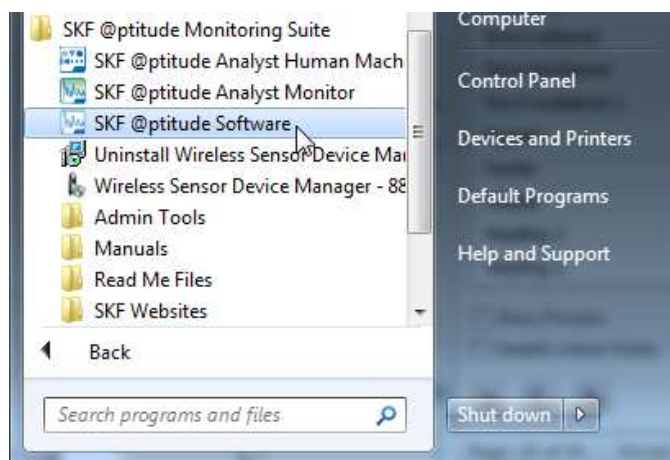


Figure 4 - 2.  
@ptitude Analyst in the Start Menu.

2. In @ptitude Analyst, select the specific IMx device in the hierarchy.
3. Click **Customize** to open the menu.

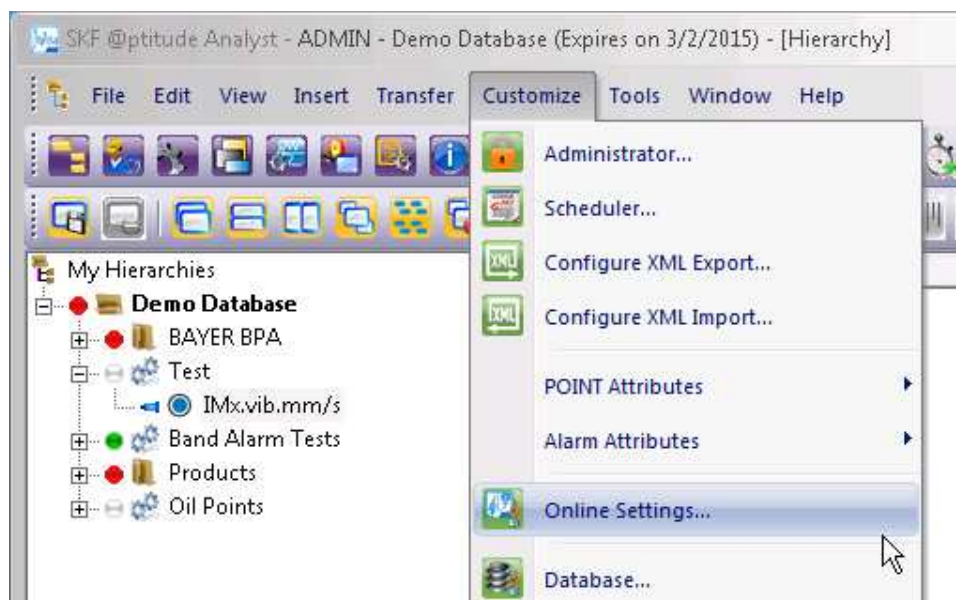


Figure 4 - 3.  
**Customize > Online Settings.**

4. Select **Online Settings...** to open the dialog.

The screenshot shows the 'Online Settings' dialog box with the 'Devices' tab selected. The 'Available hardware devices' list contains 'Unit1 11 ALPHA'. In the 'Properties' section, the 'Device name' is 'Unit1 11 ALPHA', 'DAD type' is 'IMx-S', and 'Host' is 'IMx'. A red rectangle highlights the 'Config...' button. The 'Settings' section includes 'Communication type' (Ethernet (TCP/IP)), 'DAD #' (11), 'Data collection method' (Live & scheduled), 'Compression method' (Uncompressed), 'Communication timeout' (0 Minute(s)), a checked 'Always connected' checkbox, 'Connection interval' (00:00:00), 'Reference time' (00:00:00), and 'Time zone' (UTC-06:00 Central Time (US & Cana...)). At the bottom are 'Save', 'Undo', 'Close', and 'Help' buttons.

Figure 4 - 4.  
**Online Settings** Dialog.

- Then, select the IMx unit you want to configure from the available hardware devices option and press the **Config...** button. The **Channel Properties** configuration dialog opens for the selected IMx device.
- Click **Communication** to open the **Communication** tab.

In the **Communication** tab, you can enable the Modbus communication in the IMx unit and make it a Modbus Master or Modbus Slave device.

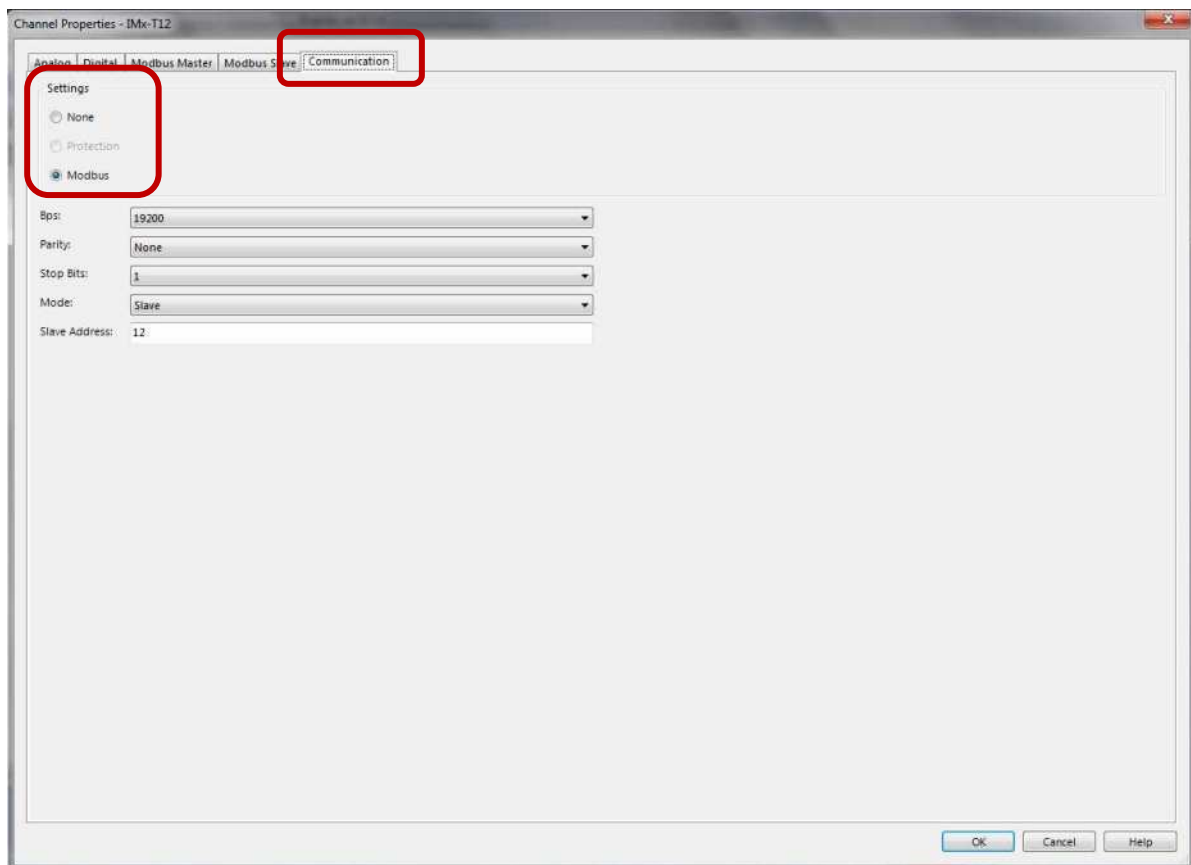


Figure 4 - 5.

**Channel Properties, Communication** dialog in @aptitude Analyst.

7. Under **Settings**, select **Modbus** to enable communication using the Modbus protocol. Additional fields display in the dialog.

Next, you will configure the IMx to serve as a Modbus slave or a Modbus master.

## Configuring the Modbus Slave

When you set this IMx as a Modbus slave, you can configure and enable virtual channels (via the **Modbus Slave** tab) to support the following Modbus data transfers:

- An external Modbus master reading data from this IMx (configured as a Modbus slave).
- Another IMx configured as a Modbus master reading data from this IMx (configured as a Modbus slave).

### To set this IMx as a Modbus slave:

1. Select **Slave** as the **Mode** for Modbus communication.

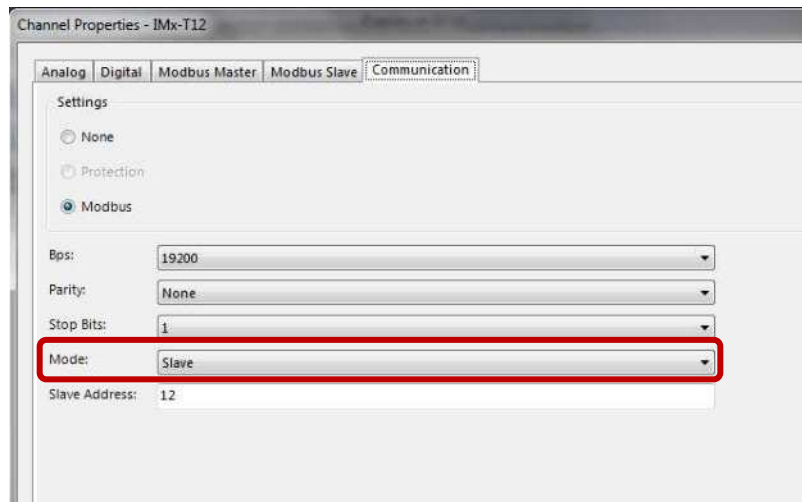


Figure 4 - 6.

**Channel Properties, Communication** dialog in @aptitude Analyst.

2. Enter the **Slave Address** matching the setup on your physical IMx that connects to the Modbus source. **Slave address** becomes the Modbus address of this Slave. This Slave address number is the address with which the Modbus Master will connect and communicate.
  - This exact **Slave address** number is to be entered when creating a Modbus Master if the Master will be communicating with this Slave and become a Modbus Master-Slave pair.
3. Check that the other parameters – **Bps** (Bits per second, or Baud rate), **Parity**, **Stop Bits** – are set appropriately or modify as needed.
  - **Bps** defines the speed of Modbus, transfer rate in bps. Refer to [Transmission Characteristics](#) for detailed information.
  - **Parity** can be set to None, Even or Odd.
  - **Stop bits** defines the number of stop bits in use. It can be 1 or 2.
4. Click **OK** to save the configuration. The **Channel Properties** window will close.

## Configuring the Modbus Master

When you set this IMx as a Modbus master, you can configure and enable virtual channels (via the **Modbus Master** tab) to support the following Modbus data transfers:

- An external Modbus master writing data to this IMx (configured as a Modbus slave).
- This IMx (configured as a Modbus master) reading data from an external Modbus slave.
- This IMx (configured as a Modbus master) reading data from another IMx configured as a Modbus slave.

### To set this IMx as a Modbus master:

1. Select **Master** as the **Mode** for Modbus communication.

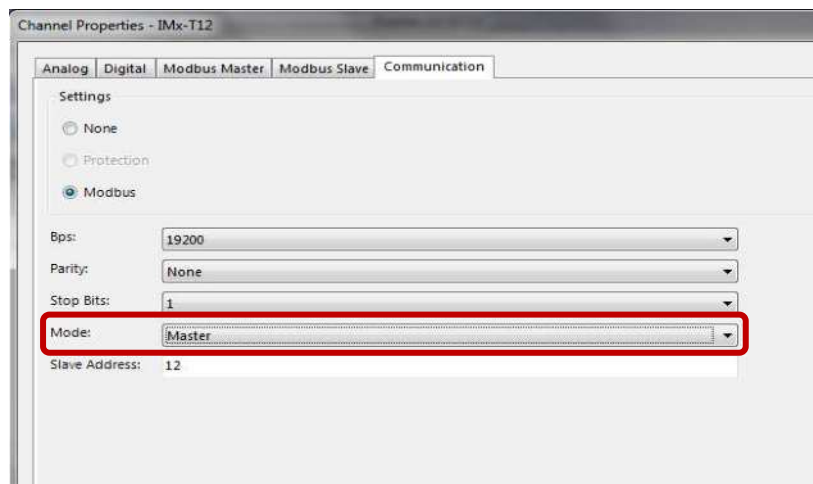


Figure 4 - 7.  
Example of IMx Unit - External Communication for Master.

2. Enter the **Slave Address** number of the Modbus Slave with which this Modbus Master will connect and communicate.
  - The exact **Slave address** number is to be entered when creating the Modbus Master to identify the Modbus Master-Slave pair.
3. Check that the other parameters – **Bps** (Bits per second, or Baud rate), **Parity**, **Stop Bits** – are set appropriately or modify as needed.
  - **Bps** defines the speed of Modbus, transfer rate in bps. Refer to [Transmission Characteristics](#) for detailed information.
  - **Parity** can be set to None, Even or Odd.
  - **Stop bits** defines the number of stop bits in use. It can be 1 or 2.
4. Click **OK** to save the configuration. The **Channel Properties** window will close.

With Modbus communication enabled and the Slave and Master pair configured, the next step is to set up the Modbus export properties for IMx-S and IMx-T units.





## Modbus Export through SKF @ptitude Analyst

### Configuring the Modbus Export

The Modbus export feature in SKF @ptitude Analyst applies to IMx-S and IMx-T only. It is supported by IMx firmware version 4.2, or later. If you are using IMx firmware version 4.1, or earlier, some Modbus export features, such as the Filter Criteria and Assign All, will be unavailable in SKF @ptitude Analyst.

On the **Modbus Slave** tab, you can configure and enable virtual channels to support the following Modbus data transfers:

- An external Modbus master reading data from this IMx (configured as a Modbus slave).
- Another IMx configured as a Modbus master reading data from this IMx (configured as a Modbus slave).

The tab enables you to map @Analyst points to specific Modbus registers and save the desired configuration into the @Analyst database.

#### To configure the Modbus Export:

1. In @ptitude Analyst, select the specific IMx device in the hierarchy.
2. Click the **Customize** option.

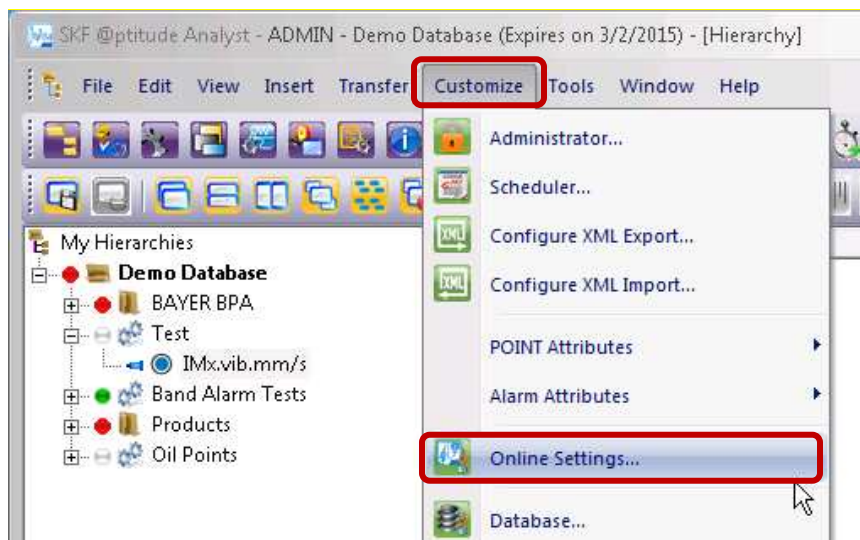


Figure 5 - 1.

**Customize** Menu > **Online Settings**.

3. From the menu, select **Online Settings...** to open the dialog.

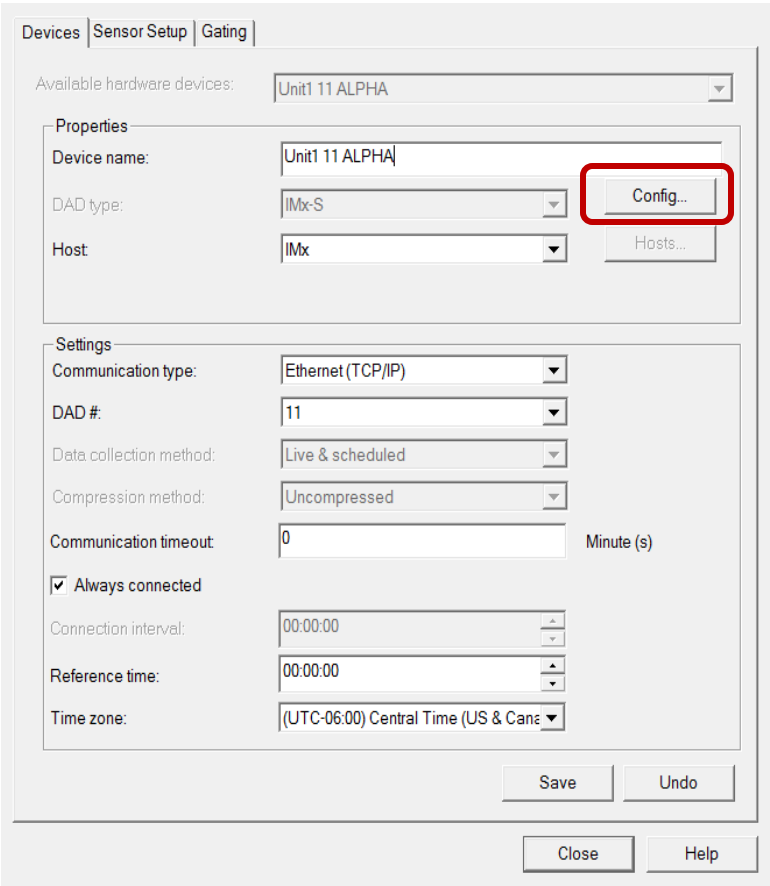


Figure 5 - 2.  
Online Settings Dialog with Config... Button.

4. In the **Online Settings** dialog, click the **Config...** button. The **Channel Properties** configuration window opens for the selected IMx device.

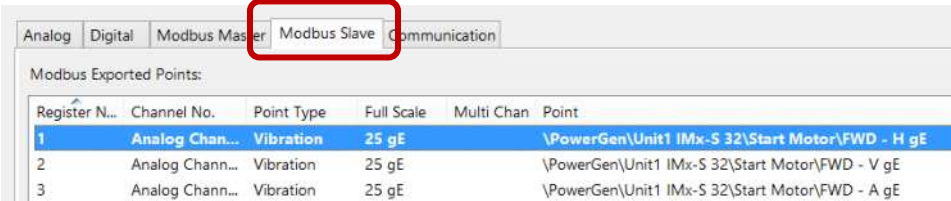


Figure 5 - 3.  
Channel Properties Window with Modbus Slave Tab Selected.

## Modbus Export Properties

- Click **Modbus Slave** to open the tab.

Modbus Exported Points:

Register N...	Channel No.	Point Type	Full Scale	Multi Chan	Point
1	Analog Chann...	Vibration	25 gE		\\PowerGen\\Unit1 IMx-S 32\\Start Motor\\FWD - H gE
2	Analog Chann...	Vibration	25 gE		\\PowerGen\\Unit1 IMx-S 32\\Start Motor\\FWD - V gE
3	Analog Chann...	Vibration	25 gE		\\PowerGen\\Unit1 IMx-S 32\\Start Motor\\FWD - A gE
4	Analog Chann...	Vibration	25 gE		\\PowerGen\\Unit1 IMx-S 32\\Start Motor\\AFT - H gE
5	Analog Chann...	Vibration	25 gE		\\PowerGen\\Unit1 IMx-S 32\\Start Motor\\AFT - V gE
6	Analog Chann...	Vibration	25 gE		\\PowerGen\\Unit1 IMx-S 32\\Start Motor\\AFT - A gE
7	Analog Chann...	Vibration	25 gE		\\PowerGen\\Unit1 IMx-S 32\\Torque Converter\\FWD - H gE
8	Analog Chann...	Vibration	25 gE		\\PowerGen\\Unit1 IMx-S 32\\Torque Converter\\FWD - V gE
9	Analog Chann...	Vibration	25 gE		\\PowerGen\\Unit1 IMx-S 32\\Torque Converter\\FWD - A gE
10	Analog Chann...	Vibration	25 gE		\\PowerGen\\Unit1 IMx-S 32\\Torque Converter\\AFT - A gE
11	Analog Chann...	Vibration	25 gE		\\PowerGen\\Unit1 IMx-S 32\\Lube Oil Motor\\Mtr - H gE
12	Analog Chann...	Vibration	25 gE		\\PowerGen\\Unit1 IMx-S 32\\Lube Oil Motor\\Mtr - V gE
13	Analog Chann...	Vibration	25 gE		\\PowerGen\\Unit1 IMx-S 32\\Lube Oil Motor\\Mtr - A gE
14					<Unassigned>
15					<Unassigned>
16					<Unassigned>
17	Digital Chann...	Speed	5000 RPM		\\PowerGen\\Unit1 IMx-S 32\\Tachos\\Tacho1 - Crank
18	Digital Chann...	Speed	5000 RPM		\\PowerGen\\Unit1 IMx-S 32\\Tachos\\Tacho1 - Run
19	Digital Chann...	Speed			<Unassigned>
20	Digital Chann...	Speed			<Unassigned>

Point Assignment

Exported point: \\PowerGen\\Unit1 IMx-S 32\\Start Motor\\FWD - H gE

Filter Criteria

Channel: <All Analog> Point type: <All>

Attributes

Register number: 1 Channel number: Analog Channel 1

Point type: Vibration Multi Channel:

Full scale range (-/+): 25 gE

Assign all Unassign all Export CSV Import CSV Save Undo

OK Cancel Help

Figure 5 - 4.  
**Modbus Slave** Tab in @ptitude Analyst.

The summary table at the top displays existing Modbus export configuration settings from the @Analyst database along with all known register assignments. If there are no existing Modbus register assignments, the Point column displays <Unassigned>. Each line shows information from a single record in the database table that associates a Modbus register with a specific point in @Analyst. See [Appendix A](#) for an example of a typical set of database records and their mappings.

The critical action to take is to assign an **Exported point** to the selected **Register number**. You can use one of two methods to assign a point to the register number:

- The **Exported Point** drop-down list with optional filter criteria
- The **Assign All** automated function

Both methods are presented below in detail. But first, we'll describe the button controls located in the lower right of the tab.

### Buttons

**Save** – Saves any modified configuration information from the lower edit fields to the summary table.

- It is the **OK** button rather than the **Save** button that saves the configuration data to the @ptitude Analyst database.

**Undo** – Discards any modifications made to configuration information in the lower edit fields and returns values to what they were before the modifications were made.

- When **Modbus Slave** first opens, the **Save** and **Undo** buttons are unavailable and appear dimmed. When you have made entries or edits in the fields, these buttons will activate.

At any time during the configuration process, you have the option to use the following buttons:

**Unassign all** – Clears all existing assignments from the summary table and sets all entries to <Unassigned>.

**OK** – Saves the Modbus export register configuration information shown in the summary table to the @ptitude Analyst database and closes the **Modbus Slave** tab.

**Cancel** – Discards any recent edits and closes the **Modbus Slave** tab.

**Help** - Opens help window providing guidance on how to use the **Modbus Slave** tab.

### Method 1 – Assign an Exported Point with optional Filter Criteria

Follow the steps below to assign an export point. The filter criteria features are optional.

- Highlight a register in the summary table. The number selected for configuration is reflected in the **Register number** field in the **Attributes** section below.
- Use the **Exported Point** drop-down arrow and select a point from the drop-down list.

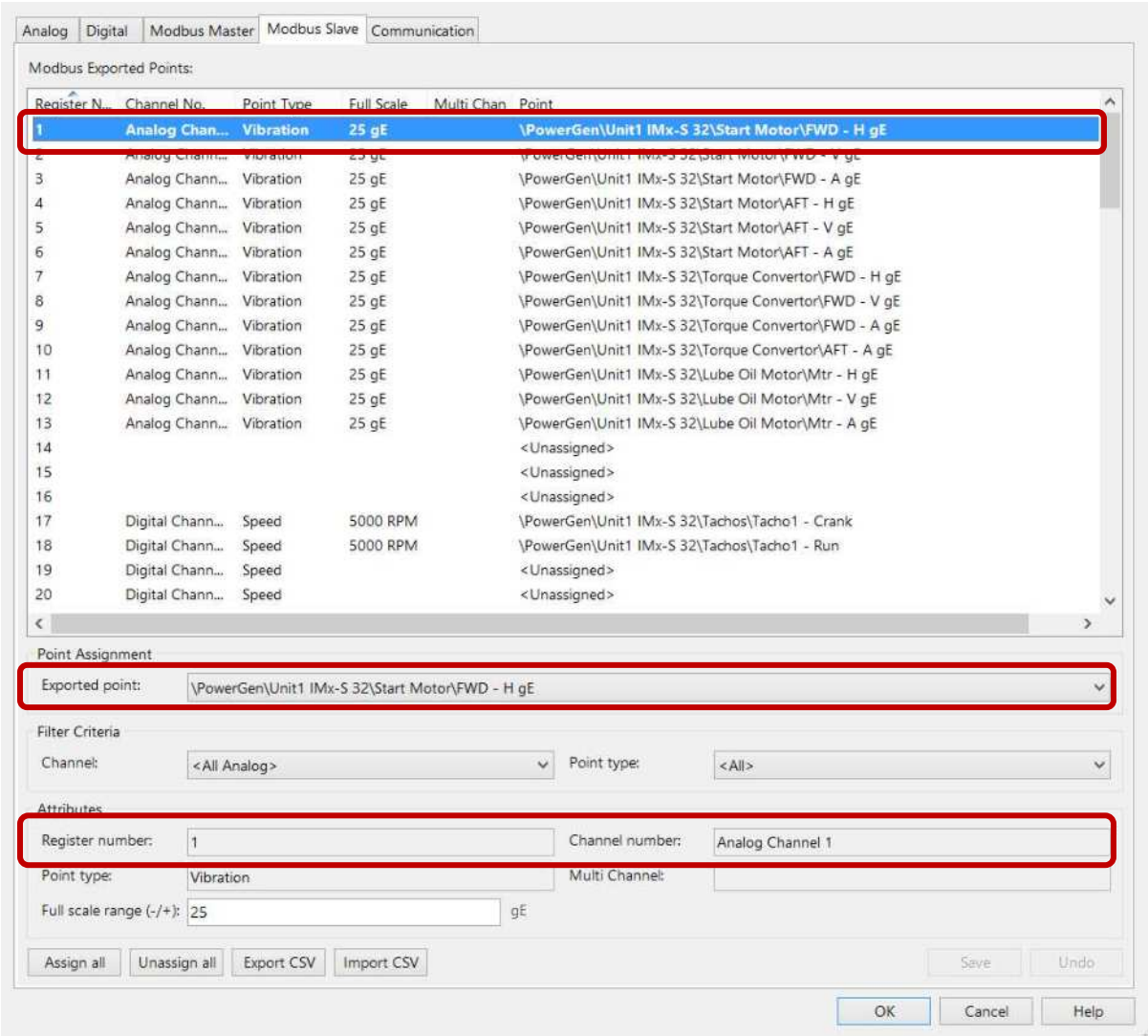


Figure 5 - 5.  
Register Number and Exported Point.

All of the available points associated with the current IMx device in the Analyst database are displayed in the **Exported point** list unless you use the **Filter Criteria** to reduce the points displayed, as described below.

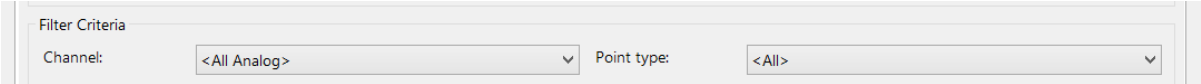


Figure 5 - 6.  
Filter Criteria.

- To limit the exported point options to a specific channel number, click the **Channel** drop-down arrow and select the desired channel. Only points related to that channel will display in the **Exported point** options.

- To limit the point options to a specific type of point, click the **Point Type** drop-down arrow and select the type. Only points of the selected type will display in the **Exported point** options.

More than one filter criterion may be used to further reduce the number of available points listed in the **Exported point** options.

The **Attributes** section in the lower part of the page displays information about the selected **Exported point**.

**Full scale range (-/+)** enables you to enter a value for the full scale range of measurement values for the selected point. This range will be from the negative of the value entered to the value.

- Click **Save** to save your changes from the lower edit fields to the summary table.
- When you are satisfied with the resulting summary table, click **OK** to save the Modbus export register configuration information shown in the summary table to the @ptitude Analyst database and close the **Channel Properties** window.

## Method 2 – Assign points by using the Assign All and optional CSV functions

Instead of selecting an exported point, you can use **Assign All**, an automatic assignment function. **Export CSV** and **Import CSV** are additional functions that work with **Assign All**. We'll describe how this works below.

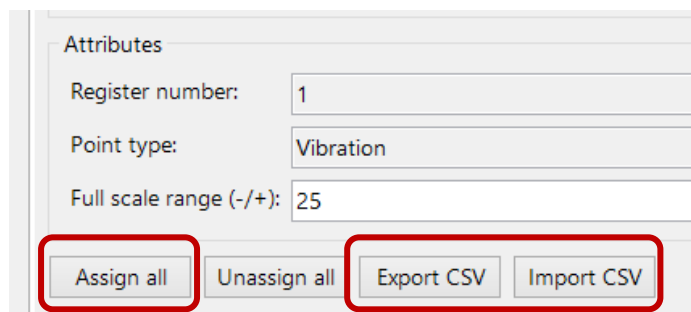


Figure 5 - 7.  
**Assign All, Export CSV, and Import CSV.**

- If you click **Assign All**, an informational dialog warns you that continuing with automatic Modbus register assignment will clear all existing configuration information from the summary table.
- If you agree to **Continue**, the summary table is populated with Modbus register assignments with all supported IMx points found to be associated with the current IMx device configuration.
  - The **Exported points** drop-down list will no longer display any points available for assignment.

You will probably want to establish the order of the register assignments and/or the assigned points. You can export the data into a CSV (comma separated values) format file. Then, open the file and reorder the assigned register numbers in another application, such as Microsoft Excel, that can facilitate this process.

- To export the summary table, click **Export CSV**. In the Windows dialog, specify the folder location and file name.
- Click **OK**. The Windows dialog closes and a CSV formatted file that contains the current Modbus register assignments is generated.
- After using the file to establish the register number/measurement POINT pairings you want, save the revised data in CSV format to import it.
- Click **Import CSV**. In the Windows dialog, browse to the updated CSV file and select it for import into SKF @ptitude Analyst.
- Click **OK**. The Windows dialog closes and the summary table is then updated with the imported Modbus export register configuration information.





# Modbus Import through SKF @ptitude Analyst

## Configuring the Modbus Import

On the **Modbus Master** tab, you can configure and enable virtual channels to support the following Modbus data transfers:

- An external Modbus master writing data to this IMx (configured as a Modbus slave).
- This IMx (configured as a Modbus master) reading data from an external Modbus slave.
- This IMx (configured as a Modbus master) reading data from another IMx configured as a Modbus slave.

Follow the same path as shown in the previous chapter to open **Modbus Import: Customize > Online Settings > Configuration** button > **Channel Properties**.

## Modbus Import Properties

The **Modbus Master** tab enables you to set up the Modbus channel inputs for the selected IMx device.

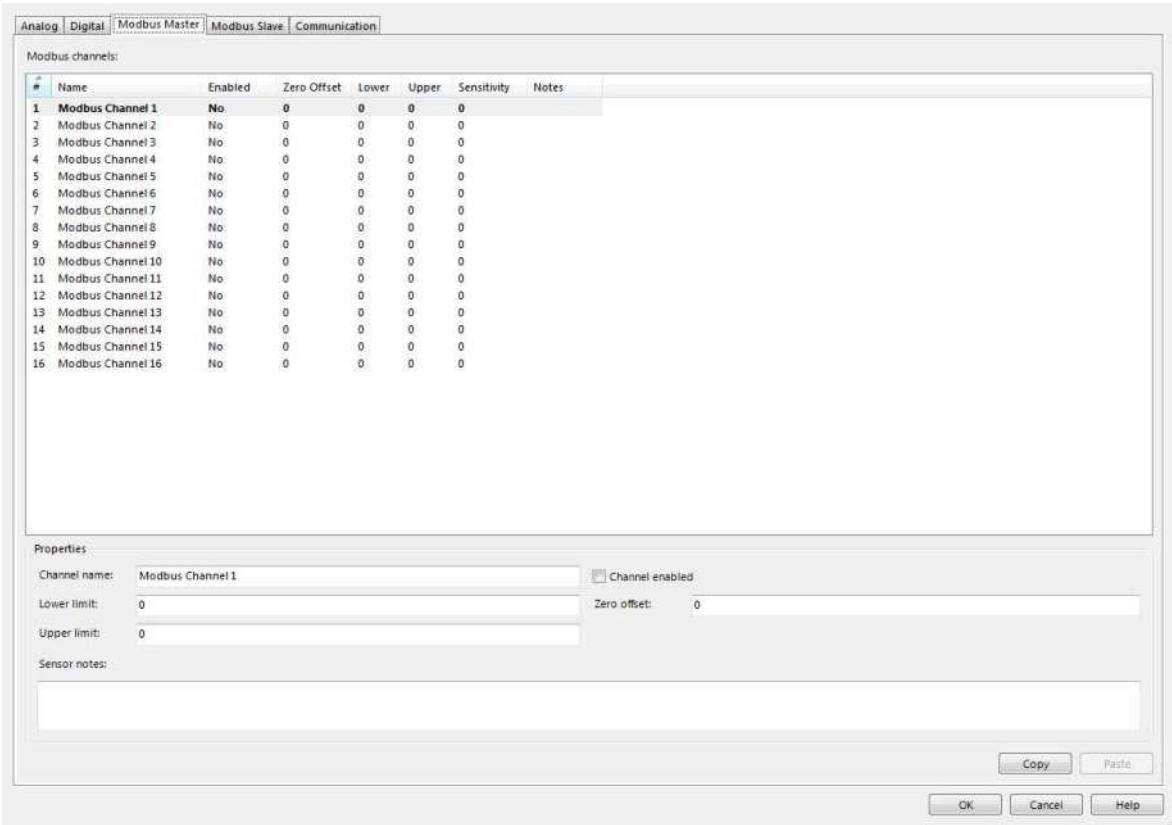


Figure 6 - 1.  
Modbus Master Tab with Channel Enabled.

The summary table at the top displays existing Modbus channels and their properties.

1. Select the channel you wish to edit from the Modbus channels list.
2. Enter a unique **Channel name**.
3. Click the **Channel enabled** checkbox to enable a channel on the IMx. If the channel is enabled, enter the following values.
  - In order to know which **Lower limit**, **Upper limit** and **Zero offset** values to configure, refer to the configuration of the Modbus device that will interface with the IMx, that is, the Programmable Logic Controller (PLC), Digital Control System (DCS) or sensors.
  - If the channel is disabled, the IMx skips the channel and points assigned to that channel during data collection.
4. Enter the **Lower limit** value.
5. Enter the **Upper limit** value.
6. In **Zero offset**, enter a value to offset the zero point of the measurement.
7. In **Sensor notes**, type in any additional information you would like to store with the selected sensor settings.
  - When you start to edit a field in the **Properties** area, the **Save** and **Undo** buttons become available.
8. When you have finished editing the channel properties, click **Save** to save your changes.
  - To cancel changes to the selected channel, click **Undo**.
- Use the **Copy / Paste** function to copy the selected channel's properties and paste them to another channel. Select a single channel and click the **Copy** button. The **Paste** button then becomes active. You can select a single channel as the target for the pasted channel properties, or use Shift+Click and Ctrl+click keyboard functions to select multiple items. Click **Paste**.
  - Channel name and sensor notes are not copied to other channels.
9. Click **OK** to apply any changes and return to the **Online Settings** window.

## Setting up a Measurement Point for Modbus

### Measurement Point Scenario

---

After channels have been set up on a unit, it is time to configure measurement points as needed.

Both Modbus Master and Slave on IMx units are required to have measurement points in the following scenario:

- Import data to IMx Modbus Master or Slave:
  - General DC measurement points to read Modbus vibration channels or virtual process channels
- Export data from IMx Modbus Slave:
  - Vibration and General AC measurement points
  - Vibration/Tach measurement points to export speed data
  - General DC measurement points to export process data

Refer to SKF @ptitude Analyst and SKF Multilog On-line Systems User Manual.



## Checking Modbus Interface and Troubleshooting

### Procedure

In order to check that Modbus configurations are done correctly, perform the following steps:

1. Start **@ptitude Analyst Multilog IMx Configurator** program located in the @ptitude Analyst / Administrative Tools directory.

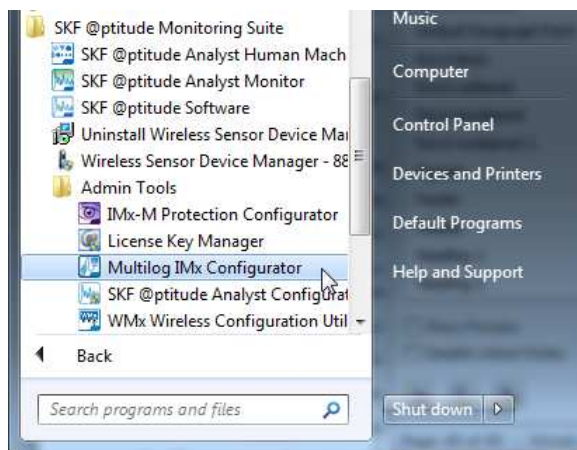


Figure 8 - 1.  
Admin Tools > Multilog IMx Configurator.

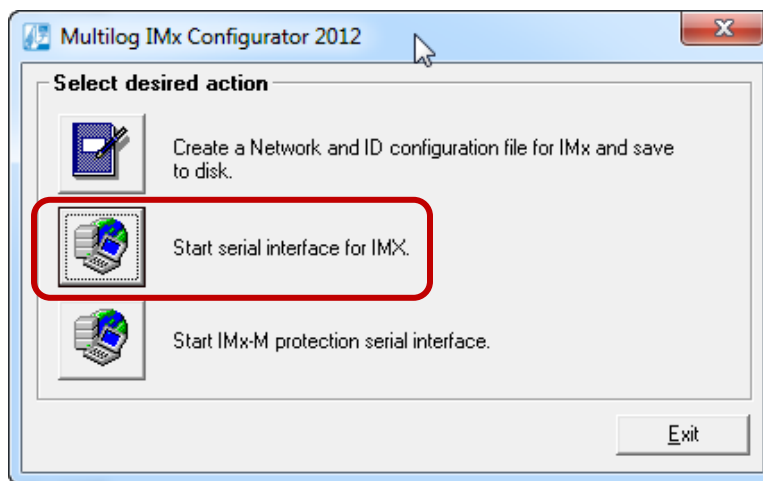


Figure 8 - 2.  
Multilog IMx Configurator, Desired Actions.

2. On the opening window, click **Start serial interface for IMx**. The **Serial interface** dialog opens.

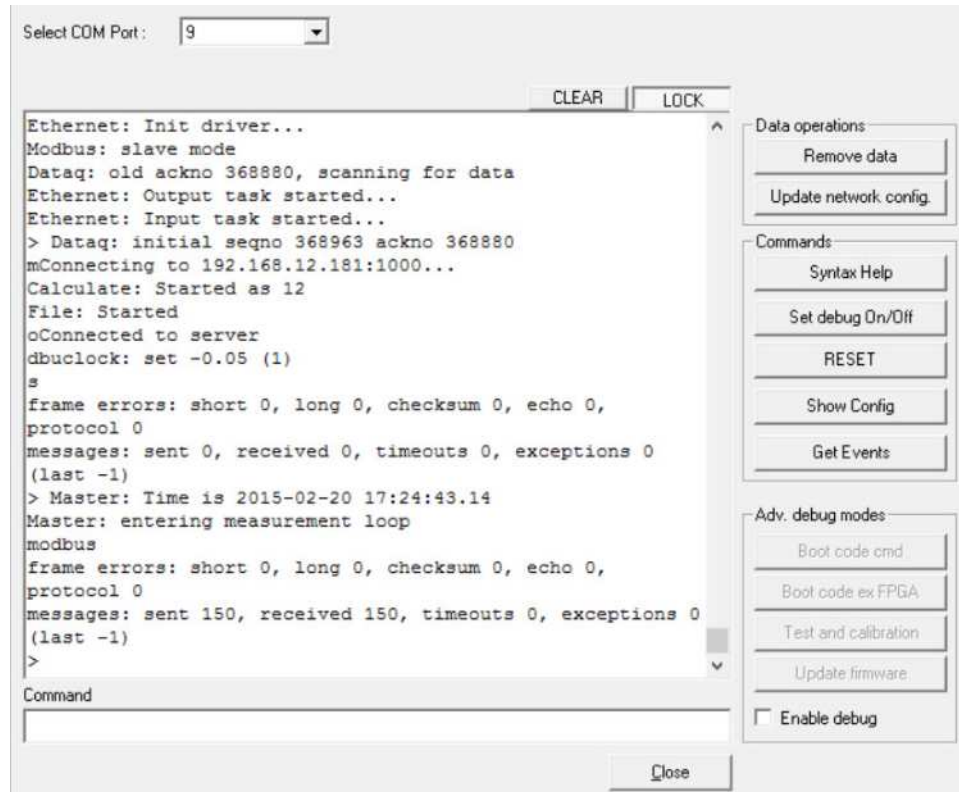


Figure 8 - 3.  
Multilog IMx Configurator, **Serial Interface** Dialog.

3. On the **Serial interface** dialog, enter the COM port number and type in the word **Modbus** in the command box.
4. Statistics on communication and the contents of the import registers will appear on the screen. The statistics are the following:
  - Frame errors (short and long)
  - Checksum errors
  - The number of messages sent
  - The number of messages received
  - The number of timeouts of requests
5. A properly working Modbus communication should exhibit increasing sent and received messages. However, it should not exhibit significant increase of errors or timeouts.
6. In case of errors or timeouts, check that all of the following:
  - The physical connections of RS 485 cable wires are done correctly as described in [Modbus \(RS 485\) Interface](#).
  - The transmission characteristics are defined correctly as described in [Transmission Characteristics](#).
  - The Modbus Master-Slave pair address is entered correctly as described in the chapter, [Configuring IMx Units for Modbus](#).

7. Verify that each IMx unit configured as a Modbus slave in the RS485 bus has a unique slave number.
8. This process of checking the Modbus sensor can be done several times during the installation/test to diagnose the communication activity, or lack of it.





# Appendix A

## Example of Database Records and their Mappings

	Register No.	Device Name	Channel No.	Full Scale	Units	Multi-Channel	Point Path
Primary Measurement	1	Unit1 11 ALPHA	1	25	gE		\PowerGen\Unit1\Start Motor\FWD - H gE
	2	Unit1 11 ALPHA	2	25	gE		\PowerGen\Unit1\Start Motor\FWD - V gE
	3	Unit1 11 ALPHA	3	25	gE		\PowerGen\Unit1\Start Motor\FWD - A gE
	4	Unit1 11 ALPHA	4	25	gE		\PowerGen\Unit1\Start Motor\AFT - H gE
	5	Unit1 11 ALPHA	5	25	gE		\PowerGen\Unit1\Start Motor\AFT - V gE
	6	Unit1 11 ALPHA	6	25	gE		\PowerGen\Unit1\Start Motor\AFT - A gE
	7	Unit1 11 ALPHA	7	25	gE		\PowerGen\Unit1\Torque Convertor\FWD - H gE
	8	Unit1 11 ALPHA	8	25	gE		\PowerGen\Unit1\Torque Convertor\FWD - V gE
	9	Unit1 11 ALPHA	9	25	gE		\PowerGen\Unit1\Torque Convertor\FWD - A gE
	10	Unit1 11 ALPHA	10	25	gE		\PowerGen\Unit1\Torque Convertor\AFT - A gE
	11	Unit1 11 ALPHA	11	25	gE		\PowerGen\Unit1\Lube Oil Motor\Mtr - H gE
	12	Unit1 11 ALPHA	12	25	gE		\PowerGen\Unit1\Lube Oil Motor\Mtr - V gE
	13	Unit1 11 ALPHA	13	25	gE		\PowerGen\Unit1\Lube Oil Motor\Mtr - A gE
Digital	17	Unit1 11 ALPHA	1	5000	RPM		\PowerGen\Unit1\Tachos\Tacho1 - Crank
	18	Unit1 11 ALPHA	2	5000	RPM		\PowerGen\Unit1\Tachos\Tacho1 - Run
Health							Relay Mask
							Warning Mask
							Alarm Mask
				32767			Heartbeat
Secondary Measurement							Reserved 1
							Reserved 2
	31	Unit1 11 ALPHA	1	0.5	in/s		\PowerGen\Unit1\Start Motor\FWD - H ips
	32	Unit1 11 ALPHA	2	0.5	in/s		\PowerGen\Unit1\Start Motor\FWD - V ips
	33	Unit1 11 ALPHA	3	0.5	in/s		\PowerGen\Unit1\Start Motor\FWD - A ips
	34	Unit1 11 ALPHA	4	0.5	in/s		\PowerGen\Unit1\Start Motor\AFT - H ips
	35	Unit1 11 ALPHA	5	0.5	in/s		\PowerGen\Unit1\Start Motor\AFT - V ips
	36	Unit1 11 ALPHA	6	0.5	in/s		\PowerGen\Unit1\Start Motor\AFT - A ips
	37	Unit1 11 ALPHA	7	0.5	in/s		\PowerGen\Unit1\Torque Convertor\FWD - H ips
	38	Unit1 11 ALPHA	8	0.5	in/s		\PowerGen\Unit1\Torque Convertor\FWD - V ips
	39	Unit1 11 ALPHA	9	0.5	in/s		\PowerGen\Unit1\Torque Convertor\FWD - A ips
	40	Unit1 11 ALPHA	10	0.5	in/s		\PowerGen\Unit1\Torque Convertor\AFT - A ips
	41	Unit1 11 ALPHA	11	0.5	in/s		\PowerGen\Unit1\Lube Oil Motor\Mtr - H ips
	42	Unit1 11 ALPHA	12	0.5	in/s		\PowerGen\Unit1\Lube Oil Motor\Mtr - V ips
	43	Unit1 11 ALPHA	13	0.5	in/s		\PowerGen\Unit1\Lube Oil Motor\Mtr - A ips
Tertiary Measurement							
	47	Unit1 11 ALPHA	1	25	Vdc		\PowerGen\Unit1\Health\BOV 11\11/01
	48	Unit1 11 ALPHA	2	25	Vdc		\PowerGen\Unit1\Health\BOV 11\11/02
	49	Unit1 11 ALPHA	3	25	Vdc		\PowerGen\Unit1\Health\BOV 11\11/03
	50	Unit1 11 ALPHA	4	25	Vdc		\PowerGen\Unit1\Health\BOV 11\11/04
	51	Unit1 11 ALPHA	5	25	Vdc		\PowerGen\Unit1\Health\BOV 11\11/05
	52	Unit1 11 ALPHA	6	25	Vdc		\PowerGen\Unit1\Health\BOV 11\11/06
	53	Unit1 11 ALPHA	7	25	Vdc		\PowerGen\Unit1\Health\BOV 11\11/07
	54	Unit1 11 ALPHA	8	25	Vdc		\PowerGen\Unit1\Health\BOV 11\11/08
	55	Unit1 11 ALPHA	9	25	Vdc		\PowerGen\Unit1\Health\BOV 11\11/09
	56	Unit1 11 ALPHA	10	25	Vdc		\PowerGen\Unit1\Health\BOV 11\11/10
	57	Unit1 11 ALPHA	11	25	Vdc		\PowerGen\Unit1\Health\BOV 11\11/11
	58	Unit1 11 ALPHA	12	25	Vdc		\PowerGen\Unit1\Health\BOV 11\11/12
	59	Unit1 11 ALPHA	13	25	Vdc		\PowerGen\Unit1\Health\BOV 11\11/13