K-PATENTS®
PROCESS INSTRUMENTS

Fieldbus converter PR-7112

Instruction Manual

Document/Revision No. IM-EN-FBC: Rev. 1.0
Effective: March 12, 2019

Table of contents

1 Introduction

The K-Patents Fieldbus Converter is designed to make easier connections of K-Patents instrumentations to Fieldbus and Industrial Ethernet through a Fieldbus converter.

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

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

The converter gets the data from the refractometer via UDP/IP communication and stores them in its Modbus registers and Ethernet/IP objects. On the “LAN1” port the converter acts as a Modbus/TCP server or Ethernet/IP adapter. On serial port P1 the converter acts as Modbus RTU 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/assets/files/downloads/manuals/software/28957_RefConverterAssistant.zip.

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.

4 Configuration and testing

Warning! **Never press the reset button on the converter.** The reset button on top of the MOXA UC-7112 Plus computer (the converter) is **not** designed to hard reboot the computer. The Fieldbus converter is implemented as a proprietary application software running on the MOXA UC-7112 Plus computer. **The application software will be permanently erased, if the reset button is pressed.**

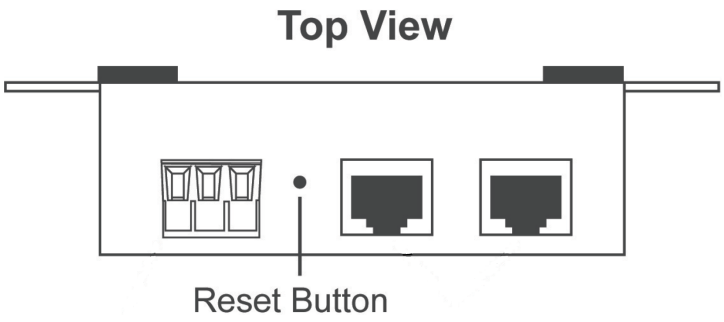

Figure 4.1 Reset button location

4.1 Configuring the fieldbus converter

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

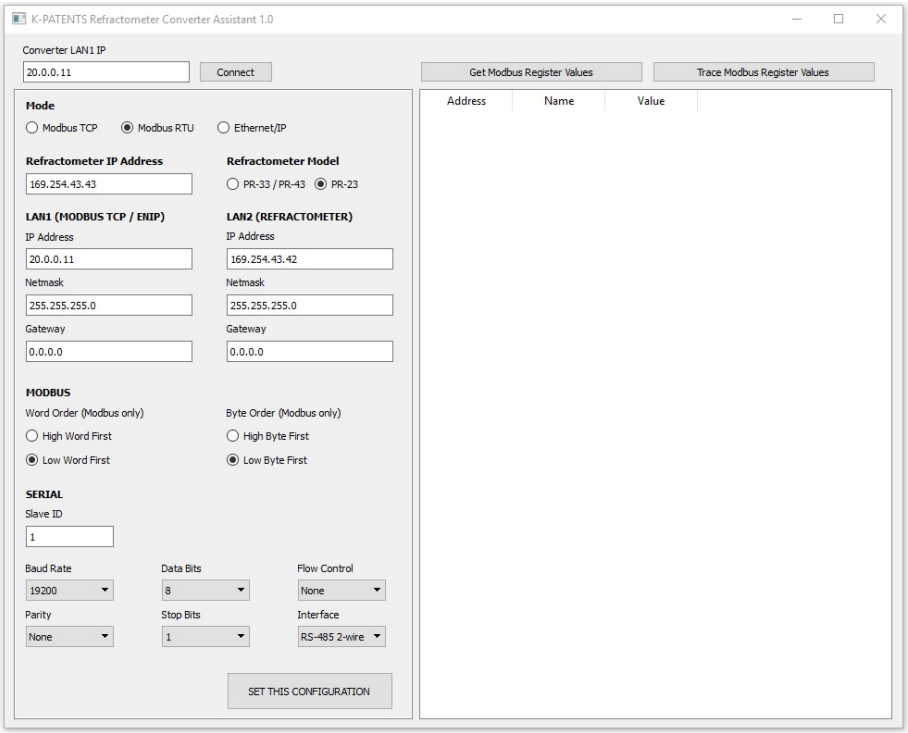

Figure 4.2 Refractometer Converter Assistant

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.

When the converter connects to a 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.

4.2 Accessing the refractometer web interface

Configuring a refractometer is not possible through the fieldbus converter, because it provides only measurement and status data into Modbus/TCP, Modbus RTU or Ethernet/IP 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 a 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 K-Patents). 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 a 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.”.

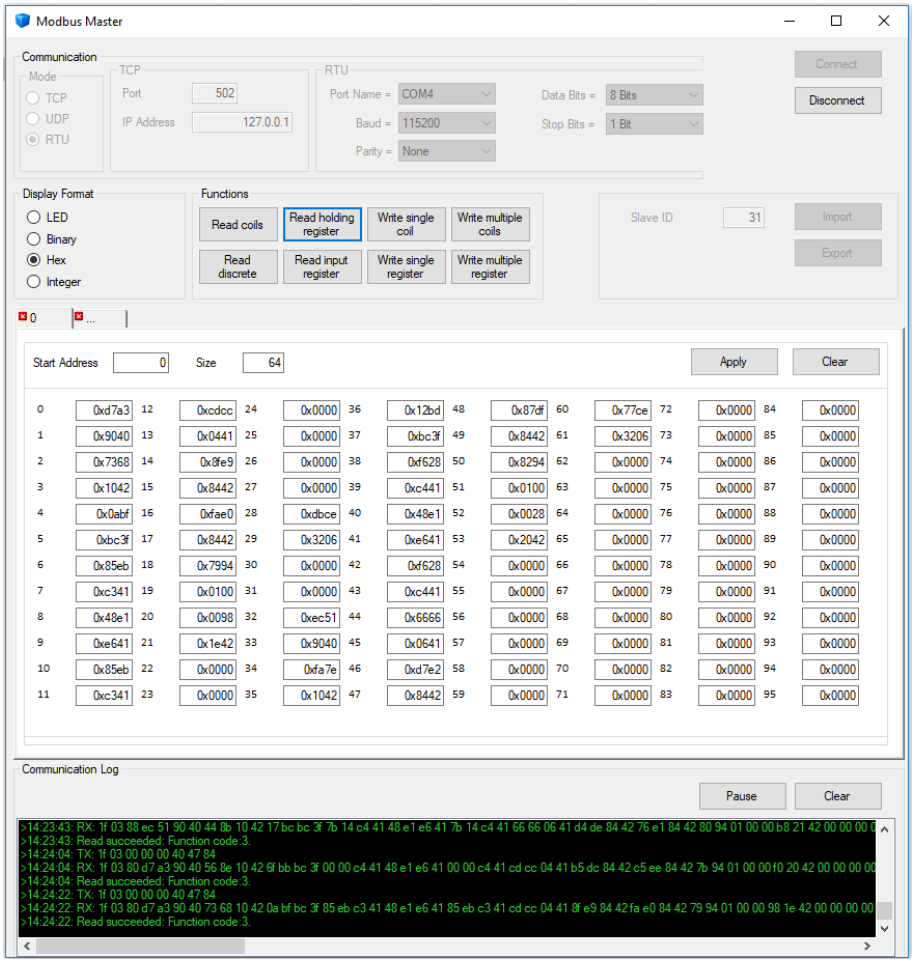

Figure 4.3 ModbusTool Modbus Master

5 Specifications

5.1 Converter environmental and electrical specs

Operating temperature	-10 to 60°C (14 to 140°F)
Maximum altitude	5000 meters
Input voltage	12 to 48 VDC
Input current	170 mA @ 24 VDC 340 mA @ 12 VDC
Power consumption	4.5 W

K-PATENTS®
PROCESS INSTRUMENTS

K-Patents Oy
P.O. Box 77
FI-01511 Vantaa, Finland
tel. +358 207 291 570
fax +358 207 291 577
info@kpatents.com

K-Patents, Inc.
1804 Centre Point Circle,
Suite 106
Naperville, IL 60653, USA
tel. (630) 955 1545
fax (630) 955 1585
info@kpatents.com

K-Patents (Shanghai) Co., Ltd
Room 1509,
Tomson Commercial Building, No.710
Dongfang RD
Pudong District, Shanghai, China
tel. +86 21 5087 0597/0598
fax +86 21 5087 0598

www.kpatents.com