Modbus® RTU Serial Communication User Manual

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Abstract

This document provides generic information for ASV-Stuebbe implementing the Modbus RTU Serial Communication protocol. Information relating to specific ASV-Stübbe devices is supplied in separate user manuals.

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1. Modbus RTU Implementation

This implementation is designed to provide a popular data exchange format connecting these instruments to foreign master devices. The Modbus RTU allows the instrument to be a citizen on a data link shared with other devices that subscribe to the Modbus RTU RS-485 specification.

Instrument Model	Description
PTM	Pressure and temperature transmitter
HFT	Hydrostatic tank level sensor
UFM - FLEX	Ultrasonic tank level sensor

Table 1-1 ASV-Stuebbe Modbus devices

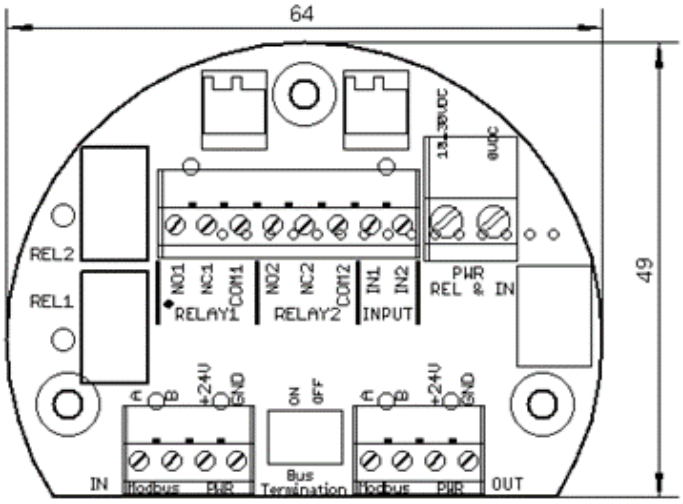
2. Modbus RTU Configuration Interface

The ASV-Stuebbe Modbus uses the RS-485 (TIA-485-A) as a physical layer.

There are two terminals in parallel marked with “IN” and “OUT” to connect the Modbus in a line configuration.

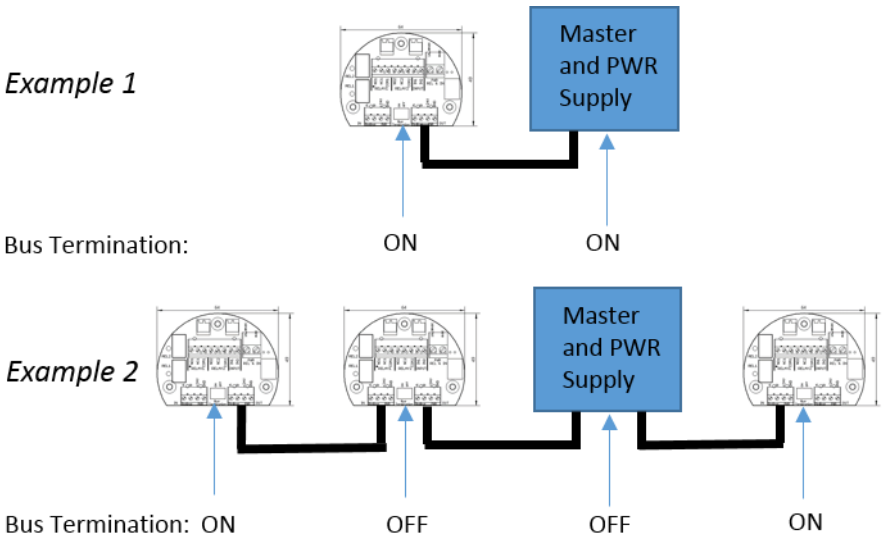
RS-485 uses a differential balanced line over twisted pair, marked with “A” and “B” and “GND”.

To connect the device use a 4 wire cable with a maximum dia. AWG22 and connect “A” and “B” with one twisted pair and a second pair with +24V and GND.



It is mandatory to terminate the RS-485 bus at the end of the line.

Therefore set the jumper “Bus Termination” to left and middle pin to the position “ON”.

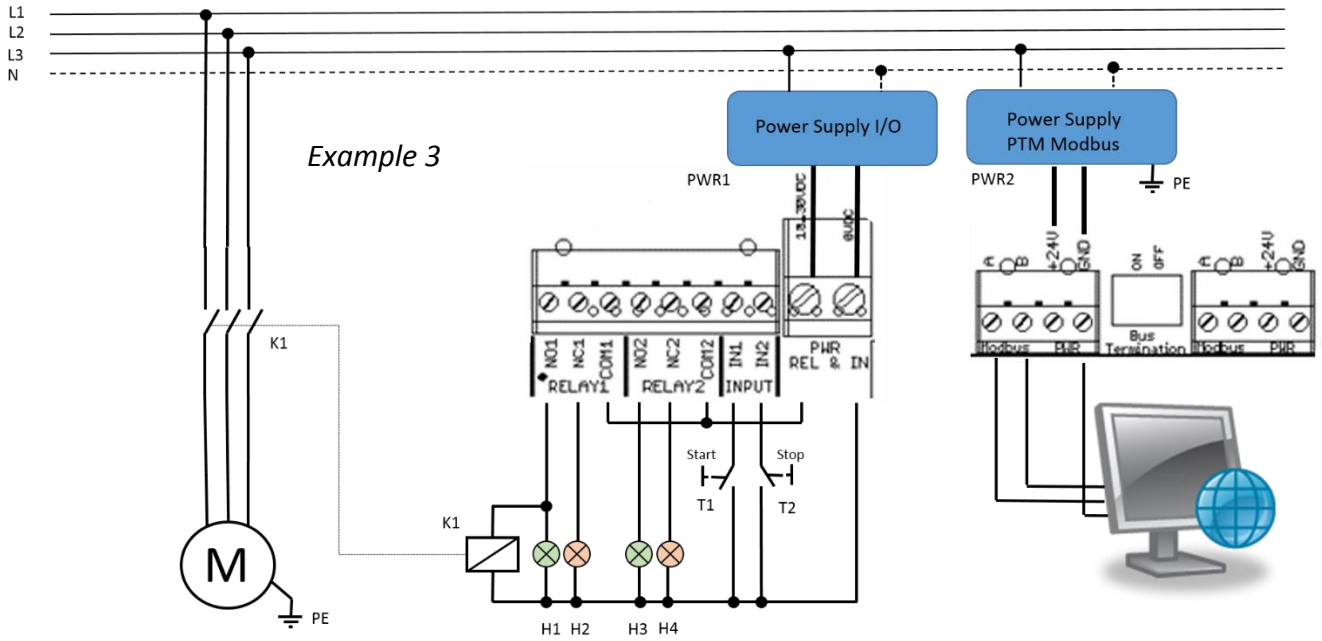


3. Input and Output Interface

Additional to the Modbus interface, there are two SPDT relays contact and two optoelectronic isolated inputs available.
The associated potential of the inputs is on the slot “PWR REL & IN”.

Relay 1 and 2 could be used internally or be controlled Modbus.

Example 3 shows a pump control circuit proposed with a PTM:



Note: It is recommended to ground PWR2 with PE, but it is mandatory to do this for the HFT.

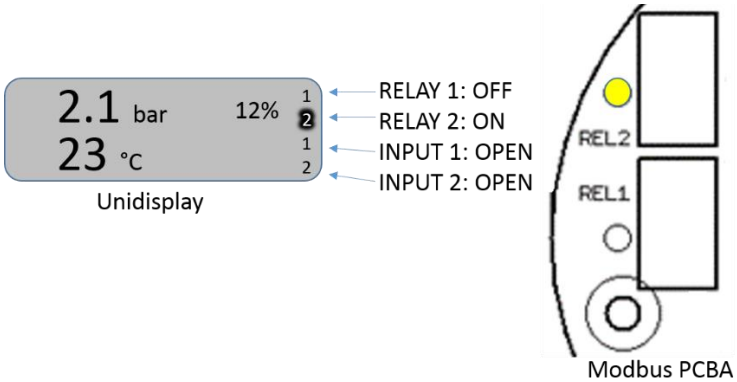
Button T1 “Start” and T2 “Stop” and RELAY1 is internally used from the PTM “pump control menu”.

RELAY2 could be controlled from the Modbus master, for e.g. H3 and H4 shows a “service required”.

To release the relays function to an external Modbus control.

Set: main menu -> output -> switching type -> relay 1,2 -> modbus controlled

The relay and input status is shown in the Unidisplay. The relay status is also shown via LEDs on the Modbus PCBA.



4. Modbus RTU Message Format

Table 2-1 Modbus RTU Message Formats

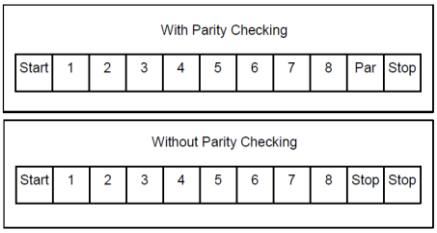
Coding system	8 bit binary
Number of data bits per character	
Parity	Even or No
Bit transfer rate	2400, 4800, 9600, 19200, 38400 Selectable
Duplex	Half duplex Transceiver with Failsafe
Error checking	CRC (cyclic redundancy check)
Polynomial	(CRC-16 10100000000001)
Bit transfer order	LSB first
End of message	Idle line for 3.5 or more characters (>1.75 msec for >19200 Bps).

Table 2-1 ASV-Stuebbe Modbus Formats

5. Modbus RTU Link Layer

The link layer includes the following properties/behaviors:

- Slave address recognition,
- Start / End of Frame detection,
- CRC-16 generation / checking,
- Transmit / receive message time-out,
- Buffer overflow detection,
- Framing error detection,

6. IEEE 32-bit Floating-Point Register Information

The Modbus applications support IEEE 32-bit floating-point information for several of the function codes.

7. Modbus General Menu Settings

In a Modbus RTU bus every slave uses an own unique address.
Use the ASV-Stuebbe Unidisplay to set up the specific slave address.
In the main menu -> basic settings -> Modbus setting -> address -> select a slave address from 1...247.

In the main menu -> basic settings -> Modbus setting -> interface -> select a baud rate from 2400 to 38400. In the second step select even parity with one stop or no parity with two stops. Keep in mind to use the same interface settings for all Modbus member.
The default settings are:

Instrument Model	Address	Interface
PTM	41	9600,8,E,1
HFT	40	9600,8,E,1
UFM - FLEX	50	9600,8,E,1

Table 3-1 ASV-Stuebbe Modbus device defaults

8. Modbus RTU Function Codes Address Table

The ASV-Stuebbe Modbus RTU protocol uses a subset of the standard Modbus RTU function codes to provide access to process-related information. Several standard Modbus RTU function codes are supported. These standard function codes provide basic support for IEEE 32-bit floating point numbers and 16-bit integer register representation of instruments process data.

Table 4-1 PTM Modbus RTU Function Codes

Function Code	Name	Address Note: Coils, Inputs and Register numbers starting from 1	Data type	Comment
01	Read Coil Status	0x00 -> RELAY1 0x01 -> RELAY2	Bit	Read relay status
02	Read Input Status	0x00 -> INPUT1 0x01 -> INPUT2	Bit	Read input status. A “TRUE” logic level on the inputs are extended to minimum 5 seconds.
03	Read Holding Registers	0x00 -> PTM Version	Unsigned Integer	Value = 310 -> V3.10
		0x01 -> Pressure [mBar]	Signed Integer	Value = 0..10000 -> 0..10 Bar
		0x02 -> Temperature [1/10 °C]	Signed Integer	Value = -350..1250 -> -35,0..125,0°C
		0x08 -> Error	Unsigned Integer	TRUE -> Sensor error FALSE -> Sensor ok
		0x09 -> Device ID [PTM]	Unsigned Integer	Value = 41 -> Device ID = 41
		0x0A -> Pressure [Bar]	Float_ABCD	IEEE 32-bit floating-point
		0x14 -> Temperature [°C]	Float_ABCD	IEEE 32-bit floating-point
04	Read Input Registers	-	-	-
05	Force Single Coil	0x00 -> RELAY1 0x01 -> RELAY2	Bit	Write relay status, if it is released to Modbus control. main menu -> output -> switching type -> relay 1,2 -> modbus controlled value = 0x0000 -> Relay off value = 0xFF00 -> Relay on

Table 4-2 HFT Modbus RTU Function Codes

Function Code	Name	Address Note: Coils, Inputs and Register numbers starting from 1	Data type	Comment
01	Read Coil Status	0x00 -> RELAY1 0x01 -> RELAY2	Bit	Read relay status
02	Read Input Status	0x00 -> INPUT1 0x01 -> INPUT2	Bit	Read input status. A "TRUE" logic level on the inputs are extended to minimum 5 seconds.
03	Read Holding Registers	0x00 -> HFT Version	Unsigned Integer	Value = 310 -> V3.10
		0x01 -> Pressure [mBar]	Signed Integer	Value = 0..10000 -> 0..10 Bar
		0x02 -> Temperature [1/10 °C]	Signed Integer	Value = -350..1250 -> -35,0..125,0°C
		0x08 -> Error	Unsigned Integer	TRUE -> Sensor error FALSE -> Sensor ok
		0x09 -> Device ID [HFT]	Unsigned Integer	Value = 40 -> Device ID = 40
		0x0A -> Pressure [mBar]	Float_ABCD	IEEE 32-bit floating-point
		0x0C -> Filling Level [cm]	Float_ABCD	IEEE 32-bit floating-point
		0x0E -> Volume [l]	Float_ABCD	IEEE 32-bit floating-point
		0x14 -> Temperature [°C]	Float_ABCD	IEEE 32-bit floating-point
04	Read Input Registers	-	-	-
05	Force Single Coil	0x00 -> RELAY1 0x01 -> RELAY2	Bit	Write relay status, if it is released to Modbus control. main menu -> output -> switching type -> relay 1,2 -> modbus controlled value = 0x0000 -> Relay off value = 0xFF00 -> Relay on

Table 4-3 UFM – FLEX Modbus RTU Function Codes

Function Code	Name	Address Note: Coils, Inputs and Register numbers starting from 1	Data type	Comment
01	Read Coil Status	0x00 -> RELAY1 0x01 -> RELAY2	Bit	Read relay status
02	Read Input Status	0x00 -> INPUT1 0x01 -> INPUT2	Bit	Read input status. A "TRUE" logic level on the inputs are extended to minimum 5 seconds.
03	Read Holding Registers	0x00 -> UFM Version	Unsigned Integer	Value = 310 -> V3.10
		0x01 -> Distance [mm]	Signed Integer	Value = 0..6000 -> 0..6000 mm
		0x02 ->	Signed Integer	-
		0x08 -> Error	Unsigned Integer	TRUE -> Sensor error FALSE -> Sensor ok
		0x09 -> Device ID [UFM]	Unsigned Integer	Value = 50 -> Device ID = 50
		0x0A -> Distance [cm]	Float_ABCD	IEEE 32-bit floating-point
		0x0C -> Filling Level [cm]	Float_ABCD	IEEE 32-bit floating-point
		0x0E -> Volume [l]	Float_ABCD	IEEE 32-bit floating-point
		0x14 -> Temperature [°C]	Float_ABCD	-
04	Read Input Registers	-	-	-
05	Force Single Coil	0x00 -> RELAY1 0x01 -> RELAY2	Bit	Write relay status, if it is released to Modbus control. main menu -> output -> switching type -> relay 1,2 -> modbus controlled value = 0x0000 -> Relay off value = 0xFF00 -> Relay on