Installation, Operation and Maintenance Manual
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Bettis RTS

Connectivity with Modbus TCP

BETTIS™

EMERSON™

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Section 1: General

A fieldbus interface for the Modbus TCP bus system is available for Emerson actuators in the Bettis RTS Series of Electric Actuators. Modbus TCP is an Ethernet-based fieldbus system. This interface is a hardware option and should already be known when ordering the actuator.

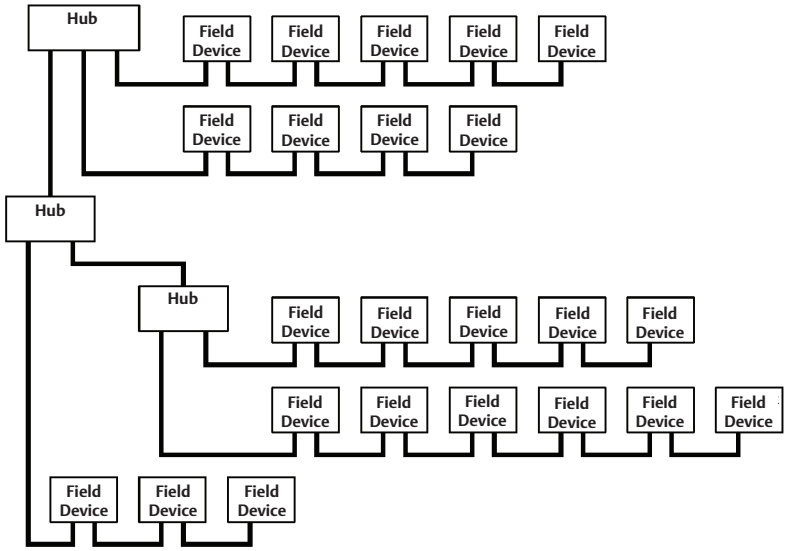
Section 2: Topology

Since two ports are executed on the additional board for the Modbus TCP, the following network topologies can be implemented:

- Line structure
- Tree structure
- Star structure
- Ring structure (if supported by the master)
- Mixed forms

Example:

Figure 1. Topology



Section 3: Connection

The connection of the RTS Control Unit to the Modbus TCP is done at the field level because of the high degree of protection required via 4-pin, D-coded, M12 connectors (see IEC 61076-2-101). The female side is on the device and the male side on the cable side.

Two equivalent M12 connectors, which are internally wired to a hub, are located on the RTS Control Unit with Modbus TCP. With this, a line structure can be implemented. Which connection is used is irrelevant for the function.

Figure 2. Pin Assignment on Device Side (Female Side)

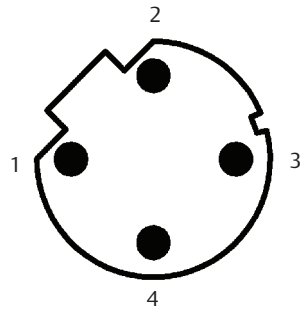


Table 1.

Pin	Function
1	Tx+
2	Rx+
3	Tx-
4	Rx-

The devices are connected via crossover cables, i.e.:

- Tx+ to Rx+
- Tx- to Rx-
- Rx+ to Tx+
- Rx- to Tx-

The cable types recommended are standard patch cables (twisted pair, S/UTP, AWG26, Cat 5e). The cable shield has to be connected to the actuator housing over the connector housing. It is important to ensure that there are no potential differences between the individual devices in the Modbus TCP network so that no transient currents flow over the cable shield.

Section 4: Settings

The following additional parameters become visible in the control unit for the Bettis RTS electric actuator with the Modbus TCP option enabled.

Table 2.

	Menu item	Submenu Item	Poss. Setting	Notes/Comments
P15.1	Bus	Modbus TCP	0: inactive	Modbus TCP disabled.
			1: fixed IP	The actuator has a fixed IP address (parameters P15.2 and P15.3 have to be parametrized correctly).
			2: DHCP	The actuator receives its IP address from the DHCP server.
			3: BOOTP	The actuator receives its IP address from the BOOTP server.
P15.2	Bus	IP Address	0 to 125	Valid IP address [only relevant if P15.1 is set to 1 (fixed IP)]
P15.3	Bus	Net Mask	0 to 125	Valid net mask [only relevant if P15.1 is set to 1 (fixed IP)].
P15.4	Bus	Swap Bytes	0, 1	Swap the low and high bytes in registers.
P15.6	Bus	Watchdog time	0.0 to 10.0 s (0.0 s)	Monitoring of the toggle bit transmitted from the master (bit 7 in the command). With a bus watchdog time set, this bit has to toggle within that time; otherwise there is a bus watchdog fault. At 0.0 s the watchdog function is disabled, in which case toggling of the toggle bit may be omitted.
P15.7	Bus	Sollwertquelle	(0): Standard	The set point is specified via the Modbus TCP (only relevant when the positioner is enabled).
			1: Analog	The set point is specified by the analog signal (only relevant when the positioner is enabled).
			2: Bus/analog	With an error-free bus, the set point is specified via the Modbus TCP. With a bus error, the analog value is switched to (only relevant when the positioner is enabled).
P15.8	Bus	Status 2	(0)	Standard assignment for Status 2.
			1 to 2	Reserved for future use.
P15.9	Bus	Status 3	(0)	Standard assignment for Status 3 (current event).
			1 to 2	Reserved for future use.
P15.10	Bus	Status 4	(0)	Standard assignment for Status 4 (current event).
			1 to 2	Reserved for future use.

⚠ WARNING

After changing parameters P15.1 to P15.3, the protocol stack for the Modbus TCP is restarted to apply the change.

⚠ WARNING

To allow the actuator to be unambiguously identified in the network, the MAC address is displayed in the bottommost line of Status Area S5.

Section 5: Description of Input and Output Data

General information: Depending on the master, it is possible that the low byte (bits 0 to 7) and the high byte (bits 8 to 15) have to be swapped in the registry values. This swapping can be done by the control unit with parameter P15.4.

The transmission mode (big endian/little endian) always has to be adjusted such that the analog values are transmitted correctly. Only then can the binary data be swapped.

5.1 Register Assignment for the Input Data (Data from Master to Slave)

The register values can be written with functions 6 (06_{Hex}: Write single register) and 16 (10_{Hex}: Write multiple registers).

The register values can be read back with function 3 (03_{Hex}: Read holding register).

⚠ WARNING

Depending on the master, the register numbers are assigned with an offset. For example, register 0 in the master has the address 1_{Dec} or 40001_{Dec}.

5.1.1 Set Point

Registry number: 0_{Hex}

Data format: 16-bit, the lower 10 bits (0 to 1023) are used.

The other bits are reserved for future use and must be set to zero.

Structure:

Table 3.

Value	Function	Description
0 (0_{Hex})	0%	-
512 (200_{Hex})	50%	-
1023 ($3ff_{Hex}$)	100%	-

5.1.2 Command

Registry number: 1_{Hex}

Data format: 16-bit (bit field)

Structure:

Table 4.

Bit no.	Function	Description	
		Bit = 0	Bit =1
0	OPEN	-	OPEN command in REMOTE mode
1	CLOSE	-	CLOSE command in REMOTE mode
2	STOP	-	STOP command in REMOTE mode
3	NOT-AUF	-	EMERGENCY OPEN command in LOCAL and REMOTE modes
4	NOT-ZU	-	EMERGENCY CLOSE command in LOCAL and REMOTE modes
5	BLOCK	-	BLOCK drive in LOCAL and REMOTE modes. The drive is not operable either via the selector switch locally nor via commands by REMOTE nor Modbus TCP
6	CONTROL INHIBIT	-	CONTROL INHIBIT in REMOTE mode engagement of the positioner is suppressed
7	WATCHDOG	Toggle bit from the master for bus watchdog monitoring With bus watchdog time set, the bit has to toggle within this time; otherwise there is a bus error	
8	OPEN-SH	-	OPEN command with self-retention in REMOTE mode jettison with STOP
9	CLOSE-SH	-	CLOSE command with self-retention in REMOTE mode jettison with STOP
10	LOCKING- OPEN	-	Trigger locking OPEN (in LOCAL and REMOTE modes) the drive runs OPEN with highest priority, the command continues to queue internally even after reaching the OPEN end position. Jettison only with LOCKING OFF, supply off or OFF mode
11	LOCKING- CLOSE	-	Trigger locking CLOSED (in LOCAL and REMOTE modes) the drive runs CLOSED with highest priority, the command continues to queue internally even after reaching the CLOSED end position. Jettison only with LOCKING OFF, supply off or OFF mode
12	LOCKING OFF	-	Jettison locking
13	BLOCK LOCAL	-	BLOCK drive in LOCAL mode The drive is not operable via the selector switch locally
14	FAIL-SAFE	-	Trigger the fail-safe unit (if there is one)
15	OVERRIDE	-	Binary inputs are not processed

5.1.3 Command 2

Register number: 2_{Hex}

Data format: 16-bit (bit field)

Structure:

Table 5.

Bit no.	Function	Description	
		Bit = 0	Bit =1
0	Bus Bit 1	-	These binary outputs can be assigned to the bus. The assignment can be done arbitrarily, including the assignment of a single bit to mulitple outputs. (Available with Firmware 1.323)
1	Bus Bit 2	-	
2	Bus Bit 3	-	
3	Bus Bit 4	-	
4	Bus Bit 5	-	
5	Bus Bit 6	-	
6	Bus Bit 7	-	
7	Bus Bit 8		
8	Intermediate Position	-	Intermediate position, defined by Bit9, Bit10 and Bit11
9	Definition intermediate Position	-	Bit-setting for intermediate position see Table 6
10	Definition intermediate Position	-	Bit-setting for intermediate position see Table 6
11	Definition intermediate Position	-	Bit-setting for intermediate position see Table 6
12	PVST-Start	-	Start PVST
13	Reserved	-	-
14	Reserved	-	-
15	Reserved	-	-

Table 6. Bit-setting for intermediate position (Bit8)

Bit11	Bit10	Bit9	Function
0	0	0	Move to intermediate position: Position 1
0	0	1	Move to intermediate position: Position 2
0	1	0	Move to intermediate position: Position 3
0	1	1	Move to intermediate position: Position 4
1	0	0	Move to intermediate position: Position 5
1	0	1	Move to intermediate position: Position 6
1	1	0	Move to intermediate position: Position 7
1	1	1	Move to intermediate position: Position 8

5.2 Modules for the Output Data (Slave to Master)

The register values can be read with function 4 (04_{Hex} : Read input register).

⚠ WARNING

Depending on the master, the register numbers are assigned with an offset. For example, register 0 in the master has the address 1_{Dec} or 40001_{Dec}.

5.2.1 Actual Value

Registry number: 0_{Hex}

Data format: 16-bit, the lower 10 bits (0 to 1023) are used.

The other bits are reserved for future use and have to be hidden.

Structure:

Table 7.

Value	Function	Description
0 (0_{Hex})	0%	-
512 (200_{Hex})	50%	-
1023 ($3ff_{Hex}$)	100%	-

5.2.2 Status

Registry number: 1_{Hex}

Data format:16-bit (bit field)

Structure:

Table 8.

Bit no.	Function	Description	
		Bit = 0	Bit = 1
0	READY	-	Actuator is ready
1	END POSITION OPEN	-	End position OPEN reached [taking into account the type of de-activation (torque- or travel-dependent)]
2	END POSITION CLOSED	-	End position CLOSED reached [taking into account the type of de-activation (torque- or travel-dependent)]
3	TRAVEL OPEN	-	Travel end position OPEN reached [no allowance for the type of de-activation (only straightforward travel information)]
4	TRAVEL CLOSED	-	Travel end position CLOSED reached [no allowance for the type of de-activation (only straightforward travel information)]
5	TORQUE OPEN	-	Cut-out torque in OPEN direction has been exceeded
6	TORQUE CLOSED	-	Cut-out torque in CLOSE direction has been exceeded
7	MOTOR TEMP.	-	Motor temperature sensor has responded (overtemp.)
8	OPERATION OPEN	-	The drive is operating by motor OPEN
9	OPERATION CLOSED	-	The drive is operating by motor CLOSED
10	LOCAL	-	Selector switch in position LOCAL
11	REMOTE	-	Selector switch in position REMOTE
12	LOCKING-OPEN	-	Locking OPEN is active. OPEN command is queued with the highest priority and will not be jettisoned even in the end position (see command for bits 10 and 12)
13	LOCKING-CLOSED	-	Locking CLOSED is active. CLOSE command is queued with the highest priority and will not be jettisoned even in the end position (see command for bits 11 and 12)
14	LIVEBIT 1	-	Livebit1 toggles every second
15	LIVEBIT 2	-	Livebit 2 is the copy from the watchdog toggle bit (see command bit 7)

5.2.3 Actual Torque

Register number: 2_{Hex}

Data format: 16-bit, only the lower 8 bits (Bit 7: in direction OPEN; bit 6 to 0: 0 to 100 corresponding to 0 to 100%) are used.

The other bits are reserved for future use and must be hidden.

5.2.4 Actual Speed

Registry number: 3_{Hex}

Data format: 16-bit, only the lower 8 bits (Bit 7: in direction OPEN; bit 6 to 0: 0 to 100 corresponding to 0 to 100%) are used.

The other bits are reserved for future use and must be hidden.

5.2.5 Extended Actual Value

(only with PID-controller option)

Registry number: 4_{Hex}

Data format: 16-bit, the lower 10 bits (0 to 1023) are used.

The other bits are reserved for future use and must be hidden.

5.2.6 Status 2

Registration number: 5_{Hex}

Data format: 16-bit (bit field)

Structure:

Table 9.

Bit no.	Function	Description	
		Bit = 0	Bit = 1
0	Dig. output 1	-	Corresponding binary output is set.
1	Dig. output 2	-	
2	Dig. output 3	-	
3	Dig. output 4	-	
4	Dig. output 5	-	
5	Dig. output 6	-	
6	Dig. output 7	-	
7	Dig. output 8	-	
8	Dig. input 1	-	Corresponding binary output is set.
9	Dig. input 2	-	
10	Dig. input 3	-	
11	Dig. input 4	-	
12	Dig. input 5	-	
13	PHASE SEQUENCE	-	Phase sequence error: Error in supply voltage the (incorrect phase sequence, phase loss, total loss, asymmetry)
14	FC ERROR	-	FC error: error in the power supply unit and/or the frequency converter (if there is one)
15	FAIL-SAFE ERROR	-	Fail-safe unit not ready (if there is one)

Parameter P15.8 can be used to set alternative output functions for Status 2.

5.2.7 Status 3

Record Number: 6_{Hex}

Data format: 16-bit, error number

Table 10.

Error Number	Meaning
3	Motor temperature warning
4	Motor temperature cut-out
5	Phase sequence error or phase loss
9	Error in the power supply or the frequency converter
11	Error in the fail-safe unit (provided there is one)
17	Fault position sensor
22	Fault torque sensor (provided there is one)

Parameter P15.9 can be used to set alternative output functions for Status 3.

5.2.8 Status 4

Record Number: 7_{Hex}

Data format: 16-bit, error number

Structure:

Table 11.

Bit no.	Function	Description		
		Bit1	Bit0	Signal
0 and 1	Channel Activity	0	0	Bus: Channel A active.
		0	1	Bus: Channel B active.
		1	0	Bus: Channel A and B active, main channel for inputs is channel A.
		1	1	Bus: Channel A and B active, main channel for inputs is channel B.
2	Reserved	-		
3	Reserved			
4	Reserved			
5	Reserved			
6	Reserved			
7	Reserved			
8 and 9	PVST Status	0	0	PVST functionality not activated or no PVST realised yet.
		0	1	PVST active: There is a PVST active currently.
		1	0	PVST OK: The last PVST was successful.
		1	1	PVST Error: The last PVST was not successful.
10	Reserved	-		
11	Reserved			
12	Reserved			
13	Reserved			
14	Reserved			
15	Reserved			

Parameter P15.10 can be used to set alternative output functions for Status 4.

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