Fieldbus Appendix

ANYBUS®-S Modbus RTU

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Preface

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About the AnyBus-S Modbus RTU Appendix

This fieldbus appendix contains fieldbus specific information about Modbus RTU for the AnyBus-S Modbus RTU module. For more information about the AnyBus-S module, please refer to the AnyBus-S Design Guides, see referenced documents below.

Conditions for trademark use

Please contact HMS for further information.

Related documents

Document name	Author	Document ID	Revision
AnyBus-S Parallel Design Guide	JoP	ABS-DGP	1.13
AnyBus-S Serial Design Guide	JpA	ABS-DGS	1.02
Modbus Protocol Reference Guide (www.modicon.com or www.modbus.org)	Modicon	PI-MBUS-300	J

Abbreviations

Important abbreviations used in this manual:

ABS	AnyBus-S
CRC	Cyclic Redundancy Check
DPRAM	Dual Port Memory
EMC	Electromagnetic Compability
LSB	Least Significant Bit
MSB	Most Significant Bit
NC	Not Connected
RO	Read Only
RTU	Remote Terminal Unit
R/W	Read/Write
TBD	To Be Defined

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1 Fieldbus Introduction

This section provides information about the Modbus RTU organisation and network.

1.1 Introduction to Modbus RTU

Modbus RTU is a fieldbus system from the company Modicon, a part of Schneider Automation.

1.2 Network Overview

The media for the fieldbus is a copper cable composed of one twisted pair. The baudrate is as standard 19200 Bit/s but can be modified on the card between 1200 Bit/s to 57 600 Bit/s. The Modbus RTU network can consist of 247 slaves but only one Master. The master always initiates the communication with a question (called a query) and the slave with the correct slave address answers the question with a response. There is also the possibility for the Master to broadcast to all slaves (slaves listening to node address 0). The maximum amount of data for the AnyBus-S Modbus RTU module are 1024 output registers and 1024 input registers.

1.3 Technical Features for Modbus RTU

- Allows a Master to establish contact with multiple slaves
- Up to 247 nodes on a network
- Support broadcast messaging in several functions
- Variable baudrate 1200 - 57600 bit/s

2 Module Overview

This section provides an overview of the AnyBus-S Modbus RTU module.

2.1 Mechanical Overview

The AnyBus module for Modbus RTU is a passive node that can be read and written to from a Modbus RTU Master node. The AnyBus module for Modbus RTU will not initiate communication to other nodes, it will only respond to an incoming command. The AnyBus-S is connected to the application via the Host Connector. Via this connector the application has an instant connection to Modbus RTU.

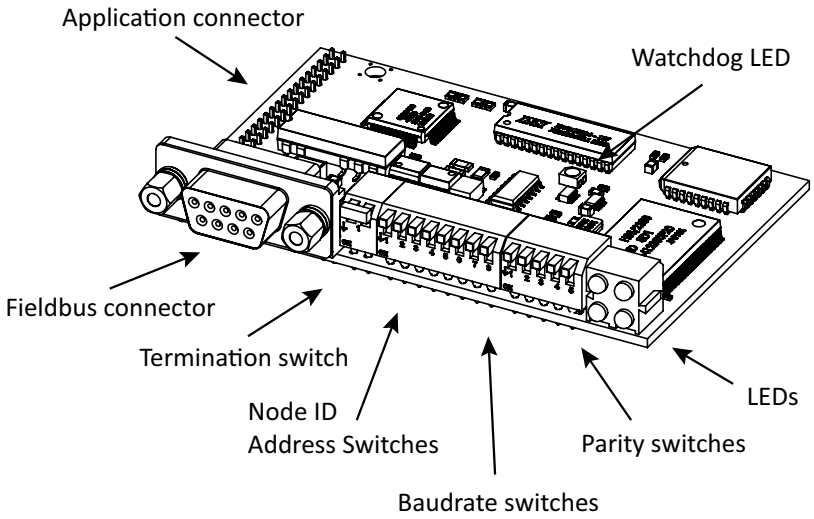


Figure 1: AnyBus-S Modbus RTU module

2.2 Protocol & Supported Functions

- Fieldbus type: Modbus RTU
- Modbus Functions supported: 1, 2, 3, 4, 5, 6, 8, 15, 16, 22, 23
- Baudrate. Dipswitch setting 1.2 - 57.6 kbps
- Save/Load configuration in Flash supported

2.3 Physical Interface

- Transmission media RS 232 or RS485
- Topology: Master-Slave communication
- Fieldbus connectors: 9 pin female DSUB, as standard.
- Cable: Shielded copper cable, Twisted pair
- Isolation: Galvanic bus isolation

2.4 Configuration & Indications

- RS232 or RS485 operation (switchable)
- Address range: 1- 247. Addresses 1 - 127 are available via the DIP-switch settings
- Input/Output/User Parameter data/Diagnostics format defined via mailbox initialisation telegram.
- Maximum data size: 1024 bytes in, max 1024 bytes out.
- Bus termination switch onboard.
- LED-indications: Fieldbus related diagnostic.

2.5 Data Exchange

Compatibility with existing ANYBUS® modules: Only compatible with other AnyBus-S modules.

2.6 Application Interface

Currently the AnyBus-S Modbus RTU is only available with a parallel DPRAM interface.

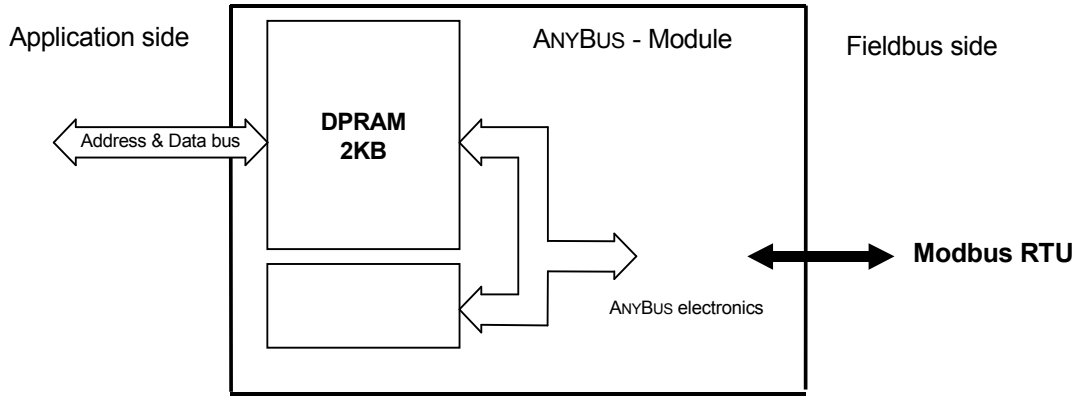


Figure 2: AnyBus-S Access Methods

2.7 Dual Port RAM Memory - DPRAM

The easiest way to use the AnyBus-S module, is to integrate it into the system microprocessor bus. This is achieved by using the parallel DPRAM interface. All the relevant access and handshaking procedures are achieved through this interface. The handshake procedure is used to ensure that there always will be consistent data available on the host application side, as well as on the fieldbus side. In the handshaking procedure, it will always be the host side that initiates the start of the handshaking whilst the AnyBus-S module will respond to it.

For more information about designing with the Parallel interface, please consult the AnyBus-S Parallel Design Guide.

3 Hardware design

3.1 Fieldbus Connectors

The Modbus RTU standard recommends the use of a 9 pin female D-sub connector. Depending on the protection class and type of application, other connector designs are also allowed.

The module have an internal DC/DC converter that provides galvanically isolated power to the bus circuitry. The power lines from the bus circuitry are also connected to the 5V and GND pins which can be used as a regulated 5VDC power output. These pins are primarily are intended to provide power to an external bias/termination network but can also be used to power external equipment such as medium converters as long as the maximum current consumption does not exceed 50mA.

3.1.1 D-SUB

Pin	Name	Function
Housing	SHIELD	Cable shield
1	-	Not connected
2	RS232 - TX	Transmit signal
3	RS232 - RX	Receive signal
4	-	Not connected
5	GND	Signal ground
6	+5V	Power supply
7	RS 485- D0 (B)	
8	RS 485+ D1 (A)	
9	-	Not connected

Table 1: D-SUB

3.1.2 Screw terminal

Pin	Name	Functiion
1	RS232 - TX	Transmit signal
2	GND	Signal ground
3	RS485 D1	
4	RS485 D0	
5	RS232 - RX	Receive signal
6	SHIELD	Cable shield

Table 2: Screw terminal

3.1.3 2 mm connector

Pin	Name	Function
1	SHIELD	Cable shield
2	GND	Signal ground
3	NC	Not connected
4	NC	Not connected
5	RS485 D1	
6	RS485 D0	
7	RS232 - RX	Receive signal
8	+5 V	Power supply
9	RS232 - TX	Transmit signal
10	NC	Not connected

Table 3: 2 mm connector

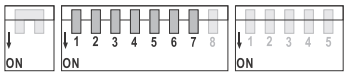
3.2 Configuration switches

There are two DIL switch blocks on the module to set the node address and the communication parameters. A switch in the ‘ON’ or ‘CLOSED’ position is interpeted as a logic ‘1’.

3.2.1 Node ID

Table 4: Binary value; node ID

Binary value	Modbus address
0000000	Setting not valid
00000001	1
00000010	2
00000011	3
...	...
...	...
11111111	127



(switch 1 is MSB and switch 7 is LSB)

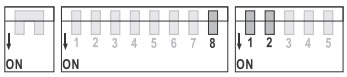
The Node ID must be configured before power on - it is not possible to change the node ID during operation. The Node ID is set in binary format. Valid settings range from 1-127 (247 with mailbox messages). Setting 0 is dedicated for SW configuration via Mailbox message in the INIT sequence. The full-extended Node address settings will only be available through the mailbox interface (see section 6.2).

Note: When all the switches are set to the “OFF”- position, this is indicated with the LED “HW Setting status” turning red. If no mailbox message is used for setting the baudrate, address and parity, the module initiates the baudrate to 19,2 kBit/s with no parity. It will then only respond to broadcast messages.

3.2.2 Baudrate

Table 5: Binary value; baudrate

Binary value	Baud rate
000	Setting not valid
001	1200
010	2400
011	4800
100	9600
101	19200 (Default on RTU)
110	38400
111	57600



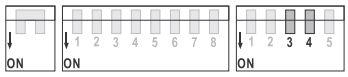
(switch 8 is MSB and switch 2 is LSB)

The baudrate must be set before power on - it is not possible to change the baud rate during operation. All baudrates are within a 0.16% to 1.76% error margin. It is also possible to set the baudrate via the mailbox interface

3.2.3 Parity

Table 6: Binary value; parity

Binary value	Parity type
00	Setting not valid
01	None (Default on RTU)
10	Even
11	Odd



(switch 3 is MSB and switch 4 is LSB)

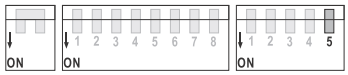
The parity must be set before power on - it is not possible to change it during operation. It is also available from the mailbox interface.

Note: If parity is enabled, one stop bit is used. If parity is not enabled, two stop bits are used.

3.2.4 Physical Interface Type

Table 7: Physical Interface Switch

Binary value	Parity type
0	RS-485
1	RS-232



3.2.5 Termination

If RS485 is used the end nodes in the network have to be terminated in order to avoid reflections on the bus line. The AnyBus-S Modbus RTU module is equipped with an internal termination resistor network that is enabled when the two-bit DIL-switch is in the ‘ON’ position. If the node should not be terminated or if an external terminator is used the switch should be in the ‘OFF’ position. See section 2.1 to locate the termination switch. The figure below shows the connection and the values of the components used in the termination and bias resistor network. If the vales does not match what the network requires an external terminator must be used instead.

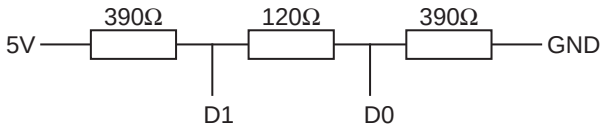


Figure 3: Internal terminator

3.3 Indications

The module is equipped with four LED's which are mounted on the front, and one LED that is placed on the board, which is used for debugging purposes. The front LED's can be mounted in two ways; either top mounted, or angle mounted. The tables and figures in this section describe the different functions of the LED's.

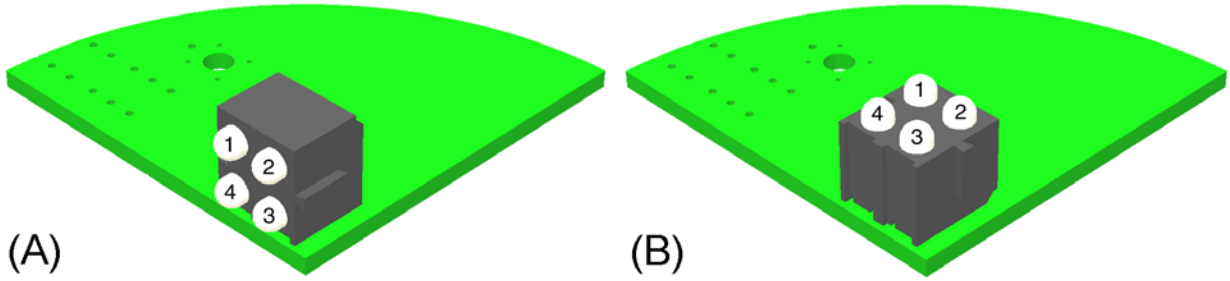


Figure 4: AnyBus-S LED´s

Table 8: LED descriptions

LED no.	Description
1	Processing
2	Bus Error
3	Bus Ready
4	HW Setting Status

3.3.1 LED 1 - Processing

LED State	Indications
Flashing Green	Module is receiving a Query and building a response
OFF	No Query is handled in the module at the moment

Table 9: LED 1 Indications

3.3.2 LED 2 - Bus Error

LED State	Indications
Solid Red	Bus Error (More than 1/10 of all queries have incorrect CRC)
OFF	Normal operation, or module not initialized

Table 10: LED 2 Indications

3.3.3 LED 3 - Bus Ready

LED State	Indications
Solid green	Bus is ready (Normal operation)
Solid red	Bus timeout error
OFF	Module is not initialized correctly

Table 11: LED 3 Indications

3.3.4 LED 4 - HW Settings Status

LED State	Indications
Solid Red	Module DIP switch is set to “NON ACTIVE” status (all in off state or illegal values)
Solid Green	DIP SW settings modified by mailbox message
OFF	DIP Switch settings in use and are OK

Table 12: LED 4 Indications

4 Fieldbus functionality

4.1 Supported Modbus RTU functions

Modbus services (commands) supported in the AnyBus S Modbus RTU;

1. **Read Coil Status.**
2. **Read Input Status.**
3. **Read Holding Registers.**
4. **Read Input Registers.**
5. **Force Single Coil.**
6. **Preset Single Register.**
8. **Diagnostics, Subfunctions: 0, 10, 12, 13, 14 is supported.**
15. **Force Multiple Coils.**
16. **Preset Multiple Registers.**
22. **Mask Write 4X Register.**
23. **Read/Write 4X Register.**

4.1.1 Modbus Function 8, Diagnostics

The AnyBus S module has some internal counters that are incremented each time a predefined event occurs. The counters are:

- Received Querys Counter
- CRC Error Counter
- Exception Illegal Function Counter
- Exception Illegal Address Counter
- Exception Data Value Counter.

The AnyBus S Modbus RTU supports these diagnostics subfunctions:

0. Return Query Data, The data passed in the query data field is to be returned (looped back) in the response.

10. Clear Counters and Diagnostic Register, This will clear all internal indication and error counters in the AnyBus S Modbus RTU module.

12. Return Bus Communication Error Count (CRC Error Counter), The response data field returns the quantity of CRC errors encountered by the slave since its last restarts, clear counters operation, or power-up.

13. Return Bus Exception Error Count (sum of Illegal Function, Illegal Address , Exception Data Value Counter) , The response data field returns the quantity of Modbus exception responses returned by the slave since its last restart clear counters operation, or power-up.

14. Return Slave Message Count (Received Querys Counter), The response data field returns the quantity of messages addressed to the slave, or broadcast, that the slave has processed since its last restart clear counters operation, or power-up.

Note: Fore more information about the Modbus function 8 telegram, please see the Modbus Protocol Reference Guide, PI-MBUS-300 Rev. J.

4.2 Exception Response

Except for broadcast messages, when a master device sends a query to a slave device it expects a normal response. One of four possible events can occur from the master's query:

- If the slave device receives the query without a communication error, it returns a normal response.
- If the slave does not receive the query due to communication error, no response is returned. The master program will eventually process a timeout condition for the query.
- If the slave receives the query, but detects a communication error (parity, CRC), no response is returned. The master program will eventually process a timeout condition for the query.
- If the slave device receives the query without a communication error, but cannot handle it (for example, if the request is to read a non-existent coil or register), the slave will return an exception response informing the master of the nature of the error.

4.2.1 Supported Exception Codes

Table 13: Supported exception codes

Code	Name	Description
01	ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the slave.
02	ILLEGAL DATA ADDRESS	The data address received in the query is not an allowable address for the slave.
03	ILLEGAL DATA VALUE	A value contained in the query data field is not an allowed value for the slave.

4.3 Fieldbus timeout

The AnyBus-S Modbus RTU module has a timeout timer implemented that can be used to check if the network is ‘alive’ and send this information back to the application via the FBRS bit in the ‘Module status register’ in the DPRAM control register area. Note that this timer is not enabled by default, it must be enabled by the application via a mailbox message. When enabled, the FBRS bit will be cleared if the module has not received any messages for the duration given in the mailbox message. When disabled, the FBRS bit will remain set. LED 3 will also indicate the status of the bus.

5 Functions & Operation

5.1 Memory map structure of the Modbus RTU Module

5.1.1 DPRAM IN/OUT Data Areas

DPRAM Address	Contents	Access	Modbus address
	IN area		
000h - 01FFh	Input data area ; 512 bytes	R/W	0001 - 0256
	OUT area		
200h - 3FFh	Output data area; 512 Bytes	R/O	1025 - 1280

Table 14: DPRAM IN/OUT data areas

The application exchanges data with the fieldbus via the DPRAM IN and OUT data areas. Prior of using the module, the length of the IN and OUT areas have to be defined. This is accomplished through initializing the module (please see chapter 6.7). The AnyBus-S has the possibility to use both fast data and slow data, but all data transferred on the Modbus RTU Fieldbus is to be considered as fast data. Thus, the configuration of the IN and OUT areas are very simple.

6 Fieldbus Specific Mailbox Commands

6.1 Mailbox Area

Area (HEX)	Contents	Access
	Mailbox IN area	
400h - 51Fh	Mailbox commands	R/W
	Mailbox OUT area	
520h - 63Fh	Mailbox responses	RO

Table 15: Mailbox area

Two types of mailbox commands can be used by the AnyBus-S Modbus RTU; standard mailbox commands, described in the AnyBus-S Design Guide, and Fieldbus Specific mailbox commands, described in this chapter.

6.2 Initialization telegram (FB_INIT)

This mailbox telegram is sent to the Anybus module during the initialization sequence and contains information required to initialize the module for Modbus RTU specific functionalities.
The FB_INIT telegram must be sent to the Anybus after ANYBUS_INIT, but before END_INIT.
Refer to the document "Anybus-S design guide" for more information about the ANYBUS_INIT telegram.

Parameter	Description
Command initiator	Application
Message name	FB_INIT
Message type	0x02
Command number	0x0001
Fragmented	No
Extended Header Data	**Command:** None **Response:** Fault information
Message Data	**Command:** Contains information required for Modbus RTU specific functionalities. Slave address, Baudrate, Parity, Query time out time. **Response:** Same as above.
Response message	If the telegram for any reason isn't accepted, the reason for this rejection will be indicated in the Message information word. If the message information indicates "Undefined ERROR", further fault information can be found in Extended word 8.

Table 16: FB_INIT

:

Register Name	*Command*	*Expected response*	
Message ID	0x0001	0x0001	
Message information	0x4002	0x0002	
Command	0x0001	0x0001	
Data size	0x0008	0x0008	
Frame count	0x0001	0x0001	
Frame number	0x0001	0x0001	
Offset high	0x0000	0x0000	
Offset low	0x0000	0x0000	
Extended word 1			
Extended word 2			
Extended word 3			
Extended word 4			
Extended word 5			
Extended word 6			
Extended word 7			
Extended word 8		Fault information	*Fieldbus specific fault information*
Message data word 1	Slave Address	Slave Address	*Modbus RTU slave address*
Message data word 2	Baudrate	Baudrate	*Modbus RTU baudrate*
Message data word 3	Parity	Parity	*Modbus RTU parity*
Message data word 4	Query Timeout time	Query Timeout time	*Modbus RTU Query timeout time*

Table 17: Command and response: FB_INIT

Explanation of Message data words 1-4

- **Message data word 1: Slave Address**

  The slave address is unique for each node on the Modbus network.
  Possible setting is 1 -247.

- **Message data word 2: Baudrate**

  Possible setting is 1 -7. (1 = 1200, 2 = 2400, 3 = 4800, 4 = 9600, 5 = 19200, 6 = 38400 and 7 = 57600) .

- **Message data word 3: Parity**

  To choose if parity will be used, and if so, even or odd.
  Possible settings are 1 - 3. (1 = No parity, 2 = Even ; 3 = Odd).

  Note: If parity is used, 1 stop bit will be used; 2 bits if no parity is used.

- **Message data word 4: Query timeout time**

  The Query timeout time defines minimum time between two messages if the new message begins earlier than 3,5 char times, following a previous message. The receiving device will consider it a continuation of the previous message. This will set an error.

  If Query timeout time is set to zero (0); default value 3,5 char time interval will be used.

  Possible setting is a ‘1 to 32 ms’ time interval. If the baudrate setting is less than 3,5 char times, we force the value to 3,5 char times.

Possible error messages in the Message information word of the response telegram header:

- "Undefined ERROR" is indicated whenever there is fault information present in Extended word 8.
- "Invalid Command" is indicated when the FB_INIT telegram is sent after the module has been initialised, or before AB_INIT.
- "Invalid Data Size" is indicated when the Data size in the header does not equal the number of Message data words.
- "Invalid Frame Count" is indicated when Frame number and/or Frame count does not equal one (no fragmented telegram)
- "Invalid Offset" is indicated when Offset high/low does not equal zero.

Note: The error codes for the error messages can be found in the AnyBus-S design guide.

Possible error codes in Extended word 8 of the response telegram header:

Error codes related to Message data words 1-4;

Error code h01: Invalid Slave Address value.
Error code h02: Invalid value of Baudrate. Default value of Baudrate is used (5 = 19200).
Error code h04: Invalid value of Parity. Default value of parity is used (1 = No parity; and 2 stop bits).
Error code h08: Invalid value of Query time out.

6.3 Run state telegram (GET_MB_COM_SETTINGS)

Parameter	Description
Command initiator	Application *RUNNING STATE*
Message name	GET_MB_COM_SETTINGS
Message type	0x02
Command number	0x0002
Fragmented	No
Extended header data	**Command:** None **Response:** Fault information
Message data	**Command:** None **Response:** Get the actual slave address, baudrate, parity and Query timeout time used in the Modbus RTU communication.
Response message	If the telegram for any reason isn't accepted, the rejection will be indicated in the Message information word. If the message information indicates "Undefined ERROR", further fault information can be found in Extended word 8.

Table 18: Run state telegram : GET_MB_COM_SETTINGS

If default time-out is requested (3,5 char times), then Query timeout should be set to zero.

Register Name	*Command*	*Expected response*	
Message ID	0x0001	0x0001	
Message information	0x4002	0x0002	
Command	0x0002	0x0002	
Data size	0x0000	0x0008	
Frame count	0x0001	0x0001	
Frame number	0x0001	0x0001	
Offset high	0x0000	0x0000	
Offset low	0x0000	0x0000	
Extended word 1	-	-	
Extended word 2	-	-	
Extended word 3	-	-	
Extended word 4	-	-	
Extended word 5	-	-	
Extended word 6	-	-	
Extended word 7	-	-	
Extended word 8	-	Fault information	*Fieldbus specific fault information*
Message data word 1		Slave address	*Modbus RTU slave address*
Message data word 2		Baudrate	*Modbus RTU baudrate*
Message data word 3		Parity	*Modbus RTU parity*
Message data word 4		Query Timeout time	*Modbus RTU queryTime out time*

Table 19: Command and response: Run state telegram; GET_MB_COM_SETTINGS

6.4 Run state telegram (GET_COM_STATUS)

Parameter	Description
Command initiator	Application *RUNNING STATE*
Message name	GET_COM_STATUS
Message type	0x02
Command number	0x0003
Fragmented	No
Extended header data	**Command:** None **Response:** Fault information
Message data	**Command:** None **Response:** Query Recieved, CRC errors, Illegal registers/coils calls, Illegal function calls.
Response message	If the telegram is not accepted, the reason for the rejection will be indicated in the Message information word. If the message information indicates "Undefined ERROR" further fault information can be found in Extended word 8.

Table 20: Run state telegram: GET_COM_STATUS

Register Name	*Command*	*Expected response*	
Message ID	0x0001	0x0001	
Message information	0x4002	0x0002	
Command	0x0003	0x0003	
Data size	0x0000	0x0008	
Frame count	0x0001	0x0001	
Frame number	0x0001	0x0001	
Offset high	0x0000	0x0000	
Offset low	0x0000	0x0000	
Extended word 1	-	-	
Extended word 2	-	-	
Extended word 3	-	-	
Extended word 4	-	-	
Extended word 5	-	-	
Extended word 6	-	-	
Extended word 7	-	-	
Extended word 8	-	Fault information	*Fieldbus specific fault information*
Message data word 1		Query Received counter	*Modbus RTU recieved queries*
Message data word 2		CRC error counter	*Modbus RTU CRC error counter*
Message data word 3		Illegal register/coils calls counter	*Modbus RTU Illegal register/coils calls*
Message data word 4		Illegal function calls counter.	*Modbus RTU Illegal function calls*

Table 21: Command and response: Run state telegram; GET_COM_STATUS

Explanation of response message data words 1-4

- **Response message data word 1: Query Received counter**

  This is an internal counter that increments each time a query is received from the Modbus Master. The counter increments from 0 up to 65535, and then starts from 0 again. Possible settings are 0 - 65535.

- **Message data word 2: CRC Error Counter**

  This is an internal counter that increments each time a CRC error is detected in a query received from the Modbus Master. The counter increments from 0 up to 65535, and then starts from 0 again. The counter also resets when the Successful Query Received counter starts from 0 again (this, to be able to make a diagnose of the Master-Slave connection). Possible settings are 0 - 65535.

- **Message data word 3: Illegal register/coils calls counter**

  This is an internal counter that increments each time a query for an illegal register or coil is received from the Modbus Master. The counter increments from 0 up to 65535, and then starts from 0 again.
  Possible settings are 0 - 65535.

- **Message data word 3: Illegal function calls counter**

  This is an internal counter that increments each time a query for an illegal (non supported) function is received from the Modbus Master. The counter increments from 0 up to 65535, and then starts from 0 again.
  Possible settings are 0 - 65535.

6.5 Run & Init state telegram (SET_OFFLINE_TIME)

Parameter	Description
Command initiator	Application
Message name	SET_OFFLINE_TIME
Message type	0x02
Command number	0x0004
Fragmented	No
Extended header data	**Command:** None **Response:** Fault information
Message data	**Command:** Contains the fieldbus offline timeout value. **Response:** Active value
Response message	If the telegram is not accepted, the reason for the rejection will be indicated in the Message information word. If the message information indicates "Undefined ERROR" further fault information can be found in Extended word 8.

Table 22: Run state telegram: SET_OFFLINE_TIME

Register Name	*Command*	*Expected response*	
Message ID	0x0001	0x0001	
Message information	0x4002	0x0002	
Command	0x0004	0x0004	
Data size	0x0002	0x0002	
Frame count	0x0001	0x0001	
Frame number	0x0001	0x0001	
Offset high	0x0000	0x0000	
Offset low	0x0000	0x0000	
Extended word 1	-	-	
Extended word 2	-	-	
Extended word 3	-	-	
Extended word 4	-	-	
Extended word 5	-	-	
Extended word 6	-	-	
Extended word 7	-	-	
Extended word 8	-	Fault information	*Fieldbus specific fault information*
Message data word 1	New timeout value	Active timeout value	*Fieldbus offline value*

Table 23: Command and response: Run state telegram; SET_OFFLINE_TIME

Message data word 1 contains the timeout time in ms. Valid range is 1 - 65535, a value of 0 can be used to turn of the timeout detection.

Note: Due to the nature of the modbus RTU protocol with its acyclic queries the module does not support any kind of online/offline indication unless specifically enabled with this message. If not enabled, the online bit in the ‘Module Status Register’ will remain set regardless of the state of the bus.

6.6 Run & Init state telegram (GET_OFFLINE_TIME)

Parameter	Description
Command initiator	Application
Message name	GET_OFFLINE_TIME
Message type	0x02
Command number	0x0005
Fragmented	No
Extended header data	**Command:** None **Response:** Fault information
Message data	**Command:** None **Response:** Active value
Response message	If the telegram is not accepted, the reason for the rejection will be indicated in the Message information word. If the message information indicates "Undefined ERROR" further fault information can be found in Extended word 8.

Table 24: Run state telegram: GET_OFFLINE_TIME

Register Name	*Command*	*Expected response*	
Message ID	0x0001	0x0001	
Message information	0x4002	0x0002	
Command	0x0005	0x0004	
Data size	0x0000	0x0002	
Frame count	0x0001	0x0001	
Frame number	0x0001	0x0001	
Offset high	0x0000	0x0000	
Offset low	0x0000	0x0000	
Extended word 1	-	-	
Extended word 2	-	-	
Extended word 3	-	-	
Extended word 4	-	-	
Extended word 5	-	-	
Extended word 6	-	-	
Extended word 7	-	-	
Extended word 8	-	Fault information	*Fieldbus specific fault information*
Message data word 1		Active timeout value	*Fieldbus offline value*

Table 25: Command and response: GET_OFFLINE_TIME

Message data word 1 contains the timeout time in ms. A value of 0 means that the timeout is disabled.

6.6.1 Fieldbus Specific Area

Area (HEX)	Contents	Access
640h - 7BFh	**Fieldbus specific area**	RO

Table 26: Fieldbus specific area

Note: The fieldbus specific area is not used in the AnyBus-S Modbus RTU module.

6.6.2 Control Area

These registers contain information about the status and control environment, both for the fieldbus and the module itself, e.g. Fieldbus type, Module Software version, Module Type, configuration, etc. The following registers are specific for the AnyBus-S Modbus RTU module. For further information about the Control Area contents, please see the AnyBus-S Design Guide.

Area (HEX)	Contents	Access
	Control area (Fieldbus specific parameters)	-
7CCh - 7CDh	Fieldbus Type (0x0045 for Modbus RTU)	RO
7CEh - 7CFh	Module Software Version	RO

Table 27: Control area

6.7 Initialization

The initialization of the AnyBus-S module in standard format is performed with the ANYBUS_INIT mailbox telegram, where the sizes of the input/output areas are defined. If specific fieldbus settings are requested, the FB_INIT mailbox telegram can be used. Then the sequence is START_INIT, ANYBUS_INIT, FB_INIT, and END_INIT.

6.7.1 Initialization Example

The example below shows how to initialize the AnyBus-S Modbus RTU module with the following configuration.

- Input I/O data of 20 bytes
- Output I/O data of 20 bytes
- Input Parameter data of 20 bytes
- Output Parameter data of 20 bytes
- An interrupt will be generated if data is changed
- The new data field is activated

This is the ANYBUS_INIT telegram, for further information, please see the AnyBus-S Design Guide.

Register Name	*Command*	*Expected response*	
Message ID	0x000A	0x000A	*Any integer value*
Message information	0x4001	0x0001	
Command	0x0002	0x0002	
Data size	0x0012	0x0012	*9 words of data = 18 bytes*
Frame count	0x0001	0x0001	*This is frame 1*
Frame number	0x0001	0x0001	*One frame*
Offset high	0x0000	0x0000	
Offset low	0x0000	0x0000	
Extended word 1	-	-	*No message header data used*
Extended word 2	-	-	*“*
Extended word 3	-	-	*“*
Extended word 4	-	-	*“*
Extended word 5	-	-	*“*
Extended word 6	-	-	*“*
Extended word 7	-	-	*“*
Extended word 8	-	-	*“*
Message data word 1	0x0014	0x0014	*Message data*
Message data word 2	0x0014	0x0014	*“*
Message data word 3	0x0014	0x0014	*“*
Message data word 4	0x0014	0x0011	*“*
Message data word 5	0x0014	0x0014	*“*
Message data word 6	0x0014	0x0014	*“*
Message data word 7	0x0200	0x0200	*“*
Message data word 8	0x0001	0x0001	*“*
Message data word 9	0x0000	0x0000	*“*

Table 28: Command and response layout; Initalization example

6.8 Data Exchange

The AnyBus S Modbus RTU device can be read/written from the Modbus master. The amount of data copied is determined in the configuration phase of the fieldbus initialization. The data will be exchanged via the IN and OUT data areas of the DPRAM, or via the mailbox messages if internal memory is used.

6.8.1 Map data to/from the Network

Example: If the module is initialized from the application with the following sizes...

IN I/O SIZE : 64 bytes (32words)
IN DPRAM SIZE : 200 bytes (100 words)
IN TOTAL SIZE : 200 bytes (100 words)

OUT I/O SIZE : 64 bytes (32words)
OUT DPRAM SIZE : 200 bytes (100 words)
OUT TOTAL SIZE : 200 bytes (100 words)

...the data map from the fieldbus will look like this (section 6.8.1.1 and 6.8.1.2):

6.8.1.1 Data to network

The "Data To Network" area always starts at 0001, and the whole content in the "Data to Network" area can be read with Modbus commands such as “Read Holding Registers” (see chapter 4.1).

“Data to Network” area

Words 0001 - 0256
I/O-Data

Table 29: Command and response layout; Data To Network

Example:
To read four words from the "Data to Network" area, use “Read Holding Registers” with start address 0001, and with number of registers to read, set to 4. This will give you the four first data words.

6.8.1.2 Data from network

The "Data from Network" always starts at 1025 and the whole "Data from Network" area can be read and written by the Modbus commands.

"Data from Network" area

Words 1025 - 1281
I/O-Data

Table 30: Command and response layout; Data From Network

Example:
To write to the first two words of the "Data from Network" area in the AnyBus module, use "Preset Multiple Register" (see chapter 4.1) with the start register 1025 and with number of registers set to 2 words.

7 Environmental specification

7.1 Temperature

7.1.1 Operating

The product is able to operate in an environment with an ambient temperature of 0°C to 55°C.

7.1.2 Non-operating

the product is able to be stored in an environment with an ambient temperature of -15°C to 85°C.

7.1.3 Relative humidity

The product is designed for a relative humidity of 5 to 95% non-condensing.

7.1.4 Shock and vibration

No tests of shock and vibration will be made on this product.

7.1.5 EMC compliance

The product is tested stand-alone in open air.

7.1.5.1 Emission

According to EN 50 081-2:1993
tested per EN 55011:1990, class A, radiated.

7.1.5.2 Immunity

According to EN 61000-6-2:1999
Tested per EN 61000-4-2:1995, EN 61000-4-3:1996, EN 61000-4-4:1995, EN 61000-4-5:1995, EN 61000-4-6:1996.

8 Electrical characteristics

8.1 Supply voltage

This product requires a power supply of ±5 V ±5%

8.2 PE and bus grounding

The module must be supplied with a PE connection to the appropriate mounting hole since the ‘shield’ in the bus connector is directed to the PE mounting hole. Refer to the AnyBus-S design guide for more information.

8.3 Application interface pin configuration

The table below describes the general pin configuration for the Application interface

Contact Pin	Description	Symbol	Min	Type	Max	Unit
1	+5V BUS	V_{CC}	4.75	5.0	5.25	V
	Bus Electronic	I_{IN}	-	70	90 (see note below)	mA
2	GNDBUS Ground					
3-4	No Connection					
5	+5V Power	V_{CC}	4.5	5.0	5.5	V
	Electronic	I_{IN}	-	100	120	mA
6	GND Ground					
7-31	Depending on Interface					
33-34						
32	RES IN	V_{IH}	0.7 V_{CC}			V
	Reset	V_{IL}			0.3 V_{CC}	V
	(pulse duration)	t_W	1.0			µS

Table 31: Application interface pin configuration

Note: The Bus input current is also dependent on any load connected to the VCC and GND pins in the bus connector. The figures in the table does not include any power consumed by an external load.

9 Mechanical specification

This chapter includes drawings of the AnyBus-S Modbus RTU module for overview and mechanical design. The tolerances for all measurements are ± 0.1 mm unless otherwise stated.

For further information regarding the AnyBus-S module, refer to the AnyBus-S Design Guide.

9.1 Mechanical drawings in this chapter

- AnyBus-S Modbus RTU Angled configuration 3-D view
- AnyBus-S Modbus RTU Angled configuration Top view
- AnyBus-S Modbus RTU Angled configuration Front- and side view
- AnyBus-S Modbus RTU Angled configuration PCB connection points

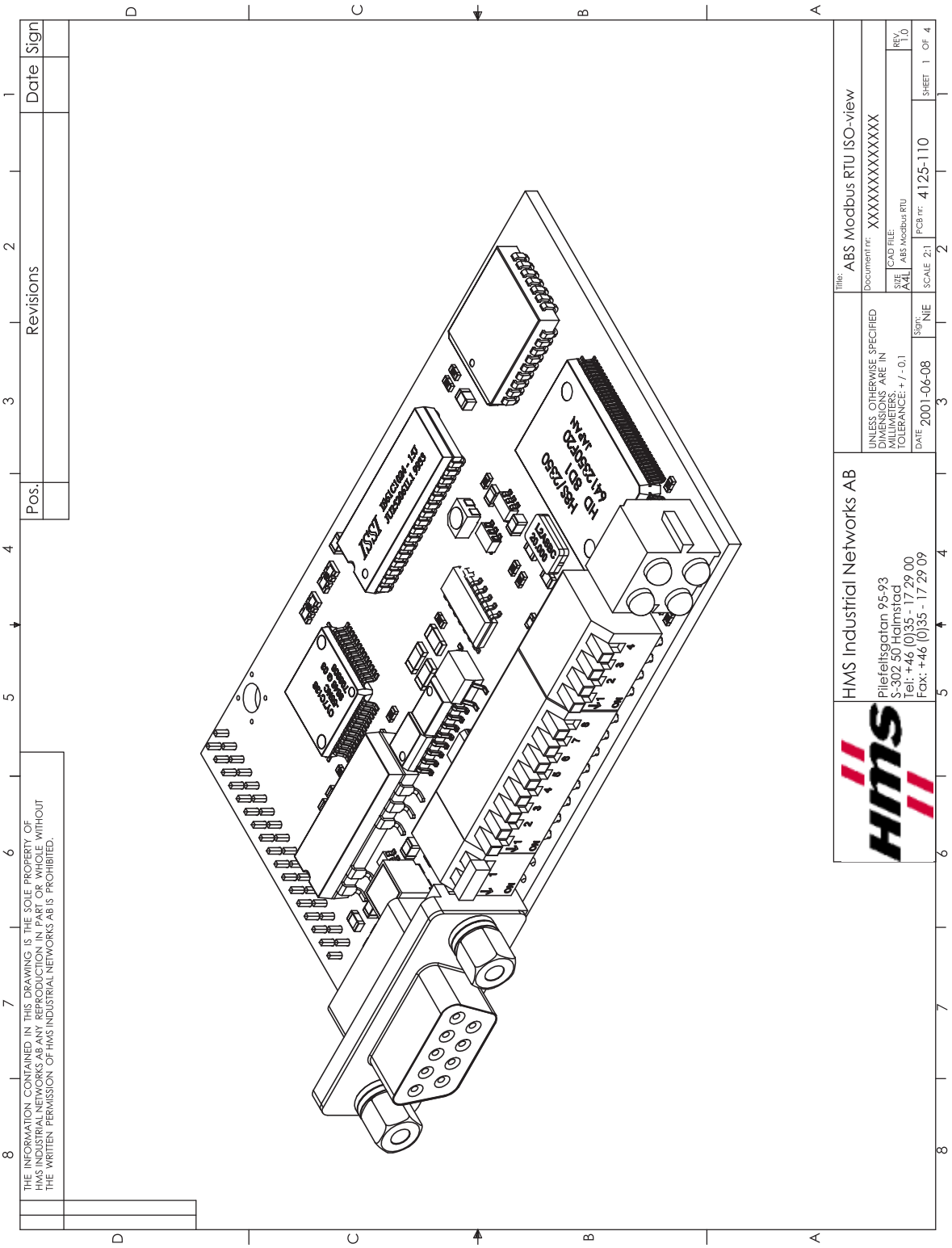


Figure 5: AnyBus-S Modbus RTU Angled configuration 3-D view

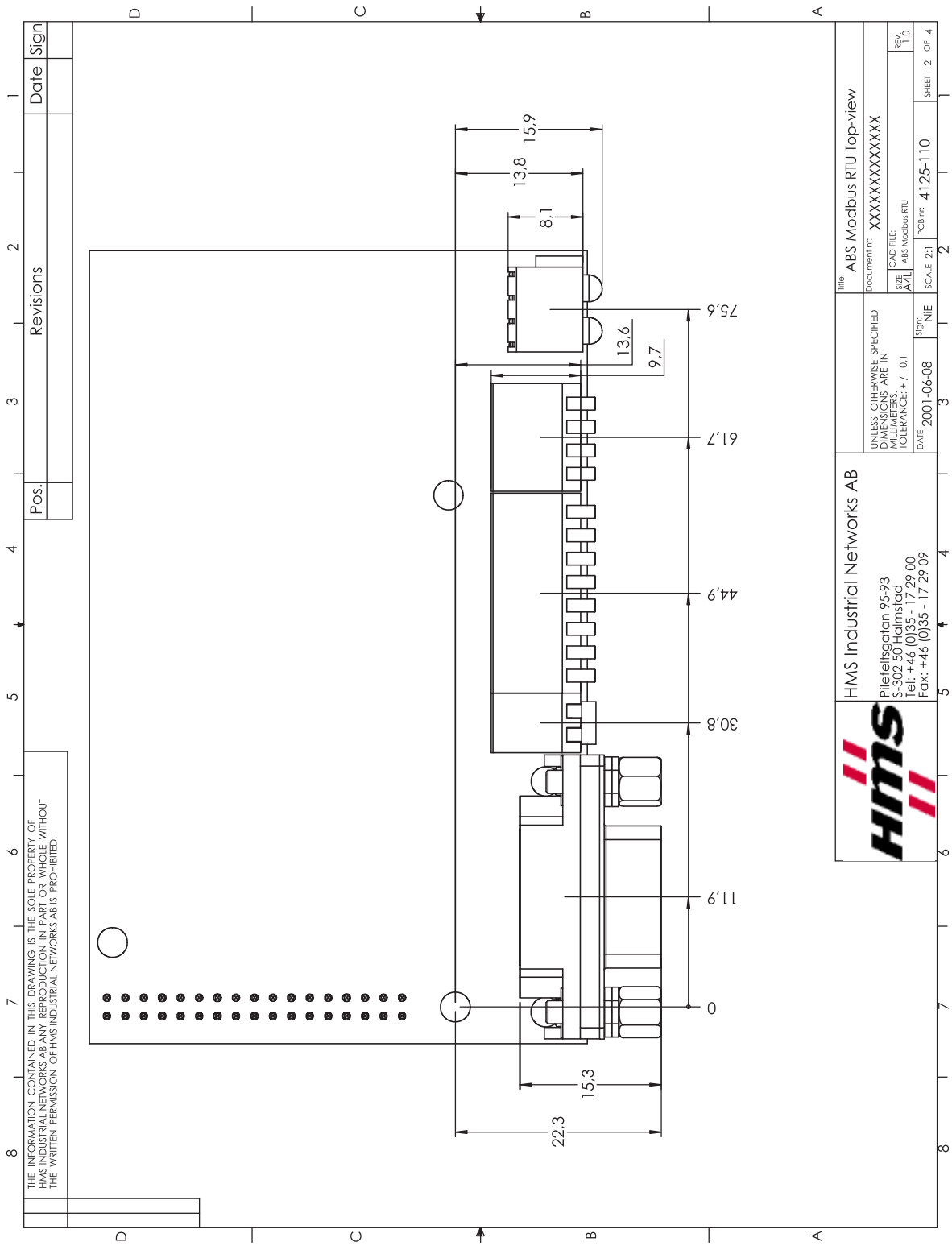


Figure 6: AnyBus-S Modbus RTU Angled configuration Top view

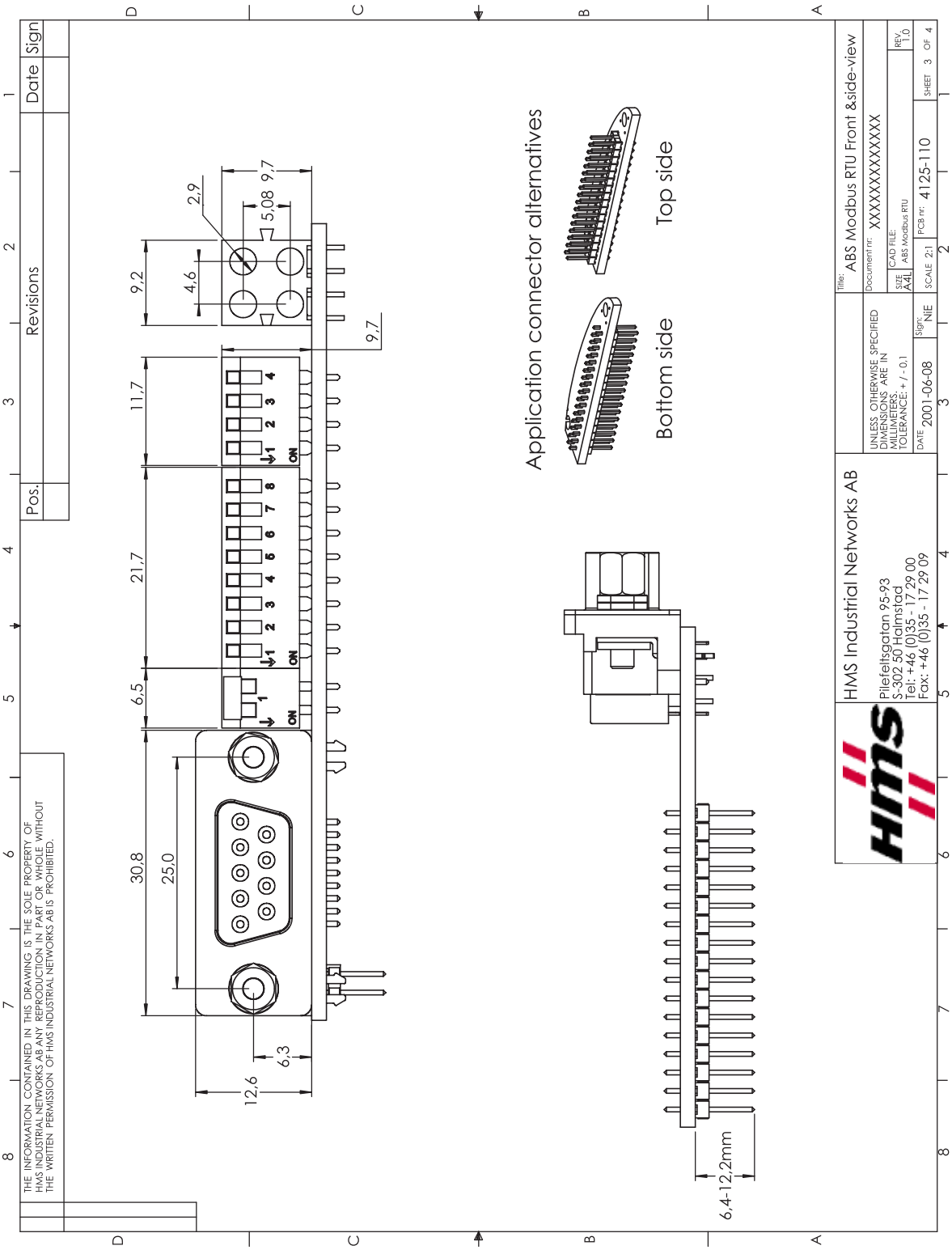


Figure 7: AnyBus-S Modbus RTU Angled configuration Front- and side view

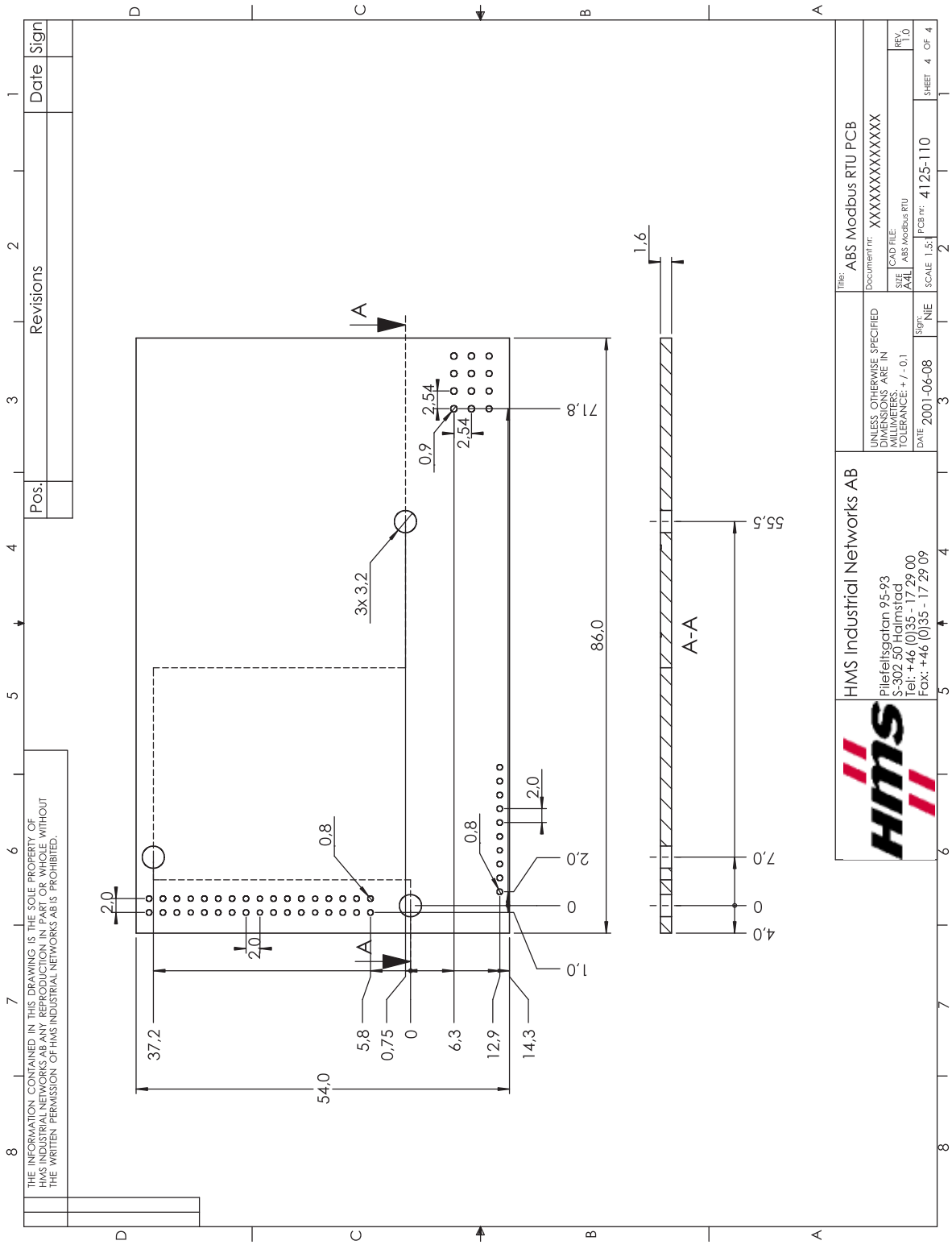


Figure 8: AnyBus-S Modbus RTU Angled configuration PCB connection points

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