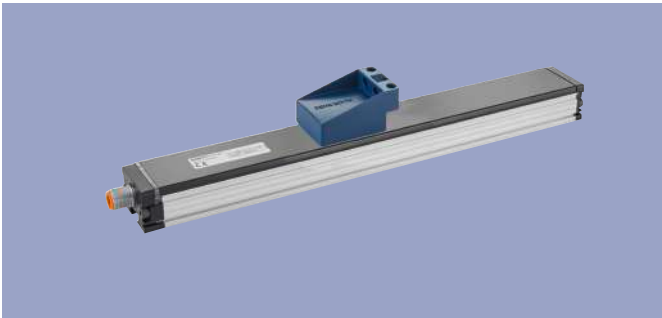


**NOVOPAD
Transducer
up to 1000 mm
touchless**

Series TF1

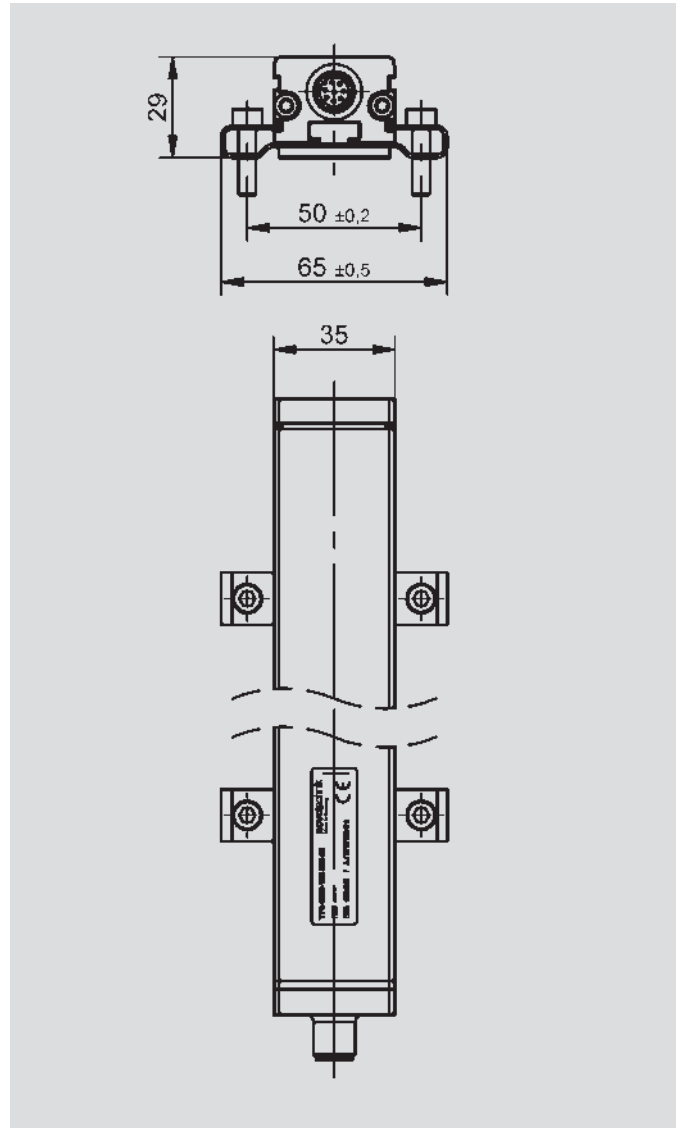


Special features

- Inductive measurement technology
- Magnetic field resistant
- Touchless, wear-free
- High dynamic, 10 kHz update rate
- Reproducibility up to 5 μm
- Protection class IP67: a GORE membrane ensures pressure equalization due to temperature change
- Offset tolerance up to ± 2 mm
- Low temperature coefficient <math>< 15 \text{ ppm/K}</math>
- Insensitive to shock and vibration
- Position-Teach-In
- Interfaces: Analog, SSI, CANopen, IO-Link

Applications

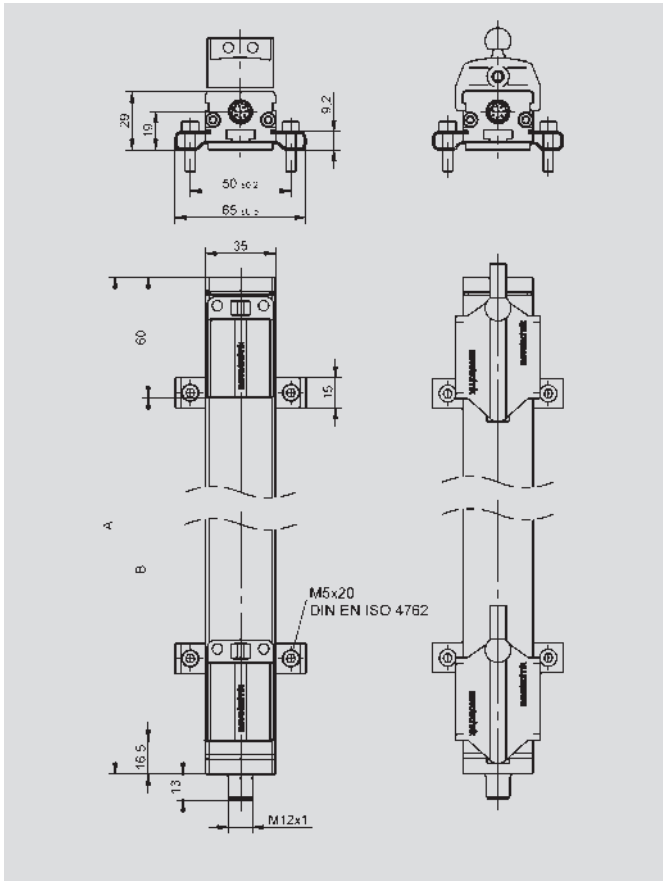
- Manufacturing Engineering
 - Plastic injection molding
 - Textile
 - Packaging
 - Sheet metal working
 - Woodwork
- Automation Technology



Contents

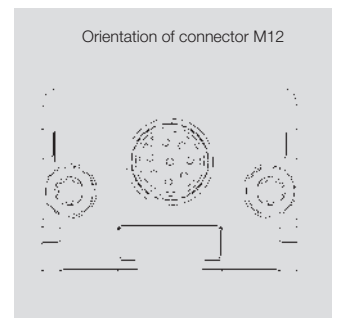
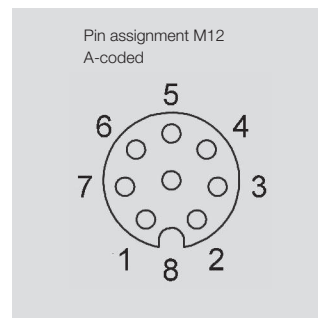
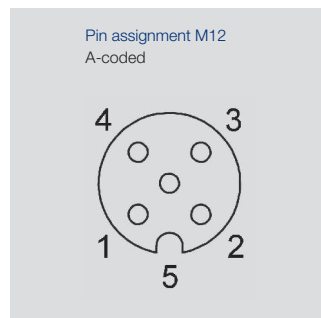
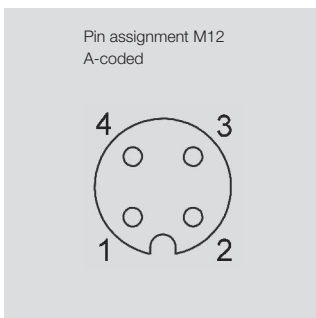
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Mechanical Data



Description	
Materials	Housing: anodized aluminum AlMgSi0,5 F22, 3.3206.71 Inner housing: PA6 GF30 End flanges: aluminum G AISI12Cu1 (FE) Status display (LED): PC
Mounting	Adjustable clamps (included in delivery) or slot nut f.e. nut M8 DIN 439
Position marker	Floating position marker, plastic Guided position marker, plastic, with angle or axial joint
Electrical connections	Connector M12x1, 4-pin / 5-pin / 8-pin, shielded
Electronic	Connector casing is connected to the sensor housing Housing is capacitively decoupled to the electronics
Others	2 x multifunction LED as an indicator of operating voltage and status
Mechanical Data	
Dimensions	see dimension drawing
Length of housing (dimension A)	Dimension B + 76.5 mm
Electrical measuring range (dimension B)	0100 up to 1000 mm in 100 mm steps, other lengths on request
Weight	220 +1.1 x B (in mm) g
Max. operational speed with valid output signal	10 ms ¹
Max. operational acceleration with valid output signal	200 ms ²
Shock (IEC 60068-2-27)	100 (11 ms) (single hit) g
Vibration (IEC 60068-2-6)	20 (5...2000 Hz, Amax = 0.75 mm) g
Protection class (DIN EN 60529)	IP67 pressure equalization via GORE membrane, with fastened connector
Life	Mechanically unlimited (with floating position marker)
Operating temperature range	-40 ... +85 (CANopen: -40 ... +75) °C
Storage temperature range	-40 ... +85 °C
Operating humidity range	0 ... 95 (no condensation) % R.H.

CAD data see
www.novotechnik.de/en/download/cad-data/



Technical Data Analog Versions

Type designations	TF1- _____001 - 41 _ - 102 Voltage	TF1- _____001 - 42 _ - 102 Current	
Electrical Data			
Electrical measuring range (dimension B)	0100 up to 1000		mm
Output signal	0,1 ... 10 V (load \geq 5 k Ω)	4 ... 20 mA (burden \leq 500 Ω)	
Number of channels	1		
Update rate (internal)	> 10		kHz
Signal propagation delay	< 1		ms
Resolution			
Dimension B \leq 400 mm	10		μ m
Dimension B > 400 mm	20		μ m
Absolute linearity	\leq 0.025 (min. \pm 100 μ m)		\pm % FS
Tolerance of electr. zero point	1		\pm mm
Reproducibility			
Dimension B \leq 400 mm	10		μ m
Dimension B > 400 mm	20		μ m
Hysteresis	\leq 10		μ m
Temperature error	\leq 15 (min. 0.01 mm/K)		ppm/K
Supply voltage	24 (18 ... 32)		VDC
Supply voltage ripple	\leq 10		% V _{SS}
Power drain (w/o load)	2.4		W
Overvoltage protection	36 (permanent)		VDC
Polarity protection	Yes, up to supply voltage max		VDC
Short circuit protection	Yes (outputs vs. GND and supply voltage max.)		
Insulation resistance (500 VDC)	\geq 10		M Ω
Environmental Data			
MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc)	> 20		Years
Functional safety	If you need assistance in using our products in safety-related systems, please contact us		
EMC compatibility	EN 61000-4-2 Electrostatic discharges (ESD) 4 kV, 8 kV EN 61000-4-3 Electromagnetic fields 10 V/m EN 61000-4-4 Fast transients (burst) 1 kV EN 61000-4-6 Conducted disturbances, induced by RF-fields 10 V eff. EN 55016-2-3 Radiated disturbances class B		



Pin assignment

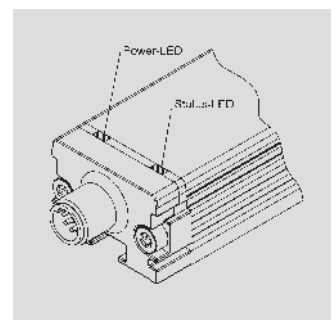
Connector M12 code 102	Connector with cable (Accessories)	Analog voltage	Analog current
PIN 1	WH	do not connect	4 ...20 mA
PIN 2	BN	Signal GND	Signal GND
PIN 3	GN	do not connect	do not connect
PIN 4	YE	PROG_L *	PROG_L *
PIN 5	GY	0 ... +10 V	do not connect
PIN 6	PK	GND	GND
PIN 7	BU	Supply voltage	Supply voltage
PIN 8	RD	PROG_H *	PROG_H *

*) connect only for Teach-In-function (see manual).

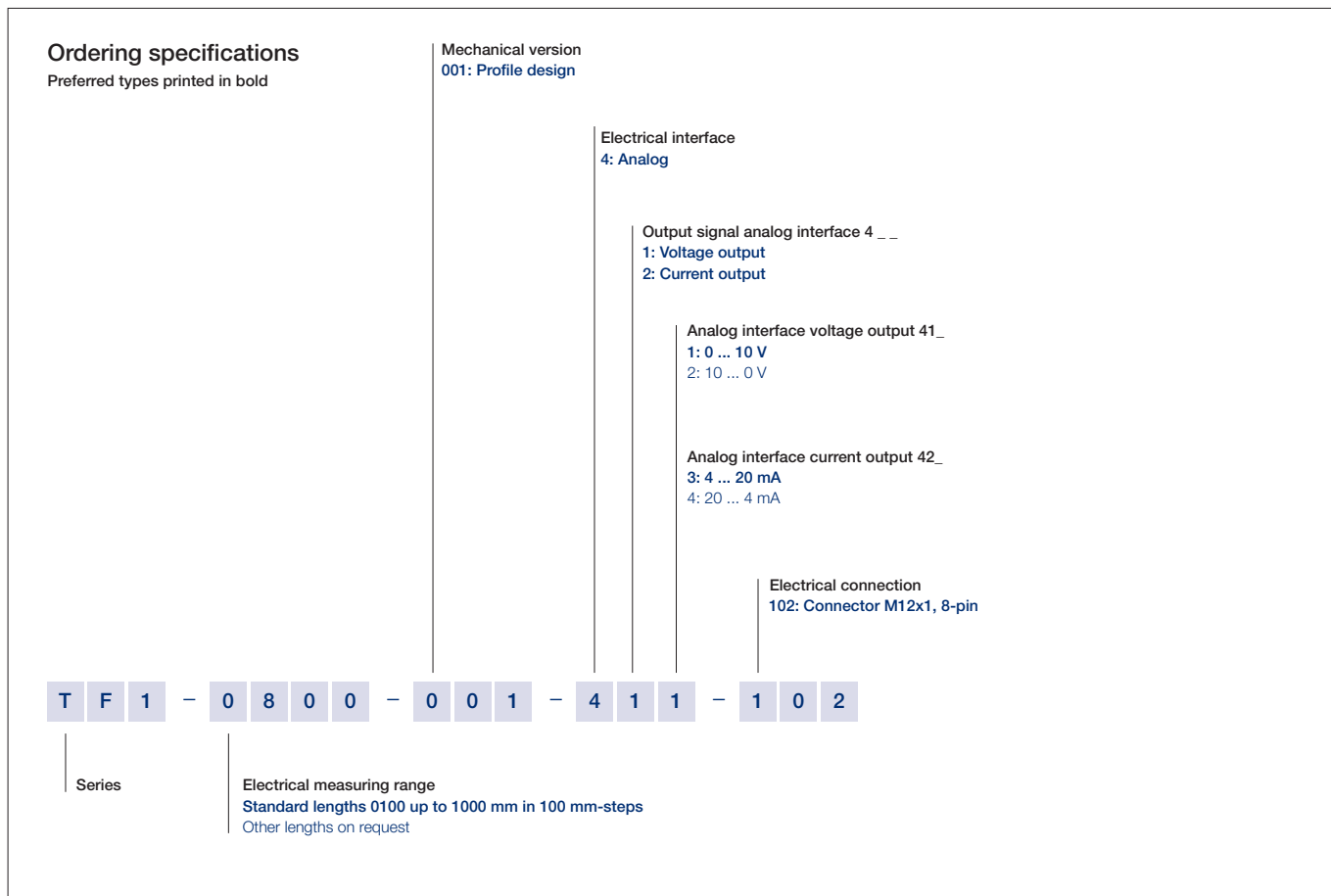
LED functionality

LED colour	Power LED for operating mode indication	Status LED for measuring range indication / functional test
Off	Sensor out of operation (no supply)	
Green	Sensor in operation	Position marker is within measuring range
Red flashing		Position marker is outside of measuring range
Red		Sensor error, internal diagnosis allows no valid signal output (f.e. absence of position marker)

Further conditions see operating manual



Ordering Specifications
Analog Versions
- Voltage
- Current



Important: Avoid equalizing currents in the cable shield caused by potential differences.
Shielded cable is recommended.

Technical Data SSI-Interface

Type designations	TF1 - _ _ _ _ - 001 - 2 _ _ - 102		
	Synchronous-serial interface (SSI)		
Electrical Data			
Electrical measuring range (dimension B)	0100 up to 1000		mm
Protocol	SSI 24 and 25 bit		
Inputs	RS422, CLK lines galvanically isolated by optocouplers		
Monoflop time (tm)	20		µs
Encoding	Gray, Binary		
Update rate	> 10		kHz
Resolution (LSB)	1, 5 or 10		µm
Reproducibility (rounded to LSB)	High prec mode	Balanced mode	High speed mode
Dimension B ≤ 400 mm	< 5	< 10	< 20
Dimension B > 400 mm	< 8	< 15	< 40
Signal propagation delay	< 3	< 1	< 0.2
Hysteresis	≤ 5	≤ 10	≤ 10
Absolute linearity	≤ 100		± µm
Tolerance of electr. zero point	1		± mm
Temperature error	≤ 15 (min. 0.01 mm/K)		ppm/K
Supply voltage	24 (18 ... 32)		VDC
Supply voltage ripple	≤ 10		% V _{SS}
Power drain (w/o load)	2.4		W
Overvoltage protection	36 (permanent)		VDC
Polarity protection	Yes, up to supply voltage max.		
Short circuit protection	Yes (outputs vs. GND and supply voltage up to 7 V)		
Ohmic load at outputs	> 120		Ω
Max. clock rate	1.5		MHz
Insulation resistance (500 VDC)	≥ 10		MΩ
Environmental Data			
MTTF (DIN EN ISO 13849-1, parts count method, w/o load, wc)	> 20		Years
Functional safety	If you need assistance in using our products in safety-related systems, please contact us		
EMC compatibility	EN 61000-4-2 Electrostatic discharges (ESD) 4 kV, 8 kV EN 61000-4-3 Electromagnetic fields 10 V/m EN 61000-4-4 Fast transients (burst) 1 kV EN 61000-4-6 Conducted disturbances, induced by RF-fields 10 V eff. EN 55016-2-3 Radiated disturbances class B		



Technical Data SSI-Interface

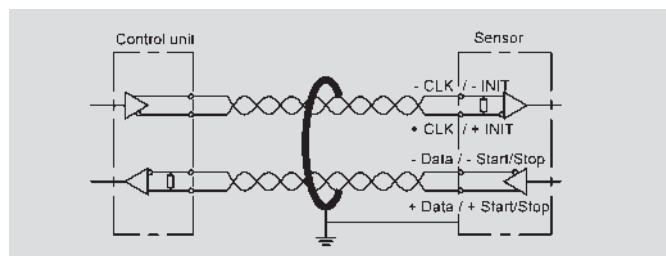
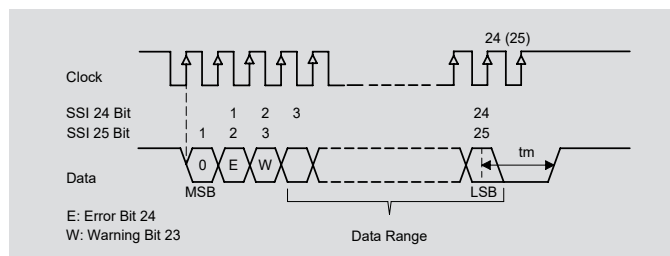
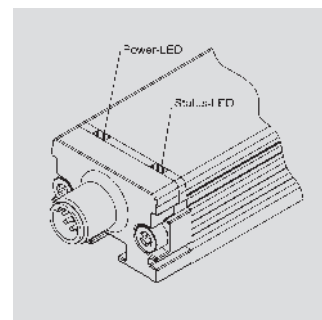
Pin assignment

Output connector code 102	Connector with cable (Accessories)	SSI-Interface
PIN 1	WH	Clk +
PIN 2	BN	Data +
PIN 3	GN	Clk -
PIN 4	YE	do not connect
PIN 5	GY	Data -
PIN 6	PK	GND
PIN 7	BU	Supply voltage
PIN 8	RD	do not connect

LED functionality

LED colour	Power LED for operating mode indication	Status LED for measuring range indication / functional test
Off	Sensor out of operation (no supply)	
Green	Sensor in operation	Position marker is within measuring range
Red flashing		Position marker is outside of measuring range
Red		Sensor error, internal diagnosis allows no valid signal output (f.e. absence of position marker)

Further conditions see operating manual



**Ordering
Specifications
Digital Versions
SSI-Interface**

Ordering specifications Preferred types printed in bold		Mechanical version 001: Profile design	Electrical interface 2: SSI	Output signal SSI interface 2 __ 1: SSI 24 bit, Gray 2: SSI 25 bit, Gray 3: SSI 24 bit, Binary 4: SSI 25 bit, Binary	Synchron-Serial interface 2 __ High prec mode 4: Resolution 1 µm 5: Resolution 5 µm 6: Resolution 10 µm Balanced mode 1: Resolution 1 µm 2: Resolution 5 µm 3: Resolution 10 µm High speed mode 7: Resolution 1 µm 8: Resolution 5 µm 9: Resolution 10 µm	Electrical connection 102: Connector M12x1, 8-pin													
T	F	1	-	0	8	0	0	-	0	0	1	-	2	1	2	-	1	0	2
Series			Electrical measuring range Standard lengths 0100 up to 1000 mm, in 100 mm-steps Other lengths on request																

Important: Avoid equalizing currents in the cable shield caused by potential differences.
Shielded twisted pair cable (STP) is recommended.

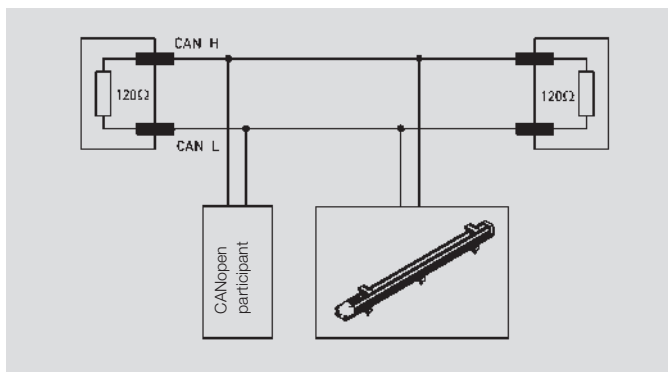
Technical Data



Type designations	TF1 - _ _ _ _ -001- 6 _ _ - 106 CANopen (available 2 nd quarter 2019)		
Electrical Data			
Measured variables	Position, speed and temperature		
Electrical measuring range (dimension B)	0100 up to 1000		mm
Measuring range speed	0 ... 10		ms ⁻¹
Output signal / protocol	CANopen protocol to CiA DS-301 V4.2.0, Device profile DS-406 V3.2 Encoder class 1, LSS services to CiA DS-305 V1.1.2		
Programmable parameter	Cams, working areas, node-ID, baud rate		
Node-ID	1 ... 127 (default 127)		
Baud rate	20 ... 1000		kBaud
Update rate (output)	1		kHz
Resolution Position	1	5	μm
Resolution Speed	0.1	0.5	mm s ⁻¹
Reproducibility (rounded to resolution)	High prec mode	Balanced mode	
Dimension B ≤ 400 mm	< 5	< 10	μm
Dimension B > 400 mm	< 8	< 15	μm
Signal propagation delay	< 3	< 1	ms
Hysteresis	≤ 5	≤ 10	μm
Absolute linearity	≤ 100		± μm
Tolerance of electr. zero point	1		± mm
Temperature error	≤ 15 (min. 0.01 mm/K)		ppm/K
Supply voltage	24 (18 ... 32)		VDC
Supply voltage ripple	≤ 10		% V _{ss}
Power drain (w/o load)	2.4		W
Overvoltage protection	36 (permanent)		VDC
Polarity protection	Yes, up to supply voltage max.		
Short circuit protection	Yes (outputs vs. GND and supply voltage max.)		
Insulation resistance (500 VDC)	≥ 10		MΩ
Bus termination internal	no (internal load resistance 120 Ω on request)		
Environmental Data			
MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc)	> 20		Years
Functional safety	If you need assistance in using our products in safety-related systems, please contact us		
EMC compatibility	EN 61000-4-2 Electrostatic discharges (ESD) 4 kV, 8 kV EN 61000-4-3 Electromagnetic fields 10 V/m EN 61000-4-4 Fast transients (burst) 1 kV EN 61000-4-6 Conducted disturbances, induced by RF-fields 10 V eff. EN 55016-2-3 Radiated disturbances class B		



Technical Data



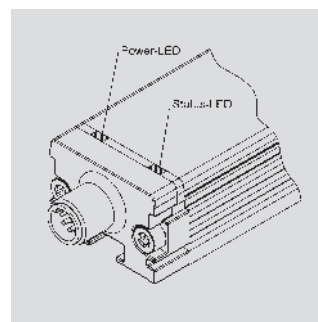
Pin assignment

Connector M12 code 106	Connector with cable (Accessories)	CAN
PIN 1	CAN-SHLD *	CAN_SHLD *
PIN 2	RD	Supply voltage
PIN 3	BK	GND
PIN 4	WH	CAN_H
PIN 5	BU	CAN_L

*) CAN_SHLD: CAN-shield, internally connected to housing

LED functionality

LED colour	Power LED for operating mode indication	Status-LED for measuring range indication / functional test
Off	Sensor out of operation (no supply)	
Green	Sensor in operation	Position marker is within measuring range
Red flashing		Position marker is outside of measuring range
Red		Sensor error, internal diagnosis allows no valid signal output (f.e. absence of position marker, CAN controller bus off)
Fast red flashing (flickering), green flashing (blinking) etc.		Sensor indicates CANopen bus status according to DS303-3
Further conditions see operating manual		



Type designations	TF1 - - - - -001- A _ _ - 107 IO-Link (available 2 nd quarter 2019)		
Electrical Data			
Measured variables	Position, speed and temperature		
Electrical measuring range (dimension B)	0100 up to 1000		mm
Output signal / protocol	IO-Link Spec V1.1 to IEC 61131-9, Smart Sensor Profil (V1.0 compatible)		
Configurability	Measured variables (position, speed) The product variants listed in the ordering specifications (e.g., 1 x position) are also customer side configurable (to, e.g. 1 x position and 1 x speed)		
Programmable parameter	Zero point offset, resolution, averaging		
Transfer rate	COM 3 (230.4 kB)		
Frame type	2.2		
Minimum cycle time	1		ms
Update rate (output)	1		kHz
Resolution Position	1	5	μm
Resolution Speed	0.1	0.5	mms^{-1}
Reproducibility (rounded to resolution)	High prec mode	Balanced mode	
Dimension B \leq 400 mm	< 5	< 10	μm
Dimension B > 400 mm	< 8	< 15	μm
Signal propagation delay	4	1	ms
Hysteresis	\leq 5	\leq 10	μm
Absolute linearity	\leq 100		$\pm \mu\text{m}$
Tolerance of electr. zero point	1		$\pm \text{mm}$
Temperature error	\leq 15 (min. 0.01 mm/K)		$\pm \text{ppm/K}$
Supply voltage	24 (18 ... 32)		VDC
Supply voltage ripple	max. 10		%Vss
Power drain (w/o load)	2.4		W
Overvoltage protection	36 (permanent)		VDC
Reverse voltage	yes, up to supply voltage max.		
Short circuit protection	yes (output vs. GND and supply voltage max.)		
Insulation resistance (500 VDC)	\geq 10		M Ω
Environmental Data			
MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc)	> 20		Years
Functional safety	If you need assistance in using our products in safety-related systems, please contact us		
EMC compatibility	EN 61000-4-2 Electrostatic discharges (ESD) 4 kV, 8 kV EN 61000-4-3 Electromagnetic fields 10 V/m EN 61000-4-4 Fast transients (burst) 1 kV EN 61000-4-6 Conducted disturbances, induced by RF-fields 10 V eff. EN 55016-2-3 Radiated disturbances class B		



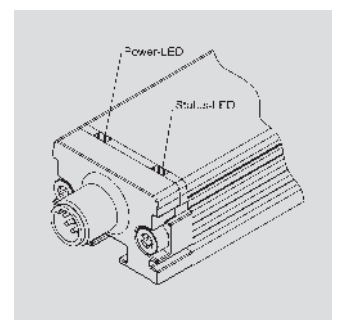
Pin assignment

Connector M12 Code 107	Connector with cable (Accessories)	IO-Link
PIN 1	BN	Supply voltage
PIN 2	WH	do not connect (alternatively to GND)
PIN 3	BU	GND
PIN 4	BK	C/Q

LED functionality

LED colour	Power LED for operating mode indication	Status-LED for measuring range indication / functional test
Off	Sensor out of operation (no supply)	
Green	Sensor in operation	
Red flashing	Position marker is within measuring range	
Red	Position marker is outside of measuring range	
Red	Sensor error, internal diagnosis allows no valid signal output (f.e. absence of position marker)	

Further conditions see operating manual



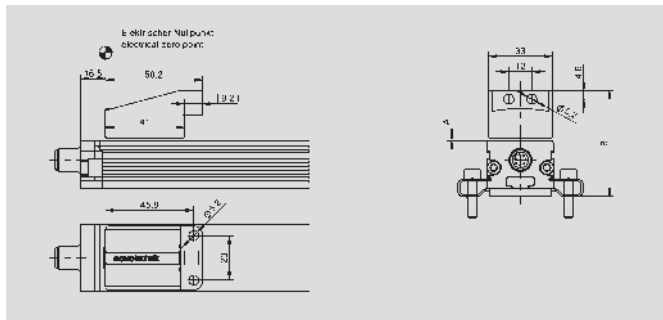
Ordering
Specifications



<p>Ordering specifications Preferred types printed in bold</p>	<p>Mechanical version 001: Profile design</p>	<p>Electrical Interface 6: CANopen A: IO-Link</p>	<p>Interface parameter for CANopen 6 __ 1: Resolution 5 µm, balanced mode, position and speed 3: Resolution 1 µm, high prec mode, position and speed</p>	<p>Interface parameter for IO-Link A __ 11: Resolution 5 µm, balanced mode, position 12: Resolution 5 µm, balanced mode, position and speed 31: Resolution 1 µm, high prec mode, position 32: Resolution 1 µm, high prec mode, position and speed</p>	<p>Baudrate CANopen 6 __ 1: Baud rate 1000 kBaud 2: Baud rate 800 kBaud 3: Baud rate 500 kBaud 4: Baud rate 250 kBaud 5: Baud rate 125 kBaud 7: Baud rate 50 kBaud 8: Baud rate 20 kBaud</p>	<p>Electrical Connection CANopen 106: Connector M12x1, 5-pin</p> <p>Electrical Connection IO-Link 107: Connector M12x1, 4-pin</p>
<p>T F 1 - 0 8 0 0 - 0 0 1 - 6 1 3 - 1 0 6</p>						
<p>Series</p>	<p>Electrical measuring range Standard lengths 0100 up to 1000 mm, in 100 mm-steps Other lengths on request</p>					

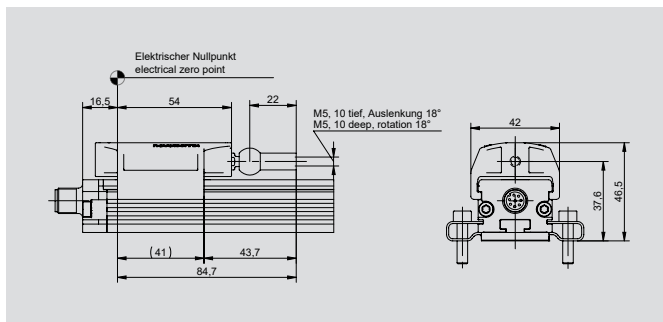
Important for CANopen interface: Avoid equalizing currents in the cable shield caused by potential differences. Shielded twisted pair cable (STP) is recommended.

Position Markers



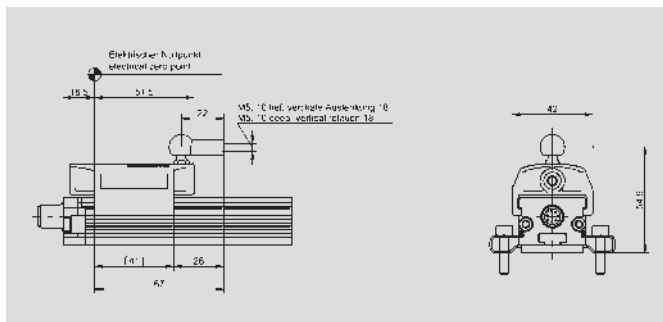
Floating position marker Z-TF1-P01	
Working distance A	0 ... 4 mm
Nominal distance	1.5 mm
Mounting (dimension B)	49 ... 53 mm
Perm. lateral offset	±2 mm
Material	PA6 GF30
Weight	approx. 40 g
P/N	400104343

The position marker can be mounted in both directions.



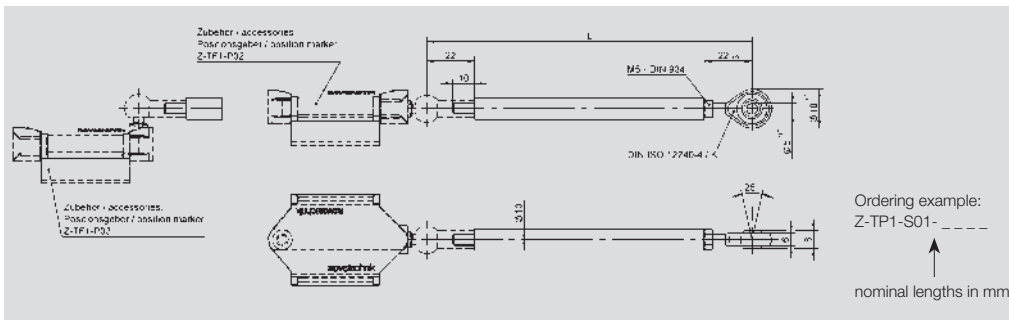
Guided position marker with axial joint Z-TF1-P02	
Material	POM
Material joint	Steel, galvanized
Weight	approx. 60 g
P/N	400104344

The position marker can be mounted in both directions.



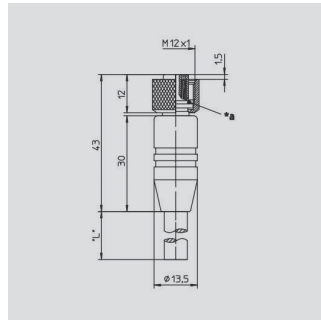
Guided position marker with angle joint Z-TF1-P03	
Material	POM
Material joint	Steel, galvanized
Weight	approx. 60 g
P/N	400104345

The position marker can be mounted in both directions.

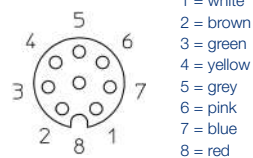


Actuating rod for guided position marker Z-TF1-P02/-P03	
Material	Aluminum
Weight	approx. 150 g
Standard-nominal lengths (mm)	0075, 0100, 0125, 0150, 0200, 0250, 0300, 0350, 0400, 0450, 0500, 0600, 0800, 1000, 1500, 2000
Z-TP1-S01-_____	

Connector System M12



Pin assignment



- 1 = white
- 2 = brown
- 3 = green
- 4 = yellow
- 5 = grey
- 6 = pink
- 7 = blue
- 8 = red



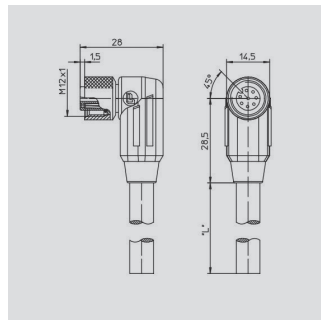
M12x1 Mating female connector, 8-pin, straight, A-coded, with molded cable, shielded, IP67, open ended

Connector housing Plastic PA

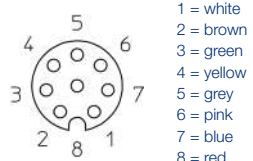
Cable sheath PUR; \varnothing = max. 8 mm
-25 °C...+80 °C (moved)
-50 °C...+80 °C (fixed)

Wires PP, 0.25 mm²

Length	Type	P/N
2 m	EEM 33-86	400005629
5 m	EEM 33-90	400005635
10 m	EEM 33-92	400005637



Pin assignment



- 1 = white
- 2 = brown
- 3 = green
- 4 = yellow
- 5 = grey
- 6 = pink
- 7 = blue
- 8 = red



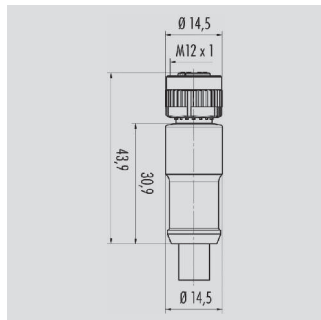
M12x1 Mating female connector, 8-pin, angled, A-coded, with molded cable, shielded, IP67, open ended

Connector housing Plastic PA

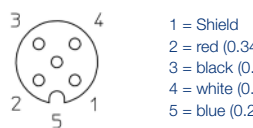
Cable sheath PUR; \varnothing = max. 8 mm,
-25 °C...+80 °C (moved)
-50 °C...+80 °C (fixed)

Wires PP, 0.25 mm²

Length	Type	P/N
2 m	EEM 33-87	400005630
5 m	EEM 33-91	400005636
10 m	EEM 33-93	400005638



Pin assignment



- 1 = Shield
- 2 = red (0.34 mm²)
- 3 = black (0.34 mm²)
- 4 = white (0.25 mm²)
- 5 = blue (0.25 mm²)



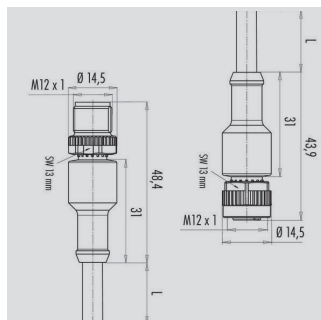
M12x1 Mating female connector, 5-pin, straight, A-coded, with molded cable, IP67, shielded, open ended, CAN-bus

Connector housing PUR

Cable sheath PUR \varnothing = max. 7.2 mm,
-25 °C...+85 °C (moved)

Wires PP 2x 0.25 mm²
+ 2 x 0.34 mm²

Length	Type	P/N
2 m	EEM 33-41	400056141
5 m	EEM 33-42	400056142
10 m	EEM 33-43	400056143



Pin assignment



- 1 = Shield
- 2 = red (0.34 mm²)
- 3 = black (0.34 mm²)
- 4 = white (0.25 mm²)
- 5 = blue (0.25 mm²)



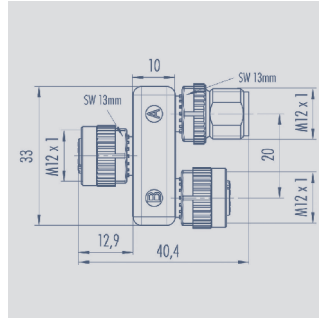
M12x1 Mating female connector, 5-pin, straight, A-coded, with molded cable, IP68, shielded, CAN-bus

Connector housing PUR

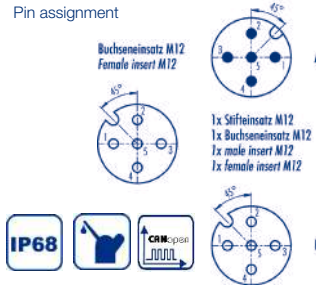
Cable sheath PUR; \varnothing 7.2 mm
-25 °C... +85 °C (fixed)

Length	Type	P/N
5 m	EEM 33-44	400056144

Connector System M12



Pin assignment

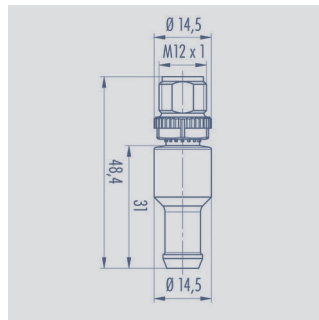


T-connector M12x1, 5-pin, A-coded, IP68, 1:1 connection, female - male - female, CAN-bus

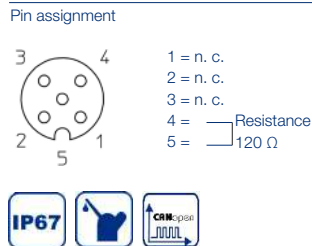
Connector housing PUR

Temperature range -25 °C... +85 °C

Type EEM 33-45, P/N 400056145



Pin assignment

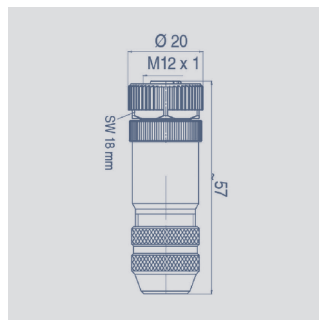


Terminating resistor M12x1, 5-pin, A-coded, IP67, 120 Ω resistance, CAN-bus

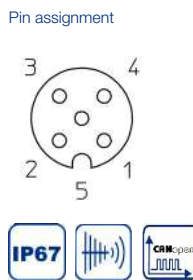
Connector housing PUR

Temperature range -25 °C... +85 °C

Type EEM 33-47, P/N 400056147



Pin assignment



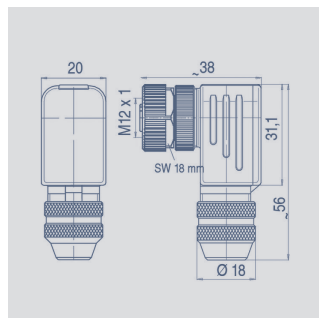
M12x1 Mating female connector, 5-pin, straight, A-coded, with coupling nut, screw termination, IP67, shieldable, CAN-bus

Connector housing Metal

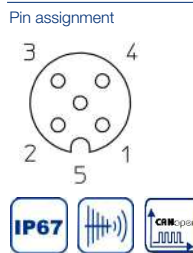
-40 °C...+85 °C

For wire gauge 6...8 mm,
max. 0.75 mm²

Type EEM 33-73, P/N 400005645



Pin assignment



M12x1 Mating female connector, 5-pin, angled, A-coded, with coupling nut, screw termination, IP67, shieldable, CAN-bus

Connector housing Metal

-40 °C...+85 °C

For wire gauge 6...8 mm,
max. 0.75 mm²

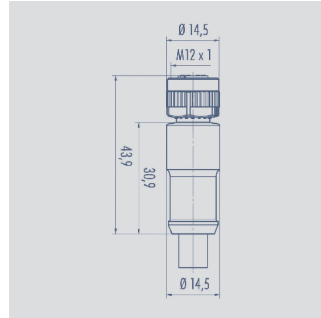
Type EEM 33-75, P/N 400005646

It is possible to turn and fix the contact carrier in 90° positions.

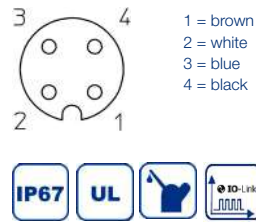
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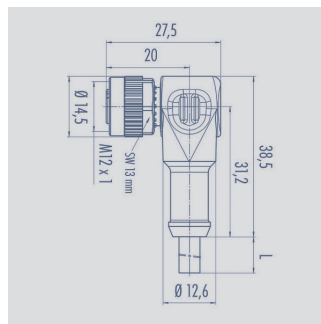


Pin assignment

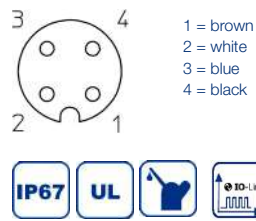


M12x1 Mating female connector, 4-pin, straight, A-coded, with molded cable, not shielded, IP67, open ended

Connector housing	Plastic PA	
Cable sheath	PUR; Ø = max. 6 mm, -40 °C...+85 °C (fixed)	
Wires	PP, 0.34 mm ²	
Length	Type	P/N
2 m	EEM 33-35	400056135
5 m	EEM 33-36	400056136
10 m	EEM 33-37	400056137



Pin assignment



M12x1 Mating female connector, 4-pin, angled, A-coded, with molded cable, not shielded, IP67, open ended

Connector housing	Plastic PA	
Cable sheath	PUR; Ø = max. 6 mm, -40 °C...+85 °C (fixed)	
Wires	PP, 0.34 mm ²	
Length	Type	P/N
2 m	EEM 33-38	400056138
5 m	EEM 33-39	400056139
10 m	EEM 33-40	400056140



Protection class IP67 to DIN EN 60529



Protection class IP68 to DIN EN 60529



CAN-bus



IO-Link



Very good Electromagnetic Compatibility (EMC) and shield systems



Very good resistance to oils, coolants und lubricants



UL - approved



Suited for applications in dragchains

Note: The protection class is valid only in locked position with its plugs.
The application of these products in harsh environments must be checked in particular cases.

The specifications contained in our datasheets are intended solely for informational purposes. The documented specification values are based on ideal operational and environmental conditions and can vary significantly depending on the actual customer application. Using our products at or close to one or more of the specified performance ranges can lead to limitations regarding other performance parameters. It is therefore necessary that the end user verifies relevant performance parameters in the intended application. We reserve the right to change product specifications without notice.