IM-EN-FBC-A

User Guide

Vaisala K-PATENTS®
Fieldbus Converter
with Moxa UC-2112 hardware
PR-7112

VAISALA

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1 Introduction

The Vaisala K-PATENTS® Fieldbus Converter is designed to make easier connections of Vaisala K-PATENTS® instrumentations to Fieldbus and Industrial Ethernet.

Note: The converter can only send data. E.g. it is not possible to change the parameters through the converter.

1.1 Disposal

When wishing to dispose of the converter or any parts thereof, please observe local and national regulations and requirements for the disposal of electrical and electronic equipment.

2 Connections

Fieldbus Converter helps to insert Vaisala K-PATENTS® refractometers into Modbus/TCP, Modbus RTU, Ethernet/IP, PROFIBUS, or PROFINET networks. The software runs on a MOXA UC-2112 LX computer PR-7112. The computer has two Ethernet connectors. The one marked as “LAN1” is connected to a Modbus/TCP, Ethernet/IP, or PROFINET capable device (if used in one of these modes), the other one (“LAN2”) to a Vaisala K-PATENTS refractometer (or, in case of PR-23, the DTR transmitter). If used in Modbus RTU or PROFIBUS mode, serial port P1 is connected to a Modbus RTU or PROFIBUS network.

The converter gets the data from the refractometer via UDP/IP communication and forwards them via the configured fieldbus protocol. On the “LAN1” port the converter acts as a Modbus/TCP server, Ethernet/IP adapter, or PROFINET device. On serial port P1 the converter acts as Modbus RTU or PROFIBUS slave.

3 Communication protocols

3.1 Modbus/TCP, Modbus RTU modes

If used in Modbus mode, clients can connect and read the registers (use function code 3). The following table shows the Modbus registers.

NAME	ADDRESS	TYPE	FUNCTION
Sensor A LED	0	FLOAT	Refractometer LED value
Sensor A CCD	2	FLOAT	Image shadow edge position
Sensor A nD	4	FLOAT	Calculated refractive index value
Sensor A T	6	FLOAT	Process temperature
Sensor A Tsens	8	FLOAT	Refractometer internal temperature
Sensor A Traw	10	FLOAT	Process temperature (without bias)
Sensor A RHsens	12	FLOAT	Refractometer internal humidity
Sensor A CALC	14	FLOAT	Calculated concentration value
Sensor A CONC	16	FLOAT	Final concentration value
Sensor A PTraw	18	INT	Raw PT1000 value
Sensor A QF	20	FLOAT	Image quality factor
Sensor A mA	22	FLOAT	mA output value
Sensor A BGLight	24	INT	Background light level
Sensor A Seq	26	INT	Sequence number of measurement
Sensor A Timestamp	28	INT	Time since device start-up
Sensor A Status	30	INT	Refractometer status message
Sensor B LED	32	FLOAT	Refractometer LED value
Sensor B CCD	34	FLOAT	Image shadow edge position
Sensor B nD	36	FLOAT	Calculated refractive index value
Sensor B T	38	FLOAT	Process temperature
Sensor B Tsens	40	FLOAT	Refractometer internal temperature
Sensor B Traw	42	FLOAT	Process temperature (without bias)
Sensor B RHsens	44	FLOAT	Refractometer internal humidity
Sensor B CALC	46	FLOAT	Calculated concentration value
Sensor B CONC	48	FLOAT	Final concentration value
Sensor B PTraw	50	INT	Raw PT1000 value
Sensor B QF	52	FLOAT	Image quality factor
Sensor B mA	54	FLOAT	mA output value
Sensor B BGLight	56	INT	Background light level
Sensor B Seq	58	INT	Sequence number of measurement
Sensor B Timestamp	60	INT	Time since device start-up
Sensor B Status	62	INT	Refractometer status message
All stored values are 4 bytes in size (either FLOAT or SIGNED INT).			

Table 3.1

Status values are transmitted as integers. These are the status messages to each value:

STATUS CODE	STATUS MESSAGE
-1	No status received
0	NORMAL OPERATION
1	EXTERNAL HOLD
2	EXTERNAL WASH STOP
3	HIGH SENSOR HUMIDITY
4	HIGH SENSOR TEMP
5	LOW IMAGE QUALITY
6	LOW TEMP WASH STOP
7	NO OPTICAL IMAGE
8	NO SAMPLE
9	NO SAMPLE/WASH STOP
10	NO SENSOR
11	NO SIGNAL
12	OUTSIDE LIGHT ERROR
13	OUTSIDE LIGHT TO PRISM
14	PRECONDITIONING
15	PRISM COATED
16	PRISM WASH
17	PRISM WASH FAILURE
18	RECOVERING
19	SHORT-CIRCUIT
20	STARTING UP
21	TEMP MEASUREMENT FAULT

Table 3.2

Note: The computer can't handle very frequent Modbus requests. As the refractometer values are updated once per second, it is recommended to request values once per second to avoid overloading the converter.

3.2 Ethernet/IP mode

When used in Ethernet/IP mode, the converter acts as an adapter, and waits for Ethernet/IP scanners to connect. Connection can be set up easily with the provided file “Converter.eds”, or manually with the following parameters:

- Port: 0xAF12 (44818)
- O->T:
  - instance number: 102
  - data size: 0
  - real time format: modeless
  - packet rate: 1000 ms
- T->O:
  - instance number: 101
  - data size: 128
  - real time format: modeless
  - packet rate: 1000 ms
  - connection type: point to point

Note: The *converter.eds* file is part of the converter configurator package (zip) that you can download at https://www.kpatents.com/support/document-downloads/software-for-connectivity-and-communications.

The 128-byte data of the T->O instance contains the following values:

NAME	BYTES	TYPE	FUNCTION
Sensor A LED	0-3	REAL	Refractometer LED value
Sensor A CCD	4-7	REAL	Image shadow edge position
Sensor A nD	8-11	REAL	Calculated refractive index value
Sensor A T	12-15	REAL	Process temperature
Sensor A Tsens	16-19	REAL	Refractometer internal temperature
Sensor A Traw	20-23	REAL	Process temperature (without bias)
Sensor A RHsens	24-27	REAL	Refractometer internal humidity
Sensor A CALC	28-31	REAL	Calculated concentration value
Sensor A CONC	32-35	REAL	Final concentration value
Sensor A PTraw	36-39	DINT	Raw PT1000 value
Sensor A QF	40-43	REAL	Image quality factor
Sensor A mA	44-47	REAL	mA output value
Sensor A BGLight	48-51	DINT	Background light level
Sensor A Seq	52-55	DINT	Sequence number of measurement
Sensor A Timestamp	56-59	DINT	Time since device start-up
Sensor A Status	60-63	DINT	Refractometer status message
Sensor B LED	64-67	REAL	Refractometer LED value
Sensor B CCD	68-71	REAL	Image shadow edge position
Sensor B nD	72-75	REAL	Calculated refractive index value
Sensor B T	76-79	REAL	Process temperature
Sensor B Tsens	80-83	REAL	Refractometer internal temperature
Sensor B Traw	84-87	REAL	Process temperature (without bias)
Sensor B RHsens	88-91	REAL	Refractometer internal humidity
Sensor B CALC	92-95	REAL	Calculated concentration value
Sensor B CONC	96-99	REAL	Final concentration value
Sensor B PTraw	100-103	DINT	Raw PT1000 value
Sensor B QF	104-107	REAL	Image quality factor
Sensor B mA	108-111	REAL	mA output value
Sensor B BGLight	112-115	DINT	Background light level
Sensor B Seq	116-119	DINT	Sequence number of measurement
Sensor B Timestamp	120-123	DINT	Time since device start-up
Sensor B Status	124-127	DINT	Refractometer status message

Table 3.3

Status values are transmitted as integers. Please see Table 3.2 on page 4 for status codes.

3.3 PROFIBUS mode

Please see Table 3.3 for the location of the measured values in the 128-byte wide data field. With only one refractometer configured in an Engineering Tool only the first 64 bytes are transmitted. With two refractometers configured in an Engineering Tool and one refractometer configured on Converter, the last 64 bytes are invalid (all fields are zero, except Sensor B Status = -1 - "No status").

Supported Baud rates: 9600, 19200, 45450, 93750, 187500.

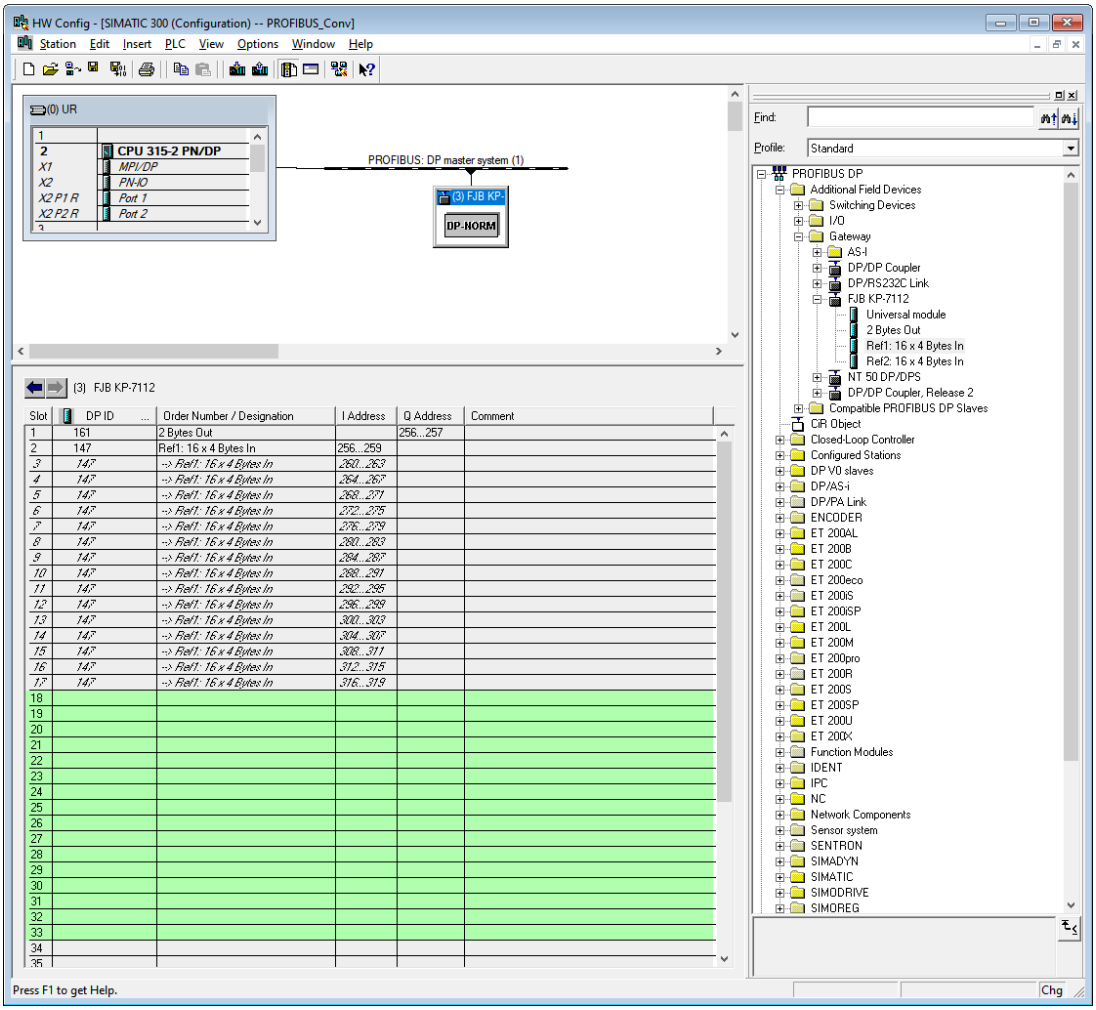


Figure 3.1 Engineering Tool PROFIBUS, one refractometer configuration display

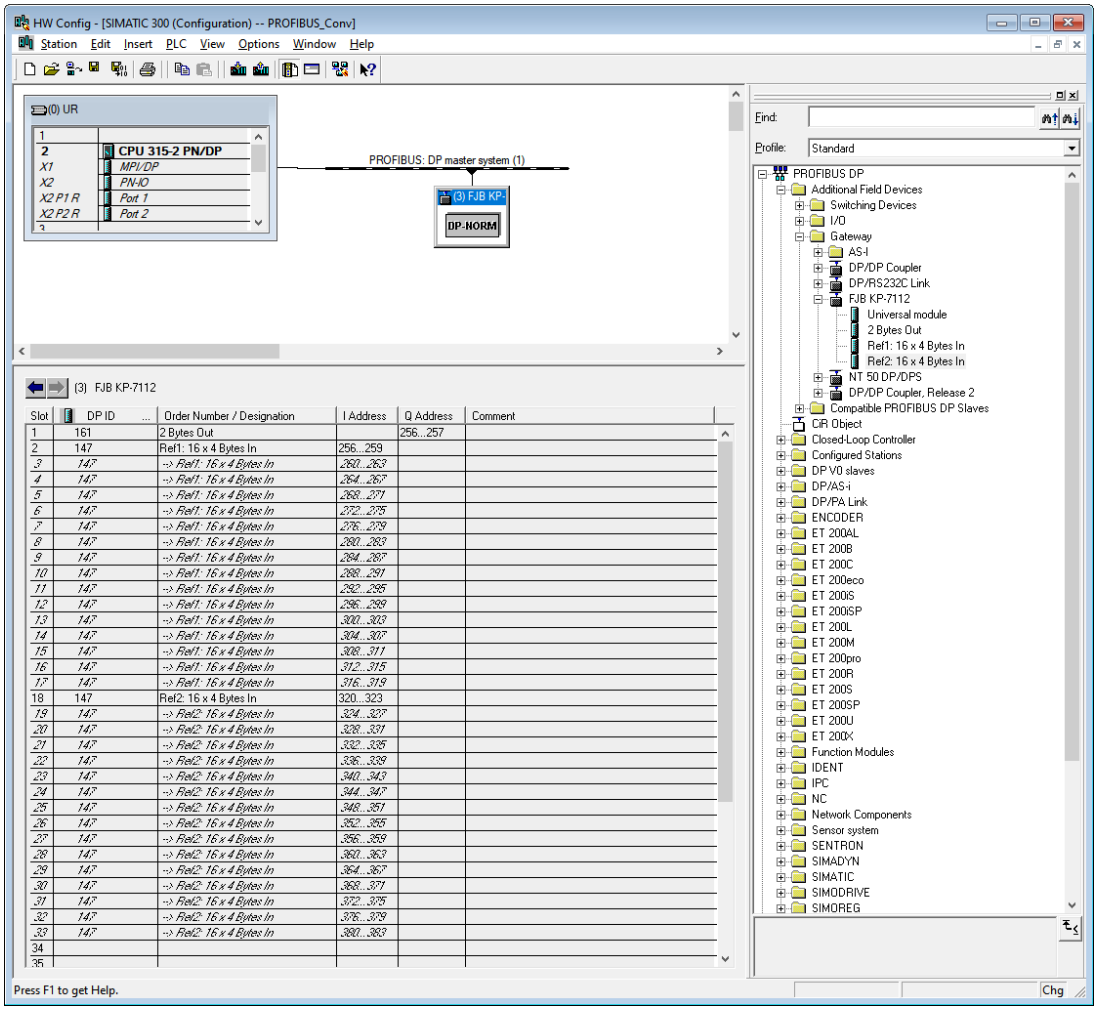
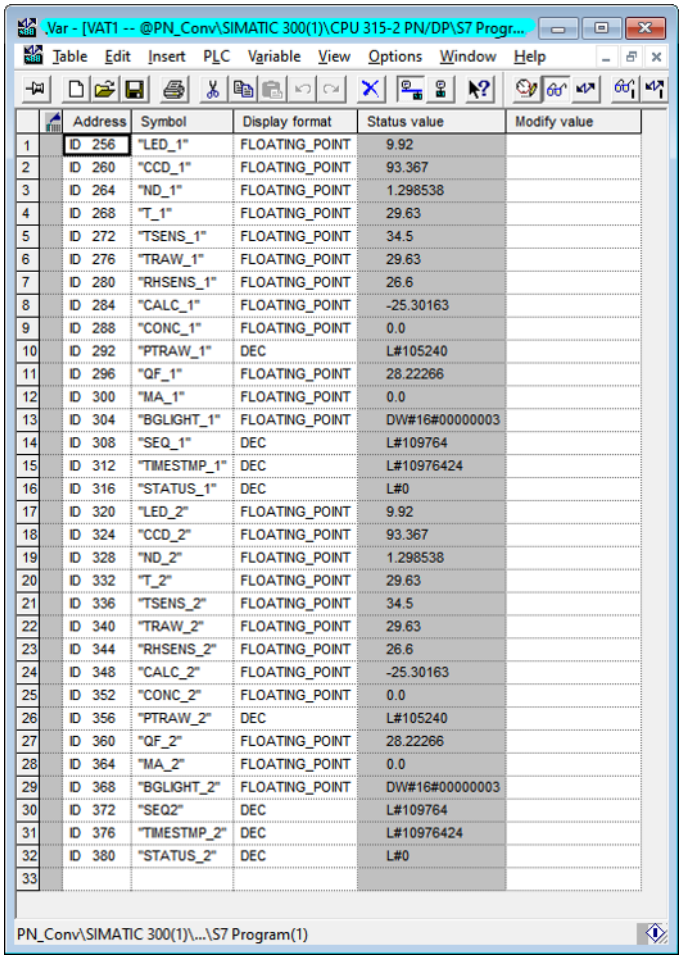


Figure 3.2 Engineering Tool PROFIBUS, two refractometer configuration display



	Address	Symbol	Display format	Status value	Modify value
1	ID 256	"LED_1"	FLOATING_POINT	9.92	
2	ID 260	"CCD_1"	FLOATING_POINT	93.367	
3	ID 264	"ND_1"	FLOATING_POINT	1.298538	
4	ID 268	"T_1"	FLOATING_POINT	29.63	
5	ID 272	"TSENS_1"	FLOATING_POINT	34.5	
6	ID 276	"TRAW_1"	FLOATING_POINT	29.63	
7	ID 280	"RHSENS_1"	FLOATING_POINT	26.6	
8	ID 284	"CALC_1"	FLOATING_POINT	-25.30163	
9	ID 288	"CONC_1"	FLOATING_POINT	0.0	
10	ID 292	"PTRAW_1"	DEC	L#105240	
11	ID 296	"QF_1"	FLOATING_POINT	28.22266	
12	ID 300	"MA_1"	FLOATING_POINT	0.0	
13	ID 304	"BGLIGHT_1"	FLOATING_POINT	DW#16#00000003	
14	ID 308	"SEQ_1"	DEC	L#109764	
15	ID 312	"TIMESTMP_1"	DEC	L#10976424	
16	ID 316	"STATUS_1"	DEC	L#0	
17	ID 320	"LED_2"	FLOATING_POINT	9.92	
18	ID 324	"CCD_2"	FLOATING_POINT	93.367	
19	ID 328	"ND_2"	FLOATING_POINT	1.298538	
20	ID 332	"T_2"	FLOATING_POINT	29.63	
21	ID 336	"TSENS_2"	FLOATING_POINT	34.5	
22	ID 340	"TRAW_2"	FLOATING_POINT	29.63	
23	ID 344	"RHSENS_2"	FLOATING_POINT	26.6	
24	ID 348	"CALC_2"	FLOATING_POINT	-25.30163	
25	ID 352	"CONC_2"	FLOATING_POINT	0.0	
26	ID 356	"PTRAW_2"	DEC	L#105240	
27	ID 360	"QF_2"	FLOATING_POINT	28.22266	
28	ID 364	"MA_2"	FLOATING_POINT	0.0	
29	ID 368	"BGLIGHT_2"	FLOATING_POINT	DW#16#00000003	
30	ID 372	"SEQ2"	DEC	L#109764	
31	ID 376	"TIMESTMP_2"	DEC	L#10976424	
32	ID 380	"STATUS_2"	DEC	L#0	
33					

Figure 3.3 Engineering Tool, two refractometer measurement display

Note: The associated GSD file (VAI_4224.GSD) is part of the converter configurator package RefConverterAssistant_2_0 (.zip) that you can download at https://www.kpatents.com/support/document-downloads/software-for-connectivity-and-communications.

3.4 PROFINET mode

Please see Table 3.3 for the location of the measured values in the 128-byte wide data field. The Converter always send the whole 128-byte data field. With only one Refractometer configured the last 64 bytes are invalid (all fields are zero, except Sensor B Status = -1 – “No status”).

The default station name stored in the GDSML file is “reffjb1”, therefore it is advised to set this name in Refractometer Converter Assistant, because the engineering tools (eg.: TIA Portal) will use this name as default.

Note: The associated GSDML file (GSDML-V2.35-Vaisala-FJB-20190829.xml) is part of the converter configurator package RefConverterAssistant_2_0 (.zip) that you can download at https://www.kpatents.com/support/document-downloads/software-for-connectivity-and-communications.

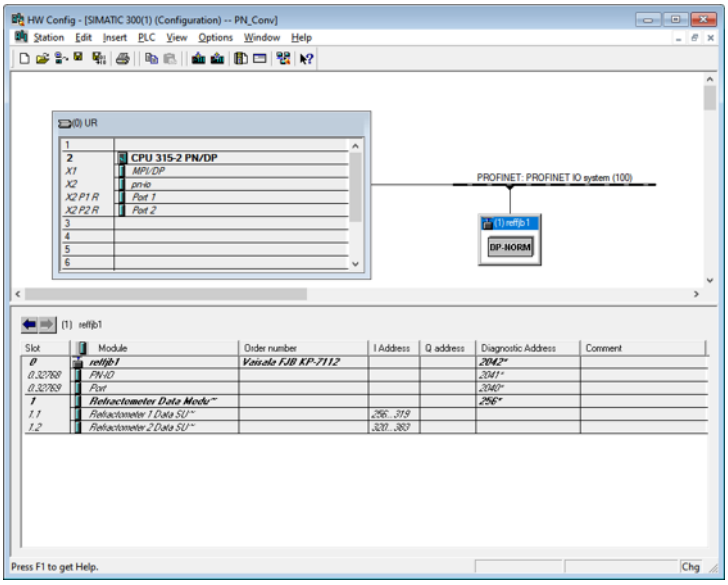
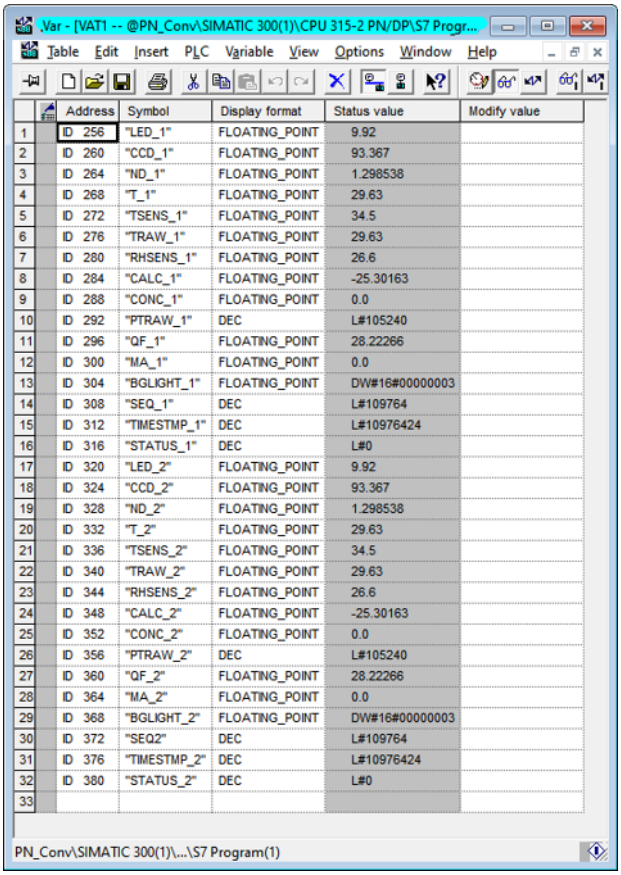


Figure 3.4 Engineering Tool PROFINET, two refractometers configuration display



	Address	Symbol	Display format	Status value	Modify value
1	ID 256	"LED_1"	FLOATING_POINT	9.92	
2	ID 260	"CCD_1"	FLOATING_POINT	93.367	
3	ID 264	"ND_1"	FLOATING_POINT	1.298538	
4	ID 268	"T_1"	FLOATING_POINT	29.63	
5	ID 272	"TSENS_1"	FLOATING_POINT	34.5	
6	ID 276	"TRAW_1"	FLOATING_POINT	29.63	
7	ID 280	"RHSENS_1"	FLOATING_POINT	26.6	
8	ID 284	"CALC_1"	FLOATING_POINT	-25.30163	
9	ID 288	"CONC_1"	FLOATING_POINT	0.0	
10	ID 292	"PTRAW_1"	DEC	L#105240	
11	ID 296	"QF_1"	FLOATING_POINT	28.22266	
12	ID 300	"MA_1"	FLOATING_POINT	0.0	
13	ID 304	"BGLIGHT_1"	FLOATING_POINT	DW#16#00000003	
14	ID 308	"SEQ_1"	DEC	L#109764	
15	ID 312	"TIMESTMP_1"	DEC	L#10976424	
16	ID 316	"STATUS_1"	DEC	L#0	
17	ID 320	"LED_2"	FLOATING_POINT	9.92	
18	ID 324	"CCD_2"	FLOATING_POINT	93.367	
19	ID 328	"ND_2"	FLOATING_POINT	1.298538	
20	ID 332	"T_2"	FLOATING_POINT	29.63	
21	ID 336	"TSENS_2"	FLOATING_POINT	34.5	
22	ID 340	"TRAW_2"	FLOATING_POINT	29.63	
23	ID 344	"RHSENS_2"	FLOATING_POINT	26.6	
24	ID 348	"CALC_2"	FLOATING_POINT	-25.30163	
25	ID 352	"CONC_2"	FLOATING_POINT	0.0	
26	ID 356	"PTRAW_2"	DEC	L#105240	
27	ID 360	"QF_2"	FLOATING_POINT	28.22266	
28	ID 364	"MA_2"	FLOATING_POINT	0.0	
29	ID 368	"BGLIGHT_2"	FLOATING_POINT	DW#16#00000003	
30	ID 372	"SEQ2"	DEC	L#109764	
31	ID 376	"TIMESTMP_2"	DEC	L#10976424	
32	ID 380	"STATUS_2"	DEC	L#0	
33					

Figure 3.5 Engineering Tool PROFINET, two refractometers measurement display

4 Configuration and testing

You may use the reset button to reset Converter to the factory settings. To execute a factory reset hold down the reset button for approximately 10 seconds. During this period the LED named ‘User’ will be blinking. After 10 seconds, the User LED lights continuously. At this point release the reset button. The device will reboot automatically.

You may connect to Converter at the LAN1 port with Refractometer Converter Assistant as soon as the User LED lights on.

Default IP Address is: 192.168.3.127.

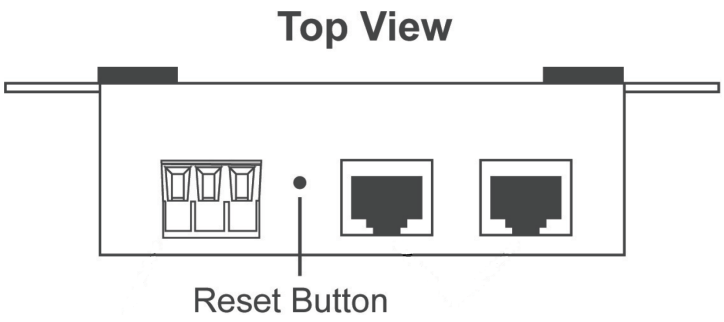


Figure 4.1 Reset button location

4.1 Configuring the fieldbus converter

To configure the fieldbus converter, use software tool "Vaisala Refractometer Converter Assistant". You can download it at https://www.kpatents.com/support/document-downloads/software-for-connectivity-and-communications.

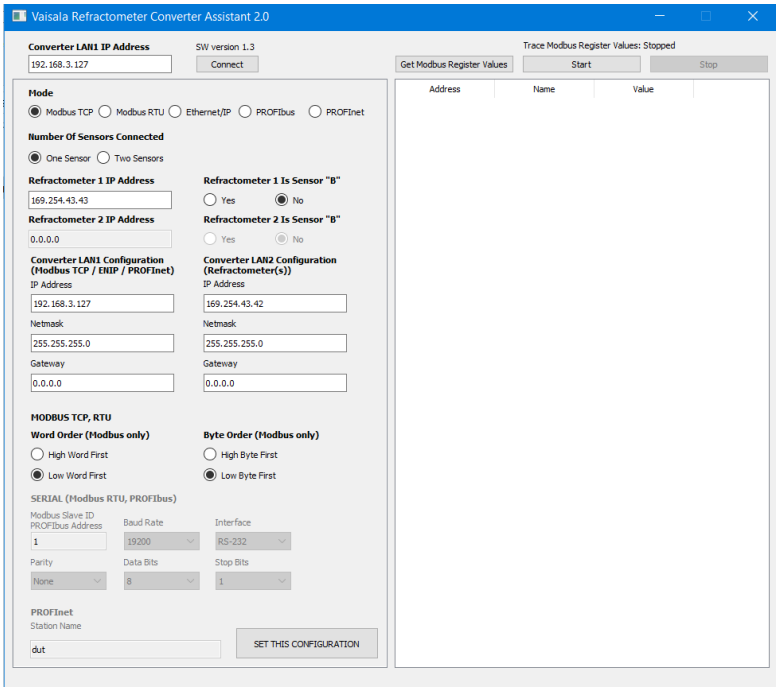


Figure 4.2 Refractometer Converter Assistant

Connect the converter's LAN1 port to a Windows PC. The default IP address of the converter is 192.168.3.127. Configure the PC's Ethernet connection to have an IP address in the same range (192.168.3.x). **Note:** The connection will not work if the computer and the refractometer have exactly the same IP address.

At the top-left corner, enter the IP address of the converter, and press "Connect". The parameters in the left frame should now get automatically filled with the current settings of the converter. Modify according to your needs, and press "SET THIS CONFIGURATION". Now the fieldbus converter will adapt to the changes and restart automatically. This may take 30-60 seconds.

With this software tool you can test the converter's connection to the refractometer in Modbus/TCP mode. Press "Get Register Values" to get all values from the Modbus registers, or "Trace Register Values" to get them constantly updating. When pressing "Get Register Values" for a first time, location of the provided file "modbus_daemon_settings.json" will be asked for.

You can set the Refractometer and Converter LAN2 Configuration field accordingly to your Refractometer IP address. Please note that the Converter LAN2 IP address need to be in the same range with the Refractometer IP address. When the converter connects to a Vaisala K-PATENTS refractometer or to a DTR transmitter with a direct cable connection, use the netmask 255.255.255.0 for LAN2 as seen on the above image.

Figures 4.3 to 4.7 show the relevant fields for different fieldbus modes. The blue boxes contain the general fields that need to be filled for all the fieldbus modes. The red boxes contain the separate fields for each different fieldbus mode.

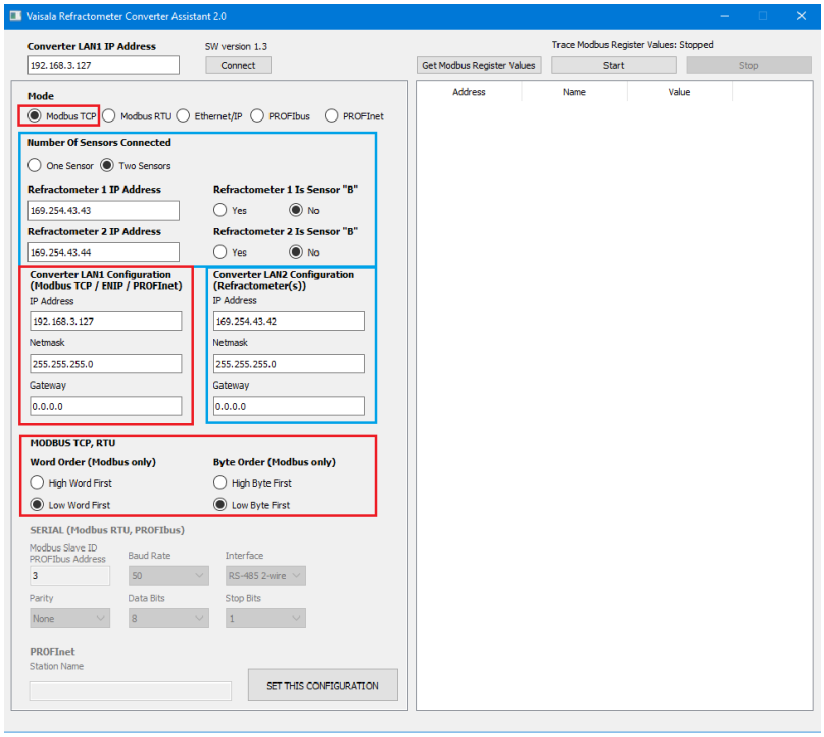


Figure 4.3 Relevant fields for Modbus TCP mode

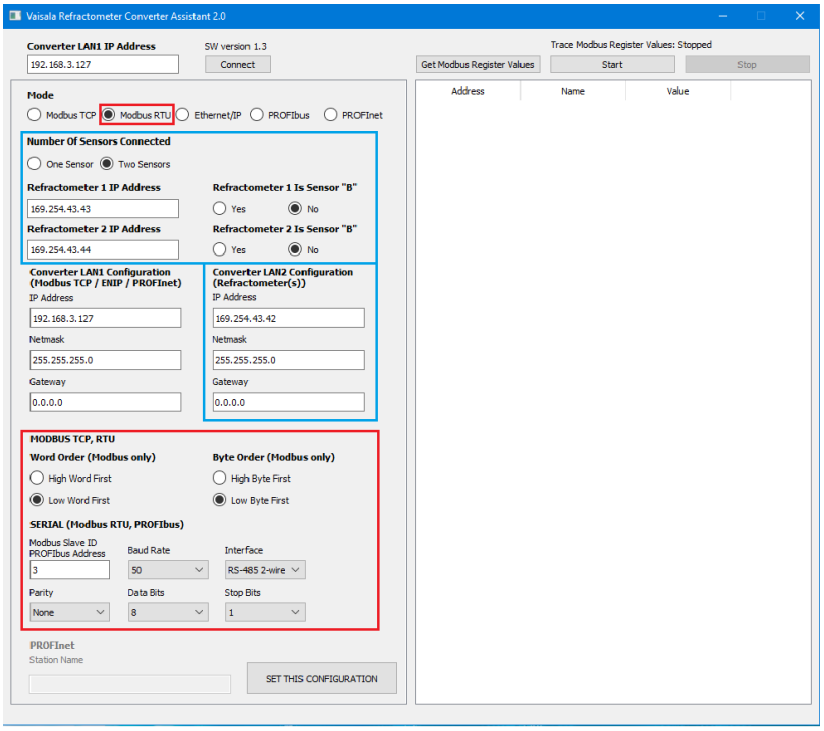


Figure 4.4 Relevant fields for Modbus RTU mode

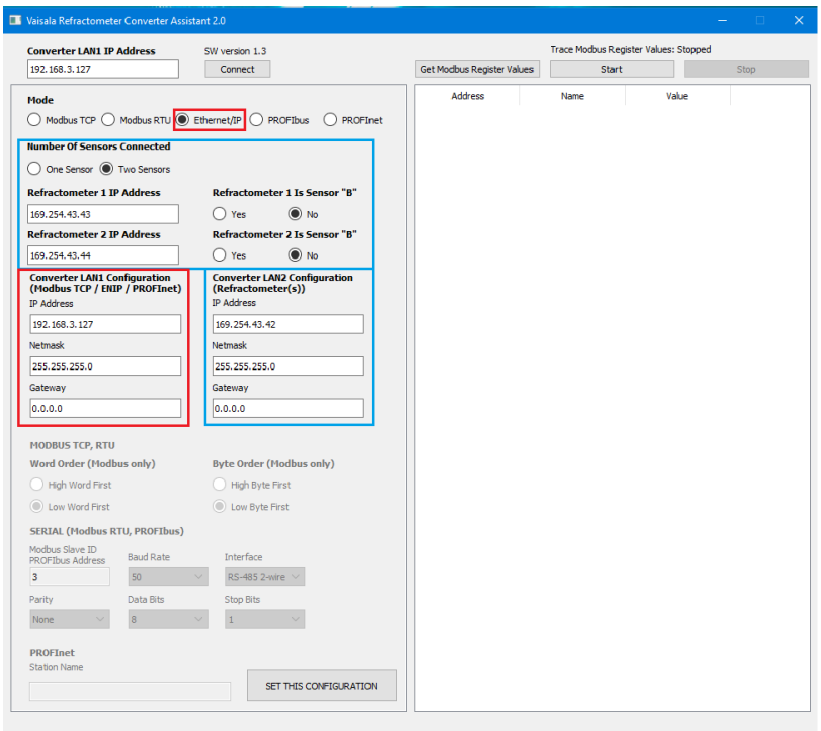


Figure 4.5 Relevant fields for Ethernet/IP mode

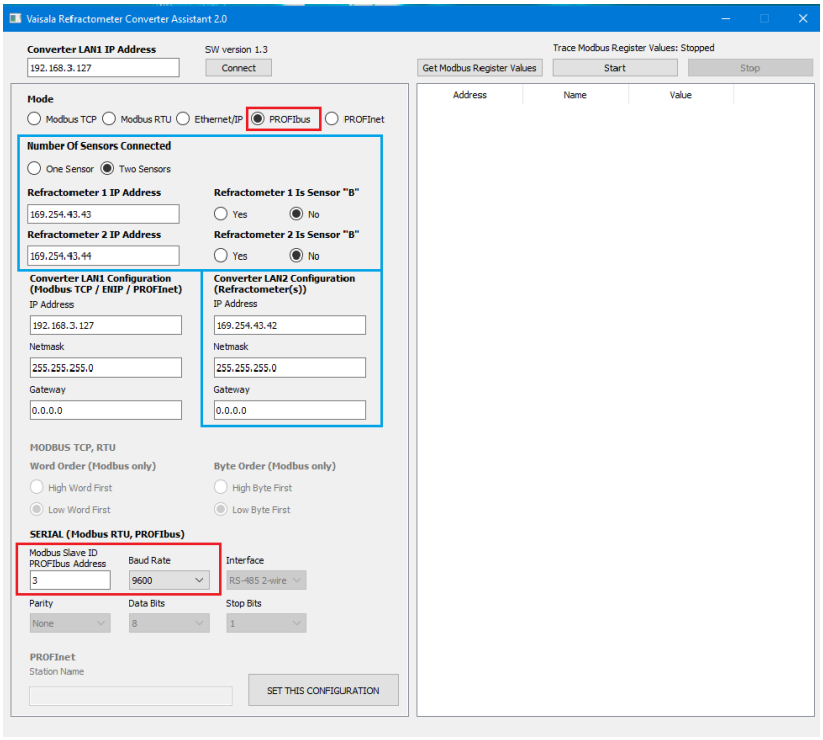


Figure 4.6 Relevant fields for PROFIBUS mode

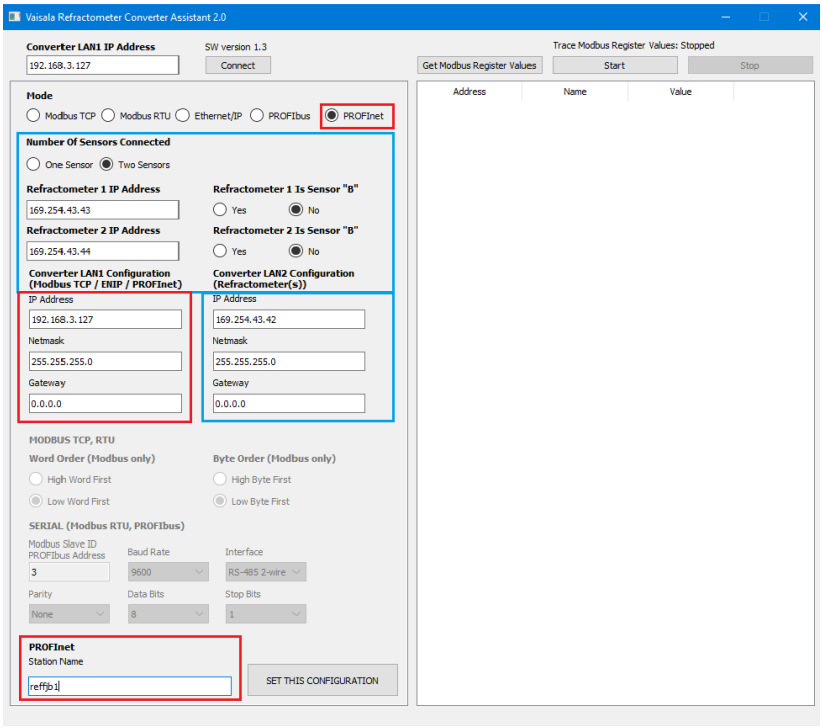


Figure 4.7 Relevant fields for PROFINET mode

4.2 Accessing the refractometer web interface

Configuring a refractometer is not possible through the fieldbus converter, because Converter provides only measurement and status data into fieldbus networks. The refractometer can be configured, verified and diagnosed by accessing its built-in web server homepage. The homepage is accessed by connecting a computer to the refractometer via a switch, a router or a direct cable connection. A connection between refractometer and Converter can be temporarily disconnected while changing refractometer parameters – the connection recovers automatically after the connection is restored. See the refractometer manual for details of its network settings.

4.3 Testing Modbus RTU connection with a PC

Modbus RTU connectivity can be tested with PC tools prior to installing the fieldbus converter to its final location. A suitable tool for this is ModbusTool which can be downloaded from https://github.com/graham22/modbustool. This program features a Modbus master and a client as well. As the converter works as a slave, we need to use the ModbusTool Master to communicate with it. Please follow the below steps:

1. Connect the fieldbus converter to the PC via serial cable. You can use a built-in serial port on your PC, or a USB-serial converter (not provided by Vaisala). Please check the supported serial communication type (RS422 / RS485 2-wire / RS485 4-wire). Both the USB-serial converter and the cable must be chosen accordingly.

2. Set up the fieldbus converter to operate in the Modbus RTU mode, and set baud rate, data bits, flow control, parity, stop bits and interface.

3. Connect the fieldbus converter to the refractometer.

4. In ModbusTool Modbus Master, select:

    a. Communication Mode: RTU
    b. Port name: the port where you connected the serial cable
    c. Baud, parity, data bits and stop bits should be the same as on converter
    d. Start address: 0
    e. Size: 64 (press Apply after these)
    f. Press “Connect”

5. Press “Read holding register” to send a read request to the converter

6. At the bottom of the screen you should see the sent (TX) and received (RX) bytes, and the message “Read succeeded: Function code: 3.”.

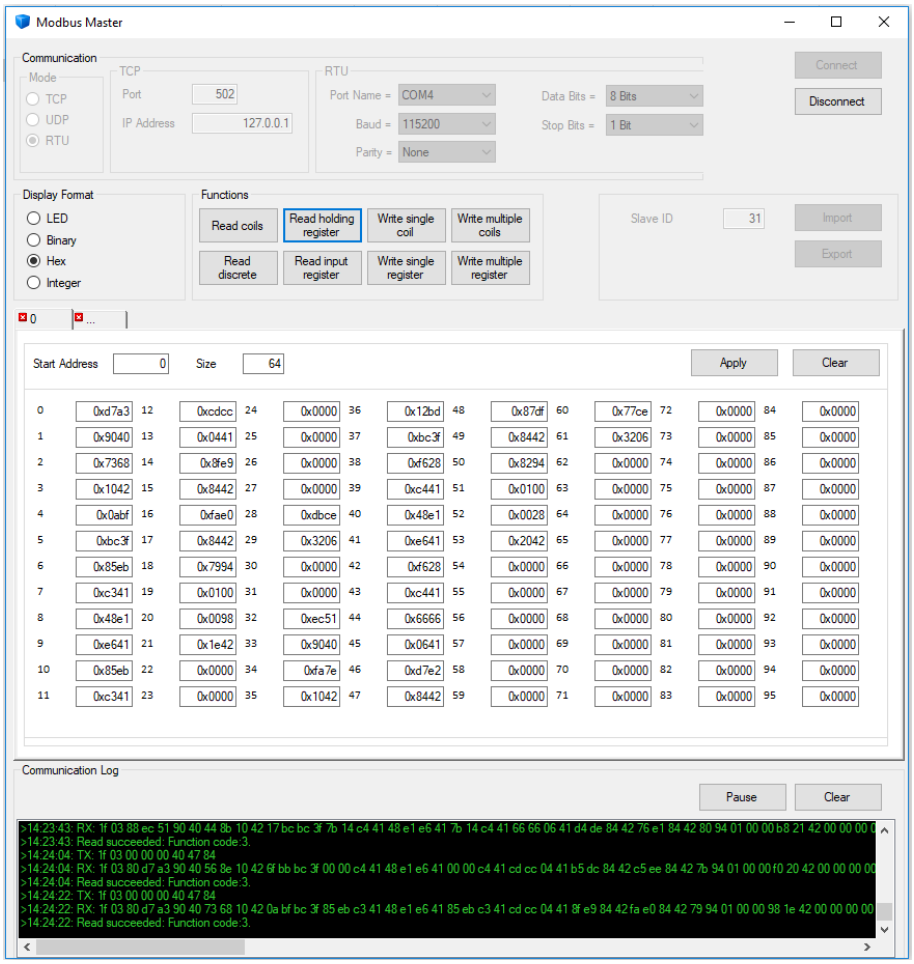


Figure 4.8 ModbusTool Modbus Master

5 Specifications

5.1 Converter environmental and electrical specs

Operating temperature	-10 to 60°C (14 to 140°F)
Input voltage	12 to 48 VDC
Input current	170 mA @ 24 VDC 340 mA @ 12 VDC
Power consumption	4.5 W

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