REV. 1.8
23/09/2020

HD33[L]MT[4b]

Configuration guide

ENGLISH

INDICE

1 INTRODUCTION

The dataloggers HD33[L]MT[4b].2/ HD33[L]MT[4b].3/ HD33[L]MT[4b].4 can be handled with software HD35AP-S that allows monitor, data download, historical data visualization and configuration of both measurement channels and connectivity functionalities. Please refer to HD35AP-S software help for a detailed description of all software functionalities.

With reference to measurement channel configurations HD35AP-S completely handles:

- four reconfigurable analog channels
- dedicated analog (e.g. temperature, relative humidity, tipping bucket rain gauge, contact input) and digital channels (e.g. atmospheric pressure)

The configuration of the two digital buses: RS485 (with Modbus RTU/RS485 proprietary protocol) and SDI-12 are not already handled in the software and will be included in a future software release. This document explains how to activate and configure RS485 and SDI-12 digital buses in order to acquire slave sensors with Modbus RTU, RS-485 proprietary protocol and SDI-12 interface. The configuration can be done using the HID Terminal included in HD35AP-S installation CD.

The RS-485 bus can also be configured as Modbus RTU slave. In this way the datalogger can be connected to PLC or SCADA software for real time monitoring via third parts softwares. The configuration as Modbus RTU slave is explained in the document.

Additionally, the document explains how to configure the switched power supply outputs +Vsw1, +Vsw2 in order to be be a) always active, b) active only during measurements acquisition or c) always disabled (if only passive sensors are used).

The following document refers to the hardware revision HD35WMT-4 of the datalogger.

2 ANALOG AND DEDICATED CHANNEL MEASUREMENTS CONFIGURATION

This section explains how to configure the 4 reconfigurable analog channels and the other dedicated channel measurements using the software HD35AP-S.

To configure the 4 reconfigurable analog channels start the software HD35AP-S connect to the instrument via USB and follow End Device Settings -> Input Setup and insert the administration password 9876 in the window that pops up. Push Apply to confirm.

Figure 1: Request for administrator password

Each of the 4 analog channels can be configured independently choosing the desired measurement type inside the following list:

- 2-wire PT100
- 3-wire PT100
- 4-wire PT100
- 2-wire PT1000
- 3-wire PT1000
- 4-wire PT1000
- Temperature Tc K
- Temperature Tc J
- Temperature Tc T
- Temperature Tc N
- Temperature Tc R
- Temperature Tc S
- Temperature Tc B
- Temperature Tc E
- Voltage (0-1V)
- Voltage (0-50mV)
- Current (4-20mA)
- Potentiometer (%)
- Mapped Voltage (0-1V)
- Mapped Voltage (0-50mV)
- Mapped Current (4-20mA)

- Mapped Potentiometer
- Undefined measurement
- Voltage (0-10V)
- Mapped Voltage (0-10V)
- Voltage (-50...50mV)
- Mapped Voltage (-50...50mV)
- Pyrgeometer

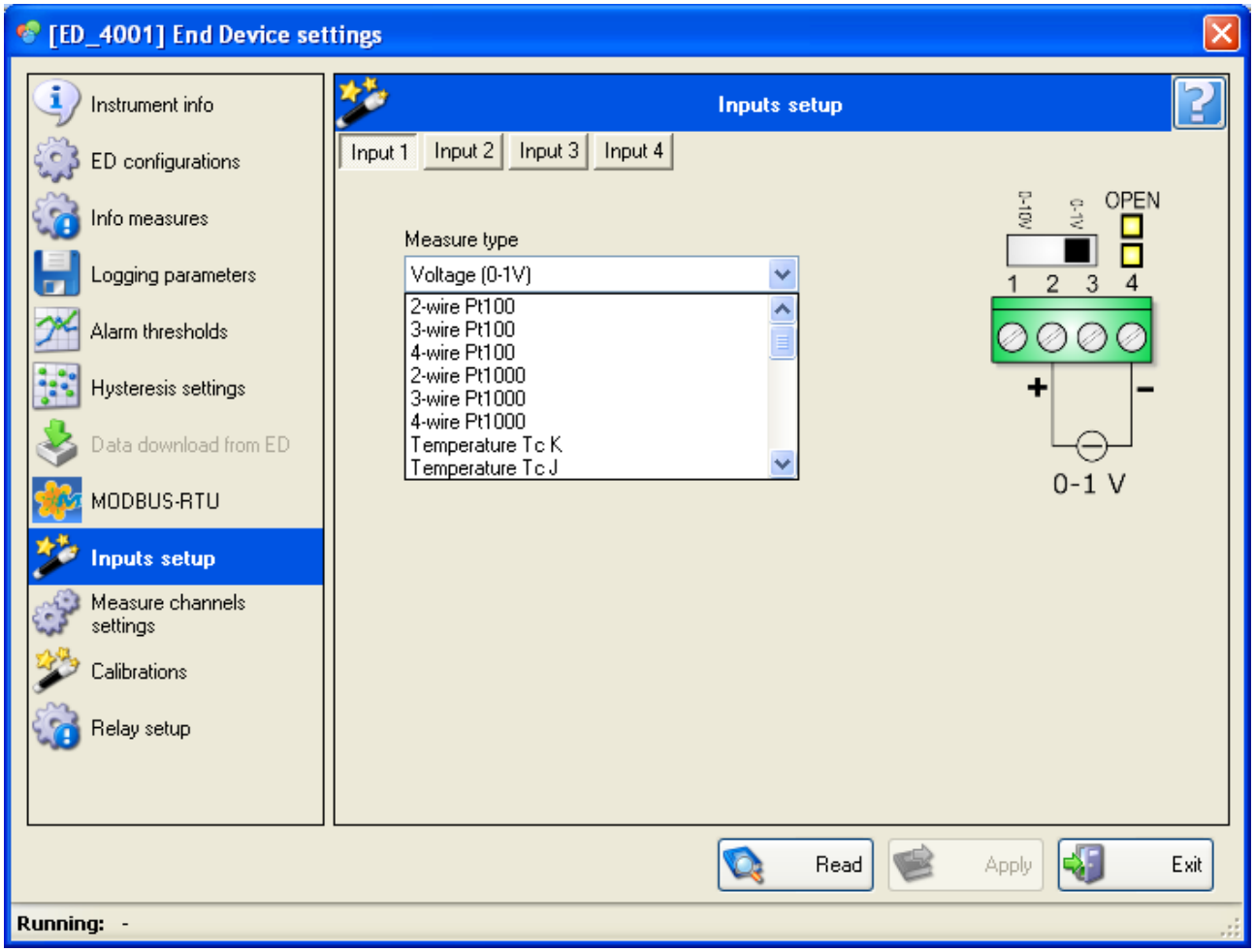


Figure 2: Inputs setup

Please notice that the following measurement types:

- Mapped Voltage (0-1V)
- Mapped Voltage (0-50mV)
- Mapped Current (4-20mA)
- Mapped Voltage (0-10V)
- Mapped Voltage (-50...50mV)

allow you to map an electrical quantity to your desired physical quantity. If for example you want to connect a 0-1V temperature sensor transmitter that maps 0 V to -40.0°C and 1V to 80.0°C you must choose Mapped Voltage (0-1V) as measurement type and configure properly the linear mapping rule between the electrical quantity and temperature measurement. Push Apply to confirm your channel changes.

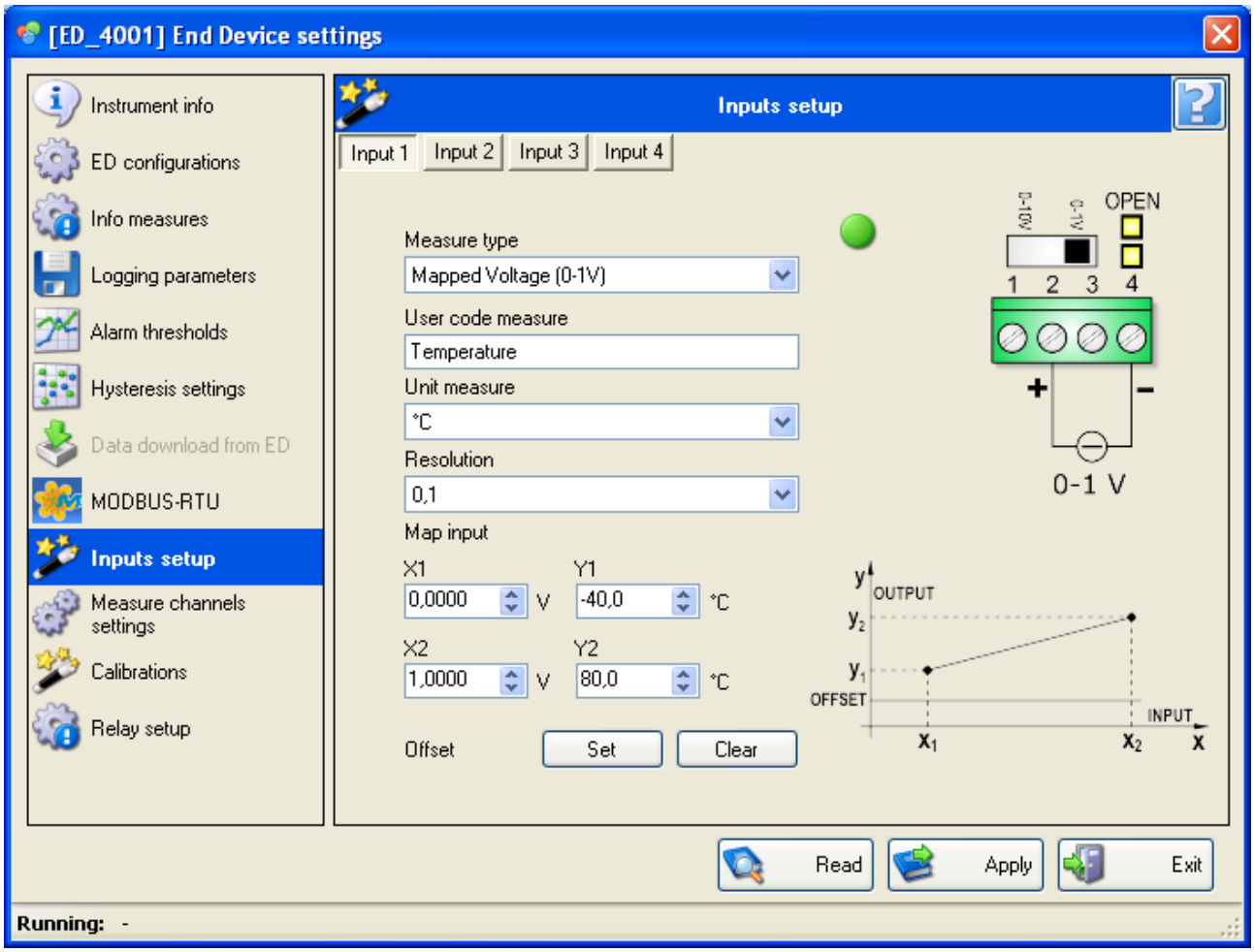


Figure 3: Mapping electrical quantity to physical quantity

Please also follow the indications on PCB or hardware datasheet for the proper configuration of the sliding switches and jumpers in J5, J6, J7, J8 to support the desired measurement type.

The datalogger can also support additional dedicated analog and digital channel measurements. To activate these specific measurements please follow End Device Settings -> Measure channel settings and insert the administration password 9876. Once authentication password is accepted you can choose other up to 8 analog/digital measurements to be performed by the datalogger.

As shown in Figure 4 the list of available measurements appears on the left column, while the list of active measurements is available on the right column. This software window does not allow to change the first 4 available measurements which can be configured only following End Device Settings -> Input Setup. The selection of the active measurement channels is possible through the arrow buttons: “>”, “<”, “>>” and “<<”. The maximum number of active channels is 12 but this limit is going to be relaxed in future firmware/software releases.

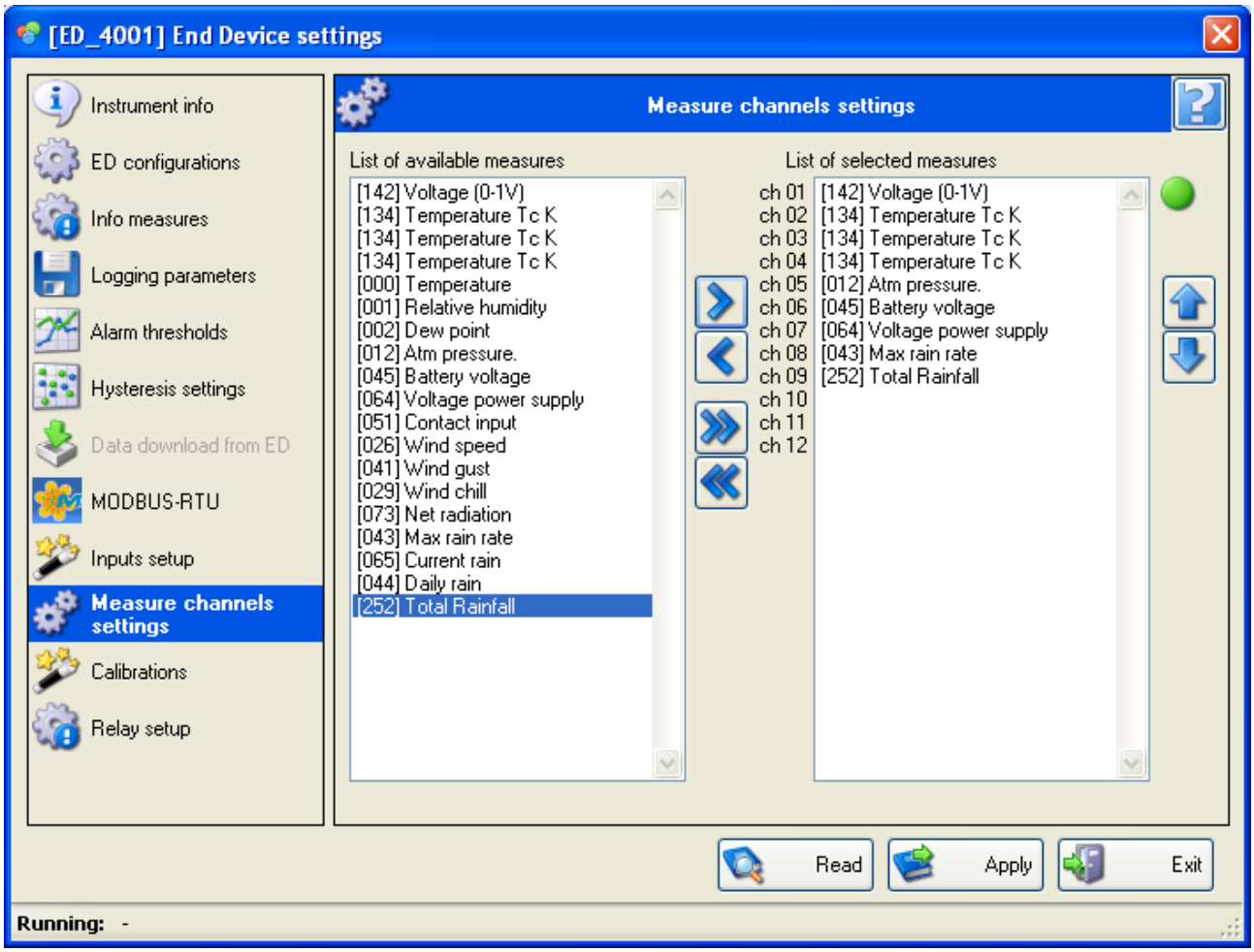


Figure 4: Measure channel settings

Below a detailed explanation of the available analog/digital measurements:

- Temperature, Relative Humidity and Dew Point refer to the dedicated channel input J15 available on PCB HD35WMT-4A. It supports temperature and relative humidity probes of the series HP3517TC... or temperature only probes of the series TP35N... . The probe HP3517TC... must be requested when performing the datalogger purchase order because it requires specific cabling and factory calibration.
- Atmospheric pressure is derived from the digital integrated barometric pressure (optional)
- Battery voltage measures the battery voltage between pins +BATT (1) and GND (2) on PCB HD35WMT-4T
- Voltage power supply measures the voltage between pins +VPanel (4) and GND (5) on PCB HD35WMT-4T
- Contact input refers to the voltage free contact input SWIN2
- Wind speed and wind gust refer to a mechanical anemometer that can be connected to SWIN2. This option must be specified when performing the datalogger purchase order because it requires specific cabling and datalogger configuration.
- Wind chill is a measurement derived from wind speed with mechanical anemometer and dedicated temperature
- Net radiation is a measurement available when the datalogger acquires pyranometer and pyrgeometer measurements of LP NET 14

- Max rain rate, current rain, daily rain and total rainfall refer to a tipping bucket rain gauge that can be connected to SWIN1. Please notice that total rainfall measurement requires 2 measurement channel slots.

Calibration and specific measurement configurations can be performed following End Device Settings -> Calibrations.

2.1 NOT-LINEAR MAPPING FOR LEAF WETNESS ADCON SENSOR

The datalogger supports the leaf wetness sensor by ADCON. The sensor needs voltage supply in the range 5.5 – 12 VDC and provides an output in the range 0 – 2.5VDC. The sensor can be acquired with an analogue channel configured for 0-10V measurement input. Moreover it is necessary to adopt a not linear mapping in the range 0-2.5V -> 0 - 10 as specified in ADCON datasheet. This can be done using the following command:

Configuration command	
Command syntax	**<000>co;CHANNEL_INDEX;MAPPING_MODE**
Waited ack	**<000>0;co;&**
Description	This command can be used to specify the mapping mode to be used in CHANNEL_INDEX = {0,1,2,3} when configured as “user configurable channel”. In detail MAPPING_MODE={0 -> default linear mapping, 1-> not linear mapping used for leaf wetness ADCON sensor}.
Reading command	
Command syntax	**<000>zo**
Waited ack	**<000>0;zo;&;MAPPING_MODE_0;…; MAPPING_MODE_3**
Description	This command can be used to read the current mapping configuration mode for the 4 available analogue channels with MAPPING_MODE_X = ={0 -> default linear mapping, 1-> not linear mapping used for leaf wetness ADCON sensor} where X = {0,1,2,3}.

3 HID TERMINAL PRELIMINARY SETUP

The following sections handle with datalogger configuration via HID Terminal. To set up a connection with datalogger via USB proceed as follows:

1. The device is equipped with mini-USB connector on the housing side. Connect it to the PC by means of the **CP23/CP31** cable.

2. Start the HD35AP-S software and select the *Tools >> HID terminal* command.

3. Select *Setup >> Uart configuration*.

4. Set the Baud Rate to 115200. Press *Apply*.

5. Select *Connect*.

6. Transmit the command **<000>PW;nnnn** with nnnn=administrator password. The waited ack is **<000>0;PW;&;2** and contains the command type “PW”, the field “&” which specifies that command has been accepted and the field “2” which specifies that the current password level is the administration password. In case ack is different try to send it again.

7. It is now possible to send commands to the instrument. When transmitting a command, in case ack contains “?” or “$” after command type it means respectively that command is not valid or device is busy and not ready to receive this command type. Try to send it again. Differently if “#” is received, current password level is expired. In this case password command needs to be sent again.

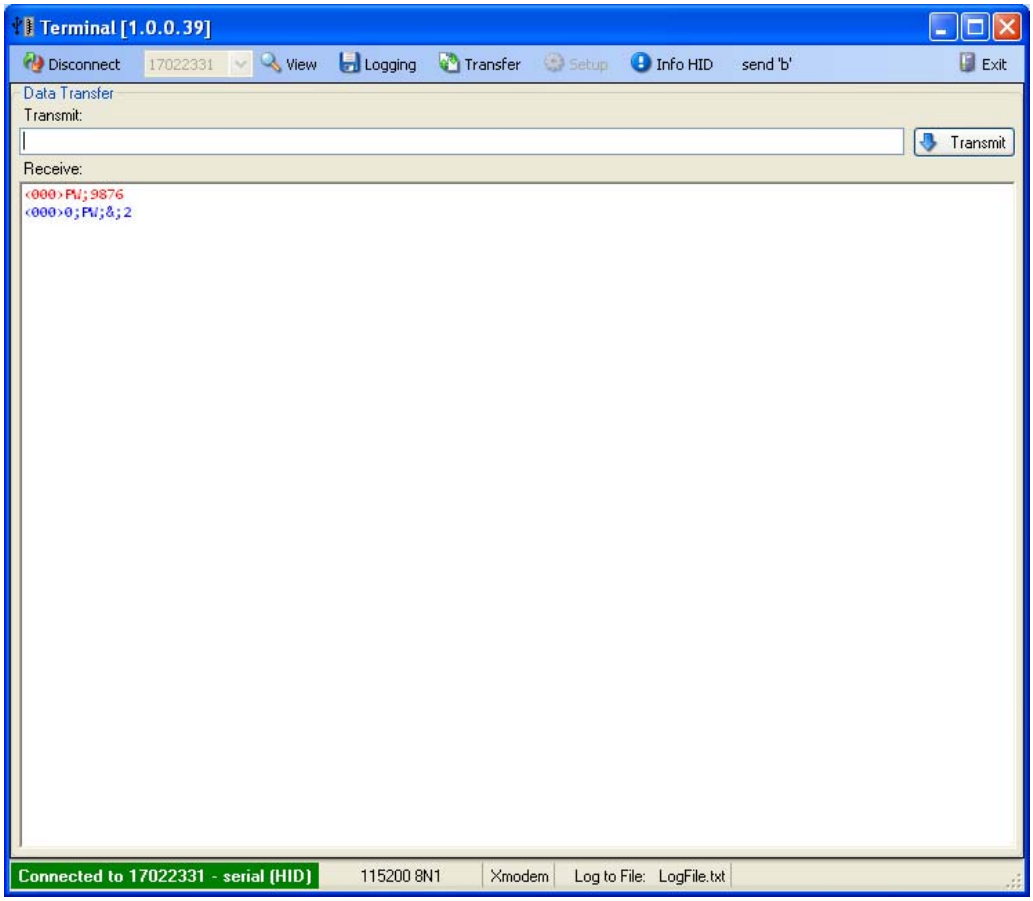


Figure 5: HID Terminal initialization

4 MODBUS RTU SLAVE SENSORS ACQUISITION

As anticipated in the introduction the configuration of RS485 and SDI-12 digital buses is not yet available in software HD35AP-S. The following sections describe how to configure RS485 digital bus via HID Terminal.

4.1 RS485 BUS CONFIGURATION

The RS485 digital bus can support either Modbus RTU protocol (e.g. HD52) or RS485 proprietary protocol (e.g. HD2003). Below the main commands to set up communication rate, modes, command transmission retries and reception timeout.

4.1.1 COMMUNICATION RATE, MODE AND MAX NUMBER OF COMMAND RETRANSMISSION

Configuration command	
Command syntax	**<000>DUM;BAUD_RATE;UART_MODE;NUM_RETRY**
Waited ack	**<000>0;DUM;&**
Description	This command is used to configure baud rate, communication mode and max number of command retries on RS485 bus. The variable BAUD_RATE can assume the following numerical values: -2: 2400 bit/s -1: 4800 bit/s 0: 9600 bit/s 1: 19200 bit/s 2: 38400 bit/s 3: 57600 bit/s 4: 115200 bit/s The baud rates 2400 and 4800 bit/s are available only with the RS485 proprietary protocol. By default BAUD_RATE=1 (19200 bit/s) The variable UART_MODE can assume the following numerical values: 0: 8N1 1: 8N2 2: 8E1 3: 8E2 4: 8O1 5: 8O2 By default UART_MODE=2 (8E1) The variable NUM_RETRY specifies the number of command transmission retries before declaring command failed and associated measurements in error. By default NUM_RETRY=0.
Reading command	
Command syntax	**<000>GUM**

Waited ack	**<000>0;GUM;&;BAUD_RATE;UART_MODE;NUM_RETRY**
Description	This command is used to read the active configuration for BAUD_RATE, UART_MODE and NUM_RETRY. Please refer to command DUM for a detailed description of these variables.

4.1.2 COMMUNICATION TIMEOUT

Configuration command	
Command syntax	**<000>cw;COMM_TIMEOUT**
Waited ack	**<000>0;cw;&**
Description	This command specifies the timeout for ack reception on each RS485 command transmission. This should be configured based on worst case RS485/Modbus sensors reply time. COMM_TIMEOUT is expressed as multiple of 512/1000 ms and by default COMM_TIMEOUT = 51 (~100ms)
Reading command	
Command syntax	**<000>zw**
Waited ack	**<000>0;zw;&;COMM_TIMEOUT**
Description	This command is used to read the active configuration for COMM_TIMEOUT parameter described in cw command.

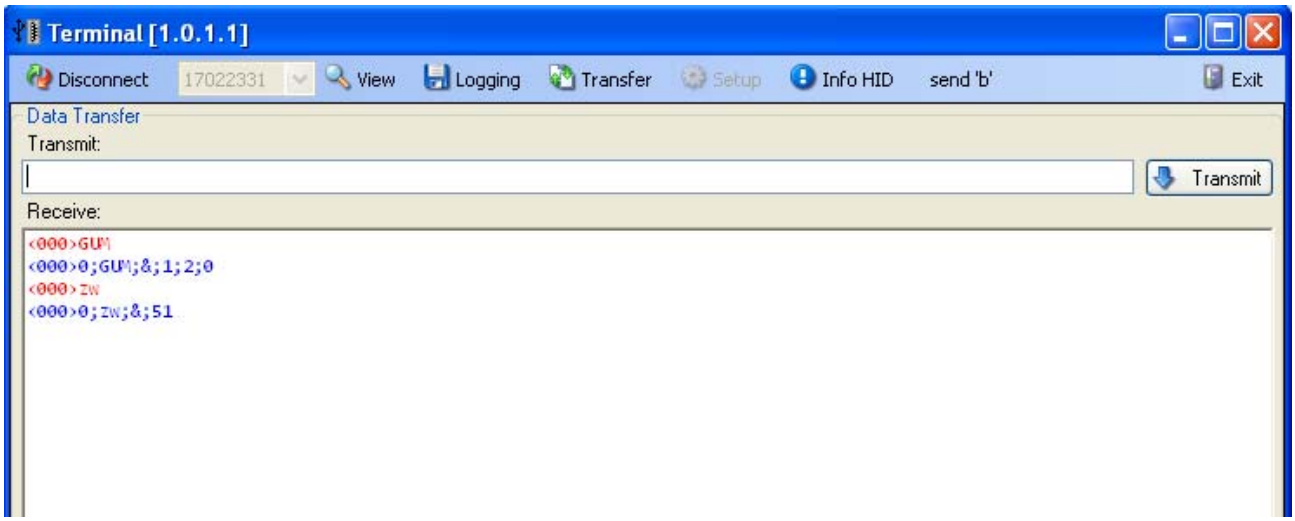


Figure 6: Read commands for RS485 bus configuration

4.2 MEASUREMENT ACQUISITION FROM RS485 / MODBUS RTU SLAVE DEVICES

The following section explains how to add measurements coming from RS485 slave sensors to the list of active measurements. The available measurement channel slots are from channel index 4 to channel index 12. The first 4 channel slots are always used for analog reconfigurable channel inputs. The limit of 12 total measurements is going to be relaxed in future firmware/software releases.

4.2.1 SELECT DEVICE FROM A LIBRARY OF AVAILABLE MODBUS RTU SENSORS

Configuration command	
Command syntax	**<000>cl;ADDRESS;LIBRARY_INDEX[;AGG_0;...;AGG_N]**
Waited ack	**<000>0;cl;&**
Description	This command can be used if only 1 RS485/Modbus RTU slave device needs to be connected to the datalogger. ADDRESS specifies the address of the RS485/Modbus RTU sensor. LIBRARY_INDEX is an index to a library of supported Modbus RTU slave sensors. The possible values for LIBRARY_INDEX are: 0: No device 2: HD52.3D and HD53LS.S 3: HD52.3DP 4: HD52.3D4 5: HD52.3D17 6: HD52.3DP4 7: HD52.3DP17 8: HD52.3D147 9: HD52.3DP147 10: HD9817 and HD9008 11: LP PYRA 0x S 12: LPSD18 13: HD3910 14: HD404ST5AZSR 15: TP32MTT.03 16: TP32MTT.03.1 25: HD404ST4AZSR 26: HD2003.1 via RS485 proprietary protocol 27: HD2003 via RS485 proprietary protocol 28: HD52.3D17 without dew point 29: HD52.3DP17 without dew point 30: HD52.3D147 without dew point 31: HD52.3DP147 without dew point 32: HD9817 and HD9008 without dew point 36: HD9008T7S 37: HD2003 with wind Cartesian components via RS485 proprietary protocol 38: LPSD18 without temperature 39: Total rainfall from MPS Total rain weighing sensor 40: HD2016 Total rainfall 41: HD2016 Partial rain from last reset command

	42: HD2003 without atmospheric pressure via RS485 proprietary protocol 43: HD52 wind gust and gust direction 44: HD52 wind gust 45: HD2003.1 via Modbus RTU 46: HD2003 via Modbus RTU 47: HD2003 without atmospheric pressure via Modbus RTU 50: Total rainfall from HD52.3DTxx 51: Partial rainfall from HD52.3DTxx (recommended way to get rainfall from HD52.3DTxx) 52: Rainfall rate from HD52.3DTxx 53: Total energy from Energy meter SOCOMEC Please notice that setting LIBRARY_INDEX=0 is also used to clear previous configuration and stop measurement acquisition from Modbus RTU slave devices. When LIBRARY_INDEX = 26,27,37,42 the ADDRESS value must be the decimal representation of the ASCII character used in RS485 proprietary protocol. The variables AGG_x are optional and can be used to configure the aggregation policy for the acquired x measurement. AGG_x is effective only on measurements relative to RS485/Modbus RTU sensors. AGG_x specifies how to aggregate the measurements acquired with measurement interval periodicity when producing the logged measurement to be save in device memory. AGG_x can assume the following values: 0: Average aggregation 1: Minimum aggregation 2: Maximum aggregation 3: No aggregation 4: No aggregation, accumulate value when measure wraps around (used for MPS and HD2016) 5: No aggregation, accumulate measure that automatically resets at every reading (used for partial rainfall in HD52.3DTxx) If not specified the default value for AGG_x = 0 (average aggregation) or default aggregation method for specified measure type
Reading command	
Command syntax	**<000>zl**
Waited ack	**<000>0;zl;&; ADDRESS;LIBRARY_INDEX;AGG_0;...;AGG_N**
Description	This command is used to read the active configuration for modbus library. Please refer to command cl for a detailed description of parameters: ADDRESS, LIBRARY_INDEX, AGG_x.

Below an example of datalogger configuration to acquire a HD52.3D147 (LIBRARY_INDEX=8) with Modbus ADDRESS = 1

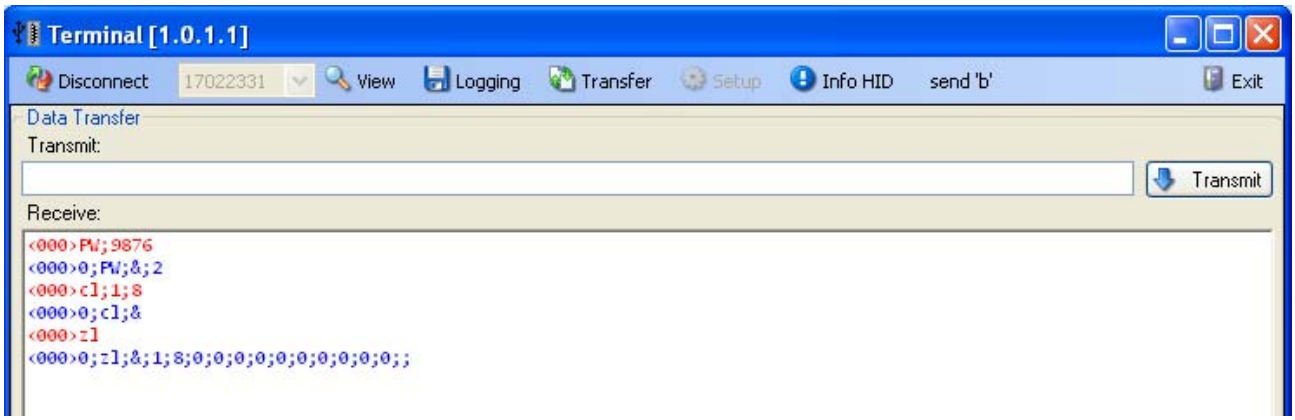


Figure 7: Selection of sensor from modbus library

4.2.2 ADD RS485 / MODBUS RTU SENSOR TO THE LIST OF ACTIVE MEASUREMENTS

In this section we describe how to add the measurements supported by a Modbus RTU sensor when:

- there are already dedicated analog/digital measurements in the list of active measurements
- multiple RS485/Modbus RTU sensors need to be connected

First we introduce the command that can be used to easily add the RS485/Modbus RTU sensor. Then we provide examples for the 2 situations listed above

Configuration command	
Command syntax	**<000>cb;ADDRESS;LIBRARY_INDEX[;AGG_0;...;AGG_N]**
Waited ack	**<000>0;cb;&**
Description	This command can be used to add the measurements supported by the RS485/Modbus RTU slave device identified by LIBRARY_INDEX. Please refer to command “cl” for a detailed description of variables: ADDRESS, LIBRARY_INDEX and AGG_x. The measurements specified in LIBRARY_INDEX are added to the list of active measurements starting from the first available channel index after the last active measurement. Channel index = {0,1,2,3} are reserved for analog reconfigurable channel inputs. The measurements available in LIBRARY_INDEX are included up to the completion of the 12 total measurements.

4.2.2.1 Add Modbus RTU sensor to already active analog/digital dedicated channel measurements

In this example we show how to add a Modbus RTU sensor when there are already active analog/digital dedicated channel measurements.

In detail we want to support HD52.3D147 and a tipping bucket rain gauge. In software HD35AP-S follow “End Device Settings -> Measure channels settings” enter the administration password 9876 and add “Total Rainfall” to the list of active measurements. Push Apply to confirm the changes.

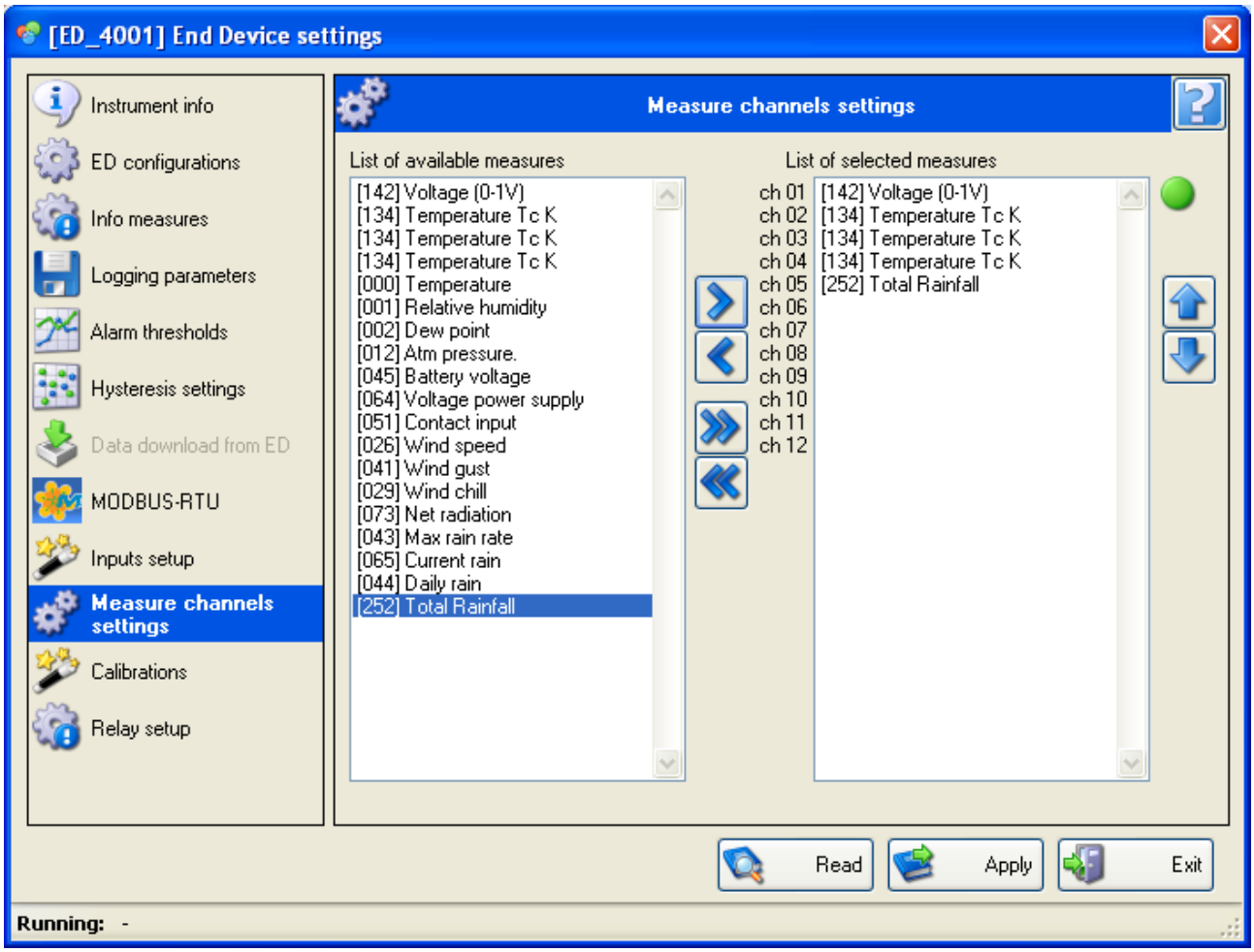


Figure 8: Add Total rainfall to active measurements

Now we disconnect from software HD35AP-S connect via HID terminal and send the command **<000>cb;1;8** where we specify that:

- Modbus RTU ADDRESS=1 for HD52.3D147
- LIBRARY_INDEX=8 to specify exactly HD52.3D147

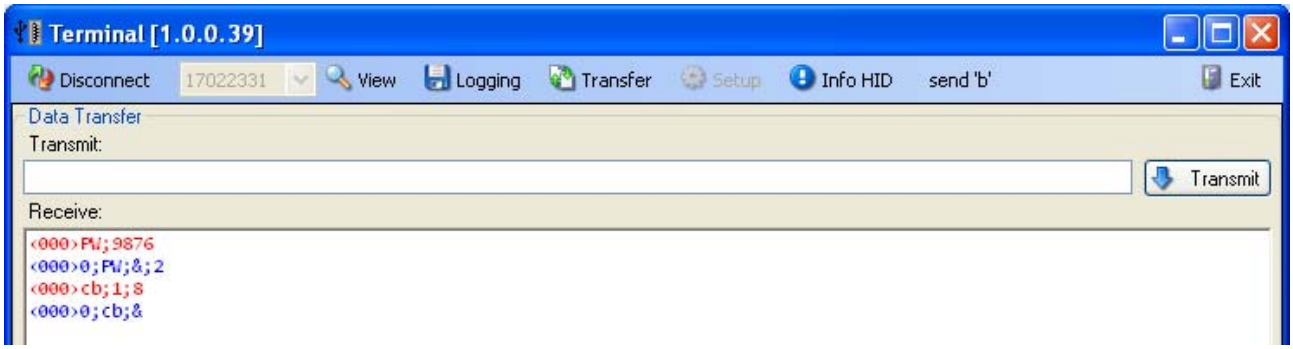


Figure 9: Add HD52.3D147 to active measurements

Connecting again via software HD35AP-S to the datalogger, we can observe monitoring activity is active for analog reconfigurable channel inputs, “Total rainfall” and HD52.3D147

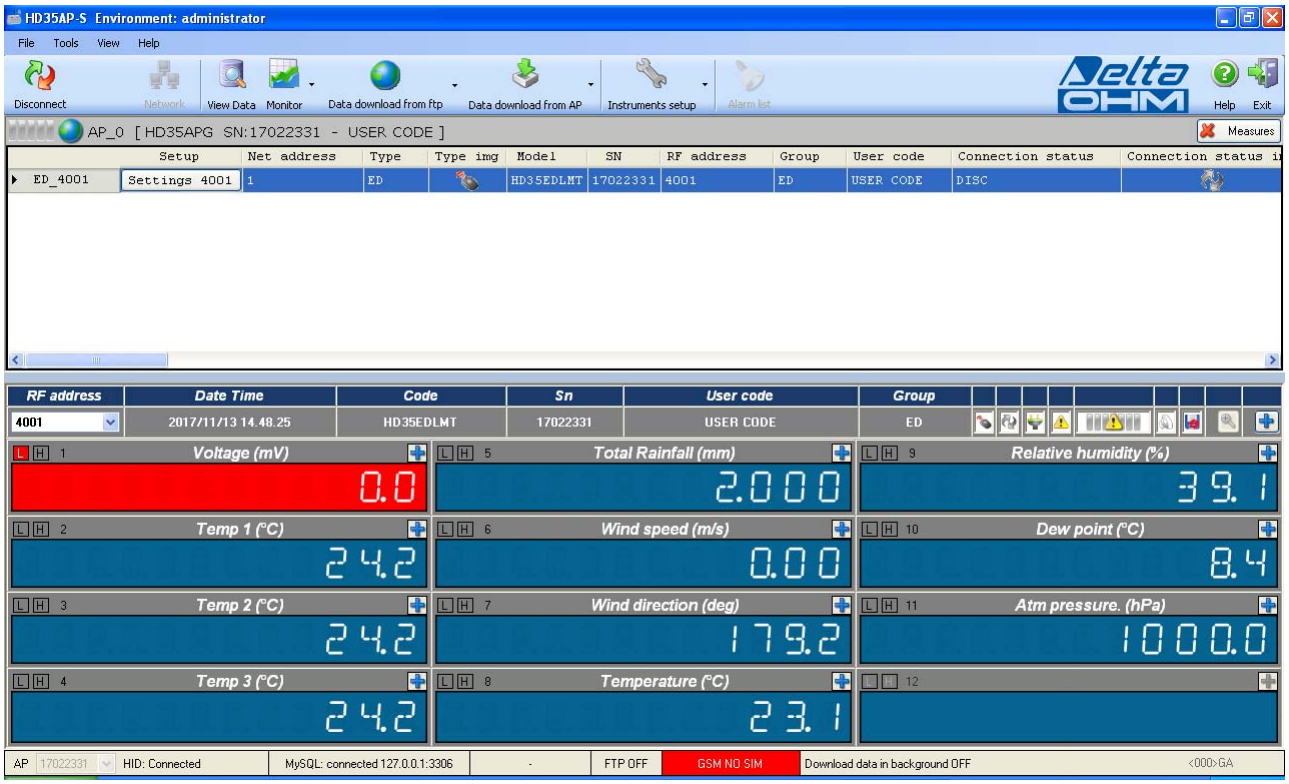


Figure 10: HD52 + dedicated analog measurements

4.2.2.2 Add more than one Modbus RTU sensors

In this example we show how to add more than one Modbus RTU sensors when there are already dedicated analog channel measurements in the list of active channels. We still start from the configuration where “Total rainfall” is among the list of active measurements, than we add HD52.3D and HD3910.

As in previous section follow “End Device Settings -> Measure channels settings” enter the administration password 9876 and add “Total Rainfall” to the list of active measurements. Push Apply to confirm the changes.

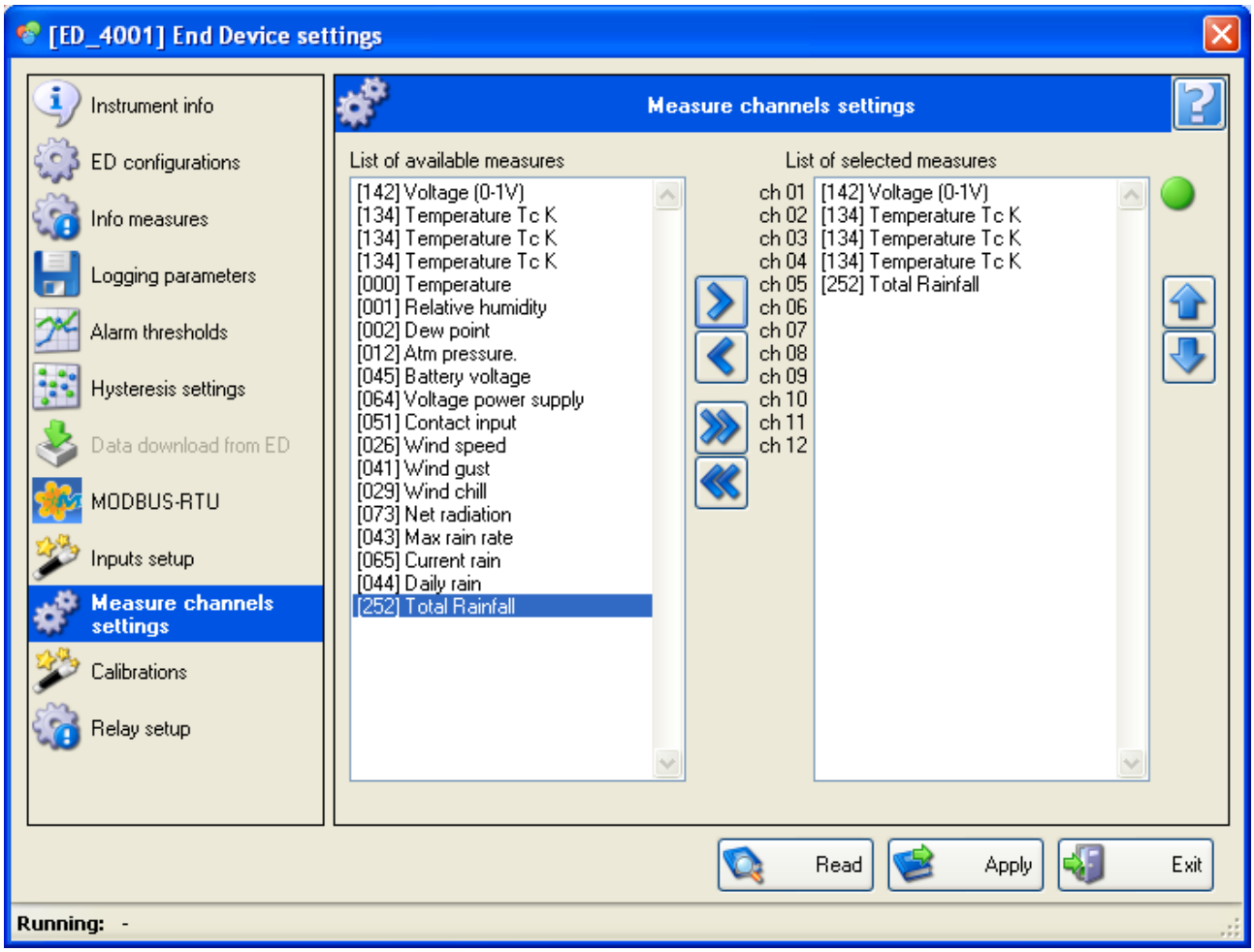


Figure 11: Total rainfall among active measurements

Then disconnect from software HD35AP-S, connect to the datalogger via HID terminal and send the command **<000>cb;1;2** where we specify that:

- Modbus RTU ADDRESS=1 for HD52.3D
- LIBRARY_INDEX=2 to specify exactly HD52.3D

To finally add HD3910 send via HID terminal the command **<000>cb;2;13** where we specify that:

- Modbus RTU ADDRESS=2 for HD3910
- LIBRARY_INDEX=13 to specify exactly HD3910

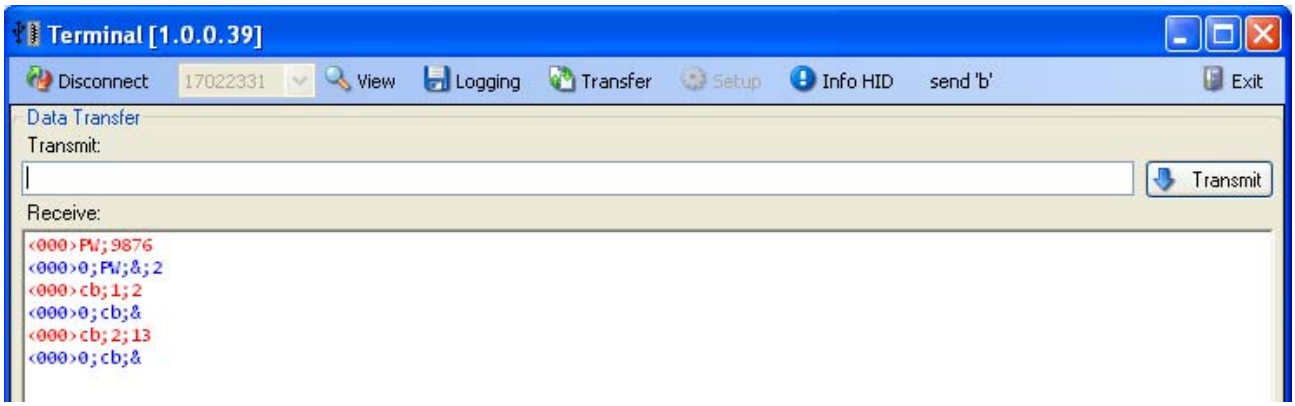


Figure 12: Add more than one Modbus RTU sensor to active measurements

Please remember that configuration via “End Device Settings -> Measure channels settings” in software HD35AP-S always clear Modbus RTU measurement configurations. Moreover the command **<000>cl;1;0** can always be used to clear both dedicated analog/digital channel measurements and RS485/Modbus RTU measurement configurations.

4.2.3 ADD MODBUS REGISTERS FOR THIRD PARTS SENSORS

In this section we describe how to acquire modbus registers from generic third parts sensors. There is the possibility to associate each datalogger measurement channel to a specific modbus register.

First we introduce the command that can be used to add a generic modbus register, then we provide examples of configurations.

<table>
<tr><th colspan="2">Configuration command</th></tr>
<tr><td>Command syntax</td><td><000>cm;CH_INDEX;ADDRESS;FUNC_CODE;REG_INDEX;MEAS_TYPE;AGGREGATION_METHOD[;UNIT_MEAS;RESOLUTION;GAIN;OFFSET]</td></tr>
<tr><td>Waited ack</td><td><000>0;cm;&</td></tr>
<tr><td>Description</td><td>This command is used to configure each datalogger measurement channel individually assigning to each channel a specific modbus register of a slave modbus sensor. The meaning of the fields are the following:
• CH_INDEX = {0,...,11} is the datalogger measurement channel
• ADDRESS = {1,...,247} is the modbus address of the slave sensor
• FUNC_CODE = {0 -> read modbus input register, 1 -> read modbus holding registers, 2 -> analog measure, 3 -> HD2003_M_measure} specifies the modbus command
• REG_INDEX is the modbus register index
• MEAS_TYPE is an index to a measurement type list specific to HD35/HD50/HD33 dataloggers. In case you need a generic measurement type not included in the list of standard measurement types, please consider MEAS_TYPE =152 (digital input). The complete list of available measurement types is the following:
<table>
<tr><th>Measure index</th><th>Measure type</th><th>Resolution and unit measure</th></tr>
<tr><td>0</td><td>Temperature NTC 1</td><td>0.1 °C</td></tr>
<tr><td>1</td><td>Relative Humidity</td><td>0.1 %</td></tr>
<tr><td>2</td><td>Dew point</td><td>0.1 °C</td></tr>
<tr><td>3</td><td>Partial vapour pressure</td><td>0.01 hPa</td></tr>
<tr><td>4</td><td>Mixing ratio</td><td>0.1 g/kg</td></tr>
<tr><td>5</td><td>Absolute humidity</td><td>0.1 g/m^3</td></tr>
<tr><td>6</td><td>Wet point</td><td>0.1 °C</td></tr>
<tr><td>7</td><td>Differential pressure</td><td>0.1 hPa</td></tr>
</table>
</td></tr>
</table>

8	Temperature NTC 2	0.1 °C
9	Solar radiation	1 W/m^2
10	Illuminance	1 lux
11	Carbon monox-ide	1 ppm
12	Atmospheric pressure	0.1 hPa
13	Frequency	1 Hz
15	Daily global ra-diation	1 Wh/m^2
16	Carbon dioxide	1 ppm
17	Volumetric water content 1	0.1 %
18	Soil moisture	0.1 mV
23	Temperature digital sensor	0.1 °C
24	Relative humidity digital sensor	0.1 %
25	Temperature NTC 3	0.1 °C
28	Differential pres-sure	1 Pa
29	Wind Chill	0.1 °C
30	Differential pres-sure	0.1 Pa
31	Differential pres-sure	1 hPa
32	Temperature PT100 solar panel	0.1 °C
33	Pyranometer	0.01 mV
34	UVA	1 mW/m^2
35	UVA proportion	1 uW/lumen
36	Natural wet bulb temperature	0.1 °C
37	Globe tempera-ture	0.1 °C
38	WBGT indoor	0.1 °C
39	WBGT outdoor	0.1 °C
40	Illuminance range 2	10 lux
41	Wind gust	0.1 m/s

42	Differential pressure	0.01 Pa
43	Max rain rate	1 counts/hour
44	Daily rain	1 counts
45	Battery	0.01 V
46	Wind speed	0.01 m/s
47	Wind direction	0.1 DEG
48	Mean kinetic temperature 1	0.1 °C
49	Mean kinetic temperature 2	0.1 °C
50	Mean kinetic temperature 3	0.1 °C
51	Contact input	
52	Flow	1 l/s
53	Flow	1 l/min
54	Flow	1 m^3/min
55	Volumetric water content 2	0.1 %
56	Soil moisture 2	0.1 mV
57	Volumetric water content 3	0.1 %
58	Soil moisture 3	0.1 mV
59	Air speed	0.01 m/s
60	PAR	1 umol/m^2
61	Max rain rate last hour	1 counts
63	Natural wet bulb temperature computed	0.1 °C
64	Voltage power supply	0.01 V
65	Current rain	1 counts
66	Sun presence	
67	Sun in last minute	1 s
68	Sun in last 10 minutes	1 counts
71	Evapotraspiration hour	0.01 mm/h
72	Daily Evapotras-	0.01

	piration	mm/day
73	Net radiation	1 W/m^2
74	Relative pressure	1 hPa
75	Fluid level	0.01 m
76	Leaf wetness down	0.1 %
77	Leaf wetness up	0.1 %
78	PAR	0.1 umol/m^2
79	Wind gust	0.01 m/s
80	Wind gust direc-tion	0.1 DEG
81	UVA	0.01 W/m^2
82	UVB	0.01 W/m^2
83	UVC	0.01 W/m^2
84	RH	0.01 %
85	Max rain rate	0.1 mm/h
86	Albedo	0.1 %
87	Temperature PT100 4 wires high resolution	0.01 °C
88	PM1.0	0.1 ug/m^3
89	PM2.5	0.1 ug/m^3
90	PM4.0	0.1 ug/m^3
91	PM10	0.1 ug/m^3
92	PM typical parti-cle size	0.01 um
128	Temperature PT100 2 wires	0.1 °C
129	Temperature PT100 3 wires	0.1 °C
130	Temperature PT100 4 wires	0.1 °C
131	Temperature PT1000 2 wires	0.1 °C
132	Temperature PT1000 3 wires	0.1 °C

133	Temperature PT1000 4 wires	0.1 °C
134	Temperature TC K	0.1 °C
135	Temperature TC J	0.1 °C
136	Temperature TC T	0.1 °C
137	Temperature TC N	0.1 °C
138	Temperature TC R	0.1 °C
139	Temperature TC S	0.1 °C
140	Temperature TC B	0.1 °C
141	Temperature TC E	0.1 °C
142	Voltage 1V	0.1 mV
143	Voltage 50 mV	0.01 mV
144	Current 4-20 mA	0.01 mA
145	Potentiometer	1 %
150	Voltage 10 V	1 mV
152	Generic digital signed measure	
153	Voltage -50…+50 mV	0.01 mV
156	Temperature float to int16	0.1 °C
158	Temperature PT100	0.01 °C
158	Temperature PT100 3 wires high resolution	0.01 °C
159	Temperature PT100 4 wires high resolution	0.01 °C
160	Temperature PT1000 3 wires high resolution	0.01 °C
161	Temperature PT1000 4 wires high resolution	0.01 °C
162	Flow rate float to int16	1 m^3/h

163	Digital signed input float to int16	not defined
192	Counter least significant part	1 count
193	Counter most significant part	1 count
196	Total rain fall least significant part	0.001 mm
197	Total rainfall most significant part	0.001 mm
198	Daily rain least significant part	0.001 mm
199	Daily rain most significant part	0.001 mm
200	Digital signed input int32 LS part	not defined
201	Digital signed input int32 MS part	not defined
202	Total energy LS part	0.01 kWh
203	Total energy MS part	0.01 kWh
204	Flow rate float to int32 LS part	0.01 m^3/h
205	Flow rate float to int32 MS part	0.01 m^3/h
206	Energy float to int32 LS part	0.001 kWh
207	Energy float to int32 MS part	0.001 kWh
208	Energy float to int32 LS part	0.001 MWh
209	Energy float to int32 MS part	0.001 MWh
252	Rain least significant part	1 count
253	Rain most significant part	1 count

- AGGREGATION_METHOD = {0 -> average, 1 -> minimum, 2 -> maximum, 3 -> none, 4 -> none with accumulation when wraps around, 5 -> none with accumulation at every reading } specifies the aggregation method for measurements logged in flash starting from raw measurements
- UNIT_MEAS, RESOLUTION, GAIN and OFFSET do not need to be specified

for standard meas_type.

If MEAS_TYPE = 152,163,200,201 then

- UNIT_MEAS can be chosen in the following table:

Index	Unit measurement
0	°C
1	°F
2	%
3	g/m^3
4	g/kg
5	mbar
6	bar
7	Pa
8	hPa
9	kPa
10	atm
11	mmHg
12	mmH2O
13	inchHg
14	inchH2O
15	kgf/cm^2
16	PSI
17	m/s
18	km/h
19	ft/sec
20	mph
21	knot
22	W/m^2
23	uW/cm^2
24	Wh/m^2

25	kWh/m^2
26	J/m^2
27	uJ/cm^2
28	V
29	mV
30	mA
31	ppm
32	Hz
33	%
34	DEG
35	lux
36	m/s^2
37	g
38	mm
39	inch
40	CNT
41	mm/h
42	inch/h
43	CNT/h
44	mW/m^2
45	m
46	s
47	uW/lm
48	dB
49	dB(A)
50	kWh
51	l/s
52	l/min

53	gal/min
54	m^3/min
55	m^3/h
56	umol/(m^2s)
57	mm/d
58	kV
59	A
60	kA
61	cm/s
62	klux
63	m^3
64	g/(m^2 * s)
65	ug/m^3
66	um
67	MWh
255	not defined

- RESOLUTION = {-4,-3,-2,-1,0,1,2,3,4} is the number of decimal digits. if resolution < 0 then measure = (register value)*(10^(-resolution))
- GAIN and OFFSET give the possibility to apply a linear mapping of register value. GAIN and OFFSET are expressed with resolution 0.01. The mapping rule is the following: measure = register value*GAIN + OFFSET

4.2.3.1 Example 1

In the following example we show how to configure the datalogger to acquire third parts ultrasonic anemometer with modbus address 1. The registers of interest are the following:

- wind speed with resolution 0.1 m/s (input register address: 42)
- wind direction with resolution 0.1 DEG (input register address: 18)

Clear datalogger configuration

TX: <000>cl;1;0

RX: <000>0;cl;&

Add wind speed from third part Modbus sensor in channel index 4 (channel number = 5)

TX: **<000>cm;4;1;0;42;152;0;17;1;100;0**

RX: **<000>0;cm;&**

Add wind direction from third part Modbus sensor in channel index 5 (channel number = 6)

TX: **<000>cm;5;1;0;18;47;0**

RX: **<000>0;cm;&**

If you desire to assign a user name to the datalogger channels and overwrite the default names assigned according to MEASURE_TYPE, you can send the following command to enable user name configuration

Configuration command	
Command syntax	**<000>dmu;CHANNEL_MASK**
Waited ack	**<000>0;dmu;&;USER_CHANNEL_MASK**
Description	This command can be used to activate user measurement channel name configuration. CHANNEL_MASK is a bit mask where if bit X = 1/0 measurement channel name is configurable/not configurable for channel X. By default CHANNEL_MASK=0. X starts from index 0

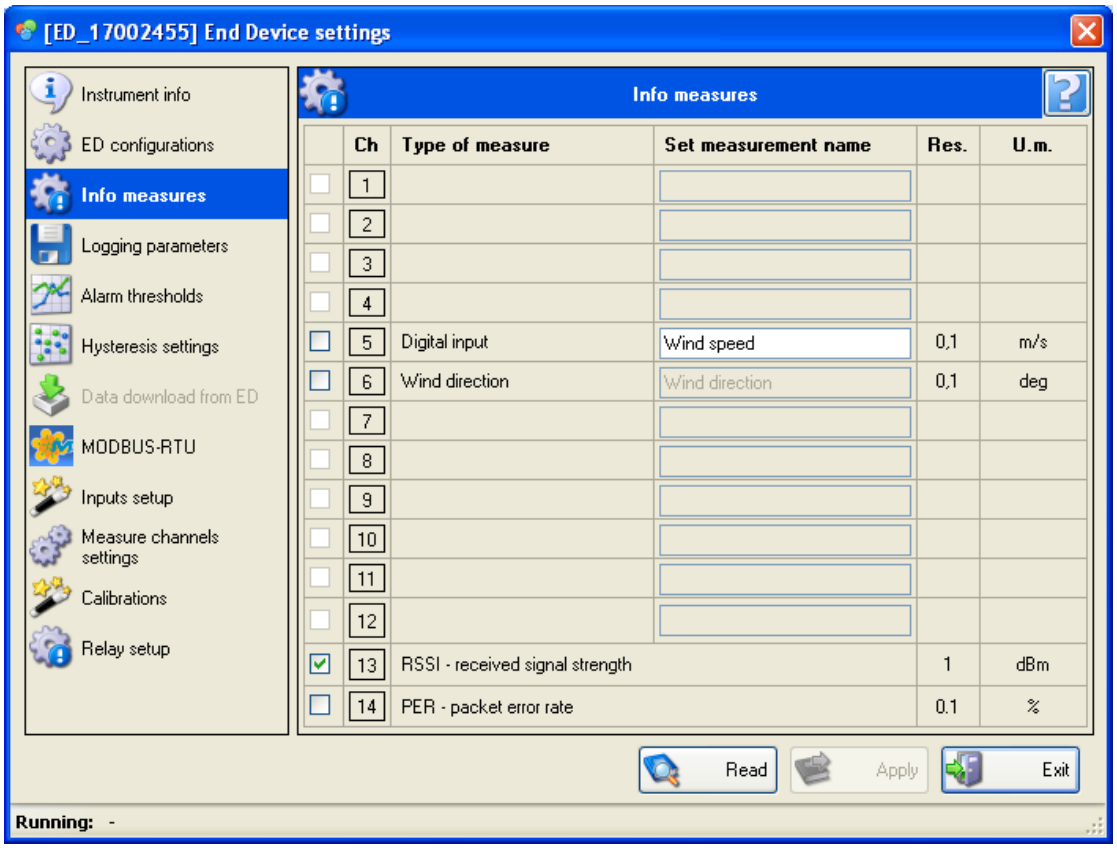
In the previous example if we want to customize measurement name for wind speed channel measure (e.g. channels index = 4, CHANNEL_MASK = 10000b = 16)

TX: **<000>dmu;16**

RX: **<000>0;dmu;&**

After that you can connect to datalogger using software HD35AP-S and you will be able to configure measurement channel names for the measurement channel = 4. Please notice that in HD33MT the first 4 channels always have measurement user name configurable.

For measure user name configuration please close HID Terminal, start software HD35AP-S, follow End Device Settings -> Info measures and configure the desired user name (e.g. Wind speed for channel number = 5 in this case).

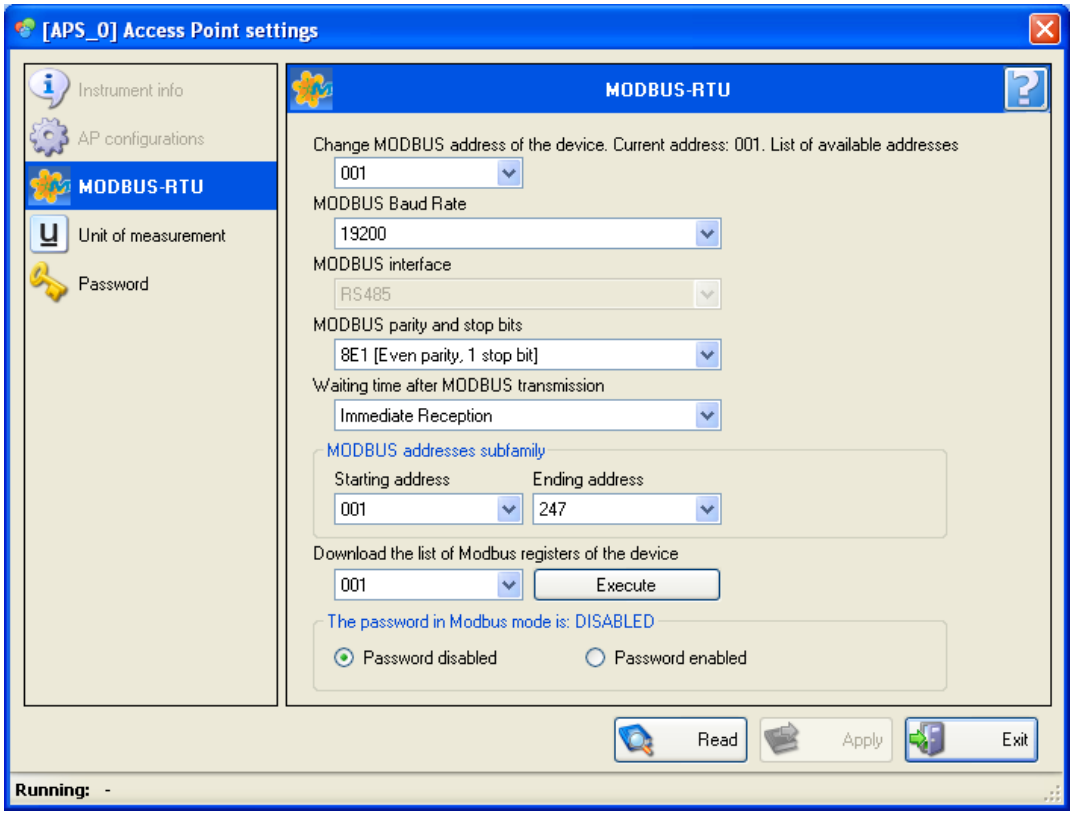

[ED_17002455] End Device settings
Instrument info
ED configurations
Info measures
Logging parameters
Alarm thresholds
Hysteresis settings
Data download from ED
MODBUS-RTU
Inputs setup
Measure channels settings
Calibrations
Relay setup
Info measures
Ch
Type of measure
Set measurement name
Res.
U.m.
1
2
3
4
5
Digital input
Wind speed
0,1
m/s
6
Wind direction
Wind direction
0,1
deg
7
8
9
10
11
12
13
RSSI - received signal strength
1
dBm
14
PER - packet error rate
0.1
%
Read
Apply
Exit
Running: -

5 RS-485 BUS AS MODBUS RTU SLAVE

The RS-485 bus of the datalogger can be configured as Modbus RTU slave for further connection to PLC or third parts SCADA software. To change from Modbus RTU Master (default configuration) to Modbus RTU slave it is necessary to execute the following command via HID Terminal.

Configuration command	
Command syntax	**<000>DUO;MASTER_SLAVE_OPTION**
Waited ack	**<000>0;DUO;&**
Description	This command specified the operating mode of the RS-485 bus where MASTER_SLAVE_OPTION = {0: master (default), 1: slave}.
Reading command	
Command syntax	**<000>GUO**
Waited ack	**<000>0;GUO;&; MASTER_SLAVE_OPTION_SAVED; MASTER_SLAVE_OPTION_ACTIVE**
Description	This command is used to read the operating mode of RS-485 bus where: MASTER_SLAVE_OPTION_SAVED = {0,1} gives the saved master/slave option configuration MASTER_SLAVE_OPTION_ACTIVE = {0,1} gives the master/slave active operating configuration

When the RS-485 bus is used as Modbus RTU slave all bus parameters (e.g. modbus address, baud rate, parity) can be controlled via software HD35AP-S following Instruments setup -> Access Point settings -> MODBUS RTU



6 MODBUS-RTU DIRECT COMMAND TO SENSOR

The datalogger can act as a “bridge” and allow to send Modbus RTU direct read/write commands to the slave sensor connected to the RS-485 bus. This functionality can be useful to configure the sensor without the need to disconnect it from the datalogger. The direct “bridge” command is described below.

Configuration command	
Command syntax	**<000>cc;MODBUS_ADDRESS;FUNC_CODE;START_ADDRESS; NUM_REGISTERS[;VALUE_0;VALUE_1;...;VALUE_N]**
Waited ack	**<000>0;cc;&[;OUT_0;OUT_1;...;OUT_N]**
Description	This command allows to send a direct modbus RTU command to the slave sensor where MODBUS_ADDRESS: is the modbus address of the sensor FUNC_CODE: is the function code according to modbus RTU standard. The supported modbus commands are: 1: read coils 2: read discrete inputs 3: read holding registers 4: read input registers 5: write single coil 6: write single register 15: write multiple coils 16: write multiple registers START_ADDRESS: is the start register address for the read/write command NUM_REGISTERS: is the number of registers to be read/write VALUE_i: is the value to be written for register i in case of write commands (e.g. function codes: 5,6,15,16) In case of read commands (e.g. function codes: 1,2,3,4) the ack contains NUM_REGISTERS additional values (OUT_x) that represent the requested registers.

7 SDI-12 BUS CONFIGURATION

The datalogger has a SDI-12 bus that can be used for a double purpose:

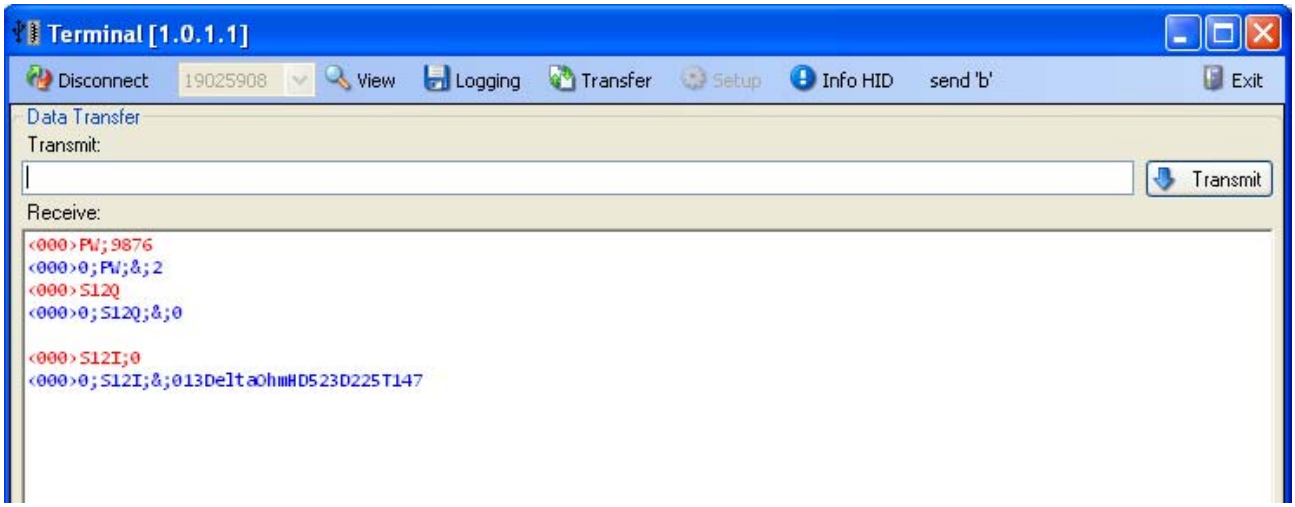
- perform direct communication with SDI-12 sensors connected to the bus
- schedule periodic measurement acquisition from SDI-12 sensors

7.1 DIRECT COMMUNICATION WITH SDI-12 SENSORS

The list of commands that can be used for direct communication with SDI-12 sensors is the following:

SDI-12 related commands	
Command syntax	**<000>S12Q**
Waited ack	**<000>0;S12Q;&;SDI12_ADDRESS**
Description	Read the SDI-12 address of the sensor connected to the bus. This command can be useful to discovery the address of the unique SDI-12 device connected to the bus. The ack gives SDI12_ADDRESS in ASCII format
Command syntax	**<000>S12I;SDI12_ADRESS**
Waited ack	**<000>0;S12I;&;IDENTIFICATION_STRING**
Description	Send SDI-12 identification command to sensor with address: SDI12_ADRESS. The ack contains in IDENTIFICATION_STRING the response to aI! SDI-12 command where 'a' is the SDI-12 address.

Please see below an example of using above commands with a HD52 ultrasonic anemometer

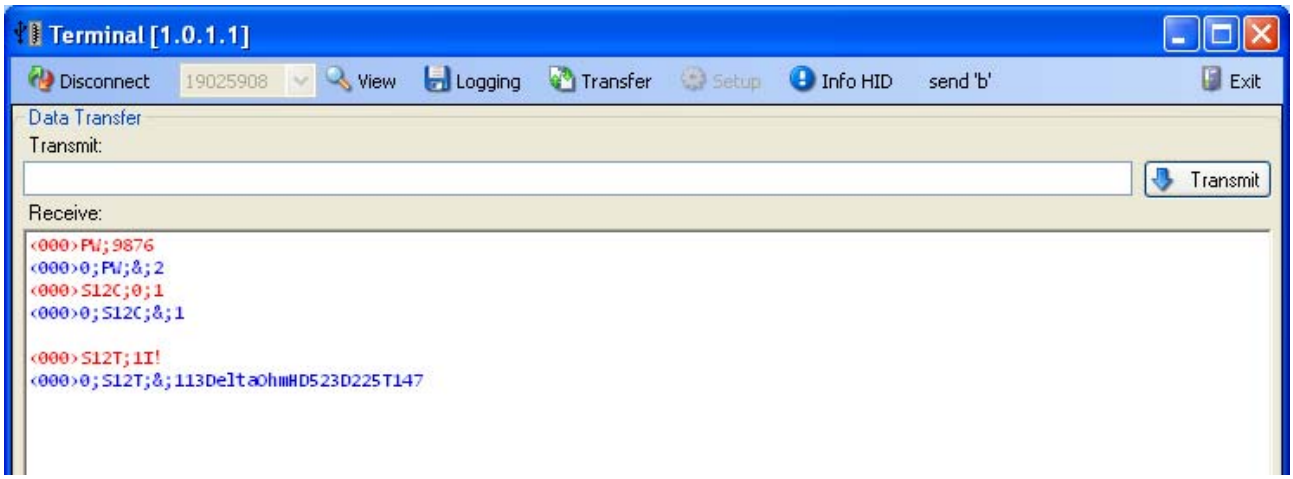


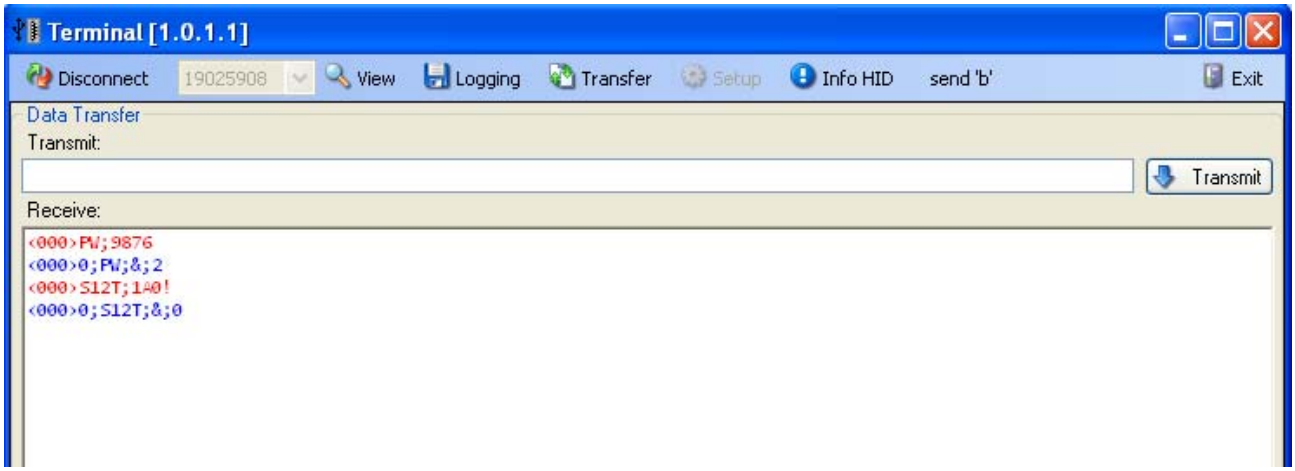
SDI-12 related commands	
Command syntax	**<000>S12C;SDI12_ADDRESS_OLD;SDI12_ADDRESS_NEW**
Waited ack	**<000>0;S12C;&;SDI12_ADDRESS_NEW**
Description	Set the new SDI-12 address (SDI12_ADDRESS_NEW) to the sensor having as address: SDI12_ADDRESS_NEW. The sensor is already scheduled for measurement acquisition by the datalogger. This command performs both address change in SDI-12 sensor and datalogger

	scheduler reconfiguration for measurement acquisition from the new address.
Command syntax	**<000>S12T;FULL_SDI12_COMMAND**
Waited ack	**<000>0;S12T;&;FULL_SDI12_RESPONSE**
Description	This command allows to send direct and full SDI12 command (FULL_SDI12_COMMAND) to the sensor. The ack contains the full SDI-12 response from the sensor

In the example below we show SDI-12 address change from address 0 to address 1 for a sensor that is already scheduled for measurement acquisition. Moreover we show the behaviour of direct SDI-12 command performing:

- identification command 1I! where '1' is the sensor address
- address change for sensor connected to the bus but not already scheduled for measurement acquisition. The SDI-12 command is 1A0! where '1' is the current address and '0' is the new address





The direct command can be used for sensor identification and configuration but not with SDI-12 commands involved in measurement acquisition (e.g. aM!, aM1!,…,aD0!, aD1!, … where 'a' is the sensor address)

7.2 SCHEDULE PERIODIC MEASUREMENT ACQUISITION FROM SDI-12 SENSORS

In this section we describe how to schedule datalogger measurement acquisition from SDI-12 sensors. There is the possibility to associate each datalogger measurement channel to a specific SDI-12 measurement. For scheduling purposes the datalogger works with commands:

0M!, 0M1!, … 0D0!, 0D1!,… where '0' is the SDI12 address

In the following we first introduce the command to add a new measurement to the scheduler and then we provide examples.

Configuration command	
Command syntax	**<000>S12a;CH_INDEX;ADDRESS;CMD_M_IDX;RESP_IDX;MEAS_TYPE; AGGREGATION_METHOD[;UNIT_MEAS;RESOLUTION;GAIN;OFFSET]**
Waited ack	**<000>0;S12a;&**
Description	This command is used to configure each datalogger measurement channel individually assigning to each channel a specific measurement obtained from SDI12 sensor response. The meaning of the fields are the following: • CH_INDEX = {0,…,11} is the datalogger measurement channel • ADDRESS = {0,1,…,9,A,…,Z,a,…,z} is the SDI12 sensor address • CMD_M_IDX = {0,1,…} is the index of the M command to be executed to get the desired measurement • RESP_IDX is the index of the desired measurement considering all measurements provided as ack to the commands 0Dx! with x={0,1,…} For a description of fields MEAS_TYPE, AGGREGATION_METHOD, UNIT_MEAS, RESOLUTION, GAIN and OFFSET refer to command "cm"
Command syntax	**<000>S12R;NUM_RETYRY**
Waited ack	**<000>0;S12R;&**
Description	Set the number of communication retries (NUM_RETRY) before declaring a measure in error due to SDI-12 communication failure.
Command syntax	**<000>S12Z**
Waited ack	**<000>0;S12Z;&;NUM_RETRY**
Description	Get the number of communication retries (NUM_RETRY) before declaring a measure in error due to SDI-12 communication failure

7.2.1.1 Example 1: connect HD52 via SDI-12 bus interface

In the following example we show how to configure the datalogger to acquire HD52.3DT147 ultrasonic anemometer with tipping bucket rain gaudge on the top and having SDI-12 address '0'. The registers of interest are the following:

Clear datalogger configuration

```
TX:  <000>cl;1;0                  //Clear dataloger configuration
RX:  <000>0;cl;&
TX:  <000>S12a;4;0;0;0;46;0       //Add wind speed
RX:  <000>0;S12a;&
TX:  <000>S12a;5;0;0;1;47;0       //Add wind direction
RX:  <000>0;S12a;&
TX:  <000>S12a;6;0;0;2;32;0       //Add temperature
RX:  <000>0;S12a;&
```

```
TX:  <000>S12a;7;0;0;3;1;0          //Add relative humidity
RX:  <000>0;S12a;&
TX:  <000>S12a;8;0;0;6;12;0         //Add atmospheric pressure
RX:  <000>0;S12a;&
TX:  <000>S12a;9;0;1;2;79;2         //Add wind gust
RX:  <000>0;S12a;&
TX:  <000>S12a;10;0;1;5;196;5       //Add total rain fall (least significant part)
RX:  <000>0;S12a;&
TX:  <000>S12a;11;0;1;5;197;5       //Add total rain fall (most significant part)
RX:  <000>0;S12a;&
```

7.2.1.2 Example 1: add SDI-12 measures when analog/digital measures are already scheduled

In this example we show how to add a SDI-12 sensor when there are already active analog/digital dedicated channel measurements.

In detail we want to add a PTM/N SDI-12 pressure sensor keeping analog battery measurement in the list of supported measures. In software HD35AP-S follow “End Device Settings -> Measure channels settings” enter the administration password 9876 and add “Battery voltage” to the list of active measurements. Push Apply to confirm the changes.

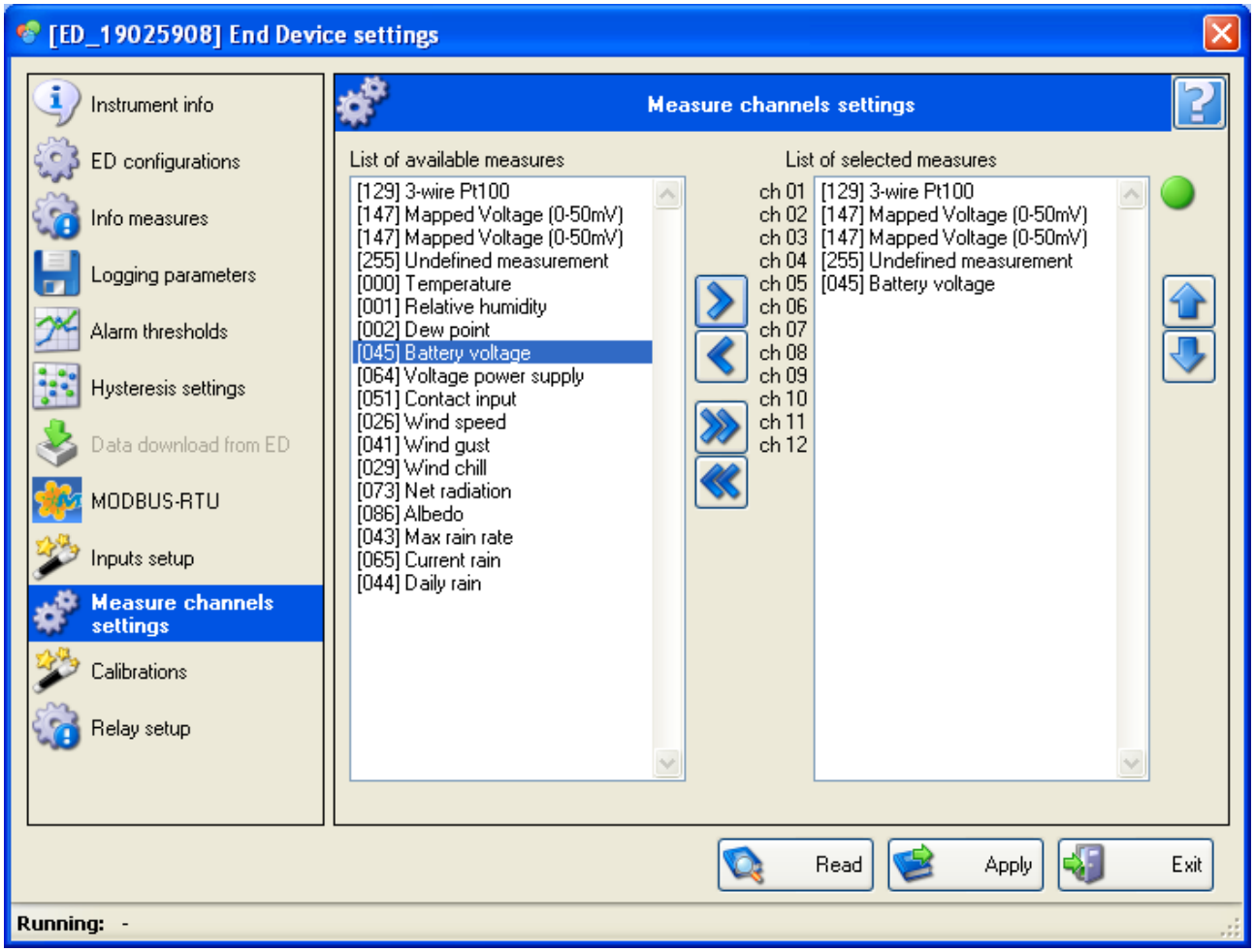


Figure 13: Add battery voltage to active measurements

Now we disconnect from software HD35AP-S connect via HID terminal and send the following commands starting from channel index 5 (since we have indexes 0,1,2,3 for reconfigurable analogue channels and channel 4 for battery voltage measure):

TX: <000>S12a;5;0;0;0;152;0;6;3;100;0 //Get pressure measure in bar with 3 decimal digits. This type of measure is not in the native list of supported measures, therefore we use the generic signed digital measure with index 152

RX: <000>0;S12a;&

TX: <000>S12a;6;0;0;1;0;0 //Get temperature with resolution 0.1 °C

RX: <000>0;S12a;&

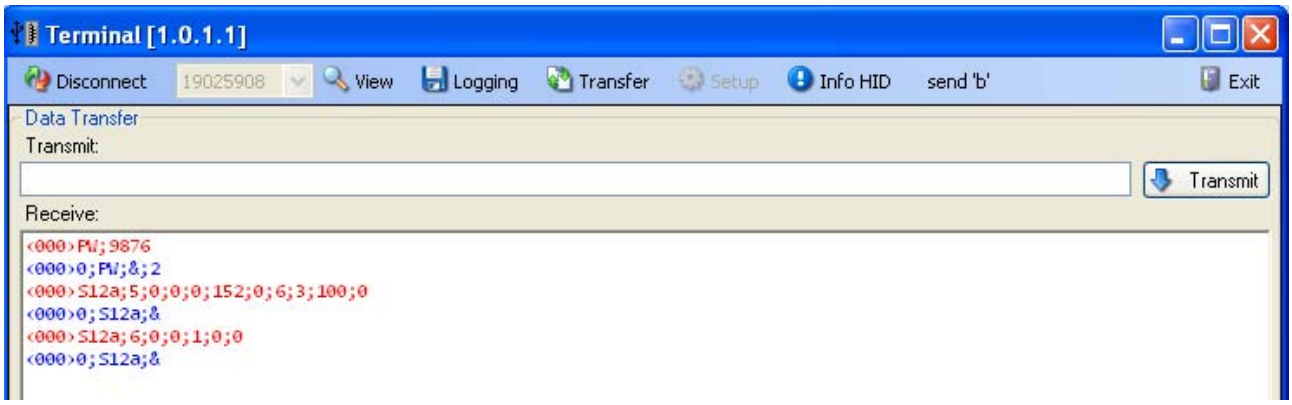


Figure 14: add PTM/N SDI-12 pressure sensor

Since we used generic digital measures the configurability of channel names can be activated with command <000>dmu;CHANNEL_MASK described in previous sections.

8 CONFIGURATION OF SWITCHED POWER SUPPLY OUTPUTS

The switched power supply outputs +Vsw1,+Vsw2 that are used respectively for digital (RS485/SDI-12) and analog sensors, support the following configuration modes:

- always active in order to continuously power up external sensors
- active only during measurements acquisition
- always disabled (if only passive sensors are used).

When active, the power supply outputs have the same value as the battery voltage if the data logger is powered by a solar panel (+Vpanel input), while it is equal to the voltage of the +Vdc input if the data logger is powered by a direct voltage power supply unit (+Vdc input). The operating mode for +Vsw1,+Vsw2 can be configured using the following commands.

Configuration command	
Command syntax	**<000>DEx;INDEX;MODE[;TIME_ON_BEFORE_MEASUREMENT]**
Waited ack	**<000>0;DEx;&**
Description	This command specifies the operating mode for switched power supply output where: INDEX = {0 -> +Vsw2 for analog measurements, 1 -> +Vsw1 for digital buses} specifies the power supply output index, MODE = {0 -> always OFF, 1 -> active only during measurements, 2 -> always ON} specifies the activation/deactivation policy for the power supply output TIME_ON_BEFORE_MEASUREMENTS expressed in seconds specifies how much time before measurement acquisition the power supply output must be turned on in order to cope with external sensors warm up/stabilization. This field must be specified and is significant only when MODE = 1. By default MODE=2 for both INDEX=0,1 when the corresponding peripheral is active for measurement acquisition.
Reading command	
Command syntax	**<000>GEx;INDEX**
Waited ack	**<000>0;GEx;&;INDEX;MODE; TIME_ON_BEFORE_MEASUREMENT;ACTIVE_MODE**
Description	This command is used to read the active configuration for the switched power supply outputs. Please refer to command DEx for the explanation of fields INDEX, MODE and TIME_ON_BEFORE_MEASUREMENT. Additionally ACTIVE_MODE specifies the configuration mode that is already active in the datalogger. MODE and ACTIVE_MODE can be different when the new configuration has not been already applied in the datalogger because waiting for the new measurement time instant or when the measurement interval is not greater than the parameter TIME_ON_BEFORE_MEASUREMENT.

For example if you want to activate +Vsw2 (INDEX=0) only during measurement acquisition (MODE=1) specifying to switch power supply output ON 1 minute before measurements (TIME_ON_BEFORE_MEASUREMENT = 60) then you must send the command **<000>DEx;0;1;60** to datalogger. MODE = 1 will become active only if the specified meas-

urement interval is greater than 1 minute (e.g. 2 minutes). Otherwise MODE = 2 will be kept as active configuration.

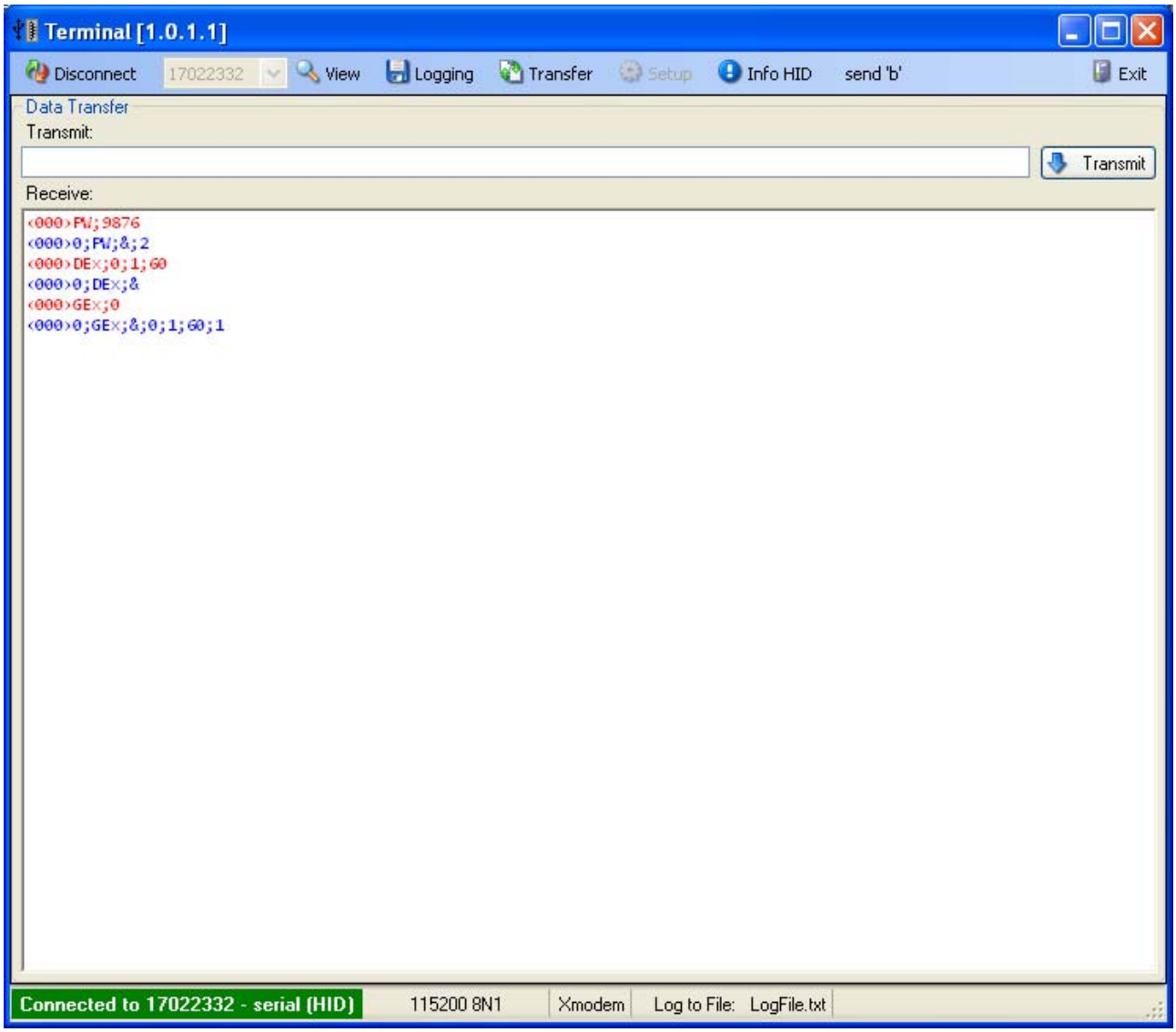


Figura 15: Configuration of power supply output +Vsw2