

Hazard Warnings

Hazard warnings in this manual indicate potential harm to the user or the product. For the person interacting with the product, the level of risk includes consequences ranging from slight, up to lethal injuries. As for the product, disobeying the warnings may cause damage to the equipment and/or void the warranty. Therefore, said warnings are made apparent to instruct and warn the user, which precautions have to be made prior to performing any actions described in this manual. The user must read and be familiar with the manual, before performing any tasks as described in this manual.

Hazard warnings in this manual are presented in these three forms:

WARNING: These warning notices refer to personal safety. Failure to obey these notices could result in personal injury or death.



WARNING

CAUTION: General precautions must be made. Failure to obey these notices could result in personal injury and/or equipment damage.



CAUTION

NOTE: Directs the user's attention to essential information.

Extension Board for MODBUS-RTU on SMARTCON Control Unit

1 General Information

NOTE: This IOM applies to the SCHIEBEL ACTUSTMART control unit with a firmware version of 1510 or higher equipped with a MODBUS board V2.

For SCHIEBEL ACTUSMART or SMARTCON actuators the standardized fieldbus interface MODBUS-RTU is available.

This interface is a product option represented in hardware on the device, thus making it beneficial to advertise intended use upon ordering.

Although enabling MODBUS-RTU a posteriori is possible, such upgrades should only be performed by authorized SCHIEBEL engineers or specially trained personnel.

MODBUS-RTU determines technical and functional characteristics of the serial fieldbus system used to connect distributed autonomous devices. MODBUS-RTU distinguishes Master- and Slave-Devices and has been designed for data-transmission on field-level, hence, the communication of central control units - as SPS or PC - with decentral field-devices over a fast serial connection.

Communication functionality is standardized by the MODBUS Organization (modbus.org).

The **physical communication layer** is based on a RS-485 interface connected through a shielded twisted two-wire cable.

SCHIEBEL Actuators ACTUSMART or SMARTCON are always slave devices.

Communication settings

In order for the SCHIEBEL MODBUS-RTU slave module to connect successfully to the field bus, the settings of the MODBUS-RTU communication must be set accordingly.

The supported baud rates are:

1200bps, 2400bps, 4800 bps, 9600 bps, 19200 bps
38400 bps, 57600 bps, 115200 bps, 230400 bps

The byte frame has following bits:

1 start bit
8 data bits, LSB first
1 parity bit (even, odd or none)
1 stop bit

NOTE: There will be two stop bits, if no parity bit is set.

The MODBUS V2 extension board is capable to act as a repeater for the bus, if ordered as such. In this case, the redundancy option cannot be realized, as the second channel is used otherwise.

2 Connection

Depending on the order there are the following connections possible:

- standard design: connection board
- explosion proof design: terminals

2.1 Standard design

Connecting the actuator to the fieldbus system is accomplished through connecting the bus cable to the connection print in the connection compartment of the actuator. Thus for convenience, the MODBUS-RTU connector is pluggable like every other external connector for signal or power on our actuators. Disconnecting

a device will have no effect on the communication of other devices in the same strand. Meaning, the network maintains full functionality if a device is disconnected while the network is in operation. But beware: At the end of each strand MODBUS-RTU has to be terminated. This termination can either be performed by a SMARTCON-Actuator or a separate active bus termination device. Note that the power for the termination resistors of SMARTCON-Devices comes from the actuator. Hence, disconnecting the terminating SMARTCON renders the bus in this strand inoperational. Therefore, it is advised to use active bus termination through a dedicated device.

The single-channel version of SMARTCON is connected to MODBUS-RTU via channel I. The dual-channel version (Option: redundant) and the repeater is connected via channel I and II.

2.1.1 Connection Board (customer end)

The connection board is situated in the connection compartment under the topmost cover.

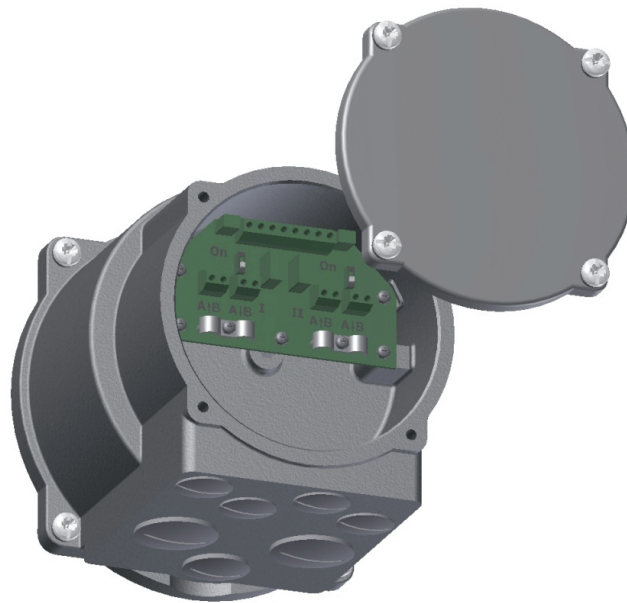
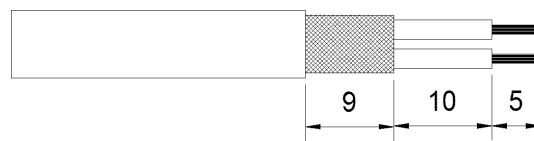


Figure 1: Connection Board

2.1.2 Connecting to MODBUS-RTU

Recommended Cable Confectioning

Prior to connection the bus lines are to be confectioned as seen in the figure below:



The clamps on the connection board are designed for a maximum line cross-section of 1.5mm². The line diameter has to be in the range of 5 to 8 mm.

Connecting to a Strand between Devices

Other devices are connected to the bus in front and behind of the new Slave-Device.
 Line configuration:

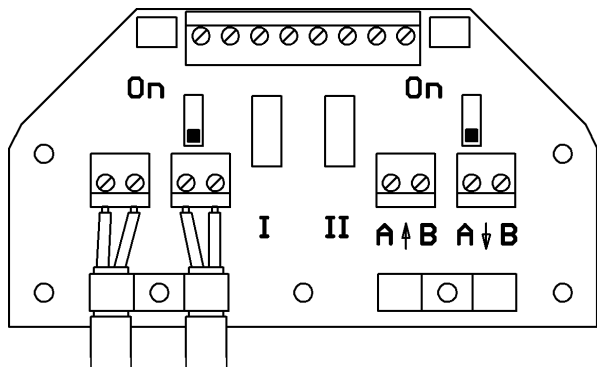


Figure 2: single channel

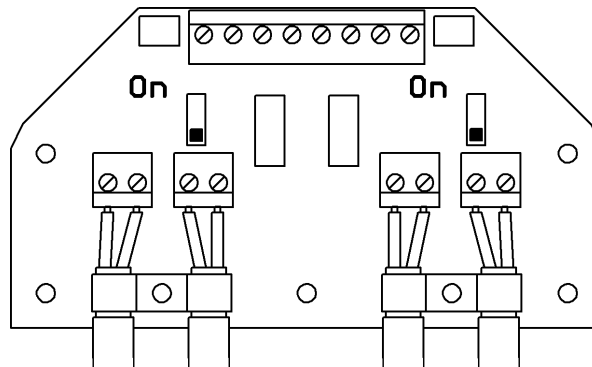


Figure 3: dual channel

Connecting at the End of a Strand, Bus Termination

There is either no device connected to the bus in front or behind of the new Slave-Device.
 Line configuration:

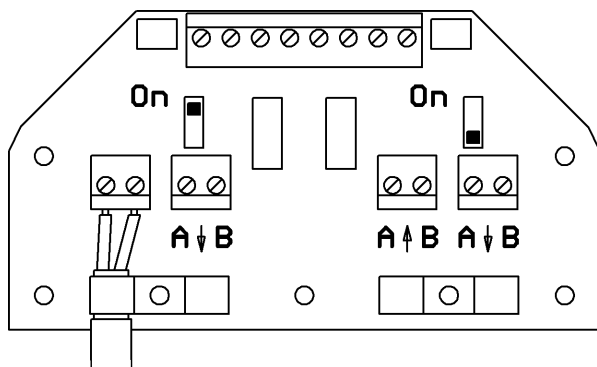


Figure 4: single channel

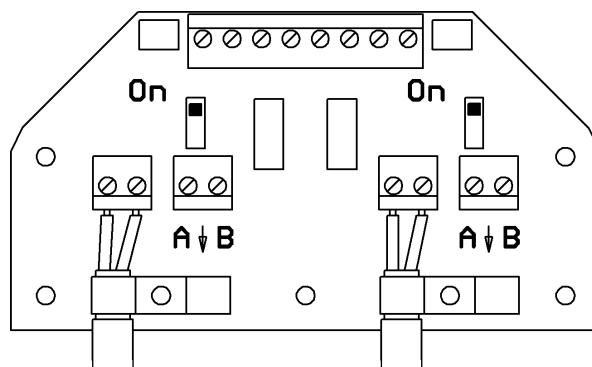


Figure 5: dual channel

Bus termination:

MODBUS-RTU has to be terminated on both ends of every strand. Termination can be accomplished through the termination resistor implemented in your SMARTCON-Device. Bus termination is activated when the respective switch on the connection board is switched to "ON" as seen in figure 4.

NOTE: The termination

2.2 Explosion proof design

Normally in explosion proof design there is no termination available in the control unit. That means that the bus termination must be done separate outside of the control unit.

Optionally also a bus termination in the control unit is possible, this must be specified by the order.

In this case you can activate the bus termination by connecting the following terminals:

A with AT and B with BT (single channel version) or

A1 with A1T, B1 with B1T, A2 with A2T and B2 with B2T (dual channel version).

CAUTION: The shield must be connected to the shielding connection clamp (windowcut) - see Figure 6 or Figure 7.



2.2.1 Design with bin. In- and Outputs

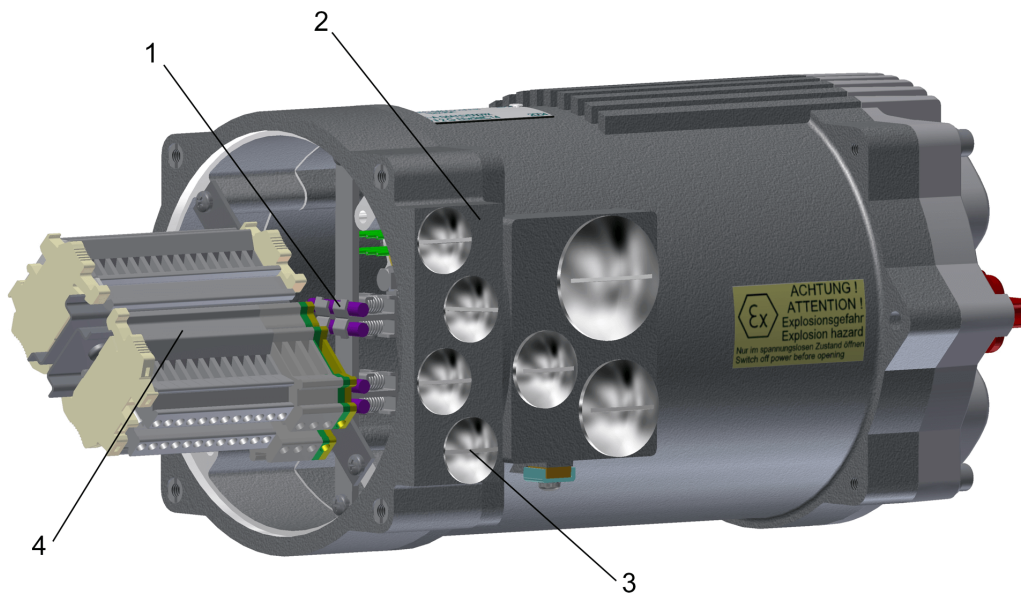


Figure 6: 1... shielding connection clamp, 2... additional frame, 3... metallic cable glands (closed with blind screw connections at delivery) 4 xM20x1,5, 4... terminal strip

2.2.2 Design without bin. In- and Outputs



Figure 7: 1... shielding connection clamp, 2... terminal strip

An additional frame with 4xM20 holes is possible on special request.

3 Setup

If MODBUS-RTU is activated, the following additional parameters will be visible in the control menu of your ACTUSMART or SMARTCON-Device.

Each device connected to a MODBUS-RTU-network has to receive a unique address during setup.

	Menu Item	Subitem	Options	Explanation/Comments
P15.1	MODBUS-RTU	Bus	0: Not activated	MODBUS-RTU deactivated.
			1: activated	MODBUS-RTU activated.
			2: Test mode	For diagnosis conducted by trained personnel.
P15.2	MODBUS-RTU	Address Channel A	1...247	Set the bus address of the first/primary channel.
P15.3	MODBUS-RTU	Address Channel B	1...247	Set the bus address of the second/secondary channel. (only for option "MODBUS-RTU redundant")
P15.4	MODBUS-RTU	Watchdogtime	0.0 – 10.0s {0.0s}	Monitoring period of the togglebit. (Bit 7 in Master's command). This bit has to toggle in the specified time or a buswatchdog error is detected. If Watchdogtime is set to 0.0s, the watchdog is deactivated. Toggling the respective bit can now be omitted.
P15.5	MODBUS-RTU	Setpoint Source	{0}: Standard	Setpoint specified by MODBUS-RTU (effective only if positioner is activated).
			1: Analog.	Setpoint specified by analogue signal. (effective only if positioner is activated)
			2: Bus/Analog.	Setpoint specified by MODBUS-RTU. In case of bus error, setpoint specified by analogue signal. (effective only if positioner is activated)
P15.6	MODBUS-RTU	Status 2	{0}	Standard value for Status 2
			1 - 2	Reserved for future use.
P15.7	MODBUS-RTU	Status 3	{0}	Standard value for Status 3 (current event).
			1 - 2	Reserved for future use.
P15.8	MODBUS-RTU	Status 4	{0}	Standard value for Status 4
			1 - 2	Reserved for future use.
P15.9	MODBUS-RTU	Baudrate	0: Auto	Automatically detects the baudrate of the bus.
			1: 1200 Baud	Sets the baudrate to the according value.
			2: 2400 Baud	
			3: 4800 Baud	
			4: 9600 Baud	
			5: 19200 Baud	
			6: 38400 Baud	
			7: 57600 Baud	
			8: 115200 Baud	
9: 230400 Baud				
P15.10	MODBUS-RTU	Parity	0: None	Sets the type parity bit.
			1: Even	
			2: Odd	
P15.11	MODBUS-RTU	Bus Timeout	0,0...60,0 sec	Sets the delay time a bus fault is signalled by the actuator after an actual bus fault occurs.
			0: Ignore	Bus fault or watchdog timeout is ignored.

continued at the next page

Continuation of the Table

	Menu Item	Subitem	Options	Explanation/Comments
P15.12 ¹⁾	MODBUS-RTU	Bus Monitor	1: Stop	The actuator stops in case of a bus fault or watchdog timeout.
			2: Open	The actuator moves to the open position in case of a bus fault or watchdog timeout.
			3: Close	The actuator moves to the closed position in case of a bus fault or watchdog timeout.
			4: Emergency Position	The actuator moves to the emergency position (see parameter P8.5) in case of a bus fault or watchdog timeout.
			5: Emergency Open	The actuator moves to the open position with a superimposed run command in case of a bus fault or watchdog timeout.
			6: Emergency Close	The actuator moves to the closed position with a superimposed run command in case of a bus fault or watchdog timeout.
			7: Last Valid Value	The actuator moves to the last valid value set by the setpoint register (see chapter 4.1.1 on page 8) in case of a bus fault or watchdog timeout
			8: Failsafe	The actuator moves to the failsafe position in case of a bus fault or watchdog timeout (only for failsafe actuators).

¹⁾FW1515 or higher

4 Specification of Input and Output Data

As per definition, MODBUS uses a "big-Endian" representation for addresses and data items. Thus, the Highbyte (Bit 8...15) is sent prior to the Lowbyte (Bit 0...7).

4.1 Input Data Modules (Master to Slave Communication)

Input data can be handled with following Modbus functions:

Function:		
06 (06 hex)	Preset Single Register	Writes data to one single register in the slave.
16 (10 hex)	Preset Multiple Registers	Writes data to multiple consecutively registers in the slave.
03 (03 hex)	Read Holding Register	Reads back one single register from the slave.
04 (04 hex)	Read Input Register	Reads back one single register from the slave.

4.1.1 Setpoint

Register number: 1, address 0000_{Hex}

Data format: 16bit, only the lowest 10 bits (0...1023) are in use.

Other bits are reserved for future use and have to be set to zero!

Value	Function:	Description:
0 (0 _{Hex})	0 %	
512 (200 _{Hex})	50%	
1023 (3ff _{Hex})	100%	

4.1.2 Command

Register number: 2, address 0001_{Hex}
Data format: 16 bit (Bitfield)

Bitno.:	Function:	Description:	
		Bit = 0	Bit = 1
0	OPEN	-	OPEN in REMOTE mode.
1	CLOSE	-	CLOSE in REMOTE mode.
2	STOP	-	STOP in REMOTE mode.
3	EMERGENCY-OPEN	-	EMERGENCY-OPEN in REMOTE & LOCAL mode.
4	EMERGENCY-CLOSE	-	EMERGENCY-CLOSE in REMOTE & LOCAL mode.
5	BLOCK	-	Blocking the actuator in REMOTE & LOCAL mode. Actuator can neither be controlled through the switch on the device nor through commands over REMOTE nor MODBUS-RTU.
6	POSITIONER OFF	-	Deactivating the positioner in REMOTE mode.
7	WATCHDOG	Togglebit for buswatchdog. Bit has to toggle before specified time-out or a buswatchdog error will be detected.	
8	OPEN-SH	-	Latched OPEN in REMOTE mode. Release with STOP.
9	CLOSE-SH	-	Latched CLOSE in REMOTE mode. Release with STOP.
10	LOCK-OPEN	-	Locks OPEN (in REMOTE and LOCAL mode) Actuator carries out a latched OPEN command with highest priority which can only be released with LOCK-OFF, power-off or mode OFF.
11	LOCK-CLOSE	-	Locks CLOSE (in REMOTE and LOCAL mode) Actuator carries out a latched CLOSE command with highest priority which can only be released with LOCK-OFF, power-off or mode OFF.
12	LOCK-OFF	-	Releases the lock.
13	BLOCK LOCAL	-	Blocking the actuator in mode LOCAL. Actuator can't be moved with selection switch.
14	FAILSAFE	-	Trigger FAILSAFE-Unit (if available).
15	OVERRIDE	-	Binary inputs will not be processed.

4.1.3 Command 2

Register number: 3, address 0002_{Hex}

Data format: 16 bit (Bitfield)

Bitno.:	Function:	Description:	
		Bit = 0	Bit = 1
0	Bus Bit 1	-	These binary outputs can be assigned to the bus. The assignement can be done arbitrarily, including the assignement 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 2, page 11.
10	Definition intermediate position	-	Bit-setting for intermediate position see table 2, page 11.
11	Definition intermediate position	-	Bit-setting for intermediate position see table 2, page 11.
12	PVST-Start	-	start PVST
13 ²⁾	Definition intermediate position	-	Bit-setting for intermediate position see table 2, page 11.
14	reserved	-	
15	reserved	-	

Bit13	Bit11	Bit10	Bit9	Function
0	0	0	0	move to intermediate position: Position 1
0	0	0	1	move to intermediate position: Position 2
0	0	1	0	move to intermediate position: Position 3
0	0	1	1	move to intermediate position: Position 4
0	1	0	0	move to intermediate position: Position 5
0	1	0	1	move to intermediate position: Position 6
0	1	1	0	move to intermediate position: Position 7
0	1	1	1	move to intermediate position: Position 8
1	0	0	0	move to intermediate position: Position 9
1	0	0	1	move to intermediate position: Position 10
1	0	1	0	move to intermediate position: Position 11
1	0	1	1	move to intermediate position: Position 12
1	1	0	0	move to intermediate position: Position 13
1	1	0	1	move to intermediate position: Position 14
1	1	1	0	move to intermediate position: Position 15
1	1	1	1	move to intermediate position: Position 16

Table 2: Bit-setting for intermediate position (Bit8)

NOTE: Bit13 is available from FW1600 or higher, thus, limiting the number of intermediate positions to 8 for older firmware versions.

4.1.4 Setpoint Revolution Speed

Only with ACTUSMART!

Register number: 4, address 0003_{Hex}

Data format: 16 bit, only the lowest 8 bits (Bit 7: Direction OPEN; Bits 6 ... 0: 0 ... 100 corresponding to 0 ... 100%) are in use.

Other bits are reserved for future use and have to be set to zero!

4.2 Output Data Modules (Slave to Master communication)

Output data can be handled with following Modbus functions:

Function:		
03 (03 hex)	Read Holding Register	Reads one single register from the slave.
04 (04 hex)	Read Input Register	Reads one single register from the slave.

4.2.1 Actual position value

Register number: 257, address 0100_{Hex}

Data format: 16bit, only the lowest 10 bits (0 ... 1023) are in use.

Other bits are reserved for future use and have to be set to zero!

Value	Function:	Description:
0 (0 _{Hex})	0%	
512 (200 _{Hex})	50%	
1023 (3ff _{Hex})	100%	

4.2.2 Status

Register number: 258, address 0101_{Hex}
Data format: 16 bit (Bitfield)

Bitno.:	Function:	Description:	
		Bit = 0	Bit = 1
0	READY	-	Actuator is ready.
1	END POSITION OPEN	-	End position OPEN reached (under consideration of switch-off mode (torque or travel dependent)).
2	END POSITION CLOSE	-	End position CLOSE reached (under consideration switch-off mode (torque or travel dependent)).
3	TRAVEL OPEN	-	End travel OPEN reached (under consideration of switch-off mode (torque or travel dependent)).
4	TRAVEL CLOSE	-	End travel CLOSE reached (travel dependent).
5	TORQUE OPEN	-	Power-off torque in opening direction exceeded.
6	TORQUE CLOSE	-	Power-off torque in closing direction exceeded.
7	MOTORTEMP.	-	Motor temperature sensor signal (overheat).
8	OPENING	-	Actuator moving in OPEN direction.
9	CLOSING	-	Actuator moving in CLOSE direction.
10	LOCAL	-	Switch in LOCAL mode position.
11	REMOTE	-	Switch in REMOTE mode position.
12	LOCK OPEN	-	Latched OPEN command with highest priority. (Refer to Command bit 10 und 12)
13	LOCK CLOSE	-	Latched CLOSE command with highest priority. (Refer to Command bit 10 und 12)
14	LIVEBIT 1	Livebit1 toggles with 1 Hz.	
15	LIVEBIT 2	Livebit2 is a copy of the watchdog toggle-bit. (Refer to command Bit 7)	

4.2.3 Actual torque value

Register number: 259, address 0102_{Hex}
Data format: 16 bit, only the lowest 8 bit (Bit 7: Direction OPEN; Bit 6 ... 0: 0 ... 100 corresponding to 0 ... 100%) are in use.
Other bits are reserved for future use and have to be set to zero!

4.2.4 Actual speed value

Only with ACTUSMART!

Register number: 260, address 0103_{Hex}
Data format: 16 bit, only the lowest 8 bit (Bit 7: Direction OPEN; Bit 6 ... 0: 0 ... 100 corresponding to 0 ... 100%) are in use.
Other bits are reserved for future use and have to be set to zero!

4.2.5 External actual value

Only with Option PID-Controller!

Register number: 261, address 0104_{Hex}
Data format: 16 bit, only the lowest 10 bits (0 ... 1023) are in use.
Other bits are reserved for future use and have to be set to zero!

4.2.6 Status 2

Register number: 262, address 0105_{Hex}
 Data format: 16 bit (Bitfield)

Structure:

Bitno.:	Function:	Description	
		Bit = 0	Bit 0 = 1
0	Dig. Output 1	-	Corresponding binary output enabled.
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 input enabled.
9	Dig. Input 2	-	
10	Dig. Input 3	-	
11	Dig. Input 4	-	
12	Dig. Input 5	-	
13	PHASE SEQUENCE	-	Phase Sequence Error: wrong phase order, phase failure, total failure, asymmetry.
14	FC ERROR	-	FC Error: Error in power supply or frequency converter (if present).
15	FAILSAFE ERROR	-	Failsafe-Unit not ready (if present).

4.2.7 Status 3

Register number: 263, address 0106_{Hex}
 Data format: 16 bit, error codes

Error Code:	Corresponds:
3	Motor temperature warning (only with ACTUSMART).
4	Motor temperature power-off.
5	Phase order error or phase failure.
9	Power supply error or frequency converter error.
11	Failsafe-Unit error (if available).
17	Travel sensor error.
22	Torque sensor error.

4.2.8 Status 4

Register number: 264, address 0107_{Hex}

Data format: 16 bit (Bitfield)

Structure:

Bitno.:	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	Bit9	Bit8	Signal
		0	0	PVST functionality not activated or no PVST realised yet.
		0	1	PVST active: A PVST is currently 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			

4.3 Status

Additional status registers are available for ACTUSMART actuators with a firmware version of 1600 or higher. Please refer to the document "Modbus Register Specification 3.0" for more information.