

Modbus for SKF Multilog On-line System IMx and SKF @ptitude Analyst



User Manual Part No. 32342700-EN
Revision C

⚠ 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 2017

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 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!](#)

042817dm

Table of Contents

Introduction	1-1
Modbus for IMx-8, IMx-S and IMx-T Devices .	1-1
About This User Manual	1-1
Important Messages	1-2
Modbus (RS 485) Interface	2-1
Terminal Blocks	2-1
Transmission Characteristics	2-2
RS485 Bus Termination	2-2
Modbus and IMx	3-1
The Modbus Protocol	3-1
Modbus Register, Modbus Channel and Measured Channel	3-3
Bit Representation of Mask	3-5
Configuring Modbus Capability for IMx	4-1
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 Devices	4-3
Configuring IMx Devices for Modbus	4-5
Modbus Export through SKF @ptitude Analyst	5-1
Configuring the Modbus Export.....	5-1
Modbus Export Properties	5-3
Modbus Import through SKF @ptitude Analyst	6-1
Configuring the Modbus Import.....	6-1
Modbus Import Properties	6-1
Setting up a Measurement Point for Modbus	7-1
Measurement Point Scenario	7-1

Checking Modbus Interface and Troubleshooting	8-1
Procedure	8-1
Example of Database Records and Their Mappings	A-1

Modbus for IMx-8, IMx-S and IMx-T Devices

This user manual describes how to use Modbus with IMx-8, IMx-S and IMx-T devices. 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 devices is described in "IMx-M User Manual", Rev M or later.

IMx devices offer the Modbus protocol over 2-wire RS 485 and TCP/IP which can run as a Modbus Master or a Modbus Slave.

- Modbus with TCP/IP requires IMx firmware version 6.0 or later.

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 devices

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 devices 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-8, IMx-S and IMx-T devices.

- 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.
General Modbus Protocol Considerations for IMx Devices Application Note	CM3226
IMx-8 User Manual, Rev A	15V-090-00049-100
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-8, 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 devices contain circuit boards that are static sensitive. Therefore, use appropriate precautions to prevent ElectroStatic Discharge (ESD) when handling circuit boards.



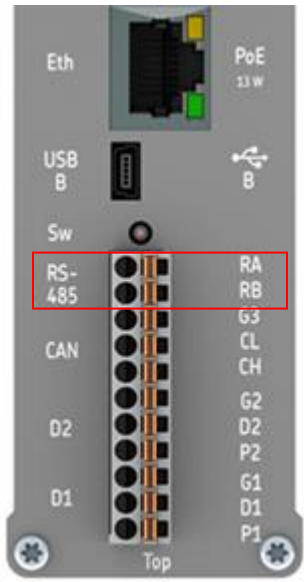
DIP switch settings must be handled with special care to prevent any damage to IMx device:

- ***Do NOT change DIP switch settings while the IMx device is powered-up, as this may cause damage and void the warranty.***
- ***Before powering up the IMx device, 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 device.***

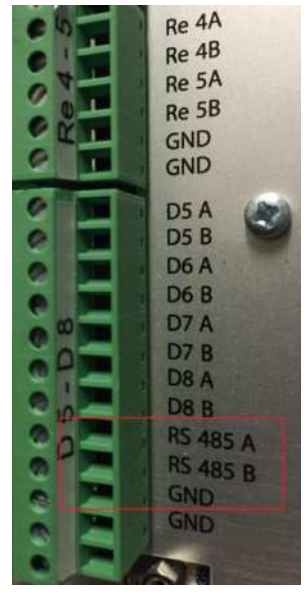
Modbus (RS 485) Interface

Terminal Blocks

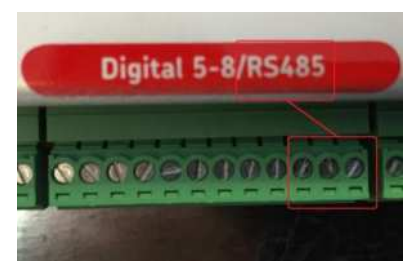
The following are different terminal blocks available on IMx devices.



IMx-8 RS 485 terminal block



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

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 / 19200
Parity	None / Even / Odd
Stop bits	1 / 2

RS485 Bus Termination

IMx-8

IMx-8 devices use an external bus termination resistor. A 120 Ω termination resistor is supplied with the device. Connect the resistor between the terminal A and B on the first and last device on the RS485 bus.

If the IMx-8 device is placed first or last in the Modbus/RTU bus chain, then an external bus termination must be connected.

*G3 (GND) (see the diagram below) - The devices that are connected to the Modbus must have the same ground potential. Therefore, ensure that all devices are connected to the same ground potential. When floating Modbus equipment is connected to the IMx-8 device's Modbus bus, the IMx-8 device's Modbus G3 connector can be used to ensure the same ground potential for the Modbus bus.

Normally, all devices are connected to the same ground connection. Make sure to avoid ground loops.

- The IMx-8 does not provide fail-safe bias to the bus.



Important: To avoid ground loops, ensure that there is only one ground connection to each equipment. The IMx-8 device's G3 (GND) connector can be used in cases where connected equipment bus is floating.

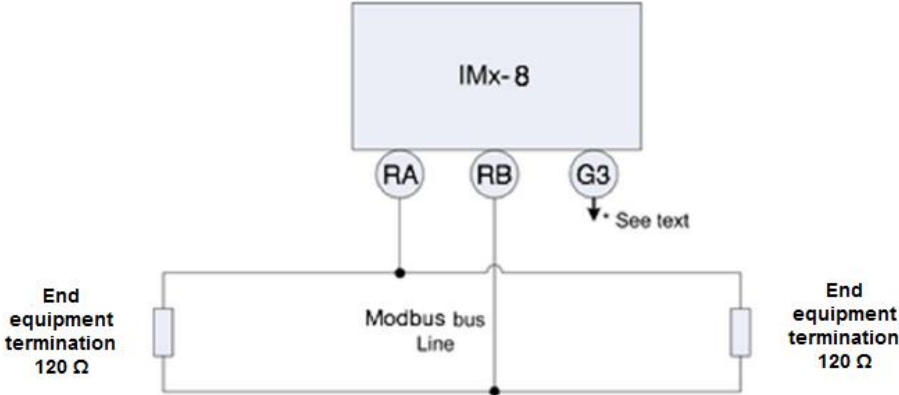


Figure 2 - 2.
IMx-8 Modbus Bus Connection and End Termination.

Other IMx devices

Other IMx devices have termination which is controlled manually with a DIP switch. If an IMx device is at the end or beginning of the RS485 Bus, activate the built-in termination resistor by setting the appropriate DIP switch:

- DIP21 for IMx-S, IMx-C and IMx-B as described in the table below. To access DIP21 on the IMx-S remove the front panel. On newer systems, there is a hole in the front panel for DIP21 (no need to remove the front panel).

Table 2-2.
RS485 Termination DIP21 settings.

DIP21 settings 1234	Functionality with I/O board version less than v1.24 (DIP21 switch with 4 positions)
0100	RS485 Termination resistor enabled
0000	RS485 Termination resistor disabled
DIP21 settings 123456	Functionality with I/O board version v1.24 or higher (DIP21 switch with 6 positions)
011010	RS485 Termination resistor enabled
001010	RS485 Termination resistor disabled

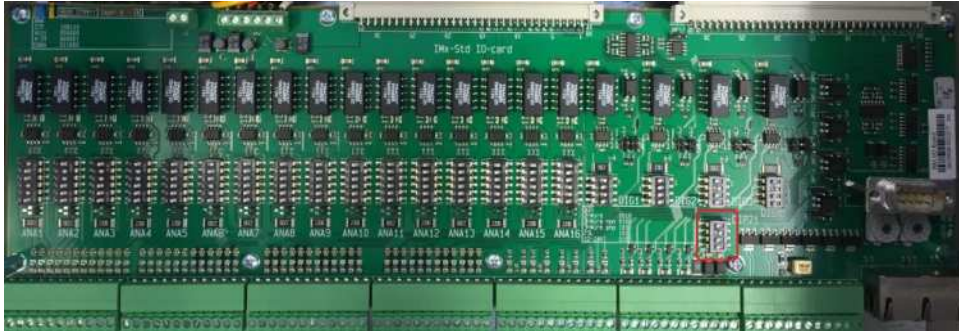
- ANA21 for IMx-T, switch number 2 to ON. ANA21 can be accessed after removing the IO board from the IMx-T rack.

Table 2-3.
RS485 Termination ANA21 settings.

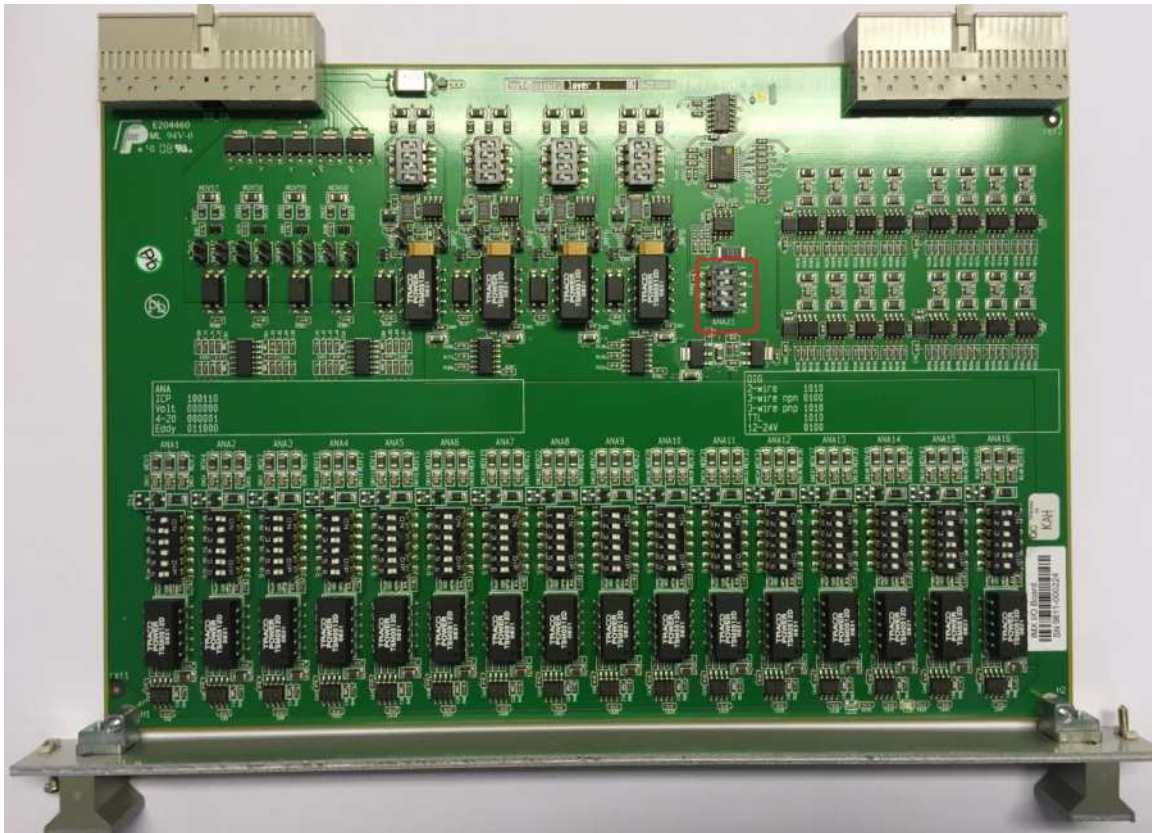
ANA21 settings 1234	Function
0100	RS485 Termination resistor enabled
0000	RS485 Termination resistor disabled

Modbus (RS 485) Interface RS485 Bus Termination

Note that for all DIP switches a setting of '1' corresponds to ON, and a setting of '0' corresponds to OFF.



IMx-S Modbus termination DIP switch (DIP21) – I/O board pre v1.24



IMx-T Modbus termination DIP switch (ANA21)

Figure 2 - 3.
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 analog 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.
- When the IMx is Modbus Master, the data type can be:
 - 16-bit signed integer
 - 32-bit signed integer
 - 16-bit unsigned integer
 - 32-bit unsigned integer
 - 32-bit floating point
- When the IMx is Modbus Slave and imports data, the data type is:
 - 16-bit signed integer
- When the IMx is Modbus Slave and exports data, the data type can be:
 - 16-bit signed integer

- 32-bit floating point
- Modbus Slave speed channels are transmitted in cycles per minute (cpm).
- The number of available relay channels varies depending on the type of IMx device.

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	Configurable measurement point*
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	System information and digital input status (FW v6.0) Bit 0-7: Digital input ch 1-8 Bit 8-13: Reserved Bit 14: Connected to server Bit 15: Maintenance mode
30030	System diagnostic status (FW v6.0) Bit 0-1: 0=No alarm, 1=Warning, 2=Danger, 3=Reserved Bit 2-15: Reserved
30031 to 30100	Configurable measurement point*

* 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
17	30017	40017
18	30018	40018
19	30019	40019
20	30020	40020
21	30021	40021
22	30022	40022
23	30023	40023
24	30024	40024
25	30025	40025
26	30026	40026
27	30027	40027
28	30028	40028
29	30029	40029
30	30030	40030
31	30031	40031
32	30032	40032

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
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

Modbus and IMx
Bit Representation of Mask

Bit Representation in Hex	Channel Numbers	Bit Representation in Hex	Channel Numbers
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 devices 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 Devices](#)

Also found in this chapter are the procedures for [Configuring IMx Devices 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 analog measurement point types of IMx devices.
- All digital measured channels of IMx devices.

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 device perform in this setting, follow the listed steps in order.

1. Determine if Modbus TCP or Modbus RTU is used. If Modbus RTU is used, set the 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 device to use in the Modbus network.
3. Configure the device as a Modbus Slave by following the instructions described in the section, [Configuring IMx Devices 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 devices 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).

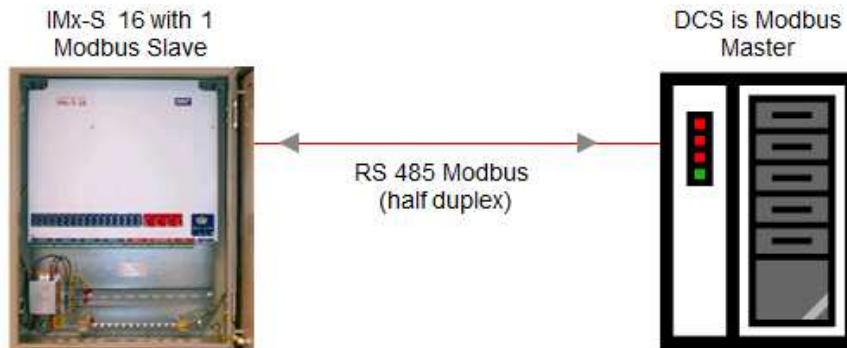


Figure 4 - 1.
Example of Modbus Slave and Modbus Master.

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 device 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 if Modbus TCP or Modbus RTU is used. If Modbus RTU is used, set the 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 device to use in the Modbus network.
5. Configure the device as a Modbus Slave by following the instructions described in the section, [Configuring IMx Devices 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 device 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 if Modbus TCP or Modbus RTU is used. If Modbus RTU is used, set the 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 device as a Modbus Master by following the instructions described in the chapter, [Configuring IMx Devices 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 Devices

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

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

1. Decide which device is to export data and which device is to import data:
 - The device which is to export data has to be configured as a Modbus Slave.
 - The other device 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 if Modbus TCP or Modbus RTU is used. If Modbus RTU is used, set the RS 485 network parameters, such as bps, parity and stop bit for both devices. Refer to [Transmission Characteristics](#) in Modbus (RS 485) Interface chapter.
5. For the device that is to export data (Modbus Slave):
 - Configure a Modbus Slave with a unique Slave address on the export device by following instructions described in the chapter, [Configuring IMx Devices 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 device 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 Devices 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 Devices for Modbus

The configuration of Modbus for IMx devices 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".

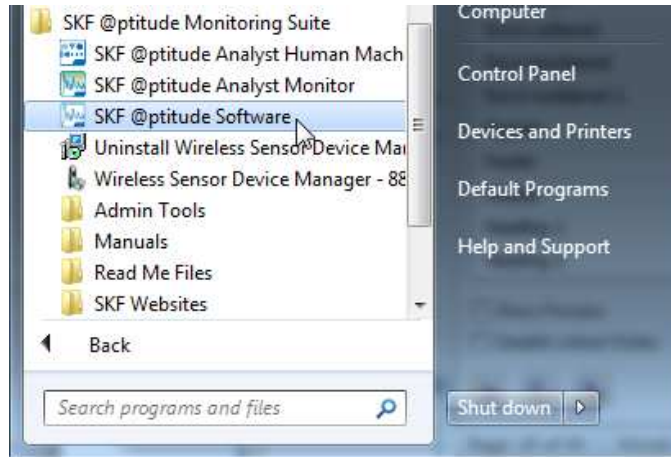


Figure 4 - 2.
@ptitude Analyst in the Start Menu.

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

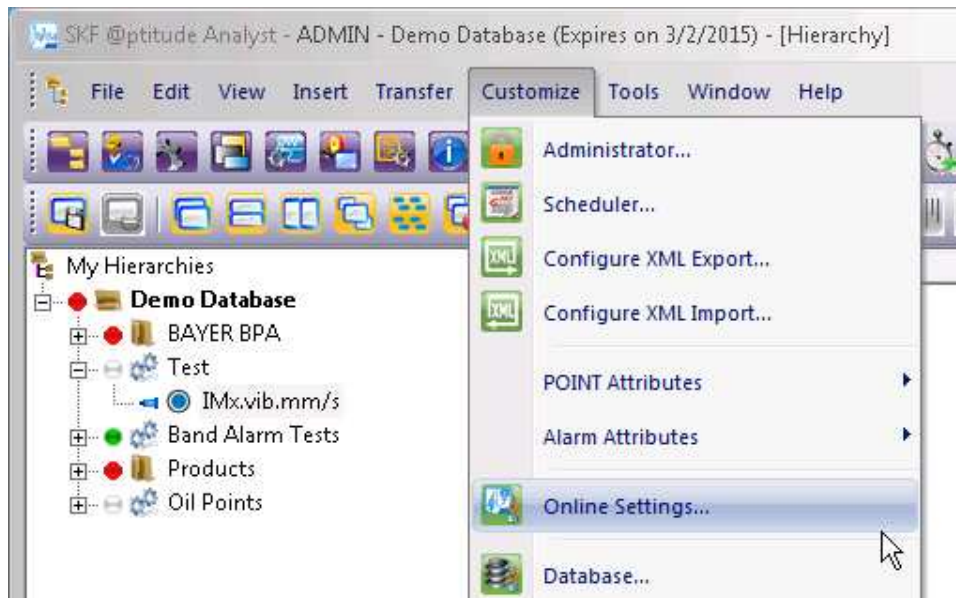


Figure 4 - 3.
Customize > Online Settings.

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

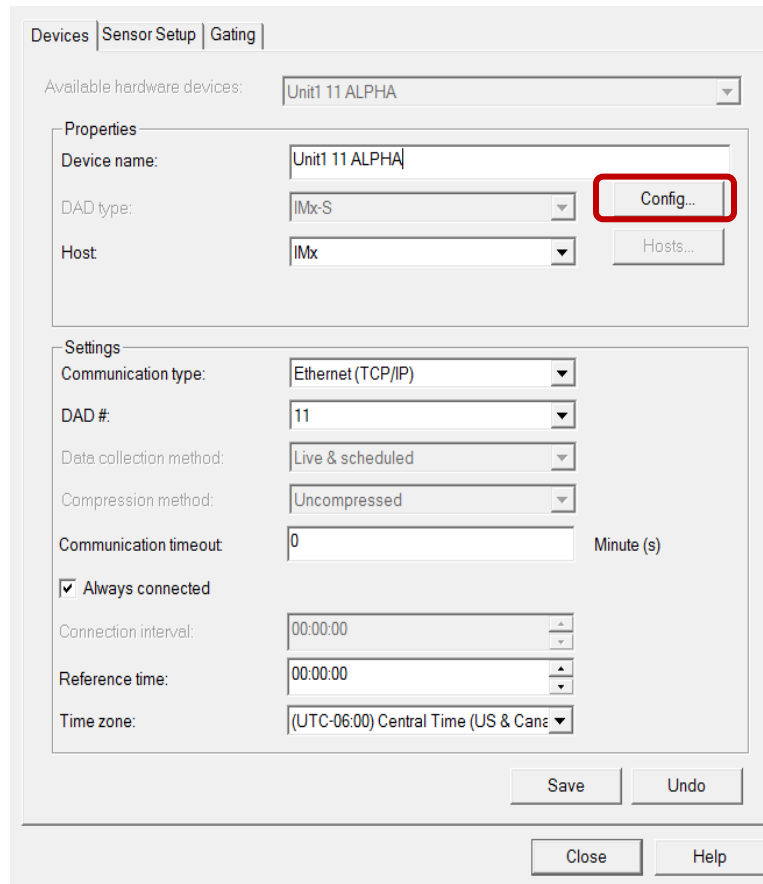


Figure 4 - 4.
Online Settings Dialog.

5. Then, select the IMx device 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.
6. Click **Communication** to open the **Communication** tab.

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

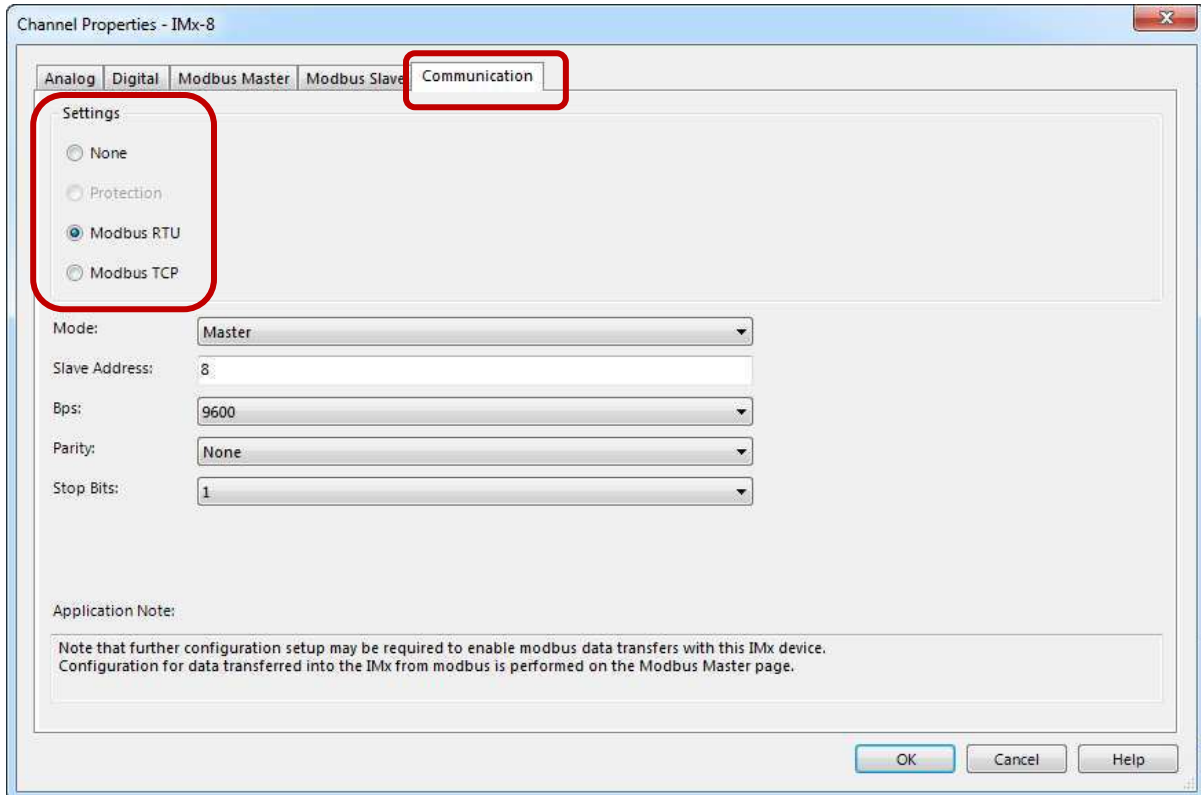


Figure 4 - 5.
Channel Properties, Communication Dialog.

7. Under **Settings**, select **Modbus RTU** or **Modbus TCP** 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 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 RTU master:

1. Select **Modbus RTU** to enable communication using the Modbus protocol.

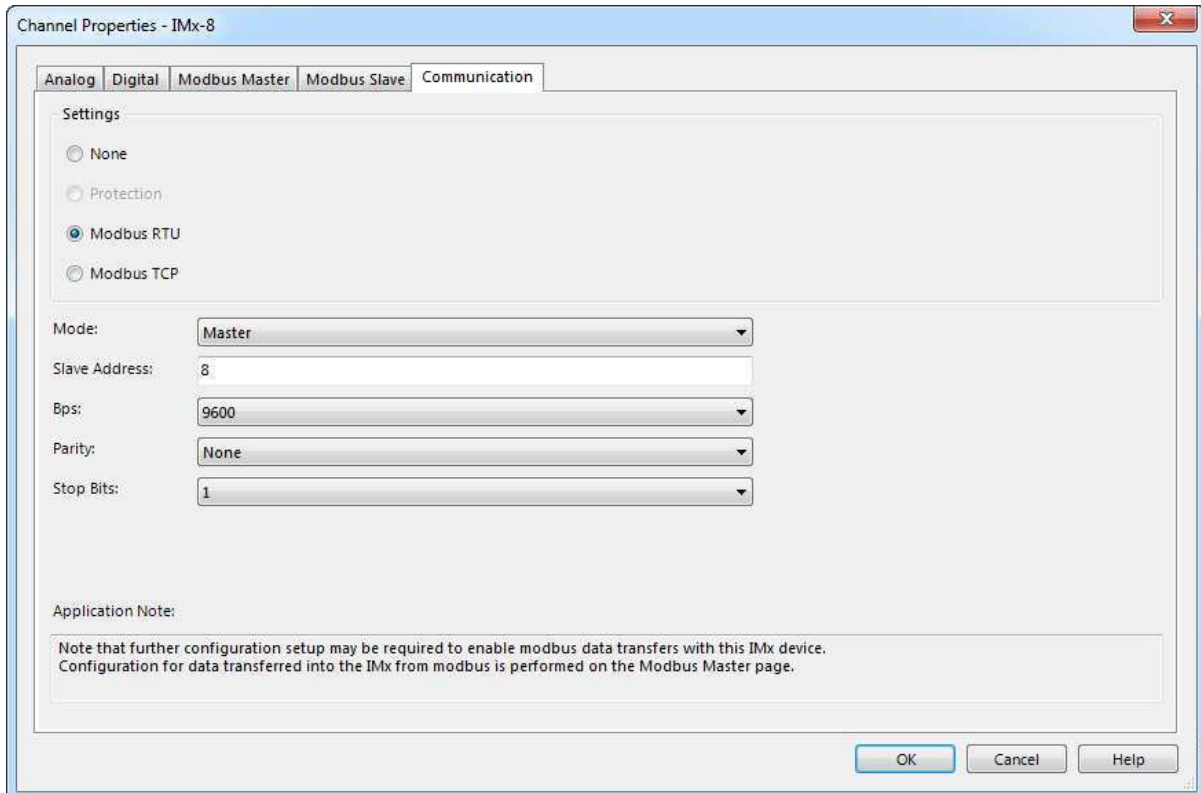


Figure 4 - 6.

Channel Properties, Communication Dialog, Modbus RTU Master.

2. Select **Master** as the **Mode** for Modbus communication.
3. 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.

To set this IMx as a Modbus TCP master:

1. Select **Modbus TCP** to enable communication using the Modbus protocol.

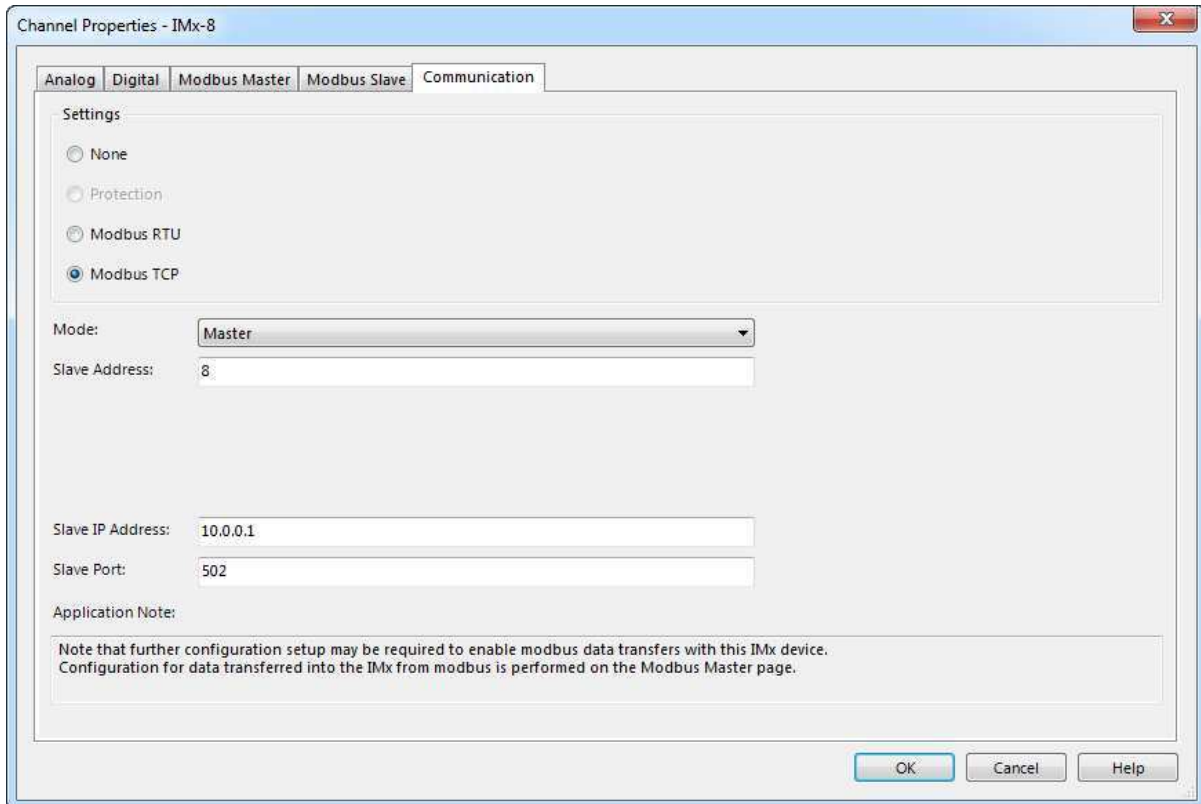


Figure 4 - 7.

Channel Properties, Communication Dialog, Modbus TCP Master.

2. Select **Master** as the **Mode** for Modbus communication
3. 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.
4. In **Slave IP Address**, enter the IP address of the Modbus slave. The IMx configured as the Modbus master will communicate with the Modbus Slave on the **Slave IP Address**.
5. Enter the **Slave Port**. In Modbus slave mode, the IMx-8 defaults to port 502.
6. Click **OK** to save the configuration. The **Channel Properties** window will close.

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 RTU slave:

1. Select **Modbus RTU** to enable communication using the Modbus protocol.

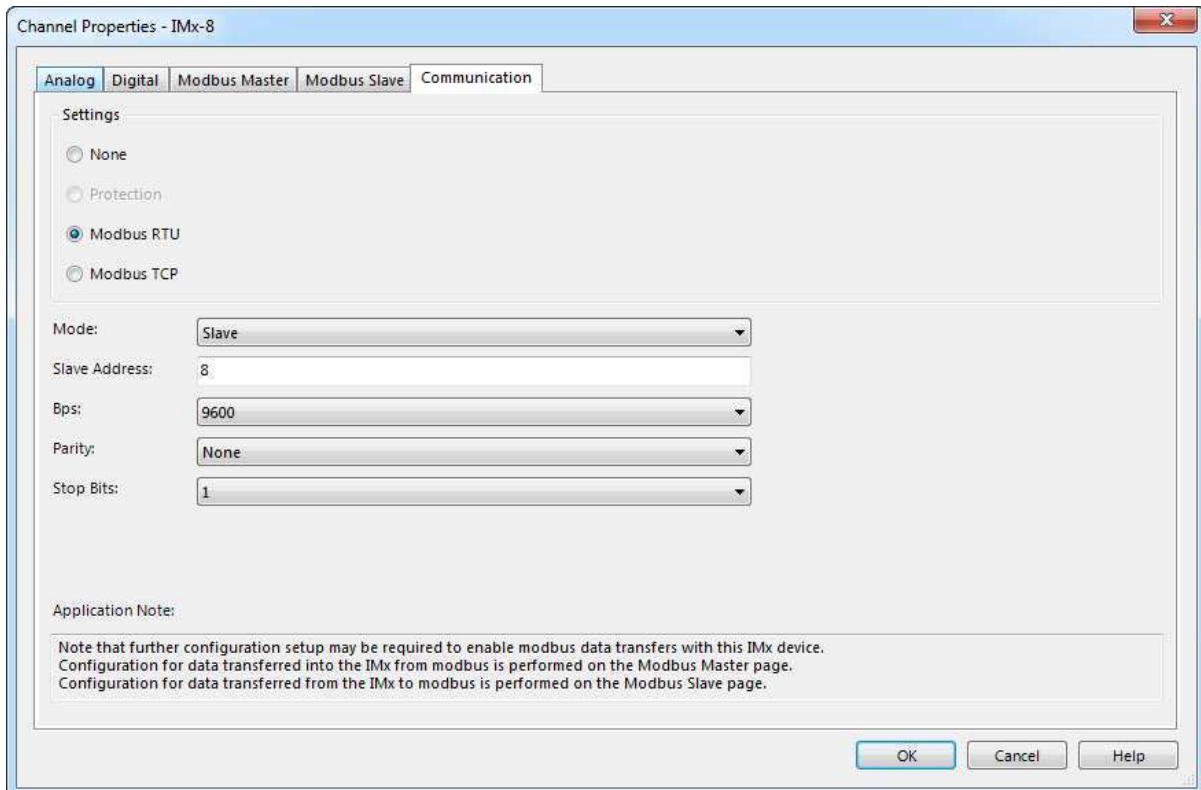


Figure 4 - 8.
Channel Properties, Communication Dialog, Modbus RTU Slave.

2. Select **Slave** as the **Mode** for Modbus communication.
3. 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.
4. 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.
5. Click **OK** to save the configuration. The **Channel Properties** window will close.

To set this IMx as a Modbus TCP slave:

1. Select **Modbus TCP** to enable communication using the Modbus protocol.

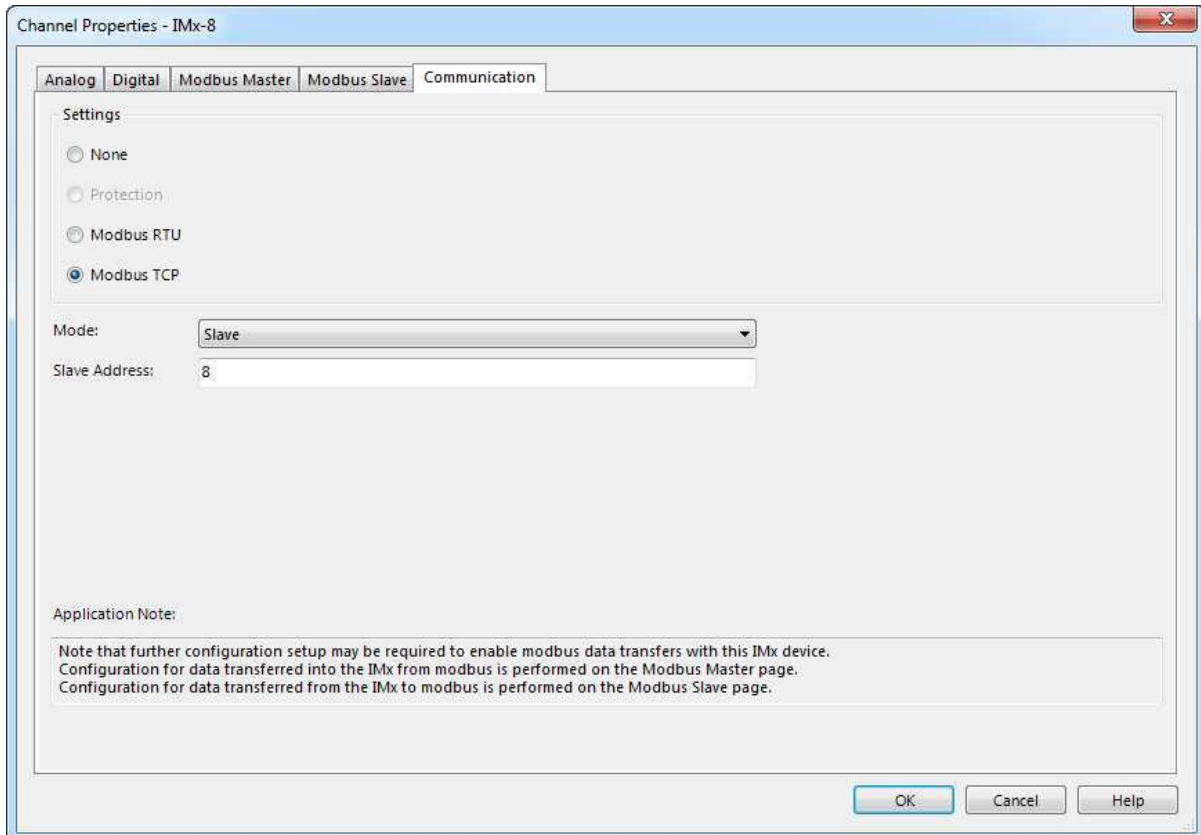


Figure 4 - 9.
Channel Properties, Communication Dialog, Modbus TCP Slave.

2. Select **Slave** as the **Mode** for Modbus communication.
3. 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.
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-8, IMx-S and IMx-T devices.

Modbus Export through SKF @ptitude Analyst

Configuring the Modbus Export

The Modbus export feature in SKF @ptitude Analyst applies to IMx-8, IMx-S and IMx-T only. In the IMx-S and IMx-T, Modbus export is supported by firmware version 5.0 or later. If you are using an earlier IMx firmware version, some Modbus export features, such as the Filter Criteria and Assign All, will be unavailable in SKF @ptitude Analyst.

- The IMx-8 is supported only by firmware version 6.0 or later.

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.

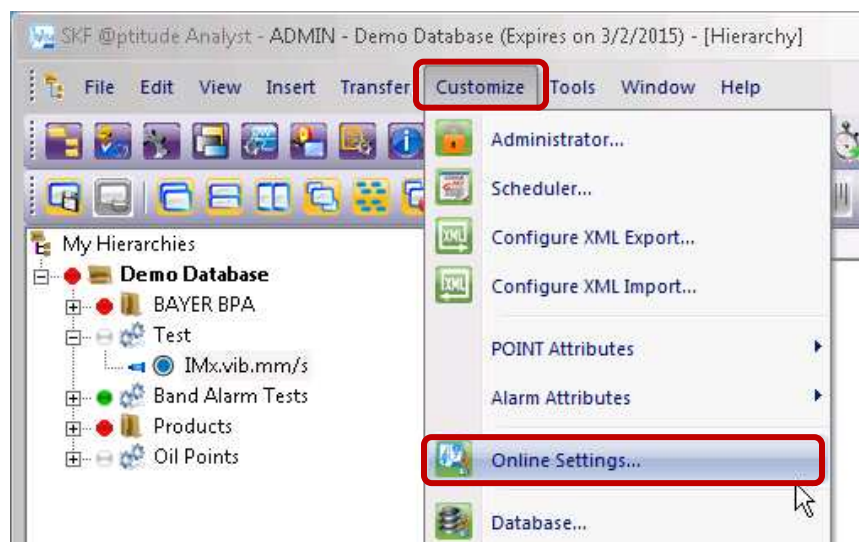


Figure 5 - 1.
Customize Menu > Online Settings.

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

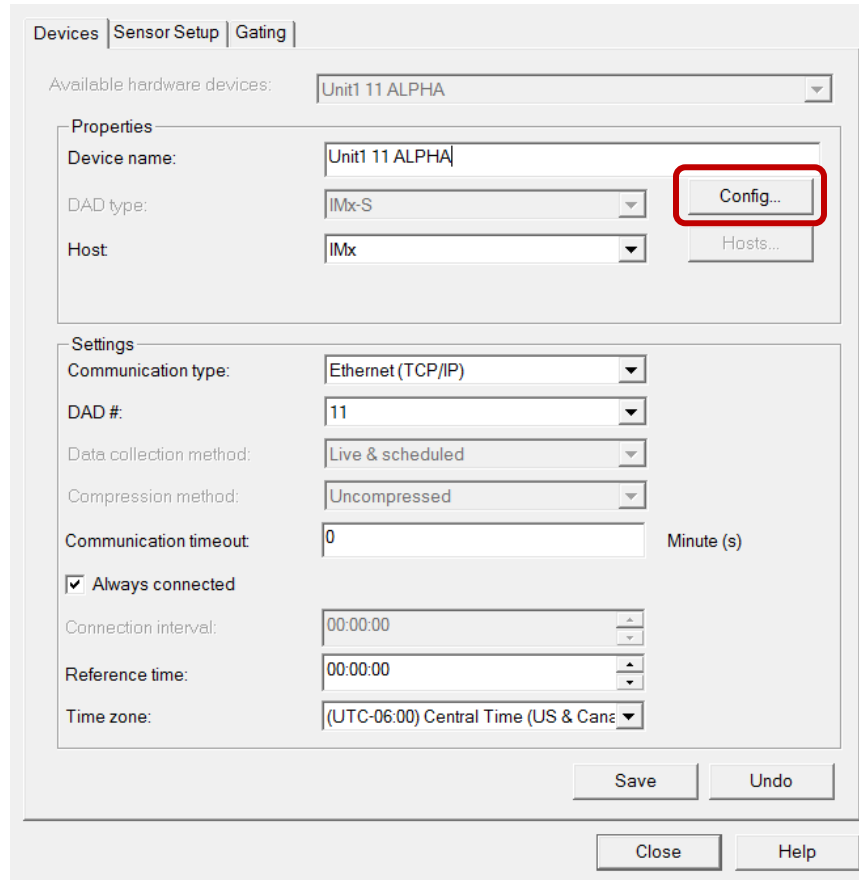


Figure 5 - 2.
Online Settings Dialog with Config... Button.

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

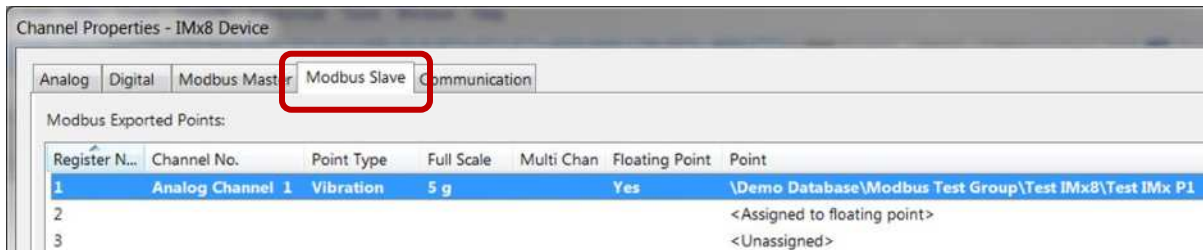


Figure 5 - 3.
Channel Properties Window with Modbus Slave Tab Selected.

Modbus Export Properties

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 listed below to assign a point to the register number. Both methods are presented in detail later in this chapter.

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

Modbus Slave Tab

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

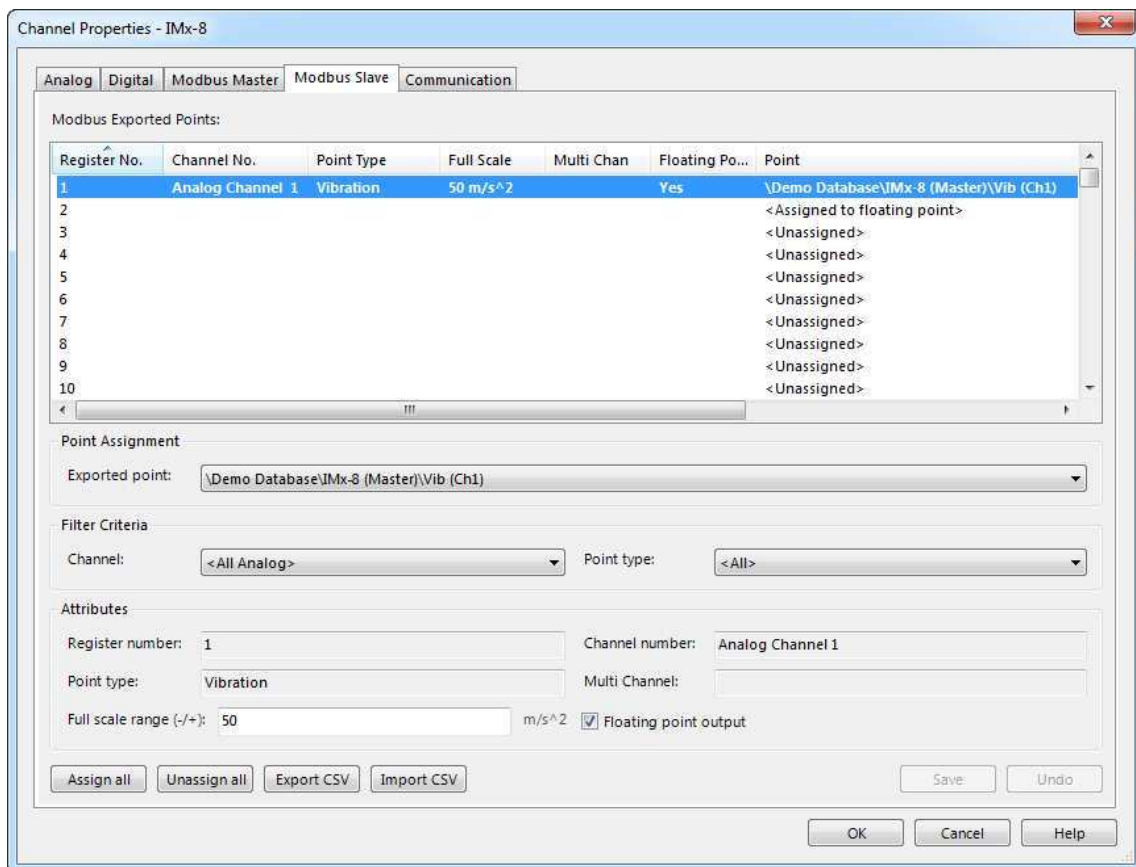


Figure 5 - 4.
Example of **Modbus Slave** Tab, IMx-8.

Multi Channel – If the **Exported point** is a multi channel point, it will be identified as CH X or CH Y (2-channel point) or CH Z (3-channel 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.

Floating point output – click the check box to enable/disable floating point format. Floating point representations are 32-bit numbers, which support a much wider range of values than fixed point.

With this format enabled, for every measurement a pair of registers is needed (that is, measurement 1 on registers 1 and 2, measurement 2 on registers 3 and 4, and so on). The point name is displayed in register 1 and register 2 displays <Assigned to floating point>.

- The floating point format is available with firmware version 6.0 or later.

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:

Assign all – assigns all exported points to a register automatically.

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

Export CSV – exports the summary table as a CSV file.

Import CSV – browse to a CSV file and import it into Analyst.

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.

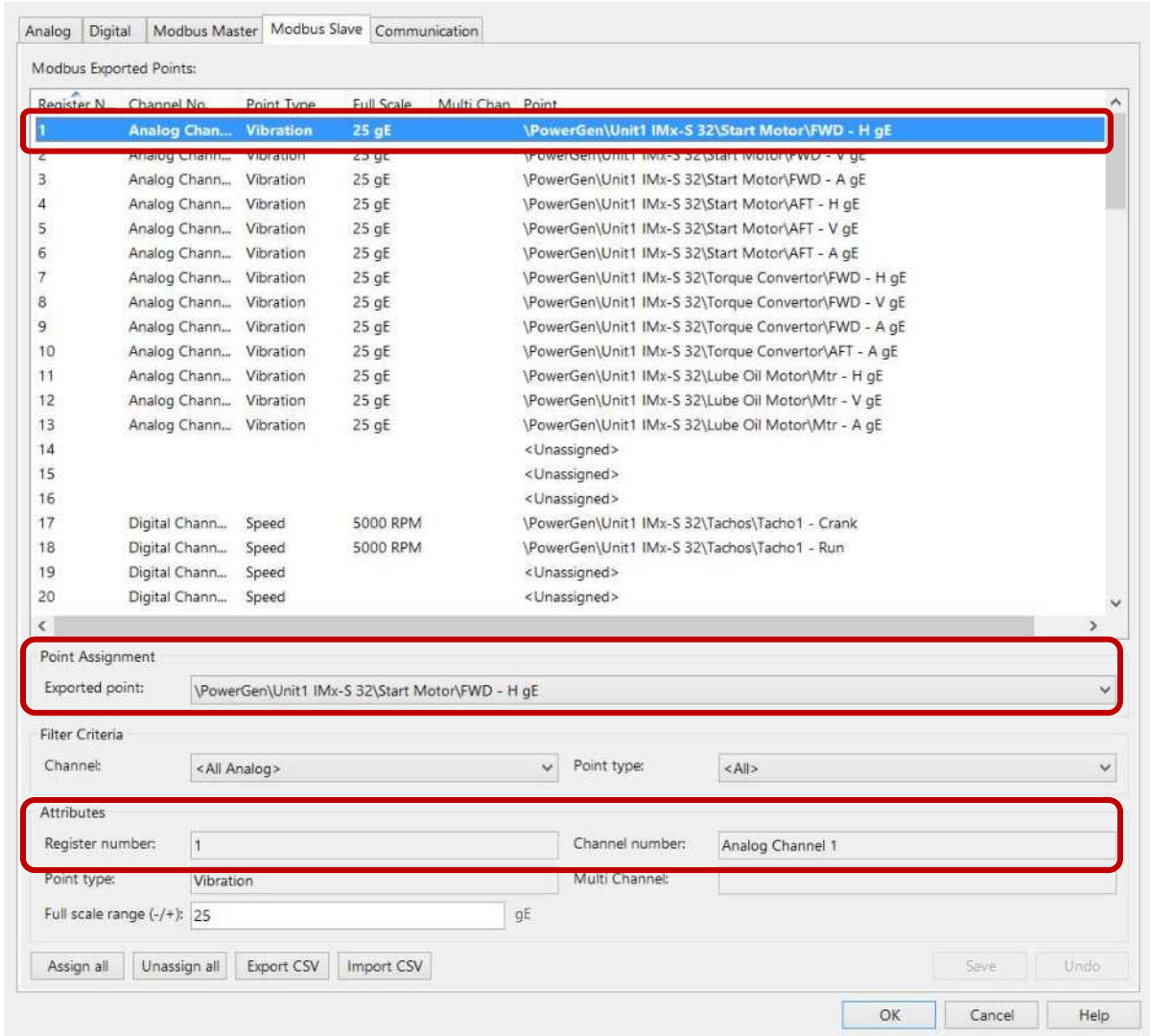


Figure 5 - 5.
 Register Number and Exported Point.

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.

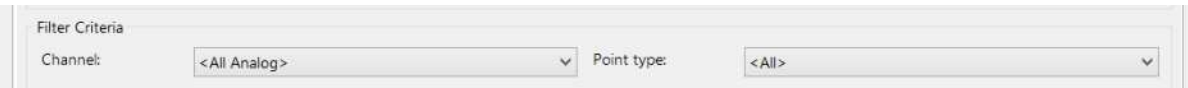


Figure 5 - 6.
Filter Criteria.

- 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.

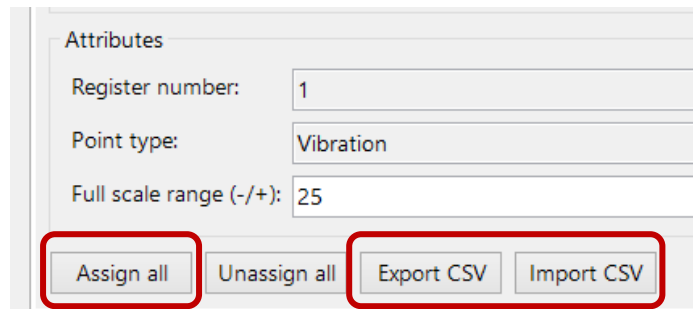


Figure 5 - 7.
Assign All, Export CSV, and Import CSV.

- 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.

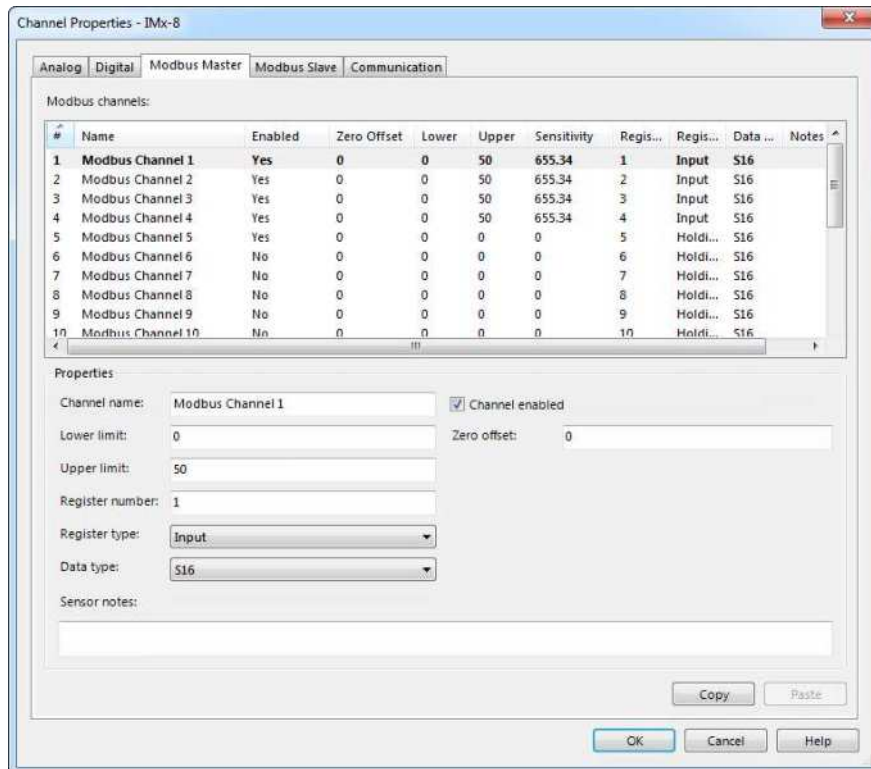


Figure 6 - 1.
Modbus Master Tab with Channel Enabled.

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. **Register number** – enter the register number from which the data will be read.
8. **Register type** – select **Input** (read only) or **Holding** (read/write).
9. **Data type** – select **S16** (16-bit signed integer value) or **Float** (32-bit).
10. 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 device, it is time to configure measurement points as needed.

Both Modbus Master and Slave on IMx devices 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.

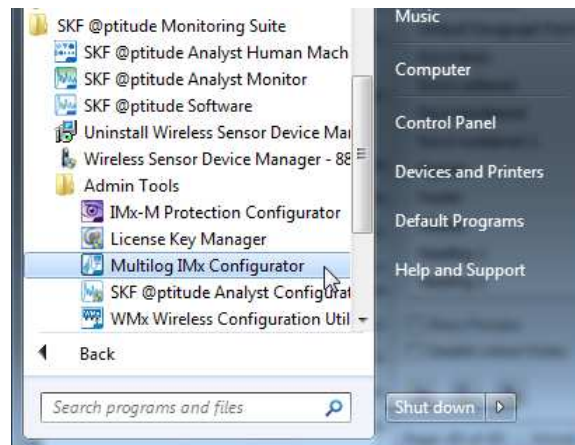


Figure 8 - 1.
Admin Tools > Multilog IMx Configurator.

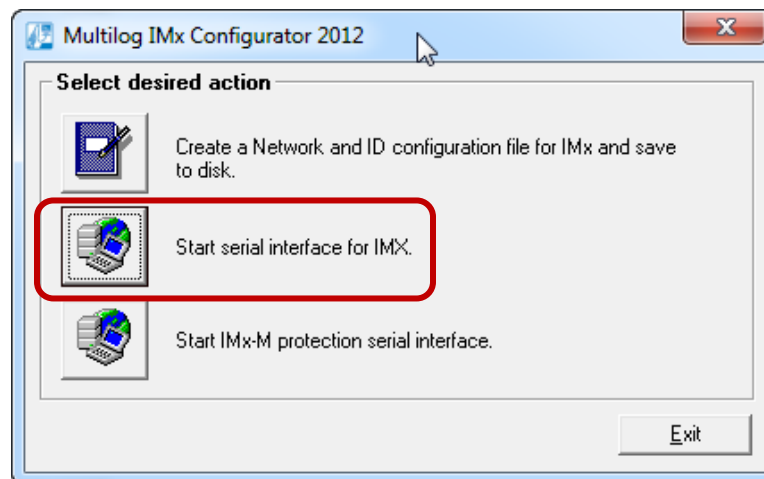


Figure 8 - 2.
Multilog IMx Configurator, Desired Actions.

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

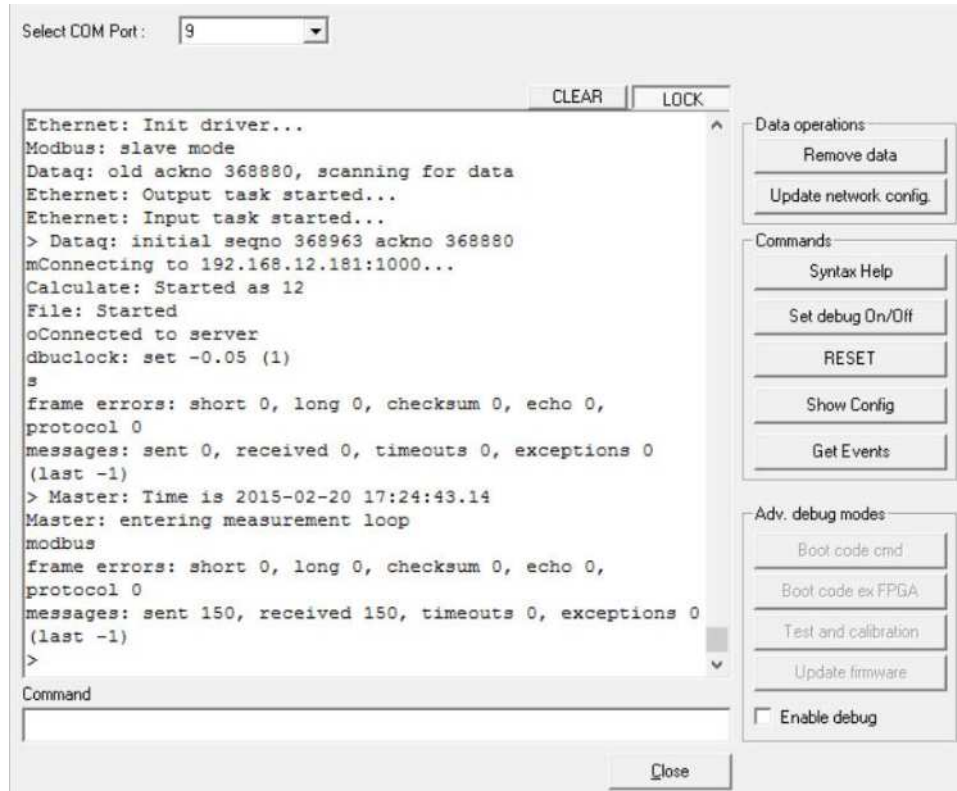


Figure 8 - 3.
Multilog IMx Configurator, **Serial Interface** Dialog.

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 Devices for Modbus](#).

7. Verify that each IMx device 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 Converter\FWD - H gE
	8	Unit1 11 ALPHA	8	25	gE		\\PowerGen\Unit1\Torque Converter\FWD - V gE
	9	Unit1 11 ALPHA	9	25	gE		\\PowerGen\Unit1\Torque Converter\FWD - A gE
	10	Unit1 11 ALPHA	10	25	gE		\\PowerGen\Unit1\Torque Converter\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
				32767			Alarm Mask
							Heartbeat
							Reserved 1
Secondary Measurement	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 Converter\FWD - H ips
	38	Unit1 11 ALPHA	8	0.5	in/s		\\PowerGen\Unit1\Torque Converter\FWD - V ips
	39	Unit1 11 ALPHA	9	0.5	in/s		\\PowerGen\Unit1\Torque Converter\FWD - A ips
	40	Unit1 11 ALPHA	10	0.5	in/s		\\PowerGen\Unit1\Torque Converter\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\1/01
	48	Unit1 11 ALPHA	2	25	Vdc		\\PowerGen\Unit1\Health\BOV 11\1/02
	49	Unit1 11 ALPHA	3	25	Vdc		\\PowerGen\Unit1\Health\BOV 11\1/03
	50	Unit1 11 ALPHA	4	25	Vdc		\\PowerGen\Unit1\Health\BOV 11\1/04
	51	Unit1 11 ALPHA	5	25	Vdc		\\PowerGen\Unit1\Health\BOV 11\1/05
	52	Unit1 11 ALPHA	6	25	Vdc		\\PowerGen\Unit1\Health\BOV 11\1/06
	53	Unit1 11 ALPHA	7	25	Vdc		\\PowerGen\Unit1\Health\BOV 11\1/07
	54	Unit1 11 ALPHA	8	25	Vdc		\\PowerGen\Unit1\Health\BOV 11\1/08
	55	Unit1 11 ALPHA	9	25	Vdc		\\PowerGen\Unit1\Health\BOV 11\1/09
	56	Unit1 11 ALPHA	10	25	Vdc		\\PowerGen\Unit1\Health\BOV 11\1/10
	57	Unit1 11 ALPHA	11	25	Vdc		\\PowerGen\Unit1\Health\BOV 11\1/11
	58	Unit1 11 ALPHA	12	25	Vdc		\\PowerGen\Unit1\Health\BOV 11\1/12
	59	Unit1 11 ALPHA	13	25	Vdc		\\PowerGen\Unit1\Health\BOV 11\1/13