Measuring systems
SIMODRIVE sensor

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Built-on optoelectronic rotary encoders

Overview

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

- SINAMICS drive systems
- SIMOTION Motion Control systems
- SINUMERIK CNC controls
- SIMATIC programmable logic controllers
- SIMODRIVE and SIMOVERT MASTERDRIVES drive systems

Application

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 are not recorded while the power is off.

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

Design

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

The encoder supply voltage is 5 V DC or alternatively 10 V to 30 V DC. The 10 V to 30 V version supports longer cable lengths. Most control systems apply the supply voltage directly on the measuring circuit connector.

For rotary encoders with cables, the cable length including the connector is 1 m (3.3 ft).
The following bending radii for the cables at the encoder must be complied with:

Single bend: ≥ 20 mm (0.8 in)
Permanent bending: ≥ 75 mm (3 in)

Built-on optoelectronic rotary encoders Incremental encoder	Built-on optoelectronic rotary encoders Absolute encoders

■ Function

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

Incremental encoders operate on the principle of optoelectronic scanning of dividing disks with 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 photoelectronic elements. With an appropriate arrangement of the line pattern on the dividing disk 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 R. The encoder electronics amplify these signals and convert them into different output levels.

The following output levels are available:

- RS 422 difference signals (TTL)
  In the case of RS 422 encoders (TTL), the resolution can be improved by a factor of four by means of edge evaluation.
- Analog signals sin/cos at a level of 1 V_{pp}
  Even better resolution can be achieved for encoders with sinusoidal signals by interpolating them in the higher-level controller.
- HTL (High Voltage Transistor Logic)
  Encoders with HTL interfaces are designed for applications with digital inputs with 24 V levels.

■ Function

Absolute 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 coded 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 [1]).

SSI and EnDat are of advantage in time-critical applications. In plants with a large number of encoders, PROFIBUS DP is more of an advantage due to the reduced wiring overhead.
The encoders with PROFIBUS DP are programmable and support isochronous mode with internode communication.

Single-turn encoders divide 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.

Multiturn 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 steps with the encoder shaft are scanned. When evaluating 12 additional tracks, this means that 2^{12} = 4096 revolutions can be coded.

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

Technical data

	Incremental encoder with TTL (RS 422)	Incremental encoder with sin/cos 1 V_{pp}	Incremental encoder with HTL	Double-track incremental encoder with TTL (RS 422)
Operating voltage at encoder	5 V DC ±10% or 10 ... 30 V DC	5 V DC ±10%	10 ... 30 V DC	5 V DC ±5%
Limit frequency, typical	–	≥ 180 kHz (-3 dB)	–	–
	–	≥ 450 kHz (-6 dB)	–	–
Scanning 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)	sinusoidal 1 V_{pp}	HTL V_H ≥ 21 V at I_H = 20 mA@ 24 V V_L ≤ 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% ... 90%) (with 1 m (3.3 ft) cable and recommended input circuit)	Rise/fall time $t_+/t_- \le 50$ ns	–	Rise/fall time $t_+/t_- \le 200$ ns	Rise/fall time $t_+/t_- \le 100$ ns
Phase angle, signal A to B min. edge spacing at:	90	90 ±10°el.	90	90
• 1 MHz	–	–	–	≥ 0.125 µs (track 2)
• 300 kHz	≥ 0.45 µs	–	≥ 0.45 µs	–
• 160 kHz	–	–	–	≥ 0.8 µs (track 1)
Cable length to electronic circuitry [1], max.	100 m (328 ft)	150 m (492 ft)	100 m (328 ft)	100 m (328 ft) (up to 500 kHz) 50 m (164 ft) (up to 1 MHz)
LED failure monitoring	High-resistance driver	–	High-resistance driver	–
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. × 3600/resolution z			Track 1: ±63 Track 2: ±12
Permissible electr. speed	$(18 \times 10^6$ rpm)/ increment	$(27 \times 10^6$ rpm) / increment (at -6 dB)	$(18 \times 10^6$ rpm)/ increment	Track 1: 9000 rpm Track 2: 6500 rpm
Mech. speed, max.	12000 rpm			
Friction torque	≤ 0.01 Nm (0.09 lb_f-in) (at +20 °C (+68 °F))			
Starting torque	≤ 0.01 Nm (0.09 lb_f-in) (at +20 °C (+68 °F))			
Shaft loading capacity				
• n > 6000 rpm	Axial 10 N (2.2 lb_f)/radial 20 N (4.5 lb_f) at shaft extension			–
• n ≤ 6000 rpm	Axial 40 N (9 lb_f)/radial 60 N (13.5 lb_f) at shaft extension			Axial 10 N (2.2 lb_f)/radial 20 N (4.5 lb_f) at shaft extension
Angular acceleration, max.	>10^5 rad/s^2			
Moment of inertia of rotor	1.45 ×10^{-6} kgm^2 (12.83 x 10^{-6} lb_f-in-s^2)			20 ×10^{-6} kgm^2 (177 x 10^{-6} lb_f-in-s^2)
Vibration (55 ... 2000 Hz) to DIN IEC 68-2-6	≤ 300 m/s^2 (984 ft/s^2) for encoder with cable ≤ 150 m/s^2 (492 ft/s^2) for encoder with flange outlet			
Shock (6 ms) to DIN IEC 68-2-27	≤ 2000 m/s^2 (6563 ft/s^2)			
Operating temperature, max.	+100 °C (+212 °F) at V_p = 5 V ±10% +70 °C (+158 °F) at V_p = 10 ... 30 V	+100 °C (+212 °F)	+85 °C (+185 °F) +100 °C (+212 °F) at V_p<15 V	+70 °C (+158 °F)
Operating temperature, min.	Flange socket or fixed cable: -40 °C (-40 °F) Movable cable: -10 °C (+14 °F)			-10 °C (+14 °F)
Degree of protection according to EN 60529 (IEC 60529)	IP67 without shaft input IP64 with shaft input			
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 (0.55 lb)			0.7 kg (1.5 lb)
CE mark	yes			

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

■ **Selection and ordering data**

Designation	Order No.
Incremental encoder with RS 422 interface (TTL)	
Synchronous flange and 5 V DC supply voltage	
Connection:	
• Axial flange outlet	**6FX2 001-2G** ■ ■ ■
• Radial flange outlet	**6FX2 001-2E** ■ ■ ■
• Cable 1 m (3.3 ft) with connector [1]	**6FX2 001-2C** ■ ■ ■
Synchronous flange and 10 ... 30 V DC supply voltage	
Connection:	
• Axial flange outlet	**6FX2 001-2H** ■ ■ ■
• Radial flange outlet	**6FX2 001-2F** ■ ■ ■
• Cable 1 m (3.3 ft) with connector [1]	**6FX2 001-2D** ■ ■ ■
Supported flange joint and 5 V DC supply voltage	
Connection:	
• Axial flange outlet	**6FX2 001-2R** ■ ■ ■
• Radial flange outlet	**6FX2 001-2P** ■ ■ ■
• Cable 1 m (3.3 ft) with connector [1]	**6FX2 001-2M** ■ ■ ■
Supported flange joint and 10 ... 30 V DC supply voltage	
Connection:	
• Axial flange outlet	**6FX2 001-2S** ■ ■ ■
• Radial flange outlet	**6FX2 001-2Q** ■ ■ ■
• Cable 1 m (3.3 ft) with connector [1]	**6FX2 001-2N** ■ ■ ■
Resolution	
500 pulses/rev.	A 5 0
1000 pulses/rev.	B 0 0
1024 pulses/rev.	B 0 2
1250 pulses/rev.	B 2 5
1500 pulses/rev.	B 5 0
2000 pulses/rev.	C 0 0
2048 pulses/rev.	C 0 4
2500 pulses/rev.	C 5 0
3600 pulses/rev.	D 6 0
5000 pulses/rev.	F 0 0

Designation	Order No.
Incremental encoder with analog signals sin/cos 1 V$_{pp}$	
Synchronous flange and 5 V DC supply voltage	
Connection:	
• Axial flange outlet	**6FX2 001-3G** ■ ■ ■
• Radial flange outlet	**6FX2 001-3E** ■ ■ ■
• Cable 1 m (3.3 ft) with connector [1]	**6FX2 001-3C** ■ ■ ■
Resolution	
1000 pulses/rev.	B 0 0
1024 pulses/rev.	B 0 2
2500 pulses/rev.	C 5 0
Incremental encoder with HTL interface	
Synchronous flange and 10 ... 30 V DC supply voltage	
Connection:	
• Axial flange outlet	**6FX2 001-4H** ■ ■ ■
• Radial flange outlet	**6FX2 001-4F** ■ ■ ■
• Cable 1 m (3.3 ft) with connector [1]	**6FX2 001-4D** ■ ■ ■
Supported flange joint and 10 ... 30 V DC supply voltage	
Connection:	
• Axial flange outlet	**6FX2 001-4S** ■ ■ ■
• Radial flange outlet	**6FX2 001-4Q** ■ ■ ■
• Cable 1 m (3.3 ft) with connector [1]	**6FX2 001-4N** ■ ■ ■
Resolution	
100 pulses/rev.	A 1 0
500 pulses/rev.	A 5 0
1000 pulses/rev.	B 0 0
2500 pulses/rev.	C 5 0
Double-track incremental encoder with RS 422 interface (TTL)	**6FX2 001-2UK00**
Synchronous flange and 5 V DC supply voltage	
Connection:	
• Cable 1 m (3.3 ft) with axial connector 2 types of resolution: 9000/1024 pulses/rev.	
Replacement connectors with external threads for encoders (3 units)	
• 12-pole with 12 contact pins for incremental encoder with RS 422, sin/cos 1 V$_{pp}$, HTL for absolute encoder with SSI	**6FX2 003-1CF12**

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[1] Universal integrated cable outlet for axial and radial outlet direction.

Measuring systems
SIMODRIVE sensor

■ Technical data

	Absolute encoder with SSI	Absolute encoder with EnDat	Absolute encoder with PROFIBUS DP (EN 50170)
Operating voltage at encoder	10 ... 30 V DC	5 V DC ±10%	10 ... 30 V DC
Power consumption, approx.	250 mA multi-turn, 180 mA single-turn		300 ... 100 mA (2.5 W)
Clock input	Differential cable receiver according to EIA standard RS 485		
Data output	Differential cable driver according to EIA standard RS 485		
Short-circuit resistance	yes		
Data transfer rate	100 kHz ... 1 MHz	100 kHz ... 2 MHz	12 Mbit/s
LED for bus diagnostics	–	–	yes (green/red)
Permissible electr. speed	5000 rpm with ±1 bit accuracy 10000 rpm with ±100 bit accuracy		5800 rpm at ±1-bit accuracy
Mech. speed, max.	12000 rpm single-turn 10000 rpm multi-turn		12000 rpm single-turn 6000 rpm multi-turn
Cable length to electronic circuitry [1], max.	50 m (164 ft) up to 1 MHz cycle 100 m (328 ft) up to 300 kHz cycle 400 m (1313 ft) up to 100 kHz cycle	50 m (164 ft) up to 1 MHz cycle 150 m (492 ft) up 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 (3938 ft) up to 93.75 kbit/s
Number of nodes, max.	–	–	99
Connection	Flange socket, axial/radial		Terminal block with address selector switch and bus terminating resistor in removable cover with 3 radial cable glands
Cable diameter	–		6.5 ... 9 mm (0.26 ... 0.35 in) Mounting on end of cover is possible without interruption of the bus
Resolution	13 bits single-turn (8192 steps) 25 bits multi-turn (8192 × 4096 steps)		13 bits single-turn (8192 steps) 27 bits multi-turn (8192 × 16384 steps)
Message frame length	13 bit single-turn, without parity 25 bit multi-turn, without parity	According to EnDat specification	–
Incremental track	–	512 pulses/rev., 1 V_{pp}	–
Code type			
• Sampling	Gray	Gray	Gray
• Transfer	Gray, fir tree format	Binary	Binary
Parameterization capability			
• Resolution per revolution	–	–	Arbitrary 1 ... 8192
• Total resolution	–	–	Arbitrary 1 ... 16384
• Preset	–	–	yes
• Counting direction	yes	–	yes
• Speed signal	–	–	yes
• Limit switch	–	–	yes, 2
• Isochronous mode and internode communication acc. to DP V2	–	–	yes
Online parameterization	–	–	yes
Network load, approx.	–	–	20 µs per encoder at 12 Mbit/s
Cycle time	–	–	667 µs
Accuracy	±60 angular seconds	±60 angular seconds (incr. track) tested acc. to EN	±½ LSB
EMC	Tested acc. to EN 50081 and EN 50082		
Friction torque	≤ 0.01 Nm (0.09 lb_f-in) (at +20 °C (+68 °F))		
Starting torque	< 0.01 Nm (0.09 lb_f-in) (at +20 °C (+68 °F))		
Shaft loading capacity			
• $n > 6000$ rpm	Axial 10 N (2.2 lb_f)/radial 20 N (4.5 lb_f) at shaft extension		
• $n \le 6000$ rpm	Axial 40 N (9 lb_f)/radial 60 N (13.5 lb_f) at shaft extension		
Angular acceleration, max.	10^5 rad/s^2		
Moment of inertia of rotor	1.45×10^{-6} kgm^2 (12.83×10^{-6} lb_f-in-s^2)		

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

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■ Technical data (continued)

	Absolute encoder with SSI	Absolute encoder with EnDat	Absolute encoder with PROFIBUS DP (EN 50170)
Vibration (55 ... 2000 Hz) to IEC 68-2-6	≤ 100 m/s^2 (328 ft/s^2)		
Shock (6 ms) to IEC 68-2-27	≤ 1000 m/s^2 (3281 ft/s^2)		
Operating temperature, max.	+85 °C (+185 °F)	+100 °C (+212 °F)	+70 °C (+158 °F)
Operating temperature, min.	-40 °C (-40 °F)	-40 °C (-40 °F)	-40 °C (-40 °F)
Degree of protection according to EN 60529 (IEC 60529)	IP67 without shaft input IP64 with shaft input		
Weight, approx. Single-turn/multi-turn	0.35 kg (0.8 lb)/0.35 kg (0.8 lb)		0.5 kg (1.1 lb)/0.7 kg (1.5 lb)
CE mark	yes	yes	yes
PROFIBUS certificate	–	–	yes
Supported profiles	–	–	Class 1, Class 2

■ Selection and ordering data

Designation	Order No.		Designation	Order No.
Absolute encoder with SSI			**Absolute encoder with PROFIBUS DP**	
Synchronous flange and 10 ... 30 V DC supply voltage			Synchronous flange and 10 ... 30 V DC supply voltage	
Connection:			• Radial connection	**6FX2 001-5FP ■ ■**
• SSI with axial flange outlet	**6FX2 001-5HS ■ ■**		Supported flange joint and 10 ... 30 V DC supply voltage	
• SSI with radial flange outlet	**6FX2 001-5FS ■ ■**		• Radial connection	**6FX2 001-5QP ■ ■**
Supported flange joint and 10 ... 30 V DC supply voltage			Resolution	
Connection:			• Single-turn 8192 steps/revolution (13 bits)	**1 2**
• SSI with axial flange outlet	**6FX2 001-5SS ■ ■**		• Multi-turn 8192 steps/revolution, 16384 revolutions (27 bits)	**2 4**
• SSI with radial flange outlet	**6FX2 001-5QS ■ ■**		**User Manual** for start-up and parameterization of PROFIBUS encoders Languages: German/English	**6SN1 197-0AB10-0YP3**
Resolution				
• Single-turn 8192 steps/revolution (13 bits)	**1 2**			
• Multi-turn 8192 steps/revolution, 4096 revolutions (25 bits)	**2 4**		**Replacement connectors with external threads for encoders** (3 units)	
Absolute encoder with EnDat			• 12-pole with 12 contact pins for incremental encoder with RS 422, sin/cos 1 V$_{pp}$, HTL for absolute encoder with SSI	**6FX2 003-1CF12**
Synchronous flange and 5 V DC supply voltage			• 17-pole with 17 contact pins for absolute encoder with EnDat	**6FX2 003-1CF17**
Connection:				
• EnDat with axial flange outlet	**6FX2 001-5HE ■ ■**			
• EnDat with radial flange outlet	**6FX2 001-5FE ■ ■**			
Supported flange joint and 5 V DC supply voltage				
Connection:				
• EnDat with axial flange outlet	**6FX2 001-5SE ■ ■**			
• EnDat with radial flange outlet	**6FX2 001-5QE ■ ■**			
Resolution				
• Single-turn 8192 steps/revolution (13 bits)	**1 3**			
• Multi-turn 8192 steps/revolution, 4096 revolutions (25 bits)	**2 5**			

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■ Overview
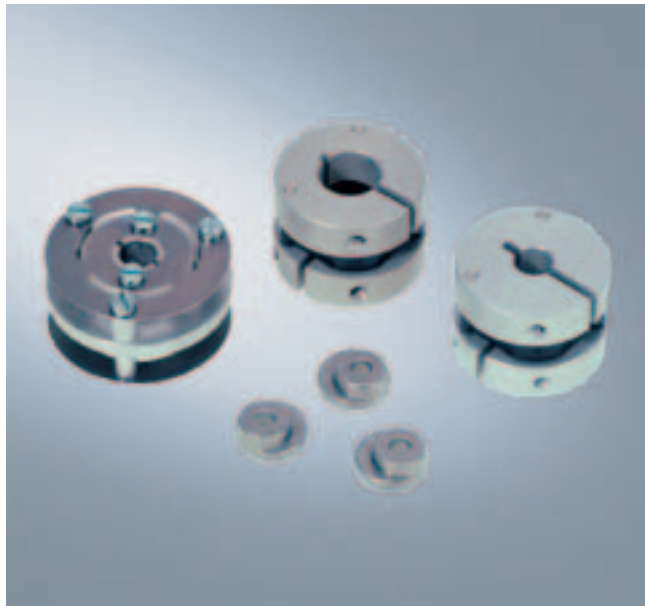
Clamp straps/couplings

Clamp straps and couplings are available as mounting accessories for the rotary encoders. The clamp straps are used to fix the encoders with a synchronous flange.

Mating connector

A mating connector is available for the encoder with flange outlet or with cable and encoder connector for cable diameters 5.5 mm (0.22 in) to 12 mm (0.47 in). The connectors with 12 contacts fit all incremental encoders as well as absolute encoders with SSI. Connectors with 17 contacts are suitable for encoders with EnDat.

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■ Technical data

	Spring disk coupling	Plug-in coupling
Transmission torque, max.	0.8 Nm (7.1 lb_f-in)	0.7 Nm (6.2 lb_f-in)
Shaft diameter	6 mm (0.24 in) on both sides or d_1 = 6 mm (0.24 in), d_2 = 5 mm (0.2 in)	6 mm (0.24 in) on both sides or 10 mm (0.39 in) on both sides
Center offset 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°
Torsional rigidity	150 Nm/rad (110.6 lb_f-ft/rad)	31 Nm/rad (22.9 lb_f-ft/rad)
Lateral spring stiffness	6 N/mm (34 lb_f/in)	10 N/mm (57 lb_f/in)
Moment of inertia	19 gcm^2 (168 x 10^{-7} lb_f-in-s^2)	20 gcm^2 (177 x 10^{-7} lb_f-in-s^2)
Max. speed	12000 rpm	12000 rpm
Operating temperature		
• Maximum	+150 °C (+302 °F)	+80 °C (+176 °F)
• Minimum	-40 °C (-40 °F)	-40 °C (-40 °F)
Weight, approx.	16 g (0.03 lb)	20 g (0.04 lb)

■ Selection and ordering data

Designation	Order No.
Clamp strap for double-track encoder and encoder with synchro flange (3 units are required)	**6FX2 001-7KP01**
Spring disk coupling Shaft diameter:	
• 6 mm (0.24 in)/6 mm (0.24 in)	**6FX2 001-7KF10**
• 6 mm (0.24 in)/5 mm (0.22 in)	**6FX2 001-7KF06**
Plug-in coupling Shaft diameter:	
• 6 mm (0.24 in)/6 mm (0.24 in)	**6FX2 001-7KS06**
• 10 mm (0.39 in)/10 mm (0.39 in)	**6FX2 001-7KS10**
Mating connector for the flange outlet or encoder connector (3 units) Female crimp contacts for cable diameters of 5.5 ... 12 mm (0.22 ... 0.47 in)	
• 12-pin 12 socket contacts for incremental encoder with TTL, sin/cos 1 V_{pp}, HTL for absolute encoder with SSI	**6FX2 003-0CE12**
• 17-pin 17 socket contacts for absolute encoder with EnDat	**6FX2 003-0CE17**

SIMAG H2 hollow-shaft measuring system

Application

SIMAG H2 is an incremental system for measuring angles of rotation and rotational speeds. Applications include hollow-shaft applications with direct drives 1FE1 and 1PH2 as well as applications as an autonomous spindle encoder. SIMAG H2 is intended to replace the SIZAG 2 hollow-shaft measuring system in new applications.

The electrical signals and the flange outlet are compatible with existing motor measuring systems. SIMAG H2 can be operated digitally on the SIMODRIVE 611 converter system with all available controls as motor measuring system or as direct measuring system.

Design

The SIMAG H2 measuring system consists of three components:
- Measuring wheel
- Scanning head with connecting lead
- Connection kit

The magnetic division on the measuring wheel is used as unit of measurement. Different internal diameters are available for each outer diameter, whereby the internal diameter can be reworked. The measuring wheel is attached with the shaft nut; alternatives are screw fitting to a shaft shoulder (not possible with all measurement variants) or shrink fitting.

The non-contact scanning head scans the incremental and reference tracks at the measuring wheel and amplifies the signals.

It is connected via a lead attached to the scanning head. The end of the lead is preassembled with contacts and an insulation insert. For assembly, the insulation insert can be fixed into a straight or angular flange outlet. For confined spaces, the encoder can also be supplied with free lead ends.

Technical data

SIMAG H2 hollow-shaft measuring system

Output signals	2 voltage signals 1 V_{pp} in quadrate; 1 reference signal per encoder revolution
Operating voltage	5 V DC ±5%
Typical power consumption	30 mA
Resolution	256 pulses/rev.
Indexing accuracy of measuring wheel	±72 angular seconds at resolution = 256 pulses/rev.
Limit speed	≤ 25000 rpm at 256 pulses/rev.
Rated distance between measuring wheel and scanning head	200 µm
Operating temperature range	-20 ... +120 °C (-4 ... +248 °F)
Shock resistance (11 ms)	1000 m/s^2 (3282 ft/s^2)
Vibration (50 ... 2000 Hz)	200 m/s^2 (656 ft/s^2)
Degree of protection to EN 60529 (IEC 60529)	IP67 when installed
Bending radius of the cable module lines	One-time bending: ≥ 25 mm (1 in) Multiple bending: ≥ 60 mm (2.4 in)
Max. length of line to converter	50 m (164 ft)
Dimensions (W x H x D), approx. Scanning head (mounted)	37 mm x 18 (+4) mm x 16 mm (1.4 in x 0.7 (+0.2) in x 0.6 in)

Measuring wheel

Internal diameter [1]	45^{H6}mm (1.77 in)	60^{H6}mm (2.36 in)
External diameter D_a	81.14 mm (3.19 in)	
Thickness	15 mm (0.59 in)	
Pulse number	256	
Moment of inertia, approx.	4.0 x 10^{-4} kgm^2 (35.4 x 10^{-4} lb$_f$-in-s^2)	3.0 x 10^{-4} kgm^2 (26.5 x 10^{-4} lb$_f$-in-s^2)
Weight, approx.	0.4 kg (0.9 lb)	0.25 kg (0.5 lb)

Selection and ordering data

Designation	Order No.
Scanning head, incremental 1 mm (0.04 in) pole pitch, 1 V_{pp}	
• with plug insert, with 0.2 m cable (0.7 ft)	**6FX2 001-6AA12-1CA0**
• with plug insert, with 0.5 m cable (1.6 ft)	**6FX2 001-6AA12-1FA0**
• with plug insert, with 2.0 m cable (6.6 ft)	**6FX2 001-6AA12-3AA0**
• open wire ends, with 1.0 m cable (3.3 ft)	**6FX2 001-6AA12-2AA5**
Measuring wheel, D_a 81.14 mm (3.2 in)	
• Internal diameter 45^{H6} mm (1.77 in)	**6FX2 001-6RB12-4EF0**
• Internal diameter 60^{H6} mm (2.36 in)	**6FX2 001-6RB12-4GA0**
Connection kit for insulation insert	
• Straight flange outlet	**6FX2 001-6FA12-0GA0**
• Angular flange outlet	**6FX2 001-6FA12-0WA0**
Extraction tool for insulation insert of straight or angular flange outlet	**6FX2 001-6FK12-0AA0**
Configuring/ Installation Instructions	
• German	**6SN1 197-0AB31-0AP1**
• English	**6SN1 197-0AB31-0BP1**

[1] The internal diameters can be reworked (hollowed up to max. 65 mm (2.56 in)); see Planning/Installation Guide.

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Diagnostic device

■ Overview

The diagnostic device permits the checking of encoders with analog signals sin/cos 1 V_{pp}. The signals, size of the signal amplitudes, offset values, and the assignment of the zero signal to the incremental track can be measured.

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 preassembled cables 6FX. 002-2CA31-.... or 6FX. 002-2CA51-.... can be used to connect built-in encoders to the diagnostic device.

■ Technical data

Diagnostic device	
Supply voltage	230 V AC, 50/60 Hz
Inputs	Encoder signal connections
Outputs	
• Encoder power supply	5 ... 8 V DC depending on encoder type I_{max} = 250 mA
• Analog outputs	Encoder signal A Encoder signal B Encoder signal R (= marker pulse) Offset from the encoder signal A or B
• Square-wave signal outputs	Encoder signal A and B converted to square signal and ANDed logically Encoder signal R (= marker pulse) converted to square signal
Displays	LED measurement valid LED encoder power supply

■ Selection and ordering data

Designation	Order No.
Diagnostic device	**6FX2 007-1AA00**