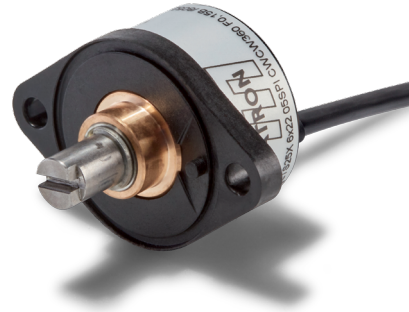


with flat ribbon cable



with round cable

Key features

- Ø25 mm housing made of glass fibre reinforced thermoplastic
- Magnetic, gradient-based signal evaluation
- Digital signal processing
- Metal sleeve bearing > 100 million shaft revolutions
- Ø6 mm / Ø6.35 mm stainless steel shaft
- Sealing up to IP55M (IP66S with special sealing option)
- Operating temperature range -40 to 85°C
- Measurement range up to 360° singleturn, 72000° multiturn
- Electrical connection: 0.15 m flat ribbon cable, 1 m round cable, solder holes or clamping terminals
- Ex works programmable signal output functions (single turn), field-programmable signal output for multiturn version
- Higher torque available for panel encoder applications

Applications

- Mechanical engineering
- Equipment manufacturing
- Speed measurement with low operational speeds (up to 100 rpm)
- Driverless transport systems
- Medical equipment
- Special vehicles
- High requirements on the lifetime
- Requirements of a user defined signal output function
- As panel encoder for manual input

Output variants

Singleturn absolute encoders	<ul style="list-style-type: none"> ▪ Analogue voltage or current loop output (12 bit resolution) ▪ Analogue PWM output (12 bit resolution) ▪ Digital output SPI (14 bit) ▪ Absolute linearity up to 0.6%
Field-Programmable single or multiturn absolute encoder	<ul style="list-style-type: none"> ▪ Analogue voltage or current loop output (12 bit resolution) ▪ Not True-Power-On (no data acquisition during voltage loss), max. 200 revolutions (72000°)
Incremental encoders	<ul style="list-style-type: none"> ▪ 1 to 1024 pulses per revolution (ppr.), selectable 1..128 or 256, 512, 1024 ▪ Outputs TTL, Push-Pull, Open Collector

ETx25F encoders – compact and versatile

The ETx25F series of encoders has been specially designed for applications where durability and adaptability are essential. Manufactured in a Ø25 mm glass-fibre reinforced thermoplastic, these contactless encoders offer a wide range of electronic and mechanical options to suit the application. Whether as incremental or absolute value encoders, they cover a wide range of applications and, depending on the output electronics, are used in systems, laboratory equipment and medical devices, for example.

The ETx25F is one of the most versatile encoders on the market. The encoders feature a high quality sleeve bearing, which is characterised by a long service life of more than 100 million shaft revolutions. Signal processing is digital and based on magnetic recording of the measured values. The gradient-based evaluation ensures high immunity, e.g. to temperature fluctuations and EMC influences. This technology overcomes the disadvantages of conventional Hall sensors. ETx25F encoders are designed for maximum lifetime. The number of defects or failures in encoders with this technology design is very low, even after decades of use.

In addition to a wide range of standard options, the modular design of the ETx25F encoders enables optimum adaptation to the specific requirements of the application. In addition, the concept allows for timely customisation (even in small batches) on the basis of a clearly structured pricing model. Typical modifications include customised shaft geometries, signal output functions, special cable lengths or customised electrical connection cables.

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Series overview

>>Please refer to the following sections for details

		Singleturn				Teach-In Multi/Singleturn	
Series		ETI25F	ETS25F	ETA25F	ETA25FX	ETP25F	ETA25FPM
Electronics redundant		NO	NO	NO	YES	NO	NO
Output signal(s)		Incremental A, B, Z	Digital absolute SPI: 14 bit	Analogue absolute 0 to 5 V 0 to 10 V 4 to 20 mA	Analogue absolute 0 to 5 V 0 to 10 V	PWM absolute 5 V / 244 Hz / PWM 10-90 %	Analogue absolute 0 to 5 V 0 to 10 V 4 to 20 mA
Effective electrical angle of rotation		360°		7° ≤ α ≤ 360° (programmable ex works)		7° ≤ α ≤ 360° (programmable ex works)	0-10° to 0-72000° (programmable by user) factory programming 0 to 3600°
Resolution		-	SPI: 14 bit	12 bit			
Supply voltage(s)	Output type	Push-Pull, open collector	SPI	Analogue 0 to 5 V	Analogue 0 to 5 V	PWM	Analogue 0 to 5 V
	Supply voltage	24 V (10 to 30 V)	5 V ± 10%	5 V ± 10% (ratiometric) or 24 V (9 to 30 V)	5 V ± 10%	5 V ± 10%	24 V (9 to 30 V)
	Output type	TTL		Analogue 0 to 10 V	Analogue 0 to 10 V		Analogue 0 to 10 V
	Supply voltage	5 V ± 10%		24 V (15 to 30 V)	24 V (15 to 30 V)		24 V (15 to 30 V)
	Output type			Current loop 4 to 20 mA			Current loop 4 to 20 mA
	Supply voltage			24 V (9 to 30 V)			24 V (11 to 30 V)
Programming options							
Programmable by customer		NO	NO	NO	NO	NO	YES
Programmable ex works		YES	YES	YES	YES	YES	YES
Electrical connection options							
Round cable		YES					
Flat ribbon cable		YES					

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Series ETA25F

Key features ETA25F:

- Analogue outputs 0 to 5 V, 0 to 10 V, 4 to 20 mA
- Redundant versions available – see separate section
- Several factory programming possibilities
- Supply voltages: 5 VDC ±10%, 15 to 30 VDC, 9 to 30 VDC



Electrical data

Effective electrical angle of rotation 1.)	7° ≤ α ≤ 360° (programmable ex works), ±0.5°		
Independent linearity (best straight line) 1.)	±0.3% @ 360°		
Absolute Linearity 1.)	±0.6% @ 360°		
Output signal	0 to 5 V ratiometric	0 to 10 V	4 to 20 mA
Resolution	12 Bit		
Update rate	200 µs		
Supply voltage	5 V ±10%	15 to 30 V	9 to 30 V
Power consumption (no load)	≤18 mA		
Output load	≥ 5 kOhm		≤ 500 Ohm
Insulation voltage 1.)	1000 VAC @ 50 Hz, 1 min		
Insulation resistance 1.)	2 MOhm @ 500 VDC, 1 min		
MTTF (EN29500-2005-1)	1173a	965a	379a

1.) According to IEC 60393

Wire colour/pin assignment

Function:	Option F	Option R
OUT	Strand 2	brown
VSUP	Strand 1 (red)	red
GND	Strand 3	black

For details on zero point definition and output programming see page 25.

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Order Code ETA25F – singleturn, analogue output, not redundant

Description	Selection: standard= black/bold , possible options= <i>grey/italic</i>							
Series	ETA25F							
Shaft diameter, shaft length: Shaft diameter Ø 6 mm, shaft length 15.6 mm <i>Shaft diameter Ø 6.35 mm, shaft length 15.6 mm</i> <i>Custom shaft dimensions [mm] Ø ≤ 6.35 mm</i>		6x15,6 <i>6,35x15,6</i> <i>XxXX</i>						
Supply voltage / output signal: VSUP=5 V (4.5 to 5.5 V) / OUT=0 to 5 V (ratiometric) VSUP=24 V (15 to 30 V) / OUT=0 to 10 V VSUP=24 V (9 to 30 V) / OUT=4 to 20 mA <i>VSUP=24 V (9 to 30 V) / OUT=0 to 5 V</i>			0505 2410 2442 <i>2405</i>					
Sense of rotation: (when looking at the shaft, from the front) Clockwise <i>Counterclockwise</i>				CW <i>CCW</i>				
Rotation angle in [°]: 360 <i>320</i> <i>270</i> <i>180</i> <i>90</i> <i>Custom rotation angle (≥7°, positive integer)</i>					360 <i>320</i> <i>270</i> <i>180</i> <i>90</i> <i>XXX</i>			
Operational Torque: Standard torque <i>Improved/medium torque</i>						- <i>MT</i>		
Shaft sealing: None <i>With shaft sealing</i>							- <i>D</i>	
Electrical connection, cable length: Solder holes Clamping terminals Flat ribbon cable, standard length 0.15 m <i>Flat ribbon cable with custom length [x,xx m]</i> Round cable, standard length 1 m <i>Round cable with custom length [x,xx m]</i>							L K F0,15 <i>FX,XX</i> R1,00 <i>RX,XX</i>	
Anti-rotation pin: Pin A <i>None (pin removed)</i>								A <i>-</i>

Order example ETA25F
Requirements:

Shaft Ø 6.00 mm, shaft length 15.6 mm, VSUP=5 V / OUT=0 to 5 V, sense of rotation CW, rotation angle 360°
round cable 1.00 m, anti-rotation pin A

Example for order code:

ETA25F 6x15,6 0505 CW 360 R1,00A

Series ETA25FX – singleturn, analogue output, redundant

Key features ETA25FX :

- Independent signal processing. The ETA25FX rotary encoder electronics are based mainly on one Hall IC in which two semiconductor dies independently capture, evaluate and output the measured values
- Supply voltage, signal output and ground are galvanically insulated => separate electrical connections
- Supply voltages: 2 x 5 VDC or 2 x 15 to 30 VDC
- Signal outputs: 2 x 0 to 5 V or 2 x 0 to 10 V

Electrical data ETA25FX – singleturn, analogue output, redundant

Effective electrical angle of rotation 1.)	7° ≤ α ≤ 360° (programmable ex works), ±0.5°	
Independent linearity (best straight line) 1.)	±0.3% @ 360°	
Absolute Linearity 1.)	±0.6% @ 360°	
Output signal	0 to 5 V ratiometric	0 to 10 V
Resolution	12 Bit	
Update rate	200 μs	
Supply voltage	5 V ±10%	15 to 30 V
Power consumption (no load)	≤ 23 mA	
Output load	≥ 5 kOhm	
Insulation voltage 1.)	1000 VAC @ 50 Hz, 1 min	
Insulation resistance 1.)	2 MOhm @ 500 VDC, 1 min	
MTTF (EN29500-2005-1)	613a	202a

1.) According to IEC 60393

Cable and pin assignment ETA25FX – singleturn, analogue output, redundant

Function:	Option F	Option R
VSUP 1	Lead 1 (red)	red
OUT 1	Lead 2	brown
GND 1	Lead 3	black
GND 2	Lead 4	green
OUT 2	Lead 5	yellow
VSUP 2	Lead 6	orange

For details on zero point definition and output programming see page 25.

Order Code ETA25FX – redundant, singleturn, analogue output									
Description	Selection: standard= black/bold , possible options= <i>grey/italic</i>								
Series	ETA25FX								
Shaft diameter, shaft length: Shaft diameter \varnothing 6 mm, shaft length 15.6 mm <i>Shaft diameter \varnothing 6.35 mm, shaft length 15.6 mm</i> <i>Custom shaft dimensions [mm] $\varnothing \leq 6.35$ mm</i>		6x15,6 <i>6,35x15,6</i> <i>XxXX</i>							
Supply voltage / output signal: VSUP=5 V (4.5 to 5.5 V) / OUT=0 to 5 V (<i>ratiometric</i>) VSUP=24 V (15 to 30 V) / OUT=0 to 10 V								0505 2410	
Sense of rotation: (when looking at the shaft, from the front) Clockwise/Clockwise (ganging) <i>Clockwise/Counterclockwise (counter rotational)</i>								CW CW <i>CW CCW</i>	
Rotation angle in [°]: 360 <i>320</i> <i>270</i> <i>180</i> <i>90</i> <i>Custom rotation angle ($\geq 7^\circ$, positive integer)</i>									<i>360</i> <i>320</i> <i>270</i> <i>180</i> <i>90</i> <i>XXX</i>
Operational Torque: Standard torque <i>Improved/medium torque</i>								- <i>MT</i>	
Shaft sealing: None <i>With shaft sealing</i>								- <i>D</i>	
Electrical connection, cable length: Flat ribbon cable, standard length 0.15 m <i>Flat ribbon cable with custom length [x,xx m]</i> Round cable, standard length 1 m <i>Round cable with custom length [x,xx m]</i>									F0,15 <i>FX,XX</i> R1,00 <i>RX,XX</i>
Anti-rotation pin: Pin A <i>None (pin removed)</i>									A <i>-</i>

Order example ETA25FX – redundant, singleturn, analogue output
Requirement:

Redundant, shaft \varnothing 6.00 mm, shaft length 15.6 mm, VSUP=5 V /OUT=0...5 V, signal 1 sense of rotation CW, signal 2 sense of rotation CW, electrical rotation 360° signal 1 and 2, no shaft sealing, flat ribbon cable 0.15 m, anti-rotation pin A

Example for order code:

ETA25FX 6x15,6 0505 CW CW 360 F0.15A

Series ETP25F – singleturn, PWM output, not redundant

Key features ETP25F:

- PWM signal output
- Frequency 244 Hz (constant)
- Pulse width (duty cycle) 10% (0°) to 90% (360°)
- Supply voltage: 5 VDC +/-10%



Electrical data ETP25F – singleturn, PWM output, not redundant

Effective electrical angle of rotation 1.)	$7^\circ \leq \alpha \leq 360^\circ$ (programmable ex works), $\pm 0.5^\circ$
Independent linearity (best straight line) 1.)	$\pm 0.4\%$ @ 360°
Absolute Linearity 1.)	$\pm 0.6\%$ @ 360°
Output signal	PWM (pulse width modulation)
Output signal voltage	5 V
Carrier frequency	244 Hz (constant)
Minimum duty cycle	10%, equal to app. 0.4 ms
Maximum duty cycle	90%, equal to app. 3.5 ms
Resolution	12 Bit
Supply voltage	5 V $\pm 10\%$
Power consumption (no load)	≤ 10 mA
Output load	≥ 5 kOhm
Insulation voltage 1.)	1000 VAC @ 50 Hz, 1 min
Insulation resistance 1.)	2 MOhm @ 500 VDC, 1 min
MTTF (EN29500-2005-1)	1267a

1.) According to IEC 60393

Function description PWM signal output ETP25F

The ETP25F provides a constant carrier frequency with 244 Hz at the signal output, with HIGH and LOW signal levels which have a constant signal amplitude. A constant carrier frequency means a constant length of the period duration. The duty cycle and thus the pulse width changes in dependency of the rotating angle between 10% to 90% relative to the signal period. If the CW option is selected, the duty cycle increases clockwise when turning the shaft clockwise. If the CCW option is selected, the duty cycle decreases clockwise if the shaft is turned clockwise. Normally no signal conversion is required for further processing of the output signal, because many μ Controllers already have an input for PWM signals.

Cable and pin assignment

Function	Option F (flat ribbon)	Option R (round cable)
OUT	Lead 2	brown
VSUP	Lead 1 (red)	red
GND	Lead 3	black

For details on zero point definition and output programming see page 25.

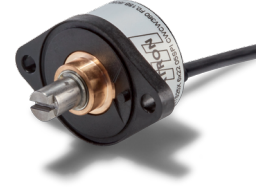
Order Code ETP25F – singleturn, PWM output, not redundant									
Description	Selection: standard= black/bold , possible options= <i>grey/italic</i>								
Series	ETP25F								
Shaft diameter, shaft length: Shaft diameter Ø 6 mm, shaft length 15.6 mm <i>Shaft diameter Ø 6.35 mm, shaft length 15.6 mm</i> <i>Custom shaft dimensions [mm] Ø ≤ 6.35 mm</i>	6x15,6 <i>6,35x15,6</i> <i>XxXX</i>								
Supply voltage / output signal: VSUP=5 V (4.5...5.5 V) / OUT=5 V / 244 Hz / PWM 10-90%		5PWM							
Sense of rotation: (when looking at the shaft, from the front) Clockwise <i>Counterclockwise</i>				CW <i>CCW</i>					
Rotation angle in [°]: 360 <i>320</i> <i>270</i> <i>180</i> <i>90</i> <i>Custom rotation angle (≥7°, positive integer)</i>					<i>360</i> <i>320</i> <i>270</i> <i>180</i> <i>90</i> <i>XXX</i>				
Operational Torque: Standard torque <i>Improved/medium torque</i>						- <i>MT</i>			
Shaft sealing: None <i>With shaft sealing</i>							. <i>D</i>		
Electrical connection, cable length: Flat ribbon cable, standard length 0.15 m <i>Flat ribbon cable with custom length [x,xx m]</i> Round cable, standard length 1 m <i>Round cable with custom length [x,xx m]</i>								F0,15 <i>FX,XX</i> R1,00 <i>RX,XX</i>	
Anti-rotation pin: Pin A <i>None (pin removed)</i>									A <i>-</i>

Order example ETP25F – singleturn, PWM output, not redundant									
Requirement: Shaft Ø 6.35 mm, shaft length 15.6 mm, VSUP=5 V / OUT=244 Hz, sense of rotation CW, rotation angle 360°, no shaft sealing, anti-rotation pin A, round cable 2 m									
Example for order code: ETP25F 6,35x15,6 5PWM CW360 R2,00A									

Series ETS25 – singleturn, digital output, not redundant

Key features ETS25:

- Supply voltage 5 VDC +/-10%
- High-speed efficient signal transmission (only possible via short signal cables limited by clock rate)



Electrical data ETS25 – singleturn, digital output, not redundant

Output signal	SPI
Effective electrical angle of rotation 1.)	360°
Independent linearity (best straight line) 1.)	±0,3% @ 360°
Absolute linearity 1.)	±0,6% @ 360°
Resolution	14 Bit
Update rate (cable length 15 cm max.)	200 µs
Supply voltage	5 VDC ±10%
Power consumption (no load)	≤ 12 mA
Insulation voltage 1.)	1000 VAC @ 50 Hz, 1 min
Insulation resistance 1.)	2 MOhm @ 500 VDC, 1 min
MTTF (EN29500-2005-1)	2046a

1.) According to IEC 60393

Cable/colour assignment – option 05SPI, not redundant

Function:	Option R (round signal cable)	Option F (flatribbon cable)
VSUP	red	Lead 1
GND	black	Lead 2
CS, MOSI	yellow	Lead 3
CLK	green	Lead 4
DATA	orange	Lead 5
-	brown n/c	

For details on zero point definition and output programming see page 25.

Order Code ETS25 – singleturn, digital output, not redundant							
Description	Selection: standard= black/bold , possible options= <i>grey/italic</i>						
Series	ETS25						
Shaft diameter, shaft length: Shaft diameter \varnothing 6 mm, shaft length 15.6 mm <i>Shaft diameter \varnothing 6.35 mm, shaft length 15.6 mm</i> <i>Custom shaft dimensions [mm] $\varnothing \leq 6.35$ mm</i>		6x15,6 <i>6,35x15,6</i> <i>XxXX</i>					
Supply voltage / output signal: 5 VDC \pm 10% / SPI (14 Bit)			05SPI				
Operational torque: Standard torque <i>Improved/medium torque</i>				- <i>MT</i>			
Shaft sealing: None <i>With shaft sealing</i>					- <i>D</i>		
Electrical connection, cable length: Flat ribbon cable, standard length 0.15 <i>Flat ribbon cable with custom length [x,xx m]</i> <i>Round cable with custom length [x,xx m] (max. 1 m for SPI, recommended < 15 cm)</i>						F0,15 <i>FX,XX</i> <i>RX,XX</i>	
Anti-rotation pin: Pin A <i>None (pin removed)</i>							A -

Order example ETS25 – singleturn, digital output, not redundant	
Requirement: Shaft \varnothing 6.00 mm, shaft length 15.6 mm, 14 Bit/5 VDC/SPI, no shaft sealing, flat ribbon cable 0.15 m, anti-rotation pin A	
Example for order code: ETS25 6x15,6 05SPI F0,15A	

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Protocol description ETS25 – Serial Peripheral Interface (SPI)

Introduction

The encoder is configured as a Slave node. The serial protocol of the is a three wires protocol (/SS, SCLK, MOSI-MISO):

- /SS output is a 5 V tolerant digital input
- SCLK output is a 5 V tolerant digital input
- MOSI-MISO output is a 5 V tolerant open drain digital input/output

Basic knowledge of the standard SPI specification is required for the good understanding of the present section.

Even clock changes are used to sample the data. The positive going edge shifts a bit to the Slave's output stage and the negative going edge samples the bit at the Master's input stage.

MOSI (Master Out Slave In)

The Master sends a command to the Slave to get the angle information.

MISO (Master In Slave Out)

The MISO of the slave is an open-collector stage. Due to the capacitive load, a >1 kΩ pull-up is used for the recessive high level (in fast mode). Note that MOSI and MISO use the same physical wire of the ETS25.

/SS (Slave Select)

The /SS output enables a frame transfer. It allows a re-synchronization between Slave and Master in case of a communication error.

Master Start-Up

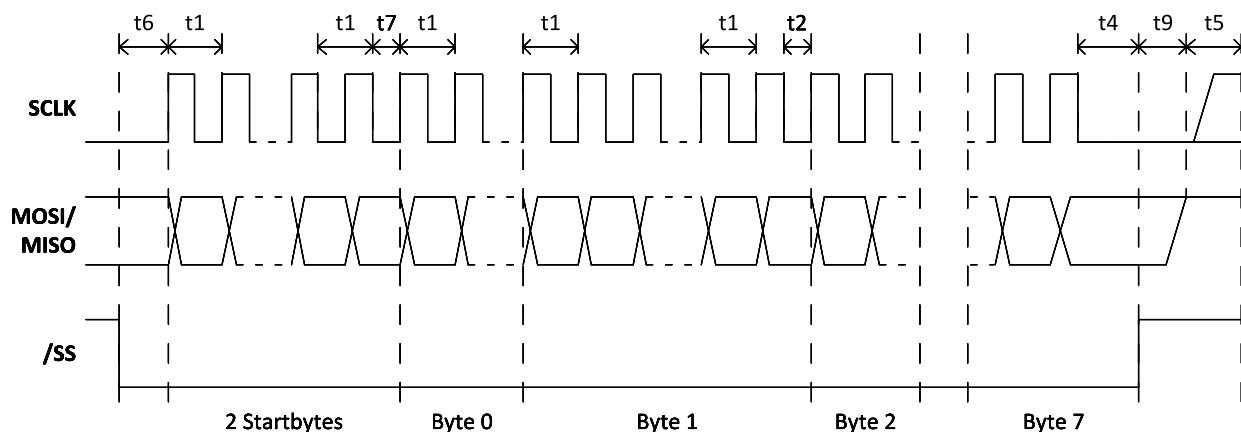
/SS, SCLK, MISO can be undefined during the Master start-up as long as the Slave is re-synchronized before the first frame transfer.

Slave Start-Up

The slave start-up (after power-up or an internal failure) takes 16 ms. Within this time /SS and SCLK is ignored by the Slave. The first frame can therefore be sent after 16 ms. MISO is Hi-Z (i.e. Hi-Impedance) until the Slave is selected by its /SS input. The encoder will cope with any signal from the Master while starting up.

Timing

To synchronize communication, the Master deactivates /SS high for at least t5 (1.5 ms). In this case, the Slave will be ready to receive a new frame. The Master can re-synchronize at any time, even in the middle of a byte transfer. Note: Any time shorter than t5 leads to an undefined frame state, because the Slave may or may not have seen /SS inactive.



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Protocol description ETS25 – Serial Peripheral Interface (SPI) (continuation)
Description Timings

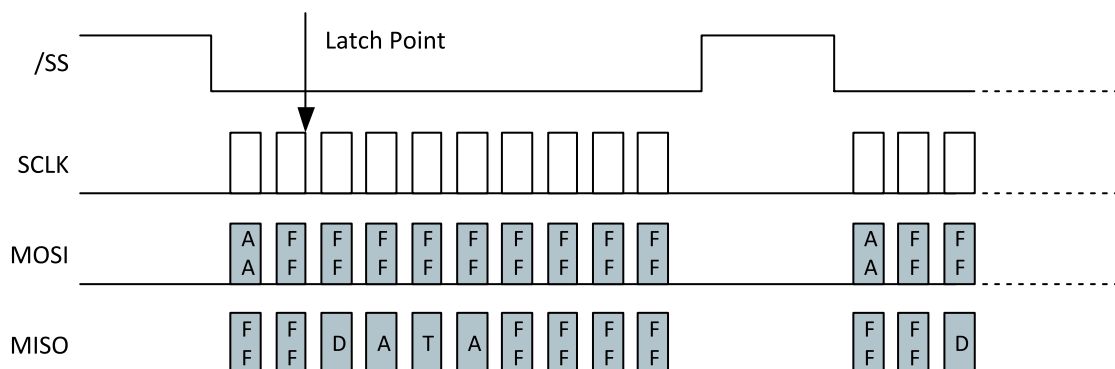
Timings	Min	Max	Remarks
t1	2.3 μ s / 6.9 μ s	-	No capacitive load on MISO. t1 is the minimum clock period for any bits within a byte.
t2	12.5 μ s / 37.5 μ s	-	t2 the minimum time between any other byte
t4	2.3 μ s / 6.9 μ s	-	Time between last clock and /SS=high=chip de-selection
t5	300 μ s / 1500 μ s	-	Minimum /SS = Hi time where it's guaranteed that a frame re-synchronizations will be started
t5	0 μ s	-	Maximum /SS = Hi time where it's guaranteed that NO frame re-synchronizations will be started.
t6	2.3 μ s / 6.9 μ s	-	The time t6 defines the minimum time between /SS = Lo and the first clock edge
t7	15 μ s / 45 μ s	-	t7 is the minimum time between the StartByte and the Byte0
t9	-	< 1 μ s	Maximum time between /SS = Hi and MISO Bus HighImpedance
T _{Startup}	-	< 10 ms / 16 ms	Minimum time between reset-inactive and any master signal change

Slave Reset

On internal soft failures the Slave resets after 1 second or after an (error) frame is sent. On internal hard failures the Slave resets itself. In that case, the Serial Protocol will not come up. The serial protocol link is enabled only after the completion of the first synchronization (the Master deactivates /SS for at least t5).

Frame Layer
Command Device Mechanism

Before each transmission of a data frame, the Master should send a byte AAh to enable a frame transfer. The latch point for the angle measurement is at the last clock before the first data frame byte.


Data Frame Structure

A data frame consists of 10 bytes:

- 2 start bytes (AAh followed by FFh)
- 2 data bytes (DATA16 – most significant byte first)
- 2 inverted data bytes (/DATA16 - most significant byte first)
- 4 all-Hi bytes

The Master should send AAh (55h in case of inverting transistor) followed by 9 bytes FFh. The Slave will answer with two bytes FFh followed by 4 data bytes and 4 bytes FFh.

Protocol description ETS25 – Serial Peripheral Interface (SPI) (Fortsetzung)
Timing

There are no timing limits for frames: a frame transmission could be initiated at any time. There is no interframe time defined.

Data Structure

The DATA16 could be a valid angle or an error condition. The two meanings are distinguished by the LSB.

DATA16: Angle A[13:0] with (Angle Span)/2¹⁴

Most Significant Byte							Least Significant Byte								
MSB						LSB	MSB							LSB	
A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0	0	1

DATA16: Error

Most Significant Byte							Least Significant Byte								
MSB						LSB	MSB							LSB	
E15	E14	E13	E12	E11	E10	E9	E8	E7	E6	E5	E4	E3	E2	E1	E0

DATA16: Error

BIT	Name	Description
E0	0	
E1	1	
E2	F_ADCMONITOR	ADC Failure
E3	F_ADCSATURA	ADC Saturation (Electrical failure or field too strong)
E4	F_RGTOOLOW	Analog Gain Below Trimmed Threshold (Likely reason: field too weak)
E5	F_MAGTOOLOW	Magnetic Field Too Weak
E6	F_MAGTOOHIGH	Magnetic Field Too Strong
E7	F_RGTOOHIGH	Analog Gain Above Trimmed Threshold (Likely reason: field too strong)
E8	F_FGCLAMP	Never occurring in serial protocol
E9	F_ROCLAMP	Analog Chain Rough Offset Compensation: Clipping
E10	F_MT7V	Device Supply VDD Greater than 7V
E11	-	
E12	-	
E13	-	
E14	F_DACMONITOR	Never occurring in serial protocol
E15	-	

Angle Calculation

All communication timing is independent (asynchronous) of the angle data processing. The angle is calculated continuously by the Slave every 350 µs at most. The last angle calculated is hold to be read by the Master at any time. Only valid angles are transferred by the Slave, because any internal failure of the Slave will lead to a soft reset.

Error Handling

In case of any errors listed above, the Serial protocol will be initialized and the error condition can be read by the master. The slave will perform a soft reset once the error frame is sent. In case of any other errors (ROM CRC error, EEPROM CRC error, RAM check error, intelligent watchdog error...) the Slave's serial protocol is not initialized. The MOSI/MISO output will stay Hi-impedant (no error frames are sent).

Series ETI25F – singleturn, incremental output, not redundant

Key features ETI25F:

- Channels: A, B and index signal Z
- TTL, Push Pull or Open Collector electronics
- Maximum number of pulses per channel 1024 pulses per revolution (4096 steps)
- Option: ex works programmable number of pulses from 1 to 128 ppr in one pulse step-width, as well as 256, 512, 1024 ppr

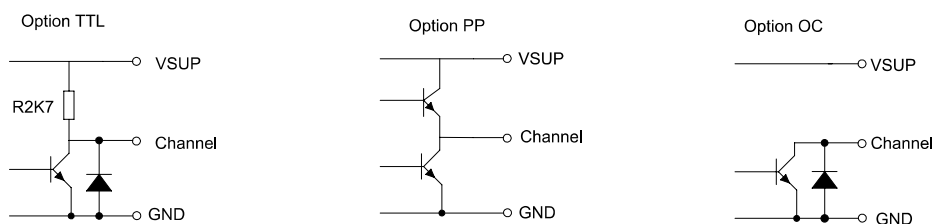


Electrical data ETI25F – singleturn, incremental output, not redundant

Output Signal	TTL	Push-Pull	Open Collector
Number of pulses	1 to 128 ppr, 256, 512, 1024 ppr		1 to 128 ppr, 256 ppr.
Limit frequency	100 kHz		10 kHz
Switch-on delay	20 ms		
Supply voltage	3.3 or 5 VDC $\pm 10\%$	10 to 30 V	10 to 30 V
Power consumption (no load)	≤ 15 mA	≤ 50 mA	≤ 25 mA
Output load	≥ 5 kOhm		
Max. pull-up voltage	-		30 VDC
Insulation voltage 1.)	1000 VAC @ 50 Hz, 1 min		
Insulation resistance 1.)	2 MOhm @ 500 VDC, 1 min		
MTTF (EN29500-2005-1)	473a	462a	570a

1.) According to IEC 60393

Output circuit ETI25F per channel



For details on zero point definition and output programming see page 25.

Order Code ETI25F – singleturn, incremental output

Description	Selection: standard= black/bold , possible options= <i>grey/italic</i>						
Series	ETI25F						
Shaft diameter, shaft length: Shaft diameter Ø 6 mm, shaft length 15.6 mm <i>Shaft diameter Ø 6.35 mm, shaft length 15.6 mm</i> <i>Custom shaft dimensions [mm] Ø ≤ 6.35 mm</i>		6x15,6 <i>6,35x15,6</i> <i>XxXX</i>					
Number of pulses (ppr): 32 64 128 256 512 (<i>only for TTL and push-pull</i>) 1024 (<i>only for TTL and push-pull</i>) <i>User-defined number of pulses 1 to 128, increment 1 pulse</i>				32 64 128 256 512 1024 <i>0XXX</i>			
Supply voltage / output signal: VSUP=24 V (10 to 30 V) / OUT=push-pull A, B, Z VSUP=5 V ± 10% / OUT=TTL A, B, Z VSUP=24 V (10 to 30 V) / OUT=open collector A, B, Z						24BZPP 05BZTTL 24BZOC	
Operational Torque: Standard torque <i>Improved/medium torque</i>						- <i>MT</i>	
Shaft sealing: None <i>With shaft sealing</i>						- <i>D</i>	
Electrical connection, cable length: Flat ribbon cable, standard length 0.15 m <i>Flat ribbon cable with custom length [x,xx m]</i> Round cable, standard length 1 m <i>Round cable with custom length [x,xx m]</i>							F0,15 <i>FX,XX</i> R1,00 <i>RX,XX</i>
Anti-rotation pin: Pin A <i>None (pin removed)</i>							A <i>-</i>

Order example ETI25F – singleturn, incremental output

Requirement:
Shaft Ø 6.00 mm, shaft length 15.6 mm, number of pulses 1024 TTL output, VSUP=5 V/TTL, no shaft sealing, round cable 1.20 m, anti-rotation pin A

Example for order code:
ETA125 6x15,6 1024 05BZTTL R1,20A

General

Contents

Overview

Voltage/Current
Redundant Analogue (ETA25F)

PWM (ETP25F)

Serial (ETS25F)

Incremental (ETI25F)

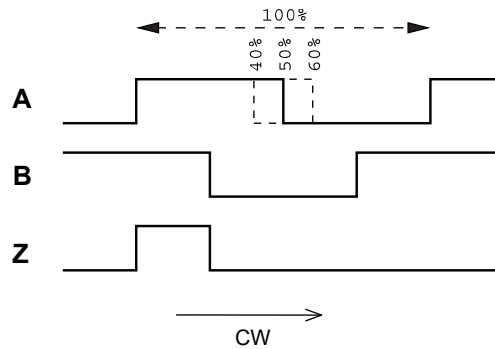
Multiturn (ETA25FPM)

Drawings

Technical Data

Accessories

Lead	Flat ribbon cable (option F)		Round signal cable (option R)	
	TTL, OC	push-pull (PP)	Wire colour	PP, TTL, OC
Lead 1 (red)	VSUP	VSUP	red	VSUP
Lead 2	GND	Z	black	GND
Lead 3	A	B	brown	A
Lead 4	B	A	orange	B
Lead 5	Z	GND	yellow	Z
			green	n/c

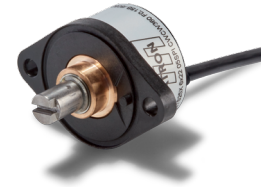
Signal details
A, B, Z (Standard)


The percentage information describes the proportion of a pulse in dependency to the duration of one period

Series ETA25FPM – single/multiturn, programmable, analogue output, not redundant

Key features ETA25FPM :

- Measuring range 10° to max. 72000° (200 shaft revolutions)
- Programmable by the user using teach-in function. Programmable are the sense of rotation (CW/CCW) and the effective electrical angle [°]
- Programmable up to 10000 times
- Can also be used as a programmable singleturn rotary encoder
- Maximum rotation of the shaft in a voltage-free state without loss of the angle information +/-179°
- Factory programming (ex works): effective electrical angle of rotation 3600° (10 shaft revolutions), sense rotation CW
- Supply voltage: 9 to 30 VDC, 15 to 30 VDC
- Output signal: 4 to 20 mA, 0 to 5 V, 0 to 10 V



Electrical data ETA25FPM – multi/singleturn, programmable, analogue output, not redundant

Effective electrical angle of rotation 1.)	0 to 10° - 0 to 72000° (max. 200 turns) Start point, endpoint and sense of rotation programmable by the customer. Ex works the angle is set to 3600°. For detecting absolute position >360° the sensor should not be turned more than ±179° without supply voltage.		
Independent linearity (best straight line) 1.)	±0.05% @ 3600°		
Absolute Linearity 1.)	±0.1% @ 3600°		
Output signal	0 to 5 V	0 to 10 V	4 to 20 mA
Resolution 1.)	12 Bit		
Update rate	3 ms		
Supply voltage	9 to 30 V	15 to 30 V	11 to 30 V
Power consumption (no load)	< 10 mA		< 14 mA
Output load	≥ 5 kOhm		≤ 500 Ohm
Insulation voltage 1.)	1000 VAC @ 50 Hz, 1 min		
Insulation resistance 1.)	2 MOhm @ 500 VDC, 1 min		
Max. number of programming cycles	10000		
MTTF (EN29500-2005-1)	224a		229a

1.) According to IEC 60393

General

Contents

Overview

Redundant Voltage/Current Analogue (ETA25F)

PWM (ETP25F)

Serial (ETS25F)

Incremental (ETI25F)

Multiturn (ETA25FPM)

Drawings

Technical Data

Accessories

Order Code ETA25FPM – multi/singleturn, analogue output, not redundant						
Description	Selection: standard= black/bold , possible options= <i>grey/italic</i>					
Series	ETA25FPM					
Shaft diameter, shaft length: Shaft diameter Ø 6 mm, shaft length 15.6 mm <i>Shaft diameter Ø 6.35 mm, shaft length 15.6 mm</i> <i>Custom shaft dimensions [mm] Ø ≤ 6.35 mm</i>		6x15,6 <i>6,35x15,6</i> <i>XxXX</i>				
Supply voltage / output signal: VSUP=24 V (15 to 30 V) / OUT=0 to 10 V VSUP=24 V (9 to 30 V) / OUT=4 to 20 mA VSUP=24 V (9 to 30 V) / OUT=0 to 5 V					2410 2442 2405	
Operational Torque: Standard torque <i>Improved/medium torque</i>						- <i>MT</i>
Shaft sealing: None <i>With shaft sealing</i>						- <i>D</i>
Electrical connection, cable length: Flat ribbon cable, standard length 0.15 m <i>Flat ribbon cable with custom length [x,xx m]</i> Round cable, standard length 1 m <i>Round cable with custom length [x,xx m]</i>						F0,15 <i>FX,XX</i> R1,00 <i>RX,XX</i>
Anti-rotation pin: Pin A <i>None (pin removed)</i>						A <i>-</i>

Order example ETA25FPM
Requirement:

Shaft Ø 6.00 mm, shaft length 15.6 mm, VSUP=24 V / OUT=0...5 V, sense of rotation CW, rotation angle ex works 3600° (can be programmed by customer), no shaft sealing, flat ribbon cable 1.00 m, anti-rotation pin A

Example for order code:

ETA25FPM 6x15,6 2405 R1,00A

Cable and pin assignment

Function	Option F	Option R
DIR	Strand 1 (red)	orange
END	Strand 2	grün
START	Strand 3	gelb
VSUP	Strand 4	rot
OUT	Strand 5	braun
GND	Strand 6	schwarz

For details on zero point definition see next page and page 25.

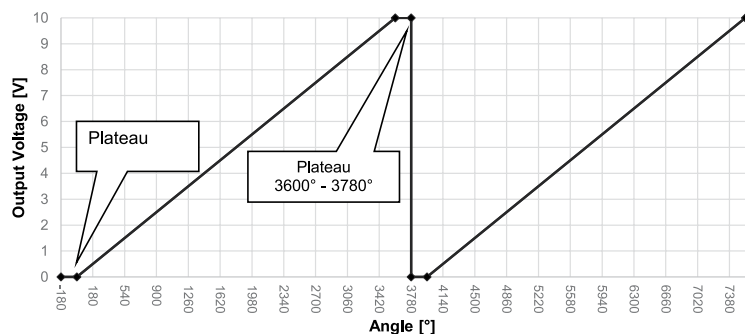
Signal output function (factory programming only). Automatic function for inserting signal plateaus

The function represents the relationship between the zero degree marking on the rotary encoder housing in dependency to the 0° position of the shaft and the resulting output signal in the state of delivery, when turning the shaft clockwise (sense of rotation CW). The effective electrical angle of rotation is 3600° ex works. Before and after the linearly rising output signal for 3600° the ETA25FPM integrates automatically signal plateaus for a rotation angle of each 180°.

The following example shows the output signal pattern when actuating the shaft in the delivery state for 11 revolutions clockwise (sense of rotation CW), starting at the 0° position:

1. 10 rotations of the shaft clockwise 0° to 3600°, linearly increasing output signal 0% to 100% FS
2. 1/2 rotation of the shaft 180° (3600° to 3780°) signal plateau 100% FS
3. 1/2 rotation of the shaft 180° (3780° to 3960°) signal plateau 0% FS

The drawing shows the signal-amplitude function for 0 to 10V signal output



Programming device PRO for programming the encoder in the field

Key features programmer:

- Programmable measuring range from 10° to max. 72000° (200 shaft revolutions)
- Programmable: sense of rotation (CW/CCW), effective electrical angle [°]
- Up to 10.000 programming cycles per rotary encoder



Order number:

135945

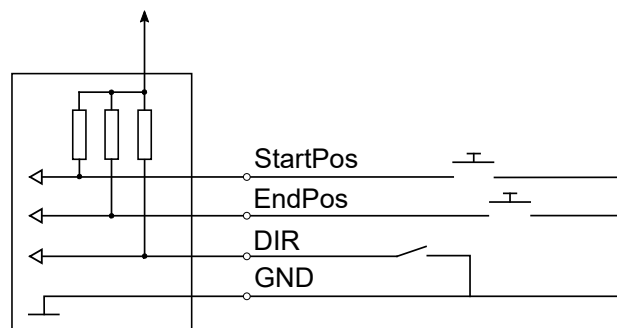
Order code:

Programmer Tool for ETA HTA PM

Circuit for field-programming

The programming guide is available for download on the MEGATRON web page <https://www.megatron.de/>

To program the encoder either the following circuit can be implemented, or one uses the programmer from MEGATRON.

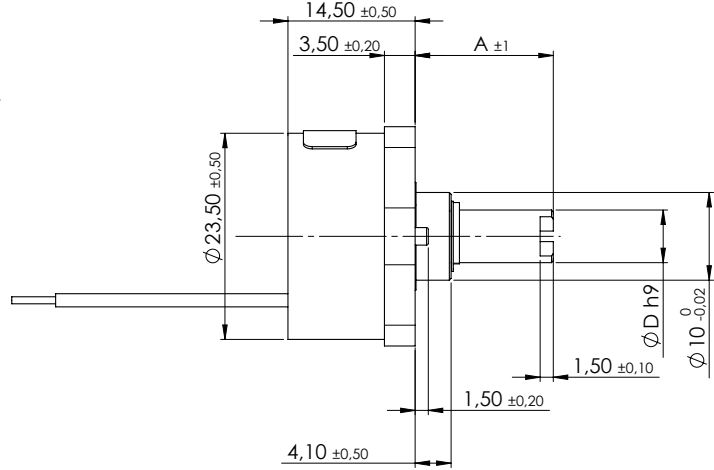
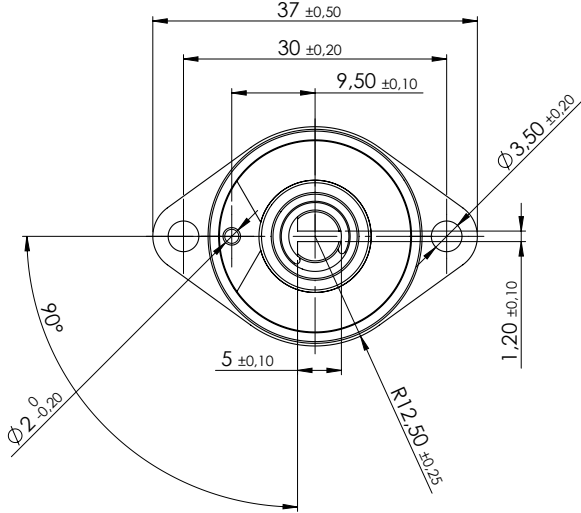


Teach-In function – manual field programming

When manual programming in the field using the teach-in function, the remaining angle for the next full revolution is divided equally into high and low. There are no further signal plateaus. Please see the programming guide on our website for more details.

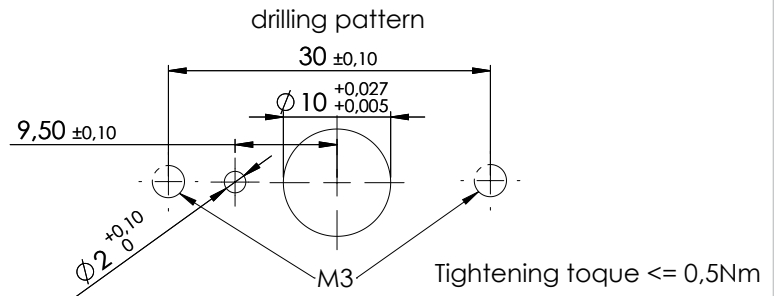
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Drawing ETx25F Family

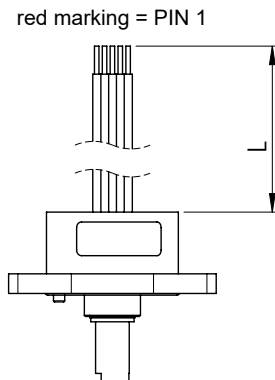


Standard shaft dimensions	
Shaft length A	15,6 mm
Shaft diameter D	6 mm

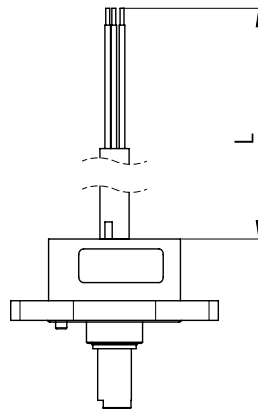
planarity of installation surface 0,1
 roughness of installation surface \sqrt{Ra} 6,3



Option F - Flat ribbon cable



Option R - Round cable



Standard shaft dimensions	
Shaft length A	15.6 +/- 1 mm
Shaft diameter D	6 h9 mm, 6.35 h9 mm
Shaft flattening (D-flat)	1 +/- 0.1 mm

All dimensions in mm

Cable specs for option F (flat ribbon cable) and R (round control cable)						
Option	Standard cable length L	Number of single strands (depends on electronics)	Cable sheath Ø or width	Single strands cross section	Allowed tolerance (L)	Minimum bending radius
R	Standard 1000 mm	3	4.3 mm	AWG26	-20 mm to +50 mm	3 x D Ø (D = cable sheath diameter Ø)
		6	5.2 mm			
		8	5.6 mm			
		12	6 mm	AWG28		
F	150 mm	3 to 12	ca. 1.25 per strand	AWG26	-20 mm to +25 mm	-

Cables without cable shield

(*) Tolerances according IPC Association

Cable length tolerances – custom lengths	
Length L	Tolerance
≤ 0.3 m	+25 mm / -20 mm
> 0.3 m - 1.5 m	+50 mm / -20 mm
> 1.5 m - 3 m	+100 mm / -40 mm
> 3 m - 7.5 m	+150 mm / -60 mm

Cable harness length measured from sensor surface or soldering pad including connector.
 Minimum cable length: 0.08 m (for round cable), 0.05 m for ribbon cable

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Mechanical and environmental data, miscellaneous	
Mechanical angle of rotation 1.)	Endless
Lifetime 2.)	> 100 Mio. shaft rotation movements Option D: Sealing specified for $\geq 200\,000$ shaft rotation movements
Bearing	Sleeve bearing
Max. operational speed	100 rpm (< 1 min. 800 rpm)
Operational torque	$0.1 \leq M \leq 0.6$ Ncm (without shaft sealing) $0.3 \leq M \leq 1.3$ Ncm (@RT, 10 rpm) (with increased torque)
Operating temperature range	Standard: -40 to +85 °C (cable not moving)
Storage temperature range	Standard: -40 to +105 °C
Protection grade (IEC 60529) front side	<ul style="list-style-type: none"> ▪ IP40 standard ▪ IP55M (IP66S) with shaft sealing (option D)
Protection grade (IEC 60529) rear side	IP66 (cable ends excluded)
Vibration (DIN EN 60068-2-6)	± 1.5 mm / 30 g / 10 to 2000 Hz / 16 frequency cycles (3x4 h)
Shock (DIN EN 60068-2-27)	50 g / 11 ms / half sine (3x6 shocks)
Housing diameter	$\varnothing 23.5$ mm (dimensions of the mounting flange, height: 37 mm, width 25 mm)
Housing depth	14.5 mm
Shaft diameter	Standards: $\varnothing 6$ mm, $\varnothing 6.35$ mm Option: User defined shaft diameter [mm]
Max. radial load	1 N
Max. axial load	1 N
Mass (circa)	<ul style="list-style-type: none"> ▪ ca. 40 g (option R: cable, valid for 1 m only) ▪ ca. 23 g (option F: flat ribbon cable, valid for 15 cm only)
Connection type	<ul style="list-style-type: none"> ▪ Ribbon cable (option F) ▪ Cable (option R)
Connection position	Axial
Sensor mounting	Flange, by means of two screws M3 (not enclosed)
Fastening parts included in delivery	If option D is ordered an additional O-Ring is part of delivery as sealing between mounting panel and rotary encoder.
Fastening torque mounting nut	≤ 3 Nm
Material shaft	Stainless steel
Material housing	Plastic / Bronze

1.) According to IEC 60393

2.) Determined by climatic conditions according to IEC 68-1, para. 5.3.1 without load collectives

Immunity / Electrostatic Discharge / REACH / RoHS	
EN 61000-4-3 RF sine wave	Class A
EN 61000-4-6 Conducted sine wave	Class A
EN 61000-4-8 Power frequency magnetic fields	Class A
EN 61000-4-2 ESD	Class B
REACH Regulation (EC) 1907/2006 including the SVHC list	
RoHS Directive 2011/65/EU	

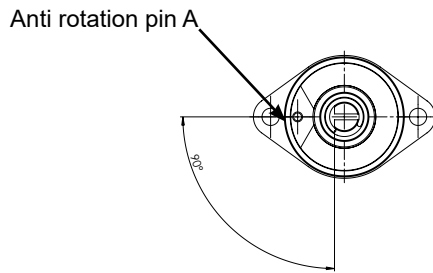
Definition of the zero position / anti-rotation pin

Output at the zero point:

- ETA25F (analogue outputs): Output signal 0% full scale (F. S.)
- ETP25F (PWM output): duty cycle 10% (10% duty cycle)
- ETS25F (serial output): Output signal 0% full scale (F. S.)
- ETI25F (incremental output): The index signal is output (Z)

Position of the zero position:

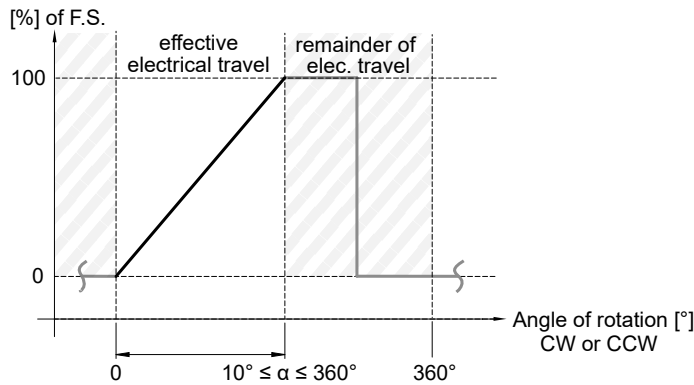
anti-rotation pin A Zero position when shaft flattening faces anti-rotation pin A



Signal definition for custom rotation angles

Custom angles <math><360^\circ</math>

When programming the electrical angle of rotation of <math><360^\circ</math>, the remaining non-effective range of rotation is divided equally into high and low.



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