Modbus Installation and operating instructions

FA 5xx Sensors

I.   Foreword

Dear customer,

thank you very much for deciding in favour of the FA 5xx. Please read this installation and operation manual carefully before mounting and initiating the device and follow our advice. A riskless operation and a correct functioning of the dew point sensors are only guaranteed in case of careful observation of the described instructions and notes.

Sales Office South/Geschäftsstelle Süd

Zindelsteiner Str. 15
D-78052 VS-Tannheim

Tel.: +49 (0) 7705 978 99 0
Fax: +49 (0) 7705 978 99 20

Mail: info@cs-instruments.com
Web: http://www.cs-instruments.com

Sales Office North/Geschäftsstelle Nord

Am Oxer 28c
D-24955 Harrislee

Tel.: +49 (0) 461 700 20 25
Fax: +49 (0) 461 700 20 26

Mail: info@cs-instruments.com
Web: http://www.cs-instruments.com

II. Table of contents

1 Instructions

This manual is intended to provide instructions for the installation and use of the FA 5xx MODBUS function. The FA 5xx MODBUS function can let the MODBUS master device to read out the online measurement values.

This manual is not intended to be a complete tutorial on the MODBUS RTU protocol, and it is assumed the end user already has a general working knowledge of MODBUS RTU Communications, especially in respect of master station configuration and operation. However an overview is included in the following section to explain some of the fundamental aspects of the protocol.

1.1   Definition and abbreviation

CRC	Cyclic Redundancy Check Used for error—checking in MODBUS RTU. See appendix
Modbus Master	A MODBUS device, which is able to access data in one or more connected MODBUS slaves
Modbus Slave	A MODBUS device, which is able to respond to requests from a single MODBUS master
Modbus Address	Throughout this document the following notation is used to address MODBUS RTU registers see chapter 8 **Addressing**: Holding Register 1009 is addressed in messages by 1008
PDU	MODBUS protocol data unit
ADU	MODBUS application data unit
MBAP	MODBUS application protocol
RS485	Refers to the 2—wire communication standard defined by EIA/TIA-485. (Physical layer)
Ethernet	

1.2   References

1.   MODBUS over Serial Line Specification and Implementation Guide V1.02
       modbus.org 2006 Dec 20
2.   MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b modbus.org
       2006 Dec 28
3.   MODBUS Messaging on TCP/IP implementation Guide V1.0b
       2006 Oct 34
4.   FA 5xx operation manuals

2   Technical data FA 5xx

2.1   FA 5xx MODBUS RTU specification

Device type	Slave
Baud Rates	1200,2400, 4800, 9600, 19200, 38400 bps
Device address range	1...247
Electrical Interface	RS485, 2 wire
Protocol	RTU
Supported function code	3 read holding register
	16 write multiple register
Broadcast	No
Standard	Modbus over serial line V1.02

2.2   General Modbus Information

The DS 500 Modbus module complies with the Modbus serial line protocol [Reference 1]. Among other things this implies **a master-slave** protocol at level 2 of the OSI model. One node (the master) issues explicit commands to one of the ,,slave"-nodes and processes responses. Slave nodes will not transmit data without a request from the master node, and do not communicate with other slaves.

Modbus is a mono **master system**, which means that only one **master** can be connected at the time.

2.2.1   Serial transmission modes (RTU)

The FA 5xx Modbus mode support only one serial transmission modes; the RTU mode. The transmission mode defines the bit contents of message fields transmitted serially on the line. It determines how information is packed into the message fields and decoded.

The transmission mode and serial port parameters must be the same for all devices on a Modbus serial line.

RTU mode Modbus Application Data Unit (ADU) frame is shown below, and is valid for both requests and responses.
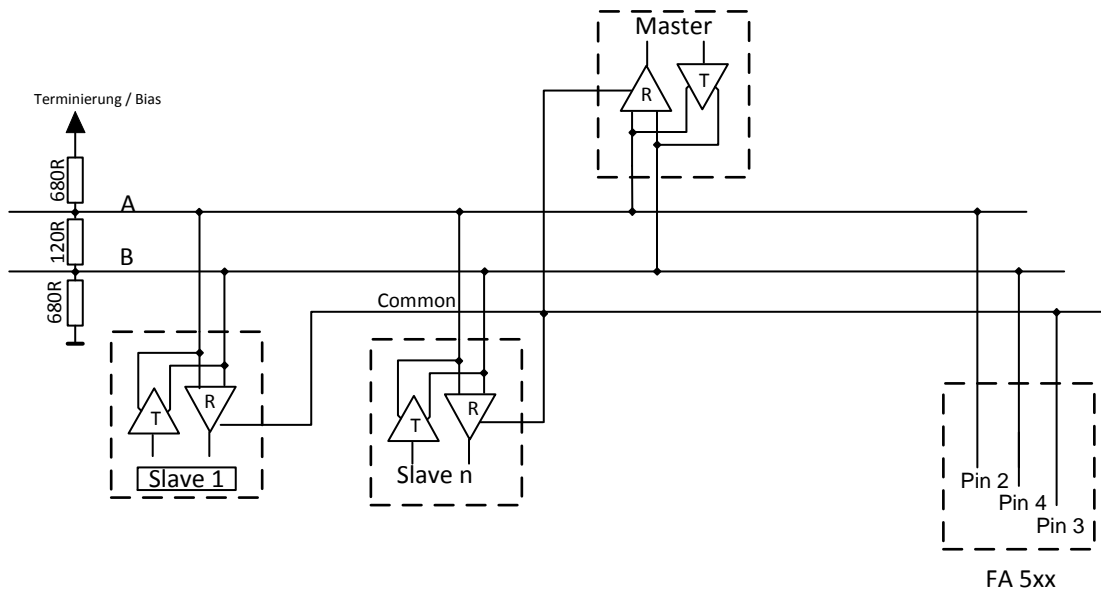
Slave address	Function code	Data	CRC
1 byte	1byte	0 up to 252 byte(s)	2 bytes

Table 1

Further details of the Modbus protocol can be found in Reference 1 and 2.

3 Installation

3.1 RS 485 bus wiring (Modbus RTU)

3.1.1 Termination

Note: In case the FA 5xx dew point sensor is the last device in the RS485 network then a termination with 120R between (between Pin 2 and Pin 4) is necessary.

Bus cable:

Only cables according to the recommendations of EIA 485 standard should be used. A maximum of 64 devices may be connected to one segment. The bus cable must be laid at a distance of at least 20 cm from other cables. It should be laid in a separate, conductive, and earthed cable trunking. It must be ensured that no potential differences occur between the individual devices on the bus.

3.1.2 Bias

In order to avoid undefined bus levels, at any llocation on the bus, a bias network, one resistor to VCC (Modbus A) as well as to GND (Modbus B), has to be used.

Cable specification:

Impedance:	135 -165 Ohm @ 3 to 20 Mhz
Cable capacity:	< 30pF/m
Cable diameter:	> 0.64 mm
Cross section:	> 0.34 mm2, conforms to AWG 22
Loop resistance	< 110 Ohm per km
Screening:	Cu shielding braid or shielding braid and shielding foil

4   Modbus RTU communication settings

Before communication with the master, baudrate, address, and framing must be defined

4.1   Accessing and changing Modbus settings

The Modbus communication settings could be changed by using either the PC service software from CS Instruments, the data loggers DS 400, DS 500 or the handheld device PI 500

Note:

It is recommended **NOT** to use the default address in a multi-slave network. It is of great
importance to ensure at the time of the procedure of device addressing, that there
is not two devices with the same address. In such a case, an abnormal behaviour of the
whole serial bus can occur, the master being then in the impossibility to communicate with
all present slaves on the bus.

5   Modbus TCP communication settings

Device type	Slave
Baud Rates	1200,2400, 4800, 9600, 19200, 38400 bps
Device address range	1...247
Electrical Interface	RS485, 2 wire
Protocol	RTU
Supported function code	3 read holding register
	16 write multiple register
Broadcast	No
Standard	Modbus over serial line V1.02

6   Modbus addressing model

The FA 5xx RS485 Modbus allows read/write access according chapter 8
Not defined registers are not accessible / not supported.

Byte Order:
The size of each Modbus-register is 2 Byte. For a 32 bit value two Modbusregister will be read out by the FA 5xx. Accordingly for a 16bit Value only one register is read.

Data format FA 5xx:

Single Word   Double Word

	HByte	LByte
18 =>	00	12
Data Order 1. Byte	2. Byte
00	12

	HWord		LWord	
	HByte	LByte	HByte	LByte
29235175522 =>	AE	41	56	52
Data Order	1.Byte	2.Byte	3.byte	4.Byte
	AE	41	56	52

For verification of a correct data format please read out register 64000 or 64004.Result should be:
Register 64000: Long Integer   Value =1 000 000
Register 64004: Float   Value = 1 000 000.0

6.1   Function Code 3 (Read holding register)

General exceptions:

• Requesting less than 1 or more than 125 registers => Exception 3 (Illegal data value)

• Requesting more than max. message size (27 registers) => Exception 2(Illegal data address)

• Requesting data out of defined range of registers chapter 8 => Exception 2 (Illegal data address)

Application exceptions:

• Application errors => Exception 4 (Slave device error)

Holes/register alignment:

• The read command always returns data if no exception is given. Bad
Start/end alignment will result in only parts of the data item being read.

6.2   Function code 16 (Write multiple registers)

In general only status register (register 2001 – 2064) are writable.

General exceptions:

• Writing less than 1 or more than 63 registers => Exception 3 (Illegal data value)

• If ByteCount is not exactly 2 times NoOfRegisters => Exception 3 (Illegal data value)

• Exceeding max. message size (27 registers) => Exception 2 (Illegal data address)

• Writing data out of defined register range chapter 8 =>Exception 2 (Illegal data address)

Application exceptions:

• Application errors => Exception 4 (Slave device error)

• Application errors include writing to ReadOnly holding registers

Holes / register alignment:

• If start-address is not the start of a mapped holding register => Exception 2 (Illegal data address)

• Writing to holes is allowed (ie ignored - and no exception occurs) — except for
the condition described above

7 Modbus Holding Register

7.1 Basic Values Register (1…1000)

Modbus Register	Modbus Address	No.of Byte	Data Type	Description	Default Setting	Read Write	Unit /Comment
1	0	4	Unit 32	Serial Number	0	R	sprintf(str,"%u.%02u",sw>>16,sw&0xffff)
3	2	4	Unit 32	SoftwareVersion	0	R	sprintf(str,"%u.%02u",hw>>16,hw&0xffff)
5	4	4	Unit 32	Hardware version	0	R	
7	6	4	Unit 32	Production Code	0	R	
9	8	4	Unit 32	Production date	0	R	Unix Time
11	10	4	Unit 32	Calibration date	0	R	Unix Time
13	12	4	Unit 32	Part Number	0	R	
15	14	4	Unit 32	Run Time Counter	0	R	[sec]
17	16	4	Unit 32	Code signature	0	R	
19	18	4	Unit 32	Atex Number	0	R	

7.2 Values register (1001….1200)

Modbus Register	Modbus Address	No.of Byte	Data Type	Description	Default Setting	Read Write	Unit /Comment
1001	1000	4	Float	Temperature		R	[°C]
1003	1002	4	Float	Temperature		R	[°F]
1005	1004	4	Float	Relative Humidity		R	[%]
1007	1006	4	Float	Dew Point		R	[°Ctd]
1009	1008	4	Float	Dew Point		R	[°Ftd]
1011	1010	4	Float	Absolute Humidity		R	[g/m³]
1013	1012	4	Float	Absolute Humidity		R	[mg/m³]
1015	1014	4	Float	Humidity Grade		R	[g/kg]
1017	1016	4	Float	Vapor Ratio (Volume)		R	[ppm]
1019	1018	4	Float	Saturation vapor pressure		R	[hPa]
1021	1020	4	Float	Partial Vapor Pressure		R	[hPa]
1023	1022	4	Float	Atmospheric DewPoint		R	[°Ctd]
1025	1024	4	Float	Atmospheric DewPoint		R	[°Ftd]

7.3 Device settings register

7.3.1 Modbus Settings (2001…2006)

Modbus Register	Modbus Address	No.of Byte	Data Type	Description	Default Setting	Read Write	Unit /Comment
2001	2000	2	UInt16	Modbus ID	1	R/W	Modbus ID 1…247
2002	2001	2	UInt16	Baudrate	4	R/W	0 = 1200 1 = 2400 2 = 4800 3 = 9600 4 = 19200 5 = 38400
2003	2002	2	UInt16	Parity	1	R/W	0 = none 1 = even 2 = odd
2004	2003	2	UInt16	Number of Stopbits		R/W	0 = 1 Stop Bit 1 = 2 Stop Bit
2005	2004	2	UInt16	Word Order	0xABCD	R/W	0xABCD = Big Endian 0xCDAB = Middle Endian
2006	2005	2	UInt16	Modbus Enabled	FA510: 1 FA515: 0	R/W	0 = Modbus disabled 1 = Modbus Enabled

7.3.2 Analog Scaling Settings (2007…2011)

Modbus Register	Modbus Address	No.of Byte	Data Type	Description	Default Setting	Read Write	Unit /Comment
2007	2006	4	UInt32	Output Value	4	R/W	0 = 4-20mA disabled 1 = Temperature [°C] 2 = Temperature [°F] 3 = relative Humidity [%] 4 = DewPoint [°C] 5 = DewPoint [°F] 6 = Absolute Humidity [g/m3] 7 = Absolute Humidity [mg/m3] 8 = Humidity Grade [g/kg] 9 = Vapor Ratio [ppm] 10 = Saturation Vapor Pressur [hPa] 11 = Partial Vapor Pressure [hPa] 12 = Atmospheric DewPoint [°C] 13 = Atmospheric DewPoint [°F]
2009	2008	4	float	4mA Scale Low	-80	R/W	
2011	2010	4	float	20mA Scale High	20	R/W	

7.3.3 System Pressure Settings (2013…2035)

Modbus Register	Modbus Address	No.of Byte	Data Type	Description	Default Setting	Read Write	Unit /Comment
2013	2012	4	UInt32	System Pressure Settings	0	R/W	false = 0; true = 1;
2015	2014	4	float	System Pressure		R/W	System Pressure (relative) [hPa] resp. [mbar]
2017	2016	4	float	Reference Pressure		R/W	Reference Pressure (absolute) [hPa] resp. [mbar]

7.3.4 One point calibration (2019…2034)

Modbus Register	Modbus Address	No.of Byte	Data Type	Description	Default Setting	Read Write	Unit /Comment
2019	2018	4	float	Calibration Value [°Ctd]	0	W	if value is read, 0 is returned; to reset one point calibration value NAN (not a number, defined in ISO C99) must be written to register. To overwrite an existing one point calibration, the old calibration has to be reset first.
2021	2020	4	float	Relative Hum Offset [%rH]	0	R	written value is ignored
2023	2022	4	UInt32	Calibration Counter		R	written value is ignored
2025	2024	16	string	Sensor Location	-	R/W	specifies the sensor location (coding in UTF8 (max 16 Byte))
2033	2032	4	UInt32	Next Calibration Date	2 years from last calib	R/W	Unix Time
2035	2034			Not used			

7.4　Free / User space register　(2501… 2520)

Diese Register sind frei belegbare Register.

Modbus Register	Modbus Address	No.of Byte	Data Type	Description	Default Setting	Read Write	Unit /Comment
2501	2500	2	user defined	user defined content	0xff	R/W	
2502	2501	2	user defined	user defined content	0xff	R/W	
2503	2502	2	user defined	user defined content	0xff	R/W	
2504	2503	2	user defined	user defined content	0xff	R/W	
2505	2504	2	user defined	user defined content	0xff	R/W	
2506	2505	2	user defined	user defined content	0xff	R/W	
2507	2506	2	user defined	user defined content	0xff	R/W	
2508	2507	2	user defined	user defined content	0xff	R/W	
2509	2508	2	user defined	user defined content	0xff	R/W	
2510	2509	2	user defined	user defined content	0xff	R/W	
2511	2510	2	user defined	user defined content	0xff	R/W	
2512	2511	2	user defined	user defined content	0xff	R/W	
2513	2512	2	user defined	user defined content	0xff	R/W	
2514	2513	2	user defined	user defined content	0xff	R/W	
2515	2514	2	user defined	user defined content	0xff	R/W	
2516	2515	2	user defined	user defined content	0xff	R/W	
2517	2516	2	user defined	user defined content	0xff	R/W	
2518	2517	2	user defined	user defined content	0xff	R/W	
2519	2518	2	user defined	user defined content	0xff	R/W	
2520	2519	2	user defined	user defined content	0xff	R/W	

7.5　Data format test register　(64001… 64003)

Modbus Register	Modbus Address	No.of Byte	Data Type	Description	Default Setting	Read Write	Unit /Comment
64001	64000	4	Dword	1000000	x	R	format test for Dword
64003	64002	4	float	1000000.0	x	R	format test for float

8 Appendix

8.1 APPENDIX A - Exception codes

The DS500 Modbus uses the following exception codes when responding to the master

Exception Code	Exception name
0x01	Illegal function
0x02	Illegal data address
0x03	Illegal data value
0x04	Slave device failure
0x05	Acknowledge
0x06	Slave device busy

Stand: 2016/06/16, version 1.01