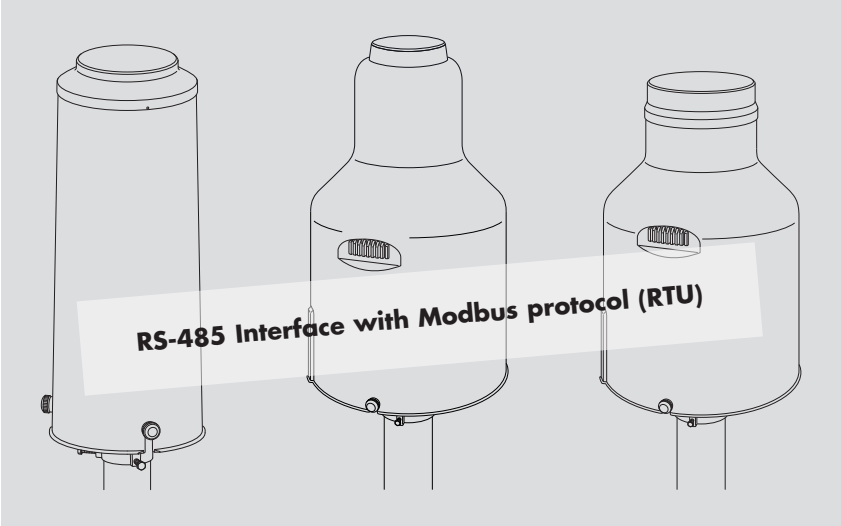
Protocol Description

Precipitation gauge OTT Pluvio² L / OTT Pluvio² S



English

We reserve the right to make technical changes and improvements without notice.

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1 Description RS-485 Interface with Modbus protocol (RTU)

1.1 General note

This "Protocol Description – Precipitation gauge OTT Pluvio² L / OTT Pluvio² S" is an add on to the OTT Pluvio² L and OTT Pluvio² S operating instructions if the Modbus transmission protocol is to be used.

Additionally, please also refer to

- "Operating Instructions – Precipitation gauge OTT Pluvio² L", particularly chapter 6.3 (document number: 70.040.000.B.E);
- "Operating Instructions – Precipitation gauge OTT Pluvio² S", particularly chapter 6.3 (document number: 70.030.001.B.E);
- "MODBUS Application Protocol Specification", available on "www.modbus.org";
- the operating instructions of the device to which the OTT Pluvio² L / OTT Pluvio² S is connected to.

1.2 Preconditions

▶ Interface	EIA-485 (RS-485)
▶ Transmission parameter	
– Data bits	8
– Stop bits	1 · 2 (only with parity „None")
– Parity	Even* · Odd · None
▶ Transmission speed	9 600* · 19 200 · 57 600 · 115 200 bit/s
▶ Bus address	1* … 247
	* factory setting

1.3 Standard Data Formats

Implementations are restricted to data points in the following standard data format:

– int: signed integer value
– uint: unsigned integer value
– bitfield: a collection of bits, multi-valued alarms or state
– string: a null terminated or fixed length value

▶ 16-bit Integer values

Values are stored in big-endian order per the Modbus specification and consist of a single register. All integer values are documented as signed or unsigned. All signed values are represented using two's compliment format.

int range: –32 767 … +32 767 not implemented: 0x8000
uint range: 0 … 65 534 not implemented: 0xFFFF
bitfield16 range: 0 … 0x7FFF not implemented: 0xFFFF

Modbus Register	1															
Byte	0								1							
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

▶ 32-bit Integer values

32-bit integers are stored using two registers in big-endian order.

int range: –214 483 647 … +214 483 647 not implemented: 0x80 000 000
uint range: 0 … +4 294 967 294 not implemented: 0xFF FFF FFF

Modbus Register	1		2	
Byte	0	1	2	3
Bit	31 … 24	23 … 16	15… 08	07 … 00

▶ Floating point values

Floating point values are 32 bits and encoded according to the IEEE 754 floating point standard.

float32 range: see IEEE 754 not implemented: 0x7F C00 000 (NaN)

Modbus Register	1															
Byte	0								1							
Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
IEEE 754	sign	Exponent							Fraction							

Modbus Register	2															
Byte	2								3							
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
IEEE 754	Fraction least															

▶ String values

Store variable length string values in a fixed size register range using a NULL (0 value) to terminate or pad the string. For example, up to 16 characters can be stored in 8 contiguous registers as follows:

not implemented values: all registers filled with NULL or 0x0000

Modbus Register	1		2		3		4		5		6		7		8	
Byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Bit	E	X	A	M	P	L	E	spc	S	T	R	I	N	G	!	NULL

Note: The OTT Pluvio² L / OTT Pluvio² S has only one "Holding Register" Block.

1.4 Function "Read Holding Registers" (0x03) – Sensor description

Register name	Register-number [1]	Data type	Length	Access mode	min. / max.	Description
Protocol ID	1 (0)	uint32	2	R		OTT HydroMet device assignment starting with register number 41001 and beginning with the 32-bit "OTTP" identifier (0x4F545420). This allows for discovery of OTT HydroMet Modbus protocol compatible devices.
Protocol description ID	3 (2)	uint16	1	R		0x0002 "Common Block Pluvio 2S/L"
Protocol description length	4 (3)	uint16	1	R		Total number of 16-bit registers (registers names are marked in italics)
Product ID	5 (4)	unit32	2	R		Product ID 70030 (0x0001118E)
Device ID	7 (6)	unit32	2	R		Device ID 001 (0x00000001)
Firmware version	9 (8)	unit32	2	R		V1.23.4 = 123400 (0x0001E208)
Bootloader version	11 (10)	unit32	2	R		V1.23.4 = 123400 (0x0001E208)
Physical element reference system	13 (12)	uint16	1	R		0x002 = OTT (0x001 = SHEF)
Unit reference system	14 (13)	uint16	1	R		0x002 = OTT (0x001 = SHEF)
Number of channels	15 (14)	uint16	1	R	1 … 40	Number of sensor channels
Channel 1 – physical element definition	16 (15)	uint16	1	R		Intensity RT 'PA'
Channel 1 – unit	17 (16)	uint16	1	R		0x0020: mm/h 0x0021: mm/min 0x0022: inch/h 0x0023: inch/min
Channel 1 – unit string	18 (17)	uint16	*5*	R		e.g. mm/h (register is 5 x 16 bit long and contains a char[10] array)
Channel 2 – physical element definition	23 (22)	uint16	1	R		Accu RT-NRT 'PB'
Channel 2 – unit	24 (23)	uint16	1	R		0x0007: inch 0x0009: mm
Channel 2 – unit string	25 (24)	uint16	*5*	R		Refer to channel 1 unit string example
Channel 3 – physical element definition	30 (29)	uint16	1	R		Accu NRT 'PC'
Channel 3 – unit	31 (30)	uint16	1	R		0x0007: inch 0x0009: mm
Channel 3 – unit string	32 (31)	uint16	*5*	R		Refer to channel 1 unit string example

[1] the corresponding register start addresses are given in brackets (register number - 1 = register start address)

Register name	Register-number [1]	Data type	Length	Access mode	min. / max.	Description
▶ Channel 4 – physical element definition	37 (36)	uint16	1	R		Accu total NRT 'PD'
▶ Channel 4 – unit	38 (37)	uint16	1	R		0x0007: inch 0x0009: mm
▶ Channel 4 – unit string	39 (38)	uint16	5	R		Refer to channel 1 unit string example
▶ Channel 5 – physical element definition	44 (43)	uint16	1	R		Bucket RT 'PE'
▶ Channel 5 – unit	45 (44)	uint16	1	R		0x0007: inch 0x0009: mm
▶ Channel 5 – unit string	46 (45)	uint16	5	R		Refer to channel 1 unit string example
▶ Channel 6 – physical element definition	51 (50)	uint16	1	R		Bucket NRT 'PE'
▶ Channel 6 – unit	52 (51)	uint16	1	R		0x0007: inch 0x0009: mm
▶ Channel 6 – unit string	53 (52)	uint16	5	R		Refer to channel 1 unit string example
▶ Channel 7 – physical element definition	58 (57)	uint16	1	R		Temperature of load cell 'TL'
▶ Channel 7 – unit	59 (58)	uint16	1	R		0x0010: DEGREE C 0x0011: DEGREE F
▶ Channel 7 – unit string	60 (59)	uint 16	5	R		Refer to channel 1 unit string example
▶ Channel 8 – physical element definition	65 (64)	uint16	1	R		Status of the heating 'SH'
▶ Channel 8 – unit	66 (65)	uint16	1	R		0x0001: none
▶ Channel 8 – unit string	67 (66)	uint16	5	R		Refer to channel 1 unit string example
▶ Channel 9 – physical element definition	72 (71)	uint16	1	R		Status of the device 'SD'
▶ Channel 9 – unit	73 (72)	uint16	1	R		0x0001: none
▶ Channel 9 – unit string	74 (73)	uint16	5	R		Refer to channel 1 unit string example

[1] the corresponding register start addresses are given in brackets (register number - 1 = register start address)

Register name	Register-number [1]	Data type	Length	Access mode	min. / max.	Description
▶ Channel 10 – physical element definition	79 (78)	uint16	1	R		Temperature of electronics unit 'TE'
▶ Channel 10 – unit	80 (79)	uint16	1	R		0x0010: DEGREE C 0x0011: DEGREE F
▶ Channel 10 – unit string	81 (80)	uint16	5	R		Refer to channel 1 unit string example
▶ Channel 11 – physical element definition	86 (85)	uint16	1	R		Supply voltage 'VB'
▶ Channel 11 – unit	87 (86)	uint16	1	R		0x0030: V
▶ Channel 11 – unit string	88 (87)	uint16	5	R		Refer to channel 1 unit string example
▶ Channel12 – physical element definition	93 (92)	uint16	1	R		Temperature of orifice rim 'TR'
▶ Channel 12 – unit	94 (93)	uint16	1	R		0x0010: DEGREE C 0x0011: DEGREE F
▶ Channel 12 – unit string	95 (94)	uint16	5	R		Refer to channel 1 unit string example

[1] the corresponding register start addresses are given in brackets (register number - 1 = register start address)

Example

Read Holding Register, register number 9 "Firmware version":

```
000088-Tx: 01 03 00 08 00 02 45 C9
000089-Rx: 01 03 04 00 00 04 24 F8 E8
```

▶ Transmit (Tx)
- Modbus address 01_{16}
- function "Read Holding Register" 03_{16}
- start address $00\ 08_{16} \rightarrow 8_{10}$
- number of registers to read $00\ 02_{16} \rightarrow 2_{10}$
- checksum $45\ C9_{16}$

▶ Receive (Rx)
- Modbus address 01_{16}
- function "Read Holding Register" 03_{16}
- number of data bytes $04_{16} \rightarrow 4_{10}$
- response $00\ 00\ 04\ 24_{16} \rightarrow 1060_{10}$ → firmware version V1.06.0 (unit32)
- checksum $F8\ E8_{16}$

(000088/000089: sequential line number of the communication software; example only, not relevant)

1.5 Function "Read Holding Registers" (0x03) – Sensor values

Register name	Register-number [1]	Data type	Length	Access mode	Description
▶ Timestamp – date	101 (100)	unit32	2	R	**Date;** format: 0x00ddMMyy dd = day; MM = month; yy = year
▶ Timestamp – time	102 (101)	unit32	2	R	**Time;** format: 0x00HHmmss HH = hour; mm = minutes; ss = seconds
▶ Channel 1	105 (104)	float32	2	R	**Intensity RT**
▶ Channel 2	107 (106)	float32	2	R	**Accu RT-NRT**
▶ Channel 3	109 (108)	float32	2	R	**Accu NRT**
▶ Channel 4	111 (110)	float32	2	R	**Accu total NRT**
▶ Channel 5	113 (112)	float32	2	R	**Bucket RT**
▶ Channel 6	115 (114)	float32	2	R	**Bucket NRT**
▶ Channel 7	117 (116)	float32	2	R	**Temperature of load cell**
▶ Channel 8	119 (118)	float32	2	R	**Status of the heating**
▶ Channel 9	121 (120)	float32	2	R	**Status of the device**
▶ Channel 10	123 (122)	float32	2	R	**Temperature of electronics unit**
▶ Channel 11	125 (124)	float32	2	R	**Supply voltage**
▶ Channel 12	127 (126)	float32	2	R	**Temperature of orifice rim**

[1] the corresponding register start addresses are given in brackets (register number - 1 = register start address)

1.6 Function "Read Holding Registers" (0x03) / "Write Single Register" (0x06) – Configuration

Register values/factory settings are described in Chapter 6 "SDI-12 commands and responses" of OTT Pluvio² L / OTT Pluvio² S Operating Instructions.

Changes to the Modbus communication settings will cause a Modbus timeout because the internal communication is restarted and the stack cannot respond. Successful changes are answered with a regular Modbus response, invalid data with "illegal data value" and unsupported register addresses with "illegal data address".

Please note: Changes to the SD-I12 address will reset the entire system and cause a Modbus timeout.

Register name	Register-number [1]	Data type	Length	Access mode	Description
▶ Unit intensity	201 (200)	uint16	1	R/W	Setting the intensity unit 0x0020: mm/h 0x0021: mm/min 0x0022: inch/h 0x0023: inch/min
▶ Unit temperature	202 (201)	uint16	1	R/W	Setting the temperature unit 0x0010: degree Celsius 0x0011: degree Fahrenheit
▶ Pulse output rate	203 (202)	uint16	1	R/W	Setting the pulse output rate 0x0002: 2 Hz 0x0005: 5 Hz
▶ Pulse output factor	204 (203)	uint16	1	R/W	Setting the pulse output rate 0x0000: pulse rate 0.5 0x0001: pulse rate 1 0x0002: pulse rate 2 0x0003: pulse rate 5 0x0004: pulse rate 10
▶ Orifice rim heater mode	205 (204)	uint16	1	R/W	Setting the orifice rim heater mode 0x0000: deactivated 0x0001: heater mode 1 0x0002: heater mode 2 0x0003: heater mode 3 0x0004: heater mode 4
▶ Orifice rim heater target temperature	206 (205)	int16	1	R/W	Setting the orifice rim target temperature 0x0002 … 0x0009: +2 … +9 °C
▶ Orifice rim heater lower temperature limit	207 (206)	int16	1	R/W	Setting the orifice rim lower temperature limit 0xFFD8 … 0x0009: –40 … +9 °C Refer to data format "16-bit Integer values"!
▶ Orifice rim heater on-time/after-run time	208 (207)	uint16	1	R/W	Setting the orifice rim heater on-time/after-run time 0x0001 … 0x05A0: 1 … 1440 minutes
▶ Orifice rim heater starting time (hour)	209 (208)	uint16	1	R/W	Setting the orifice rim heater starting time; 0x0000 … 0x017: 0 … 23 (o'clock)
▶ Orifice rim heater starting time (minutes)	210 (209)	uint16	1	R/W	Setting the orifice rim heater starting time; 0x0000 … 0x003B: 0 … 59 minutes
▶ Orifice rim heater starting time (seconds)	211 (210)	uint16	1	R/W	Setting the orifice rim heater starting time; 0x0000 … 0x003B: 0 … 59 seconds

[1] the corresponding register start addresses are given in brackets (register number - 1 = register start address)

Register name	Register-number [1]	Data type	Length	Access mode	Description
▶ Orifice rim heater self-test interval	212 (211)	uint16	1	R/W	Setting the orifice rim heater self-test interval 0x0000 … 0xFDE8: 0 … 65000 min
▶ Serial interface	213 (212)	uint16	1	R/W	Setting the serial interface 0x0000: SDI-12 0x0001: RS-485 2-wire 0x0002: RS-485 4-wire
▶ RS-485 interface mode	214 (213)	uint16	1	R/W	Setting the serial interface 0x0000: SDI-12 protocol 0x0001: ASCII (RS-485 command line mode) 0x0002: – (special application) 0x0003: Modbus (RTU) protocol
▶ SDI-12 address	215 (214)	uint16	1	R/W	Setting the SDI-12 address ASCII value!; e.g. SDI-12 address "0" = 0x0030 0x0030 … 0x0039: 0 … 9 0x0041 … 0x005A: A … Z 0x0061 … 0x007A: a … z
▶ Modbus bus address	216 (215)	uint16	1	R/W	Setting the Modbus bus address 0x0001 … 0x00F7: 1 … 247
▶ RS-485 baud rate	217 (216)	uint16	1	R/W	Setting the Modbus baud rate 0x0000: 9 600 bit/s 0x0001: 19 200 bit/s 0x0002: 57 600 bit/s 0x0003: 115 200 bit/s
▶ Modbus parity framing	218 (217)	uint16	1	R/W	Setting the Modbus parity framing 0x0000: None (1 stop bit) 0x0001: None (2 stop bits) 0x0002: Odd (1 stop bit) 0x0003: Even (1 stop bit)
▶ Reset Accu total NRT	219 (218)	uint16	1	R/W	Resetting the "Accu total NRT" value; write "0x0001" into register to reset the value

[1] the corresponding register start addresses are given in brackets (register number - 1 = register start address)

Example

Write Single Register, register number 201, setting the intensity unit to mm/min:

```
000242-Tx: 01 06 00 C8 00 21 C8 2C
000243-Rx: 01 06 00 C8 00 21 C8 2C
```

▶ Transmit (Tx) / Receive (Rx)
- – Modbus address 01_{16}
- – function "Write Single Register" 06_{16}
- – start address $00\ C8_{16} \rightarrow 200_{10}$
- – write $00\ 21_{16} \rightarrow$ mm/min
- – checksum $C8\ 2C_{16}$

(`000242/000243`: sequential line number of the communication software; example only, not relevant)

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