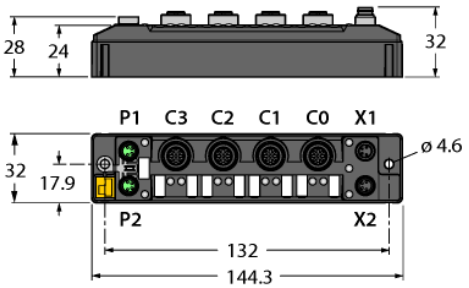
Compact Multiprotocol I/O Module for Ethernet
4 Analog Inputs, Configurable as Voltage, Current, RTD or Thermocouple
TBEN-S2-4AI



Type	TBEN-S2-4AI
ID	6814025
Supply	
Supply voltage	24 VDC
Admissible range	18…30 VDC Total current max. 4 A per voltage group V1
Voltage supply connection	2 × M8, 4-pin, A-coded
Operating current	V1: min. 100 mA, max. 240 mA mA
Sensor/actuator supply	supply of ports C0-C3 from V1 short-circuit proof, max. 1 A for group C0-C3
Electrical isolation	galvanic isolation of the voltage groups V1 and V2, voltages up to 500 VAC
System data	
Fieldbus transmission rate	10/100 Mbps
Fieldbus connection technology	2 × M8, 4-pin
Protocol detection	automatic
Web server	default: 192.168.1.254
Service interface	Ethernet via P1 or P2
ARGEE functionality	Supported
Modbus TCP	
Addressing	Static IP, DHCP
Supported function codes	FC1, FC2, FC3, FC4, FC5, FC6, FC15, FC16, FC23
Number of TCP connections	8
Input register start address	0 (0x0000 hex)
Output register start address	2048 (0x0800 hex)

- PROFINET device, EtherNet/IP device, Modbus TCP server, CC-Link IE field basic
- Integrated Ethernet switch
- Supports 10 Mbps/100 Mbps
- 2 × M12, 4-pin, D-coded, Ethernet fieldbus connection
- PROFINET S2 system redundancy
- Glass fiber reinforced housing
- Shock and vibration tested
- Fully potted module electronics
- Protection classes IP65, IP67, IP69K
- 4-pin M8 male connector for power supply
- ATEX Zone 2/22
- Each channel is freely selectable for voltage, current, RTD, resistance or thermocouple
- Measuring ranges:
- Voltage: ±500 mV, ±100 mV, ±50 mV, ±1 V, 0/1–5 V, ±10 V, 0/2–10 V
- Current: 0/4–20 mA, ±20 mA
- RTD: PT100, NI100, PT200, PT500, PT1000, NI1000
- Resistance: 0–100 Ω/400 Ω/2 kΩ/4 kΩ
- Thermocouples: Type B, C, E, G, J, K, N, R, S, T
- Inputs differential or common reference
- Programmable ARGEE

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Ethernet/IP	
Addressing	acc. to EtherNet/IP specification
Quick Connect (QC)	< 500 ms
min. RPI	2 ms
Device Level Ring (DLR)	supported
Class 3 connections (TCP)	3
Class 1 connections (CIP)	10
Input Assembly Instance	103
Output Assembly Instance	104
Configuration Assembly Instance	106

PROFINET	
Version	2.35
Addressing	DCP
Conformance class	B (RT)
MinCycleTime	1 ms
Fast Start-Up (FSU)	< 500 ms
Diagnostics	acc. to PROFINET alarm handling
Topology detection	supported
Automatic addressing	supported
Media Redundancy Protocol (MRP)	supported
System redundancy	S2
Netload class	3

CC-Link	
Interface	CC-Link IE Field Basic
Type	Intelligent device station
Message Transmission	Yes
Profile specification	CSP+
Max. occupied stations	2
IP change mechanism	Yes
Acyclic SLMP communication	Yes

Analog inputs	
Number of channels	4
Operating modes	Voltage, current, RTD, resistance, thermocouple
Resolution	16 Bit

Operating mode voltage	
Input filter	standard, smooth, fast, off
Max. input voltage	11.85 V
Load resistance	100 KΩ
Input signal types	differential, differential without ground, single ended
Measuring range	0…10 V, +/-10 V, 2…10 V, 0…5 V, 1…5 V, +/-1 V +/-500 mV, +/-100 mV, +/-50 mV
Gleichtaktspannung	± 15 V
Mains suppression	no, ≤ 50 Hz, 60 Hz
Cycle time	4 ms
Basic error at 25 °C	< 0.1 %
Repeat accuracy	< 0.015 %
Temperature coefficient	< 100 ppm/°C of full scale
Measurement error total (FSR)	≤ 0.75 %

Operating mode current	
Input filter	standard, smooth, fast, off
Max. input current	23 mA
Load resistance	50 Ω
Input signal types	differential, differential without ground, single ended
Measuring range	0…20 mA, 4…20 mA, +/-20 mA
Gleichtaktspannung	± 15 V
Mains suppression	no, ≤ 50 Hz, 60 Hz
Cycle time	4 ms
Basic error at 25 °C	< 0.1 %
Repeat accuracy	< 0.015 %
Temperature coefficient	< 100 ppm/°K of full scale
Measurement error total (FSR)	≤ 0.75 %

Operating Mode RTD/Resistance	
Temperature unit	°Celsius, °Fahrenheit
Measuring range	Pt100 -200 °C…850 °C, Pt100 -200 °C…150 °C *2) Pt200 -200 °C…850 °C*3)*4), Pt200 -200°C…150 °C Pt500 -200 °C…850 °C*1), Pt500 -200°C…150 °C*3)*4) Pt1000 -200 °C…850 °C,Pt1000 -200 °C…150 °C*1) Ni100 -60 °C…250 °C*2), Ni100 -60°C…150 °C*2)*4) Ni1000 -60 °C…250 °C*2)*4), Ni1000 -60 °C…150° C *4) 0…100 Ω *2), 0…400 Ω, 0…2 kΩ, 0…4 kΩ
Connection type	2-wire, 3-wire, 4-wire
Input filter	standard, smooth
Cycle time	400 ms
Basic error at 25 °C	< 0.2 % *1) < 0.3 % 2-wire, *2) < 0.3 %, 3-wire, *3) < 0.3 %, 4-wire, *4) < 0.7 % 2-wire
Repeat accuracy	< 0.015 %
Temperature coefficient	< 100 ppm/°C of full scale
Total measurement error (MBE)	< 0.85 % *1) < 0.95 % 2-wire, *2) < 0.95 %, 3-wire, *3) < 0.95 %, 4-wire, *4) < 1.35 %, 2-wire

Operating Mode Thermocouple	
Temperature unit	°Celsius, °Fahrenheit
Measuring range	Type K -270…1370 °C *3), Type B 100…1820 °C *2) Type E -270…1000 °C *4), Type J -210…1200 °C Type N -270…1300 °C, Type R -50…1768 °C *1) Type S -50…1768 °C *1), Type T -270…400 °C *3) Type C 0…2315 °C, Type G 0…2315 °C *5)
Input filter	standard, smooth
Cold junction compensation	Fixed 23°C, Pt100, Pt1000, channel 0
Cycle time	400 ms
Basic error at 25 °C	≤ 0.1% *1) < 0.2 %, *2) < 0.5 %, *3) < 0.7 %, *4) < 1 %, *5) < 1.6% 3, 4, 5 only to the lower measuring range
Repeat accuracy	< 0.015 %
Temperature coefficient	< 100 ppm/°C of full scale
Total measurement error (MBE)	< 0.75% *1) < 0.85%, *2) < 1.15%, *3)< 1.35%, *4) < 1.65%, *5) < 2.25% 3, 4, 5 only from lower limit of range

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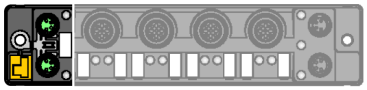
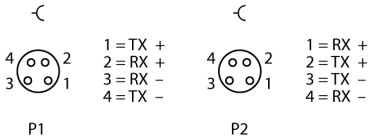
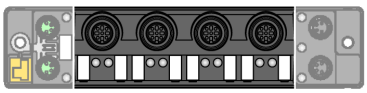
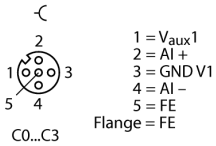
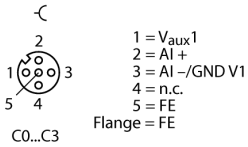
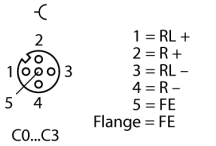
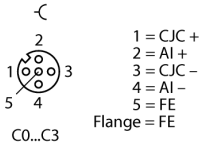
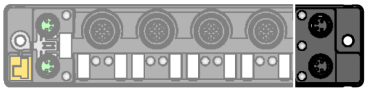
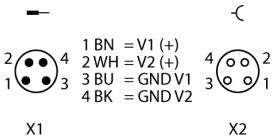
Standard/Directive conformity	
Vibration test	Acc. to EN 60068-2-6 Acceleration up to 20 g
Shock test	acc. to EN 60068-2-27
Drop and topple	acc. to EN 60068-2-31/IEC 60068-2-32
Electromagnetic compatibility	Acc. to EN 61131-2
Approvals and certificates	CE and UKCA FCC statement, UV resistant acc. to DIN EN ISO 4892-2A (2013)
UL Certificate	cULus LISTED 21 W2, Encl.Type 1 IND.CONT.EQ.
Note on ATEX/IECEx	The Quick Start Guide with information on use in Ex Zones 2 and 22 must be observed.

General Information	
Dimensions (W x L x H)	32 x 144 x 32 mm
Ambient temperature	-40…+70 °C
Storage temperature	-40…+85 °C
Altitude	Max. 5000 m
Protection class	IP65 IP67 IP69K
MTTF	145 years acc. to SN 29500 (Ed. 99) 20 °C
Housing material	PA6-GF30
Housing color	Black
Connector material	Nickel-plated brass
Material label	Polycarbonate
Halogen-free	yes
Mounting	2 mounting holes □ 4.6 mm

	Note the numbering of the IO range: From firmware version 3.1.2.0 and higher ports C0 to C3 and channels CH0 to CH3 are counted. For more details on the corresponding change see manual.

	**Note** We strongly recommend only using ready-made Ethernet cables!	M8 x 1 Ethernet 
	**Note** General information on the modes of operation: Factory setting: Operating Mode: Thermocouple It is strongly recommended to configure the operating mode before connecting any sensors. Please disable any unused channels in voltage mode to avoid mis-diagnosis. Connect and operate sensors only in the modes provided for this purpose. Otherwise there is the danger of damaging the sensors! Do not operate the TC sensors in the modes current or voltage.	
	Operating Mode: Voltage and Current	M12 x 1 Symmetrical Input  Common Ground 
	Operating Mode: RTD/Resistance When operating 2 or 3-wire resistors, unused pins must remain free.	M12 x 1 I/O Port 
	Operating Mode: Thermocouple	M12 x 1 I/O Port 

		M8 x 1 Voltage Supply 

Module Status LED

LED	Color	Status	Description
ETH1 / ETH2	Green	ON	Ethernet link (100 Mbps)
		flashing	Ethernet communication (100 Mbps)
	Yellow	ON	Ethernet link (10 Mbps)
		flashing	Ethernet communication (10 Mbps)
		OFF	No Ethernet link
BUS	Green	ON	Active connection to a master
		Flashing	Steady flashing: Ready Sequence of 3 flashes in 2 seconds: FLC/ARGEE active
	Red	ON	IP address conflict or Restore Mode or Modbus timeout
		Flashing	Blink/Wink command active
	Red/ Green	Alternating	Waiting for assignment of an IP address, DHCP or BootP
		OFF	Power off
ERR	Green	On	No diagnostics available
	Red	On	Diagnostics available Undervoltage diagnosis response is parameter dependent
PWR	Green	On	V_1 power supply OK
		Off	V_1 power supply off or V_1 undervoltage

LED Status I/O

LED	Color	Status	Description
Operating mode Voltage/Current AI 0…3	Green	ON	Input active
	Red	Flashing (~0.5Hz)	Current: Wire-break at the input
		Flashing (~4 Hz)	Measuring range exceeded
		ON	Overcurrent port supply V_{AUX1}
		OFF	Input inactive
Operating Mode RTD/Resistance AI 0…3	Green	ON	Input active
	Red	Flashing (~0.5Hz)	Wire-break
		Flashing (~4 Hz)	Measured value out of range
		ON	RTD: Short-circuit
		OFF	Input inactive
Operating mode thermocouple AI 0…3	Green	ON	Input active
	Red	Flashing (~0.5Hz)	Wire-break
		Flashing (~4 Hz)	Measured value out of range
		ON	Cold junction error
		OFF	Input inactive

Process Data Mapping of the Single Protocols

For more details on the corresponding protocols see manual.

Modbus TCP register mapping

	Reg	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Inputs (RO)	0x0000	Channel 0 MSB								Channel 0 LSB							
	0x0001	Channel 1 MSB								Channel 1 LSB							
	0x0002	Channel 2 MSB								Channel 2 LSB							
	0x0003	Channel 3 MSB								Channel 3 LSB							
Diag LSB channel 0 MSB channel 1	0x0004	LLVU	UFL	OFL	WBR	V1AOL	ULVE	RTDSC	CJE	LLVU	UFL	OFL	WBR	V1AOL	ULVE	RTDSC	CJE
LSB channel 2 MSB channel 3	0x0005	LLVU	UFL	OFL	WBR	V1AOL	ULVE	RTDSC	CJE	LLVU	UFL	OFL	WBR	V1AOL	ULVE	RTDSC	CJE
Status (RO)	0x0006		FCE					V1		V2							DIAG

EtherNet/IP Data Mapping

	Word	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input Data (Station -> Scanner)																	
Status Word	0x0000		FCE					V1		V2							DIAG
Inputs (RO)	0x0001	Channel 0 MSB								Channel 0 LSB							
	0x0002	Channel 1 MSB								Channel 1 LSB							
	0x0003	Channel 2 MSB								Channel 2 LSB							
	0x0004	Channel 3 MSB								Channel 3 LSB							
Diag LSB Channel 0 MSB Channel 1	0x0005	LLVU	UFL	OFL	WBR	V1AOL	ULVE	RTDSC	CJE	LLVU	UFL	OFL	WBR	V1AOL	ULVE	RTDSC	CJE
LSB Channel 2 MSB Channel 3	0x0006	LLVU	UFL	OFL	WBR	V1AOL	ULVE	RTDSC	CJE	LLVU	UFL	OFL	WBR	V1AOL	ULVE	RTDSC	CJE

PROFINET Process Data

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Inputs	0x00	Channel 0 LSB							
	0x01	Channel 0 MSB							
	0x02	Channel 1 LSB							
	0x03	Channel 1 MSB							
	0x04	Channel 2 LSB							
	0x05	Channel 2 MSB							
	0x06	Channel 3 LSB							
	0x07	Channel 3 MSB							
Diag Channel 0	0x08	LLVU	UFL	OFL	WBR	V1AOL	ULVE	RTDSC	CJE
Diag Channel 1	0x09	LLVU	UFL	OFL	WBR	V1AOL	ULVE	RTDSC	CJE
Diag Channel 2	0x0A	LLVU	UFL	OFL	WBR	V1AOL	ULVE	RTDSC	CJE
Diag Channel 3	0x0B	LLVU	UFL	OFL	WBR	V1AOL	ULVE	RTDSC	CJE
Status	0x0C	V2							DIAG
	0x0D		FCE					V1	

Key:

V1	Undervoltage V1	CFG	I/O configuration error
V2	Undervoltage V2	FCE	I/O-ASSISTANT Force Mode active
Cx	Port x	Px	Pin x
I/ODiag	I/O diagnostics connected		
Diag	Diagnostic at least on 1 channel		
CJE	Cold junction error	RTDSC	Overcurrent (RTD only)
ULVE	Upper limit value exceeded	V1AOL	Overcurrent supply VAUX1
WBR	Wire-break	OFL	Overflow
UFL	Underflow	LLVU	Lower limit value underrun
OVL	Overload		

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