

8.8 Commissioning the device in Modbus TCP

8.8.1 Implemented Modbus functions

The devices support the following functions for accessing process data, parameters, diagnostics and other services.

Function codes	
1	Read Coils – reading multiple output bits
2	Read Discrete Inputs – reading multiple input bits
3	Read Holding Registers – reading multiple output registers
4	Read Input Registers – reading multiple input registers
5	Write Single Coil – writing single output bit
6	Write Single Register – writing single output register
15	Write Multiple Coils – writing multiple output bits
16	Write Multiple Registers – writing multiple output
23	Read/Write Multiple Registers – reading and writing multiple registers

8.8.2 Modbus registers

Address	Access	Meaning
0x0000...0x01FF	read only	Process data of the inputs (identical to registers 0x8000...0x8FFF)
0x0800...0x09FF	read/write	Process data of the outputs (identical to registers 0x9000...0x9FFF)
0x1000...0x100B	read only	Module identifier
0x100C	read only	Module status
0x1017	read only	Register mapping revision (always 2, if not, mapping is incompatible with this description)
0x1020	read only	Watchdog, actual time [ms]
0x1120	read/write	Watchdog predefined time [ms] (default: 500 ms)
0x1130	read/write	Modbus connection mode register
0x1131	read/write	Modbus Connection Timeout in sec. (def.: 0 = never)
0x113C...0x113D	read/write	Modbus Parameter Restore (reset of parameters to default values)
0x113E...0x113F	read/write	Modbus Parameter Save (permanent storing of parameters)
0x1140	read/write	Deactivate protocol Deactivates explicitly the selected Ethernet protocol: <ul style="list-style-type: none"> ■ Bit 0 = deactivate EtherNet/IP™ ■ Bit 1 = deactivate Modbus TCP ■ Bit 2 = deactivate PROFINET ■ Bit 15 = deactivate web server
0x1141	read/write	Active protocol <ul style="list-style-type: none"> ■ Bit 0 = EtherNet/IP™ active ■ Bit 1 = Modbus TCP active ■ Bit 2 = PROFINET active ■ Bit 15 = Web server active

Address	Access	Meaning
0x1150	read only	LED behavior (PWR) at V2 undervoltage bit 0: 0 = red 1 = green flashing
0x2400	read only	V1 [mV]: 0 at < 18 V
0x2401	read only	V2 [mV]: 0 at < 18 V
0x8000...0x8400	read only	Process data of the inputs (identical to registers 0x0000...0x01FF)
0x9000...0x9400	read/write	Process data of the outputs (identical to registers 0x0800...0x09FF)
0xA000...0xA400F	read only	Diagnostics
0xB000...0xB400	read/write	Parameters

The following table shows the register mapping for the different Modbus addressing methods:

Description	Hex	decimal	5-digit	Modicon
Inputs	0x0000...0x01FF	0...511	40001...40512	400001...400512
Outputs	0x0800...0x09FF	2048...2549	42049...42560	402049...402560
Module identifier	0x1000...0x1006	4096...4102	44097...44103	404097...404103
Module status	0x100C	4108	44109	404109
Watchdog, actual time	0x1020	4128	44129	404129
Watchdog, predefined time	0x1120	4384	44385	404385
Modbus connection mode re- gister	0x1130	4400	44401	404401
Modbus Connection Timeout in sec.	0x1131	4401	44402	404402
Modbus Parameter Restore	0x113C...0x113D	4412...4413	44413...44414	404413...404414
Modbus Parameter Save	0x113E...0x113F	4414...4415	44415...44416	404415...404416
Deactivate protocol	0x1140	4416	44417	404417
Active protocol	0x1141	4417	44418	404418
LED behavior (PWR) at V2 under- voltage	0x1150	4432	44433	404433
V1 [mV]:	0x2400	9216	49217	409217
V2 [mV]:	0x2401	9217	49218	409218
Process data inputs	0x8000, 0x8001	32768, 32769	-	432769, 432770
Process data outputs	0x9000, 0x9001	36864, 36865	-	436865, 436866
Diagnostics	0xA000, 0xA001	40960, 40961	-	440961, 440962
Parameters	0xB000, 0xB001	45056, 45057	-	445057, 445058

Register 0x1130: Modbus connection mode

This register defines the behavior of the Modbus connections.

Bit	Designation	Value	Meaning
0	MB_OnlyOneWritePermis- sion	0	All Modbus connections receive the write au- thorization
		1	Only one Modbus connection can receive the write permission. A write permission is opened until a Disconnect. After the Disconnect the next connection which requests a write access receives the write authorization.
1	MB_ImmediateWritePer- mission	0	With the first write access, a write authoriza- tion for the respective Modbus connection is requested. If this request fails, an exception re- sponse with exception-code 0x01 is gener- ated. If the request is accepted, the write ac- cess is executed and the write authorization remains active until the connection is closed.
		1	The write authorization for the respective Modbus connection is already opened during the connection establishment. The first Mod- bus connection thus receives the write author- ization, all following connections don't (only if bit 0 = 1).
2...15	reserved	-	-

Register 0x1131: Modbus Connection Timeout

This register defines after which time of inactivity a Modbus connection is closed through a Dis-
connect.

Value range: 0...65535 s

default: 0 s = never (Modbus connection will never be closed)

Behavior of the BUS LED

If Modbus is the active protocol in case of a connection Time out and no further Modbus con-
nections exist, the BUS LED behaves as follows:

Connection timeout	BUS LED
Timeout	Green flashing

Register 0x113C and 0x113D: Restore Modbus-Connection-Parameters

Registers 0x113C and 0x113D serve for resetting the parameter-register 0x1120 and 0x1130 to
0x113B to the default settings. The service resets the parameters without saving them.

Procedure:

- ▶ Write 0x6C6F to register 0x113C.
- ▶ To activate the reset of the registers, write 0x6164 ("load") within 30 seconds in register
0x113D. Both registers can also be written with one single request using the function
codes FC16 and FC23.
- ⇒ The parameters are reset tot default values.
- ▶ Save changes via a subsequent Save service.

Register 0x113E and 0x113F: Save Modbus-Connection-Parameters

Registers 0x113E and 0x113F are used for the non-volatile saving of parameters in registers 0x1120 and 0x1130 to 0x113B.

Procedure:

- ▶ Write 0x7361 to register 0x113E.
- ▶ Write 0x7665 ("save") within 30 seconds in register 0x113F to activate the reset of the registers. Both registers can also be written with one single request using the function codes FC16 and FC23.
- ⇒ The parameters are saved.

8.8.3 Data width

Module	Process input data	Process output data	Alignment
TBEN-L...-8IOL	344 byte	260	word by word

8.8.4 Register mapping

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	MSB								LSB							
	Input data															
0x0000... 0x00xx	Process input data [► 126]															
	Module status															
0x00xx + 1 re- gister	see status- and control word [► 130]															
	Output data															
0x0800... 0x08xx	Process output data [► 128]															
	Diagnostics [► 130]															
0xA000	DXP channel diagnostics															
0xA001	IO-Link channel diagnosis															
...																
0xA004																
	Parameters															
	IO-Link Basic															
0xB000	-	-	-	-	-	-	-	-	DXP7_ SRO	-	DXP5_ SRO	-	DXP3_ SRO	-	DXP1_ SRO	-
0xB001	-	-	-	-	-	-	-	-	DXP7_ EN DO	-	DXP5_ EN DO	-	DXP3_ EN DO	-	DXP1_ EN DO	-
	IO-Link port 1															
0xB002	Cycle time								GSD	Activate Quick Start-Up	Data storage mode		Mode			
0xB003	-	-	-	-	-	-	-	-	Mapping PCDO		Mapping PDIN		Deactivate diag.		PDIN invalid	Rev.
0xB004... 0xB005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0xB006	Vendor ID															
0xB007 ... 0xB008	Device ID															
0xB009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	IO-Link port 2															
0xB00A... 0xB011	8 registers parameter data, assignment similar to port 1															
	IO-Link port 3															
0xB012... 0xB019	8 registers parameter data, assignment similar to port 1															

Register no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	IO-Link port 4															
0xB01A... 0xB021	8 registers parameter data, assignment similar to port 1															
	IO-Link port 5															
0xB022... 0xB029	8 registers parameter data, assignment similar to port 1															
	IO-Link port 6															
0xB02A... 0xB031	8 registers parameter data, assignment similar to port 1															
	IO-Link port 7															
0xB032... 0xB039	8 registers parameter data, assignment similar to port 1															
	IO-Link port 8															
0xB30A... 0xB041	8 registers parameter data, assignment similar to port 1															
	VAUX1 monitoring															
0xB042	-	-	-	-	-	-	VAUX1 pin1 C1 (ch2/3)	-	-	-	-	-	-	-	VAUX1 pin1 C0 (ch0/1)	
0xB043	-	-	-	-	-	-	VAUX1 pin1 C3 (ch6/7)	-	-	-	-	-	-	-	VAUX1 pin1 C2 (ch4/5)	
0xB044	-	-	-	-	-	-	VAUX1 pin1 C5 (ch10)	-	-	-	-	-	-	-	VAUX1 pin1 C4 (ch8)	
0xB045	-	-	-	-	-	-	VAUX1 pin1 C7 (ch14)	-	-	-	-	-	-	-	VAUX1 pin1 C6 (ch12)	
0xB046... 0xB047	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	VAUX1 monitoring															
0xB048	-	-	-	-	-	-	VAUX2 pin2 C5 (ch11)	-	-	-	-	-	-	-	VAUX2 pin2 C4 (ch9)	
0xB049	-	-	-	-	-	-	VAUX2 pin2 C7 (ch15)	-	-	-	-	-	-	-	VAUX2 pin2 C6 (ch13)	

8.8.5 Error Behavior (watchdog)

Behavior of outputs

In case of a failure of the Modbus communication, the outputs' behavior is as follows, depending on the defined time for the Watchdog (register 0x1120):

Watchdog	Behavior of outputs
0 ms	All outputs maintain the actual value in case of an error
> 0 ms (default = 500 ms)	Outputs switch to 0 after the watchdog time has expired (setting in register 0x1120).



NOTE

Setting the outputs to predefined substitute values is not possible in Modbus TCP. Eventually parameterized substitute values will not be used.

Behavior of the BUS LED

If the watchdog triggers, the BUS LED behaves as follows:

Watchdog	BUS LED
Tripped	Red

Behavior of the device in case of loss of Modbus communication

If Modbus is the active protocol and all Modbus connections are closed, the watchdog switches all outputs to "0" after the watchdog time has expired, unless another protocol (PROFINET, EtherNet/IP™) has been activated in the meantime.

8.9 Commissioning the device in EtherNet/IP™

8.9.1 Common EtherNet/IP™ features

Features	Description
QuickConnect	No
Device Level Ring (DLR)	yes
Number of TCP connections	3
Number of CIP connections	10
Input assembly instance	103, 120, 121, 122, 123, 124, 125
Output assembly instance	104, 150, 151, 152
Configuration assembly Instance	106

8.9.2 EDS files and catalog files

The EDS and catalog files can be downloaded free of charge from www.turck.com.

■ TBEN-L_ETHERNETIP.zip

10 Operating

10.1 Process input data

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Basic																
0x00	-	DI14 (SIO)	-	DI12 (SIO)	-	DI10 (SIO)	-	DI8 (SIO)	DXP7	DI6 (SIO)	DXP5	DI4 (SIO)	DXP3	DI2 (SIO)	DXP1	DI0 (SIO)
0x01	-	DVS 14	-	DVS 12	-	DVS 10	-	DVS 8	-	DVS6	-	DVS4	-	DVS2	-	DVS0
IO-Link process input data																
0x02 ... 0x11	IO-Link port 1, structure depends on the channel parameterization (0...32 byte per channel)															
0x12 ... 0x21	IO-Link port 2, structure depends on the channel parameterization (0...32 byte per channel)															
0x22 ... 0x31	IO-Link port 3, structure depends on the channel parameterization (0...32 byte per channel)															
0x32 ... 0x41	IO-Link port 4, structure depends on the channel parameterization (0...32 byte per channel)															
0x42 ... 0x51	IO-Link port 5, structure depends on the channel parameterization (0...32 byte per channel)															
0x52 ... 0x61	IO-Link port 6, structure depends on the channel parameterization (0...32 byte per channel)															
0x62 ... 0x71	IO-Link port 7, structure depends on the channel parameterization (0...32 byte per channel)															
0x72 ... 0x81	IO-Link port 8, structure depends on the channel parameterization (0...32 byte per channel)															
Diagnostics																
	VAUX1/VAUX2															
0x82	VERR V2 C7 Ch1 5	VERR V2 C6 Ch13	VERR V2 C5 Ch11	VERR V2 C4 Ch9	-	-	-	-	VERR V1 C7 Ch14	VERR V1 C6 Ch12	VERR V1 C5 Ch10	VERR V1 C4 Ch08	VERR V1 C3 Ch6Ch 7	VERR V1 C2 Ch4Ch 5	VERR V1 C1 Ch2Ch 3	VERR V1 C0 Ch0Ch 1
	DXP channels															
0x83	-	-	-	-	-	-	-	-	ERR DXP 7	-	ERR DXP 5	-	ERR DXP 3	-	ERR DXP 1	-
	IO-Link port 1															
0x84	GEN-ERR	OVL	V HIGH	V LOW	UL VE	LL VU	O TMP	PRM ERR	EVT1	EVT2	PD INV	HW ERR	DS ERR	CFG ERR	PPE	-

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x85	IO-Link port 2, assignment similar to port 1															
0x86	IO-Link port 3, assignment similar to port 1															
0x87	IO-Link port 4, assignment similar to port 1															
0x88	IO-Link port 5, assignment similar to port 1															
0x89	IO-Link port 6, assignment similar to port 1															
0x8A	IO-Link port 7, assignment similar to port 1															
0x8B	IO-Link port 8, assignment similar to port 1															
IO-Link Events																
0x8C	Port (1st Event)								Qualifier (1st Event)							
0x8D	Event Code low byte (1st Event)								Event Code high byte (1st Event)							
...																
0xAA	Port 16th Event)								Qualifier (16th Event)							
0xAB	Event Code low byte (16th Event)								Event Code high byte (16th Event)							
Module status (status word)																
0xAC	-	FCE	-	-	-	COM	V1	-	V2	-	-	-	-	-	-	DIAG

Meaning of process data bits

Name	Value	Meaning
I/O data		
DIx	Digital input x	
	0	No signal at DI (pin 4, SIO)
	1	Signal at DI (pin 4, SIO)
DXPx	configurable digital channel (DXP channel)	
	0	No input signal at DXP-channel (pin 2)
	1	Input signal at DXP-channel (pin 2)
DVSx	Input value valid (Data Valid Signal)	
	0	The IO-Link data are invalid. Possible causes: <ul style="list-style-type: none"> ■ Sensor supply is below the admissible range. ■ IO-Link port is parameterized as simple digital input. ■ No device connected to the master. ■ No input data received from the connected device (only valid for devices with an input data length > 0). ■ No reaction from the connected device to the sending of output data (only valid for devices with an output data length > 0). ■ The connected device sends an process input data invalid error.
	1	The IO-Link data are valid.
IO-Link process input data	Process input data of the connected device The order of the IO-Link process input data can be changed via the parameter Process input data mapping .	
Diagnostics	▶ 130]	
IO-Link Events	▶ 122]	

Name	Value	Meaning
Module status	▶ 130]	

10.2 Process output data

Word no.	Bit no.															
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Basic																
0x00	-	-	-	-	-	-	-	-	DXP7	-	DXP5	-	DXP3	-	DXP1	-
IO-Link process output data																
0x01 ... 0x10	IO-Link port 1, structure depends on the channel parameterization (0...32 byte per channel)															
0x11 ... 0x20	IO-Link port 2, structure depends on the channel parameterization (0...32 byte per channel)															
0x21 ... 0x30	IO-Link port 3, structure depends on the channel parameterization (0...32 byte per channel)															
0x31 ... 0x40	IO-Link port 4, structure depends on the channel parameterization (0...32 byte per channel)															
0x41 ... 0x50	IO-Link port 5, structure depends on the channel parameterization (0...32 byte per channel)															
0x51 ... 0x60	IO-Link port 6, structure depends on the channel parameterization (0...32 byte per channel)															
0x61 ... 0x70	IO-Link port 7, structure depends on the channel parameterization (0...32 byte per channel)															
0x71 ... 0x80	IO-Link port 8, structure depends on the channel parameterization (0...32 byte per channel)															
	VAUX1/VAUX2															
0x81	VAUX 2 pin2 C7 (ch15)	VAUX 2 pin2 C6 (ch13)	VAUX 2 pin2 C5 (ch11)	VAUX 2 pin2 C4 (ch9)	-	-	-	-	VAUX 1 pin1 C7 (ch14)	VAUX 1 pin1 C6 (ch12)	VAUX 1 pin1 C5 (ch10)	VAUX 1 pin1 C4 (ch8)	VAUX1 pin1 C3 (ch6/7)	VAUX1 pin1 C2 (ch4/5)	VAUX1 pin1 C1 (ch2/3)	VAUX1 pin1 C0 (ch0/1)

Name	Value	Meaning
I/O data		
DXPx		DXP output
	0	Output inactive
	1	Output active, max. output current 2 A
VAUX1 Pin1 Cx (chy/chz)	0	The 24 VDC sensor/actuator supply at Pin1 of the connector is switched off.
	1	The 24 VDC sensor/actuator supply at Pin1 of the connector is switched on.

LED IOL 9, 11, 13, 15 (IO-Link Class B ports)	Meaning
Off	VAUX2 at Pin 2 inactive
Green	VAUX2 at Pin 2 active
Red	VAUX2 at Pin 2 active, overload/short-circuit at VAUX2
Red flashing	Overcurrent supply VAUX1

10.4 Software diagnostic messages

The device provides the following software diagnostic messages:

- V1/V2 overcurrent diagnostics
Overcurrent diagnostics for the sensor-/ actuator supply VAUX1 and the Class B supply VAUX2
- DSP diagnostics
Diagnostic messages of the universal digital channels of the module (DXP 1, 3, 5, 7).
- IO-Link master diagnostics
The IO-Link master reports problems within the IO-Link communication.
- IO-Link device diagnostics
The device diagnostics map the IO-Link Event Codes (according to the IO-Link specification) sent from the IO-Link devices to the diagnostic telegram of the master.
Event Codes can be read from the connected devices by using appropriate device tools (e.g. IODD-Interpreter).
Further information concerning the IO-Link Event Codes and their meaning can be found in the IO-Link specification or in the documentation of the connected devices.

10.4.1 Status- and control word

Status word

EtherNet/IP™ Modbus	PROFINET	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	Byte 1	V2	-	-	-	-	-	ARGEE	DIAG
Byte 1	Byte 0	-	FCE	-	-	-	COM	V1	-

Bit	Description
COM	Internal error The device-internal communication is disturbed.
DIAG	Diagnostic messages at the device
FCE	The DTM Force Mode is activated, which means, the actual output values may no match the ones defined and sent by the field bus.
V1	V1 or V2 too low (< 18 V DC).
V2	

The status word is mapped into the module's process data.

In EtherNet/IP™ the mapping can be deactivated via the Gateway Class (VSC 100).



NOTE

Activating or deactivating the status and control word modifies the process data mapping.

Control word

The control word has no function.

10.4.2 Diagnostic telegram

Channel	Byte no.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
V1/V2		V1/V2 overcurrent diagnostics							
	0	VERR V1 C7 ch14	VERR V1 C6 ch12	VERR V1 C5 ch10	VERR V1 C4 ch08	VERR V1 C3 ch6ch7	VERR V1 C2 ch4ch5	VERR V1 C1 ch2ch3	VERR V1 C0 ch0ch1
	1	VERR V 2 C7 ch15	VERR V2 C6 ch13	VERR V2 C5 ch11	VERR V2 C4 ch9	-	-	-	-
DXP		DXP diagnostics							
	0	ERR DXP7	-	ERR DXP5	-	ERR DXP3	-	ERR DXP1	-
	1	-	-	-	-	-	-	-	-
IO-Link		Device diagnostic messages				Master diagnostics			
IO-Link port 1	0	EVT1	EVT2	PD INV	HW_ ERR	DS ERR	CFG ERR	PPE	-
	1	GEN ERR	OLV	VHIGH	VLOW	ULVE	LLVU	OTEMP	PRM ERR
IO-Link port 2	2...3	Assignment similar to IO-Link port 1							
...	...								
IO-Link port 8	14...15								



NOTE

The "process data" invalid diagnostic (PDINV) can be sent from both devices, IO-Link master or IO-Link device.

Meaning of diagnostic Bits

Bit	Meaning
V1/V2 overcurrent diagnostics	
VErrV1 Cx	Overcurrent VAUX1 (pin1) at connector/channel group chy/chz
VErrV1 Cxchy	Overcurrent VAUX1 (pin 1) at connector/channel
VErrV2 Cxchy	Overcurrent VAUX2 (pin 2) at connector/channel
DXP diagnostics	
ERR_DXPx	Overcurrent at the output (if the DXP channel is used as output)
IO-Link master diagnostics	
CFGER	Wrong or missing device The connected device does not match the channel configuration or there is no device connected to the channel. This diagnostic message depends on the parameterization of the channel.