

# Measuring systems SIMODRIVE sensor



**Built-on optoelectronic rotary encoders**

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products certified for  
Canada and U.S.A.

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Further information contained in  
Catalog NC Z.

# Measuring Systems

## SIMODRIVE sensor

Built-on optoelectronic rotary encoders



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### Application, design

SIMODRIVE sensors are built-on optoelectronic encoders for the recording of paths, angles, or rotary speeds of machines. They can be used in conjunction with numerical controllers, programmable logic controllers, drives and position displays, e.g.:

- SIMOTION; motion control systems
- SINUMERIK; CNC controls
- SIMATIC; programmable logic controllers
- SIMODRIVE and SIMOVERT MASTERDRIVES MC; drive systems

A distinction is made between incremental and absolute measuring procedures. In the case of incremental encoders, the machine must travel to a reference point after each power-off state, as the position is not usually stored in the controller, and movements of the machine while the power is off are not recorded.

Absolute value encoders, on the other hand, also record these movements while the power is off and return the actual position at power-on. Travel to a reference point is not necessary.

All encoders are available in synchro flange and clamp flange versions. Encoders with a synchro flange can be attached to the machine by means of three clamps. Mounting with axial screws is also possible. The encoder is driven by means of a push-on coupling or a spring disk coupling. Alternatively, pulleys can also be used.

The power supply for the encoder is 5 V DC, or optionally between 10 V and 30 V DC. The versions between 10 V and 30 V DC allow longer cables to be used. Most control systems supply the voltage direct from the measurement circuit.

### Mode of operation

#### Incremental encoders

These encoders deliver a defined number of electrical pulses for each rotation, which represent the measurement of the distance or angle moved.

Incremental encoders operate on the principle of optoelectronic scanning of index disks operating on the transmitted light principle. The light source is a light emitting diode (LED). The light-dark modulation generated as the encoder shaft rotates is picked up by optoelectronic elements. With an appropriate arrangement of the line pattern on the index disks connected to the shaft and the fixed aperture, the photoelectronic elements provide two trace signals A and B at 90° to one another, as well as a reference signal. The encoder electronics amplify these signals and convert them into different output levels.

The following output levels are available:

- RS 422 difference signals (TTL)
- Analog signals sine/cosine with level one  $V_{pp}$
- HTL (high voltage transistor logic)

In the case of RS 422 encoders (TTL) the resolution can be improved by a factor of four by means of edge evaluation.

In order to obtain an even finer resolution, in the case of encoders with sinusoidal signals, these signals are interpolated in the higher-level controller. Encoders with HTL interfaces (High Voltage Transistor Logic) are well suited for applications with counter modules.

#### Absolute value encoder (single turn/multi-turn)

Absolute value encoders (absolute shaft encoders) are designed on the same scanning principle as incremental encoders, but have a greater number of tracks. For example, if there are 13 tracks, then  $2^{13} = 8192$  steps are included in the case of single turn encoders. The code used is a one-step code (Gray code), which prevents any scanning errors from occurring. After switching on the machine, the position value is transmitted immediately to the controller. There is no need to travel to a reference point. The data are transmitted between encoder and controller either via the synchronous serial interface (SSI), via EnDat or via PROFIBUS-DP <sup>1)</sup>.

SSI and EnDat have advantages in time-critical applications. In plants with a large number of encoders, PROFIBUS-DP is more of an advantage due to the reduced wiring expense. The encoders with PROFIBUS-DP are programmable.

Single turn encoders resolve one rotation (360 degrees mechanical) into a specific number of steps, e.g. 8192. A unique code word is assigned to each position. After 360 degrees the position values are repeated.

Multi-turn encoders also record the number of revolutions, in addition to the absolute position within one revolution. To do this, further code discs which are coupled via gear stages with the encoder shaft are scanned. When evaluating 12 additional tracks, this means that  $2^{12} = 4096$  revolutions can be included.

1) For references on the subject of PROFIBUS, see Section 12 "Documentation".

Ordering data	Order No.
<b>Incremental encoder</b>	
<b>Incremental encoder with RS 422 interface (TTL)</b>	
Synchro flange and 5 V DC power supply	
Connection:	
<ul style="list-style-type: none"> <li>Flange socket, axial</li> <li>Flange socket, radial</li> <li>1 m (3 ft 3 in) cable with connector<sup>1)</sup></li> </ul>	<b>6FX2 001 - 2G</b> ■■■ <b>6FX2 001 - 2E</b> ■■■ <b>6FX2 001 - 2C</b> ■■■
Synchro flange and 10 V - 30 V DC power supply	
Connection:	
<ul style="list-style-type: none"> <li>Flange socket, axial</li> <li>Flange socket, radial</li> <li>1 m (3 ft 3 in) cable with connector<sup>1)</sup></li> </ul>	<b>6FX2 001 - 2H</b> ■■■ <b>6FX2 001 - 2F</b> ■■■ <b>6FX2 001 - 2D</b> ■■■
Clamp flange and 5 V DC power supply	
Connection:	
<ul style="list-style-type: none"> <li>Flange socket, axial</li> <li>Flange socket, radial</li> <li>1 m (3 ft 3 in) cable with connector<sup>1)</sup></li> </ul>	<b>6FX2 001 - 2R</b> ■■■ <b>6FX2 001 - 2P</b> ■■■ <b>6FX2 001 - 2M</b> ■■■
Clamp flange and 10 V - 30 V DC power supply	
Connection:	
<ul style="list-style-type: none"> <li>Flange socket, axial</li> <li>Flange socket, radial</li> <li>1 m (3 ft 3 in) cable with connector<sup>1)</sup></li> </ul>	<b>6FX2 001 - 2S</b> ■■■ <b>6FX2 001 - 2Q</b> ■■■ <b>6FX2 001 - 2N</b> ■■■
Resolution	
500 S/R	A 5 0
1000 S/R	B 0 0
1024 S/R	B 0 2
1250 S/R	B 2 5
1500 S/R	B 5 0
2000 S/R	C 0 0
2048 S/R	C 0 4
2500 S/R	C 5 0
3600 S/R	D 6 0
5000 S/R	F 0 0
<b>Double-track encoder with RS 422 interface (TTL)</b>	
Synchro flange and 5 V DC power supply	
Connection:	
1 m (3 ft 3 in) cable with connector, axial, 2 off	
Resolution: 9000/1024 S/R	
<b>6FX2 001 - 2UK00</b>	
<b>Incremental encoder with 1 V<sub>pp</sub> sinusoidal analog signals</b>	
Synchro flange and 5 V DC power supply	
Connection:	
<ul style="list-style-type: none"> <li>Flange socket, axial</li> <li>Flange socket, radial</li> <li>1 m (3 ft 3 in) cable with connector<sup>1)</sup></li> </ul>	<b>6FX2 001 - 3G</b> ■■■ <b>6FX2 001 - 3E</b> ■■■ <b>6FX2 001 - 3C</b> ■■■
Resolution	
1000 S/R	B 0 0
1024 S/R	B 0 2
2500 S/R	C 5 0

Ordering data	Order No.
<b>Incremental encoder with HTL interface</b>	
Synchro flange and 10 V - 30 V DC power supply	
Connection:	
<ul style="list-style-type: none"> <li>Flange socket, axial</li> <li>Flange socket, radial</li> <li>1 m (3 ft 3 in) cable with connector<sup>1)</sup></li> </ul>	<b>6FX2 001 - 4H</b> ■■■ <b>6FX2 001 - 4F</b> ■■■ <b>6FX2 001 - 4D</b> ■■■
Clamp flange and 10 V - 30 V DC power supply	
Connection:	
<ul style="list-style-type: none"> <li>Flange socket, axial</li> <li>Flange socket, radial</li> <li>1 m (3 ft 3 in) cable with connector<sup>1)</sup></li> </ul>	<b>6FX2 001 - 4S</b> ■■■ <b>6FX2 001 - 4Q</b> ■■■ <b>6FX2 001 - 4N</b> ■■■
Resolution	
100 S/R	A 1 0
500 S/R	A 5 0
1000 S/R	B 0 0
2500 S/R	C 5 0
<b>Absolute value encoders</b>	
<b>Absolute value encoders SSI</b>	
Synchro flange and 10 V - 30 V DC power supply	
Connection:	
<ul style="list-style-type: none"> <li>SSI with flange socket, axial</li> <li>SSI with flange socket, radial</li> </ul>	<b>6FX2 001 - 5HS</b> ■■■ <b>6FX2 001 - 5FS</b> ■■■
Clamp flange and 10 V - 30 V DC power supply	
Connection:	
<ul style="list-style-type: none"> <li>SSI with flange socket, axial</li> <li>SSI with flange socket, radial</li> </ul>	<b>6FX2 001 - 5SS</b> ■■■ <b>6FX2 001 - 5QS</b> ■■■
<b>PROFIBUS-DP absolute value encoder</b>	
Synchro flange and 10 V - 30 V DC power supply	
Radial connection	
<b>6FX2 001 - 5FP</b> ■■■	
Clamp flange and 10 V - 30 V DC power supply	
Radial connection	
<b>6FX2 001 - 5QP</b> ■■■	
Resolution	
Single turn 4096 steps/revolution (12 bits)	1 2
Multi-turn 4096 steps/revolution, 4096 revolutions (24 bits)	2 4
<b>Documentation</b>	
User's Guide for commissioning and parameterization of PROFIBUS sensors	
Languages: German/English	
<b>6SN1 197-0AB10-0YP1</b>	
<b>Absolute value encoder EnDat</b>	
Synchro flange and 5 V DC power supply	
Connection:	
<ul style="list-style-type: none"> <li>EnDat with flange socket, axial</li> <li>EnDat with flange socket, radial</li> </ul>	<b>6FX2 001 - 5HE</b> ■■■ <b>6FX2 001 - 5FE</b> ■■■
Clamp flange and 5 V DC power supply	
Connection:	
<ul style="list-style-type: none"> <li>EnDat with flange socket, axial</li> <li>EnDat with flange socket, radial</li> </ul>	<b>6FX2 001 - 5SE</b> ■■■ <b>6FX2 001 - 5QE</b> ■■■
Resolution	
Single turn 8192 steps/revolution (13 bits)	1 3
Multi-turn 8192 steps/revolution, 4096 revolutions (25 bits)	2 5

1) Universal integral cable outlet for axial and radial directions.

# Measuring Systems SIMODRIVE sensor

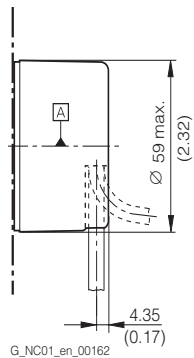
## Built-on optoelectronic rotary encoders

### Technical specifications of the incremental encoders

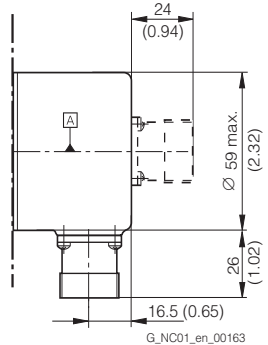
Type	Encoder with TTL (RS 422)	Encoder with 1 V <sub>pp</sub> sinusoidal	Encoder with HTL	Double-track encoder with TTL (RS 422)
Operating voltage at encoder	5 V DC ±10% or 10 V to 30 V DC	5 V DC ±10%	10 V to 30 V DC	5 V DC ± 5%
Cut-off frequency (-3 dB) (-6 dB)	– –	≥ 180 kHz (typ.) ≥ 450 kHz (typ.)	– –	– –
Sampling frequency (max.)	300 kHz	–	300 kHz	Track 1: 160 kHz Track 2: 1 MHz
No-load current consumption (max.)	150 mA			150 mA per track
Signal level	TTL (RS 422)	1 V <sub>pp</sub> sinusoidal	HTL $U_H \geq 21$ V at $I_H = 20$ mA @ 24 V $U_L \leq 2.8$ V at $I_L = 20$ mA @ 24 V	TTL (RS 422)
Outputs protected against short-circuit to 0 V	yes	yes	yes	yes
Switching time (10% to 90%) (with 1-m cable and recommended input circuit)	Rise/fall time $t_r / t_f \leq 50$ ns	–	Rise/fall time $t_r / t_f \leq 200$ ns	Rise/fall time $t_r / t_f \leq 100$ ns
Phasing, signal A to B min. edge spacing at: 1 MHz 300 kHz 160 kHz	90° ≥ 0.45 μs –	90° ±10° el. – –	90° – ≥ 0.45 μs –	90° – ≥ 0.125 μs (track 2) ≥ 0.8 μs (track 1)
Cable length to electronic circuitry <sup>1)</sup> , max.	100 m (328 ft)	150 m (492 ft)	100 m (328 ft)	100 m (up to 500 kHz) (328 ft) 50 m (up to 1 MHz) (164 ft)
LED failure monitoring	Driver at high resist.	–	Driver at high resist.	–
Resolution, max.	5000 S/R	2500 S/R	2500 S/R	Track 1: 1024 S/R Track 2: 9000 S/R
Accuracy (in angular seconds)	±18° mech. x 3600/encoder line z			
Permissible electr. speed	$18 \times 10^6$ rpm increments	$27 \times 10^6$ rpm increments (at 6 dB)	$18 \times 10^6$ rpm increments	Track 1: 9000 rpm Track 2: 6500 rpm
Max. mech. speed	12000 rpm			
Frictional torque	≤ 0.01 Nm (at 20° C) [≤ 0.09 lb-in (at 68° F)]			
Starting torque	≤ 0.01 Nm (at 20° C) [≤ 0.09 lb-in (at 68° F)]			
Shaft loading capacity • $n > 6000$ rpm • $n \leq 6000$ rpm	Axial 10 N/radial 20 N at shaft extension Axial 40 N/radial 60 N at shaft extension			– Axial 10 N/ radial 20 N at shaft extension
Angular acceleration, max.	$> 10^5$ rad/s <sup>2</sup>			
Moment of inertia of rotor	$1.45 \cdot 10^{-6}$ kgm <sup>2</sup>			$20 \cdot 10^{-6}$ kgm <sup>2</sup>
Vibration (55 Hz to 2000 Hz) to DIN IEC 68-2-6	≤ 100 m/s <sup>2</sup>			
Shock (6 ms) to DIN IEC 68-2-27	≤ 1000 m/s <sup>2</sup>			
Maximum working temperature	100 °C (212 °F) ( $U_p = 5$ V ±10%) 70 °C (158 °F) ( $U_p = 10$ V to 30 V)	100 °C (212 °F)	85 °C (185 °F) (100 °C (212 °F) at $U_p < 15$ V)	70 °C (158 °F)
Minimum working temperature	Flange socket or fixed cable: –40 °C (–40 °F) Movable cable: –10 °C (+14 °F)			–10 °C (+14 °F)
Degree of protection to DIN EN 60529 (IEC 60529)	IP 67 at the housing IP 64 at the shaft inlet			
EMC	Tested in accordance with the guidelines for electromagnetic compatibility 89/336/EEC and the regulations of the EMC guidelines (applicable basic standards)			
Weight, approx.	0.25 kg (9 oz)			0.7 kg (1 lb 9 oz)
CE marking	yes			

### Connection options

#### Cable



#### Flange socket



1) With recommended cable and input circuit of the follow-up electronics; observe max. permissible cable length of module to be evaluated.



### Technical specifications of the absolute value encoders

Type	Absolute value encoder with synchronous serial interface SSI	Absolute value encoder with EnDat	Absolute value encoder with PROFIBUS-DP (EN 50170)
Operating voltage at encoder	10 V to 30 V DC	5 V DC ±10%	10 V to 30 V DC
Power consumption, approx.	180 mA multi-turn, 120 mA single turn	250 mA multi-turn, 180 mA single turn	300 mA to 100 mA (3.5 W)
Input cycle	Differential cable receiver according to EIA standard RS 485		
Data output	Differential cable driver according to EIA standard RS 485		
Short-circuit resistance	yes		
Transmission rate	100 kHz to 1 MHz	100 kHz to 2 MHz	12 Mbit/s
LED for bus diagnostics	–	–	yes (green/red)
Permissible electr. speed	1500 rpm with ±1 bit accuracy	5000 rpm with ±1 bit accuracy	1500 rpm with ±1 bit accuracy
Max. mech. speed	12000 rpm for single turn, 6000 rpm for multi-turn	12000 rpm for single turn, 10000 rpm for multi-turn	12000 rpm for single turn, 6000 rpm for multi-turn
Cable length to electronic circuitry <sup>1)</sup> , max.	50 m (164 ft) up to 1 MHz cycle 100 m (328 ft) up to 300 kHz cycle 400 m (1310 ft) up to 100 kHz cycle	50 m (164 ft) up to 1 MHz cycle 150 m (492 ft) to 300 kHz cycle	100 m (328 ft) up to 12 Mbit/s 200 m (656 ft) up to 1.5 Mbit/s 1200 m (3937 ft) up to 93.75 kbit/s
Node count, max.	–	–	99
Connection	Flange socket, axial/radial	–	Terminal block with address selector and bus terminator in removable cover with 3 radial cable glands 6.5 mm to 9 mm (0.26 in to 0.35 in) Removal of cover possible without interrupting bus
Cable diameter	–	–	–
Resolution	12 bit single turn (4096 steps) 24 bit multi-turn (4096 × 4096 steps)	13 bit single turn (8192 steps) 25 bit multi-turn (4096 × 8192 steps) According to EnDat specification	12 bit single turn (4096 steps) 24 bit multi-turn (4096 × 4096 steps)
Frame length	13 bit single turn, without parity 25 bit multi-turn, without parity	–	–
Incremental track	–	512 S/R, 1 V <sub>PP</sub>	–
Code type	–	–	–
• Sampling	Gray	Gray	Gray
• Transmission	Gray	Binary	Binary
Parameterization capability	–	–	–
• Resolution per revolution	–	–	Arbitrary 1 to 4096
• Total resolution	–	–	Arbitrary 1 to 4096
• Preset	–	–	yes
• Counting direction	yes	–	yes
• Speed signal	–	–	yes
• Limit switches	–	–	yes, 2 pieces
• Clock synchronism and lateral communication <sup>2)</sup>	–	–	yes <sup>2)</sup>
Online parameterization	–	–	yes
Bus loading, approx.	–	–	20 μs per encoder at 12 Mbit/s
Cycle time	–	–	667 μs
Accuracy	± ½ LSB	± 60 angular seconds (incr. track)	± ½ LSB
EMC	Tested in accordance with DIN EN 50081 and EN 50082		
Ballbearing life	10 <sup>4</sup> hours at 8000 rpm and +50 °C (+122 °F)		
Frictional torque	≤ 1 Ncm (≤ 0.885 lb-in)		
Breakaway torque	< 5 Ncm (< 4.425 lb-in)		
Shaft loading	–		
• Synchro flange, axial/radial	20 N/110 N (4.5 lbf/24.73 lbf)		
• Clamp flange, axial/radial	20 N/110 N (4.5 lbf/24.73 lbf)		
Angular acceleration, max.	10 <sup>5</sup> rad/s <sup>2</sup>		
Moment of inertia	–		
• Synchro flange, approx.	2 · 10 <sup>-6</sup> kgm <sup>2</sup>		
• Clamp flange, approx.	3 · 10 <sup>-6</sup> kgm <sup>2</sup>		
Oscillating load	100 m/s <sup>2</sup> (10 Hz to 2500 Hz) in accordance with DIN IEC 68-2-6		
Impact load	1000 m/s <sup>2</sup> (11 ms) in accordance with DIN IEC 68-2-29		
Permissible ambient temp.	–		
• during storage and transport	–40 °C to +85 °C (–40 °F to +185 °F)		
• during operation	–30 °C to +85 °C (–22 °F to +185 °F) w/o condensation	–40 °C to +100 °C (–40 °F to +212 °F) w/o condensation	–30 °C to +70 °C (–22 °F to +158 °F) w/o condensation
Degree of protection to DIN EN 60529 (IEC 60529) with/without shaft inlet	IP 67/IP 64		
Weight	–		
Single turn/multi-turn, approx.	0.2 kg/0.3 kg (7.05 oz/10.58 oz)	0.35 kg/0.35 kg (12.34 oz/12.34 oz)	0.5 kg/0.7 kg (1 lb 2 oz/1 lb 9 oz)
CE marking	yes	yes	yes
PROFIBUS certificate	–	–	yes
Supported profiles	–	–	Class 1, Class 2

1) Observe the maximum permissible cable length of the connected module.

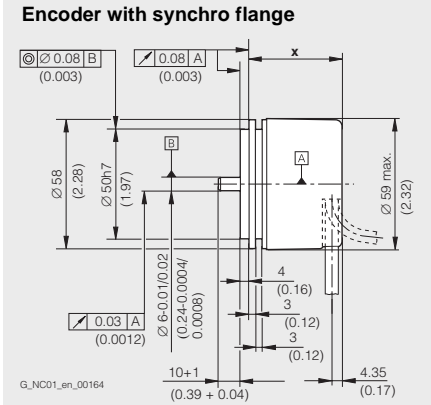
2) Available soon.

# Measuring Systems SIMODRIVE sensor

Built-on optoelectronic rotary encoders

## Dimensions in mm (inches)

### Incremental encoder, absolute value encoder

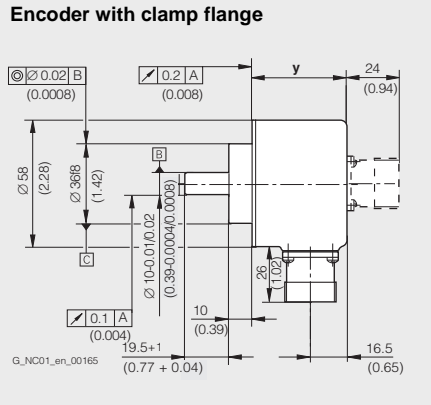


#### Encoder with synchro flange

<u>Incremental encoder</u>	
Cable, axial/radial:	x = 42±1 (1.65±0.004)
Flange socket, axial:	x = 48±1 (1.89±0.004)
Flange socket, radial:	x = 52±1 (2.05±0.004)

<u>Absolute value encoder SSI</u>	axial	radial
Single turn:	x = 52 (2.05)	x = 58 (2.28)
Multi-turn:	x = 78 (3.07)	x = 78 (3.07)

<u>Absolute value encoder EnDat</u>	axial	radial
Single turn:	x = 48 (1.89)	x = 52 (2.05)
Multi-turn:	x = 59 (2.32)	x = 59 (2.32)

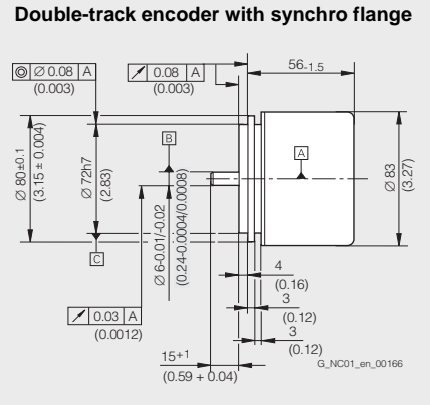


#### Encoder with clamp flange

<u>Incremental encoder</u>	
Cable, axial/radial:	y = 36±1 (1.42±0.004)
Flange socket, axial:	y = 42±1 (1.65±0.004)
Flange socket, radial:	y = 46±1 (1.81±0.004)

<u>Absolute value encoder SSI</u>	axial	radial
Single turn:	y = 52 (2.05)	y = 58 (2.28)
Multi-turn:	y = 78 (3.07)	y = 78 (3.07)

<u>Absolute value encoder EnDat</u>	axial	radial
Single turn:	y = 42 (1.65)	y = 46 (1.81)
Multi-turn:	y = 53 (2.09)	y = 53 (2.09)

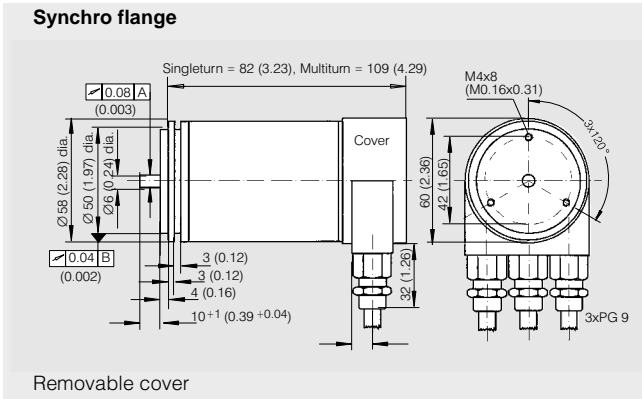


#### Double-track encoder with synchro flange

Axial connection

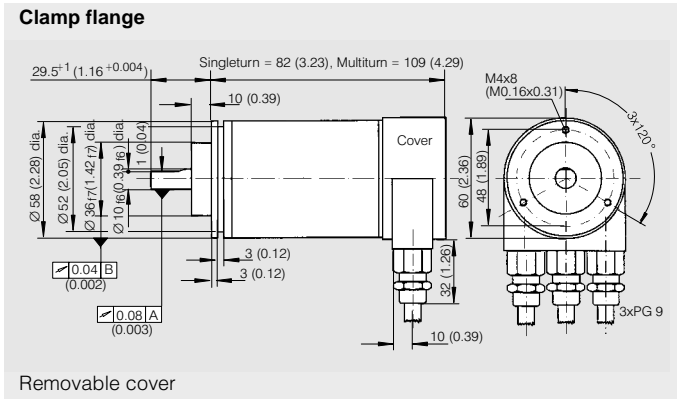
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### Absolute value encoder with PROFIBUS-DP



#### Synchro flange

Removable cover



#### Clamp flange

Removable cover

#### Note:

In the case of incremental encoders, jumpers connect PIN 10 to PIN 11, and PIN 2 to PIN 12 in the encoder. In the case of SSI encoders PIN 8 is open or connected to 0 Volt, counter direction adding; PIN 8 to U<sub>B+</sub> subtracting, in each case for rotation to the right and looking at the shaft.

# Measuring Systems SIMODRIVE sensor

Built-on optoelectronic rotary encoders  
Mounting accessories



## Description

Clamps and couplings are available as mounting accessories for the rotary encoders.

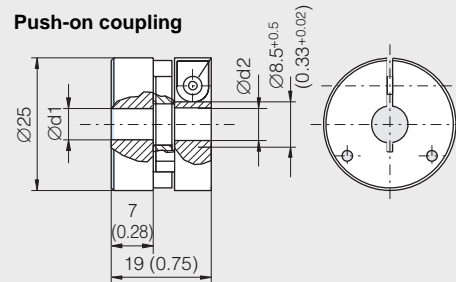
## Technical specifications

Type		Spring disk coupling	Push-on coupling
Transmission torque	max.	0.45 Nm (3.98 lb-in)	0.7 Nm (6.2 lb-in)
Shaft diameter		6 mm (0.236 in) both ends or d <sub>1</sub> = 6 mm (0.236 in), d <sub>2</sub> = 5 mm (0.197 in)	6 mm (0.236 in) both ends or d <sub>1</sub> = 6 mm (0.236 in), d <sub>2</sub> = 5 mm (0.197 in)
Eccentricity of shafts	max.	0.4 mm (0.016 in)	0.5 mm (0.02 in)
Axial offset		± 0.4 mm (± 0.016 in)	± 0.5 mm (± 0.02 in)
Angular displacement of shafts	max.	3°	1°
Spring disk thickness		0.25 mm (0.01 in)	–
Torsional rigidity		50 Nm/rad	31 Nm/rad
Lateral spring stiffness		18 N/mm	10 N/mm
Mass moment of inertia		24 gcm <sup>2</sup>	20 gcm <sup>2</sup>
Speed	max.	12000 rpm	12000 rpm
Weight	appr.	16 g (0.6 oz)	20 g (0.7 oz)

## Ordering data

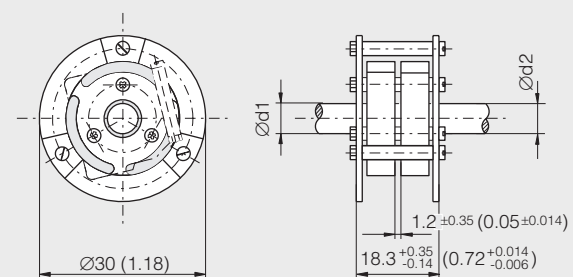
	Order No.
<b>Clamp</b> (3 clamps are required) for encoder with synchro flange and double-track encoder	<b>6FX2 001 - 7KP01</b>
<b>Spring disk coupling</b> Shaft diameter: • 6 mm (0.236 in)/6 mm (0.236 in) • 6 mm (0.236 in)/5 mm (0.197 in)	<b>6FX2 001 - 7KF10</b> <b>6FX2 001 - 7KF06</b>
<b>Push-on coupling</b> Shaft diameter: • 6 mm (0.236 in)/6 mm (0.236 in) • 10 mm (0.394 in)/10 mm (0.394 in)	<b>6FX2 001 - 7KS06</b> <b>6FX2 001 - 7KS10</b>

## Push-on coupling



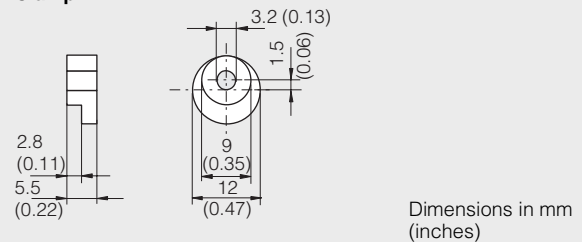
d<sub>1</sub> = d<sub>2</sub> = 6 mm (0.236 in) or d<sub>1</sub> = d<sub>2</sub> = 10 mm (0.394 in)

## Spring disk coupling



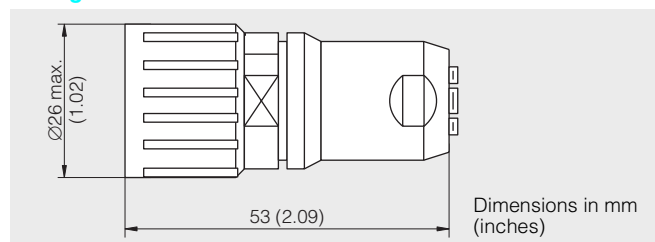
d<sub>1</sub> = d<sub>2</sub> = 6 mm (0.236 in) or d<sub>1</sub> = 5 mm (0.197 in); d<sub>2</sub> = 6 mm (0.236 in)

## Clamp



Dimensions in mm (inches)

## Mating connector



Dimensions in mm (inches)

The cable length is 1 m (3 ft 3 in) for the encoders with cable including plug.

The following bending radii must be observed:

Single bending: ≥ 20 mm (≥ 0.79 in)

Repeated bending: ≥ 75 mm (≥ 2.96 in)

## Ordering data

	Order No.
<b>Mating connector for flange socket or encoder connector</b> Crimp version, socket contacts for cable diameters 5.5 mm (0.217 in) to 12 mm (0.472 in) (3 items packed as a unit)	
• With 12 contacts for: TTL, 1 V <sub>pp</sub> , HTL, SSI	<b>6FX2 003 - 0CE12</b>
• With 17 contacts for: EnDat	<b>6FX2 003 - 0CE17</b>

# Measuring Systems

## SIMODRIVE sensor

SIZAG 2 hollow-shaft measuring system for 1PH2/1FE1 motors



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### Description

A hollow-shaft measuring system consisting of scanning head and gearwheel is available for 1PH2 and 1FE1 built-in motors. Gearwheels are available with 256 or 512 teeth. Gearwheel and scanning head must be ordered separately with their respective Order Nos. In the table of Ordering data for the gearwheels, appropriate gearwheels are assigned to the 1PH2 motors. It is possible to choose a different version, but the gearwheel must be assigned to the scanning head shown in the Ordering data. The encoder is connected directly to the converter.

The scanning head of the gearwheel encoder contains magnetoresistors for non-contact scanning as well as amplifier electronics. The plug connection and the encoder signals are compatible with the encoders of the 1PH7 and 1PH4 motors. The scanning head is assembled using a spacing gauge.

### Technical specifications

Absolute precision	± 36 angular seconds
• 512 teeth	± 72 angular seconds
• 256 teeth	
Operational voltage	5 V DC ± 5%
Power consumption	250 mA max.
Cut-off frequency (-3 dB)	90 kHz
Signal level	sin/cos 1 V <sub>pp</sub>
Limit speed	
• with 512 teeth	≤ 12000 rpm
• with 256 teeth	≤ 24000 rpm
Degree of protection to (DIN EN 60529) (IEC 60529)	IP 65
Permissible bend radius of connecting cable on encoder	
• during fatigue bending	> 100 mm (3.94 in)
• during single bending	> 52 mm (2.05 in)
Permissible ambient temperature	
• during storage and transport	-20 °C to +85 °C (-4 °F to +185 °F)
• during operation	-20 °C to +85 °C (-4 °F to +185 °F)
Vibratory load to DIN IEC 68-2-6	200 m/s <sup>2</sup>
Shock load to DIN IEC 68-2-29	1000 m/s <sup>2</sup>
Weight of the scanning head	approx. 300 g (10.6 oz)
Connection dimensions	See Planning Guide and Assembly Instructions
Permissible cable length	max. 50 m (164 ft)

#### Note:

for C-axis drive a gearwheel with 512 teeth is recommended.

Scope of delivery for SIZAG 2 hollow-shaft measuring system:

- Gearwheel
- Scanning head with cable and 17-pin plug insert
- Rectangular, divided flange socket
- Spacing gauge

The plug insert is inserted into the divided flange socket, and the latter into the spindle housing. The temperature sensor of the motor must be connected to the free ends of the cable.

# Measuring Systems SIMODRIVE sensor

SIZAG 2 hollow-shaft measuring system  
for 1PH2/1FE1 motors

## Ordering data

Scanning head	Gearwheel	External diameter of gearwheel	Error per 1 $\mu$ eccentricity	Internal diameter of gearwheel	Moment of inertia approx.	Number of teeth	Module	Distance between scanning head/tip circle of gearwheel	Gearwheel thickness	Recommendation for the 1PH2 motors
Order No.	Order No.	mm (in)	Angular seconds	mm (in)	$10^{-4}$ kgm <sup>2</sup> (10 lb in sec)			mm (in)	mm (in)	Type
<b>6FX2 001 - 8A 05</b>	<b>6FX2 001 - 8RA05 - 1F</b>	129 (5.08)	3.2	65 (2.56)	30	256	0.5	0.3 (0.012)	15 (0.59)	1PH2 093-6WF41 1PH2 095-6WF41
<b>6FX2 001 - 8A 03</b>	<b>6FX2 001 - 8RA03 - 1D</b>	154.2 (6.07)	2.7	80 (3.15)	61	512	0.3	0.15 (0.006)	15 (0.59)	1PH2 113-6WF41 1PH2 115-6WF41 1PH2 117-6WF41 1PH2 118-6WF41
<b>6FX2 001 - 8A 03</b>	<b>6FX2 001 - 8RA03 - 1E</b>	154.2 (6.07)	2.7	110 (4.33)	49	512	0.3	0.15 (0.006)	15 (0.59)	1PH2 186-6WB41 1PH2 188-6WB41
<b>6FX2 001 - 8A 05</b>	<b>6FX2 001 - 8RA05 - 1G</b>	257 (10.12)	1.6	150 (5.91)	449	512	0.5	0.3 (0.012)	15 (0.59)	
<b>6FX2 001 - 8A 03</b>	<b>6FX2 001 - 8RA03 - 1B</b>	77.4 (3.05)	5.3	45 (1.77)	4	256	0.3	0.15 (0.006)	15 (0.59)	
<b>6FX2 001 - 8A 03</b>	<b>6FX2 001 - 8RA03 - 1C</b>	77.4 (3.05)	5.3	60 (2.36)	3	256	0.3	0.15 (0.006)	15 (0.59)	



**K** Cable length 0.2 m (7.9 in)  
**A** Cable length 0.5 m (19.7 in)  
**J** Cable length 2.0 m (78.7 in)

# Measuring Systems

## SIMODRIVE sensor

### Diagnostic device

#### Description

The diagnostic device permits the checking of encoder signals with analog level sine/cosine  $1 V_{pp}$ . Signals from built-in encoders with these levels can be checked. It can be used to measure the size of the signal amplitudes, offset values, and the assignment of the zero signal to the incremental track.

The device has its own encoder power supply with monitoring. This permits checking of the encoder system without requiring additional external components, such as a converter or control.

The pre-assembled cables 6FX2 002-2CA61-0... or -2CA31 or -2CA51-0... can be used to connect built-in encoders to the diagnostic device.

#### Technical specifications

Supply voltage	230 V AC, 50/60 Hz
Inputs	Encoder signal connections
Outputs	
• Encoder power supply	5 V to 8 V DC for each device type $I_{max} = 250 \text{ mA}$
• Analog outputs	Encoder signal A Encoder signal B Encoder signal R (= zero pulse) Offset from the encoder signal A or B
• Square-wave signal outputs	Encoder signal A and B Converted to square-wave and logical ANDed Encoder signal R (= zero pulse) Converted to square-wave
Displays	LED - valid measurement LED - encoder power supply

#### Ordering data

Order No.

#### Diagnostic device

**6FX2 007 - 1AA00**