8 Encoders

8.1 General description

The purpose of encoders is to sense the motor speed used for speed control. This information can also be used for positioning the drive system.

Encoders are distinguished by the following criteria:

- Incremental or absolute encoders.
- Mechanical mounting to the motor, that is built-in encoder or add-on encoder, and mechanical interfaces, such as spread shaft, plug-in shaft, and solid shaft.
- Output signals, such as sin/cos, TTL, HTL, RS485 + sin/cos, SSI + sin/cos or TTL.

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8.2 Type designation for encoders from SEW-EURODRIVE

The type designation of encoders from SEW-EURODRIVE consists of 4 characters, for example ES7C, and is used in the type designation of the motor.

1st character: Encoder design

Identification	Description
E	Incremental encoder
A	Absolute encoder
X	Special encoder

2nd character: Mechanical interfaces with the motor

Identification	Description
I	Integrated in the motor
S	Spread shaft (shaft centered)
G	Plug-in shaft (shaft centered)
V	Solid shaft with coupling (flange centered)
H	Hollow shaft (shaft centered)

3rd character: Key figure for identifying the geometry of the encoder mounting adapter

Identification	Description
7	Standard geometry of the DRN.. motor
1 – 6	Various geometric variants
0	Special designs

4th character: Electrical interface of the encoder

Identification	Description
S	Sin/cos
R	TTL (RS422) for U = 9 – 30 V
T	TTL (RS422) for V_B = 5 V
C	HTL
W	RS485 (multi-turn) + sin/cos
Y	SSI (multi-turn) + sin/cos or TTL (RS422)
A	Design of the mounting adapter (see chapter "Encoder mounting adapter" (→ 🗎 311))
1 – 6	Periods per revolution

8.3 Built-in encoders

Built-in encoders EI7. from SEW-EURODRIVE are completely integrated into the motor. This means the overall length of the drive remains unchanged. The components of the built-in encoder do not protrude beyond the contour of the drive, which means they are particularly well protected from environmental influences and damage.

Areas of application

EI.7 built-in encoders are suited for the following applications:

- Simple positioning
- Speed monitoring
- Direction of rotation monitoring
- The EI7C type is also available as EI7C FS safety encoder.

Evaluation

EI7. built-in encoders can be evaluated with the following products from SEW-EURODRIVE:

- MOVITRAC® B in the technology version: Evaluation via "Simple positioning" application software
- MOVIFIT® FC with "technology" function level
- MOVIMOT® with fieldbus interfaces MQ (with EI71, 2 and 6) and MF (with EI71)
- MOVIPRO® with encoder option
- MOVIDRIVE® B
- MOVIAXIS®

EI7C FS safety encoders can be evaluated as follows:

- MOVIFIT® FC: Functional safety with S12 safety option

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8.3.1 Technical details

Technical data

Encoder		EI7C	EI76	EI72	EI71
for motor size		**DRN80. – 132S.**			
Mounting type		Integrated			
Supply voltage	V_B	DC 9 V – 30 V			
Max. current consumption	I_{in}	120 mA			
Output amplitude	V_{high} V_{low}	V_{cc} - 3.5 V to V_{cc} 0 V to 3 V			
Signal output		HTL (push-pull)			
Output current per track	I_{out}	± 60 mA			
Max. pulse frequency	f_{max}	1.44 kHz			
Periods per revolution A, B C		 24 0	 6 0	 2 0	 1 0
Pulse duty factor		1 : 1 ± 20%			
Phase angle A: B		90° ± 20°			
Vibration resistance according to EN 60068-2-6 at 5 Hz – 2 kHz		≤10 g (98.1 m/s²)			
Shock resistance according to EN 60068-2-27		≤100 g (981 m/s²)			
Maximum speed	n_{max}	3600 1/min			
Ambient temperature		Motor: -30 °C to +60 °C Encoder: -30 °C to +85 °C			
Degree of protection		IP66			
Connection		Connection unit in the terminal box or M12 (8- or 4-pin)			

Notes on selection

Increase in inertia when using EI7. built-in encoder.

Motor	$J_{Mot} + J_{EI7} - J_{PA}$	Increase in inertia
	10^{-4} kgm²	**%**
DRN80MS	21	14
DRN80M	27.2	10
DRN90S	64.3	19
DRN90L	77.5	15
DRN100LS	91.7	13
DRN100LM	100	11
DRN100L	121.6	9
DRN112M	192	8
DRN132S	255	6

INFORMATION

Due to the slight increase in inertia, it is not necessary to reduce the no-load starting frequency Z0.

8.3.2 Order information

Type designation /EI7.

8.4 Add-on encoder

The add-on encoder is mounted to the motor on the B-side by means of various mechanical interfaces. The interface to be used depends on the motor size or the selected option:

Identification	Motors	Design
S	DRN80 – 132S	Mounting via spread shaft
G	DRN132M – 280	Mounting via plug-in shaft
V	DRN80 – 280	Mounting via coupling and solid shaft
H	DRN315	Mounting via hollow shaft

The following electrical interfaces are available depending on the design of the incremental encoder or absolute encoder:

- Incremental encoder with 1024 periods per revolution.

  See chapter "Type designation for encoders from SEW-EURODRIVE" (→ 🗎 301)

Identification	Description
S	Sin/cos
R	TTL (RS422) for U = 9 – 30 V
T	TTL (RS422) for V_B = 5 V
C	HTL

- Absolute encoder (multi-turn) with 2048 periods per revolution

  See chapter "Type designation for encoders from SEW-EURODRIVE" (→ 🗎 301)

Identification	Description
W	RS485 (multi-turn) + sin/cos
Y	SSI (multi-turn) + sin/cos or TTL (RS422)

Electronic nameplate

In E.7S and A.7W encoders, important startup data are stored in an electronic nameplate. This facilitates starting up the drive and ensures that motor parameters are set correctly in the inverter.

During startup, the engineering software checks whether an electronic nameplate is present in the encoder and suggests the use of this data.

Advantages of auto identification of the drive:

- Complete and correct identification of motor and gear unit.
- No manual entry of data is necessary, which saves time during startup.
- Easy startup of drives that are installed in locations that are difficult to access.

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8.4.1 Incremental encoders

Technical details

Technical data

Designation	Value
Storage temperature	-15 °C to +70 °C
Maximum angular acceleration	10^4 rad/s^2

Incremental rotary encoders E..S – sin/cos

Encoder		ES7S	EV7S	EG7S	EH7S
Sizes	DRN..	80 – 132S	80 – 280	132M – 280	315
Supply voltage	V_B	DC 7 V – 30 V	DC 7 V – 30 V		DC 10 V – 30 V
Max. current consumption	I_{in}	140 mA_{RMS}			
Max. pulse frequency	f_{max}	150 kHz	150 kHz		180 kHz
Periods per revolution	A, B	1024			
	C	1			
Output amplitude per track	V_{high} / V_{low}	1 V_{PP}			
Signal output		Sin/cos			
Output current per track	I_{out}	10 mA_{RMS}			
Pulse duty factor		Sin/cos			90° ± 10°
Phase angle A: B		90 ° ± 3 °	90 ° ± 3 °		–
Accuracy[1]		0.0194°	–	0.0194°	–
Vibration resistance according to EN 60088-2-6		≤ 100 m/s^2			
Shock resistance according to EN 60088-2-27		≤ 1000 m/s^2		≤ 2000 m/s^2	
Maximum speed	n_{max}	6000 1/min			
Duration until error message (disabled outputs)[2]		25 ms	–	25 ms	–
Degree of protection according to EN 60529		IP66			IP65
Connection		Terminal box on incremental encoder			12-pin plug connector
Ambient temperature	°C	-30 to +60	-30 to +80	-30 to +60	-40 to +60

1) Due to the stiffness of the torque bracket, you have to take into account an automatically resetting ±0.6° twist (depending of the direction of rotation) of the encoder housing compared to the encoder shaft.

2) Sin/cos encoders have a self-diagnostics function. If an error is detected, the sensor reports it by deactivating the output signals to the encoder evaluation unit.

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Incremental rotary encoders E..R – TTL (RS422), 9 V ≤ V_B ≤ 30 V

Encoder		ES7R	EV7R	EG7R	EH7R
Sizes	DRN..	80 – 132S	80 – 280	132M – 280	315
Supply voltage	V_B	DC 7 V – 30 V	DC 7 V – 30 V		DC 10 V – 30 V
Max. current consumption	I_{in}	160 mA_{RMS}			140 mA_{RMS}
Max. pulse frequency	f_{max}	120 kHz			300 kHz
Periods per revolution	A, B	1024			
	C	1			
Output amplitude per track	V_{high}	≥ DC 2.5 V	≥ DC 2.5 V		≥ DC 2.5 V
	V_{low}	≤ DC 0.5 V			
Signal output		TTL (RS422)			
Output current per track	I_{out}	25 mA_{RMS}			20 mA_{RMS}
Pulse duty factor		1 : 1 ± 10%			
Phase angle A: B		90 ° ± 20 °			
Vibration resistance according to EN 60088-2-6		≤ 100 m/s^2			
Shock resistance according to EN 60088-2-27		≤ 1000 m/s^2		≤ 2000 m/s^2	
Maximum speed	n_{max}	6000 1/min			6000 1/min 2500 at 60 °C
Degree of protection according to EN 60529		IP66			IP65
Connection		Terminal box on incremental encoder			12-pin plug connector
Ambient temperature	°C	-30 to +60	-30 to +60		-40 to +60

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Incremental rotary encoders E..C – HTL

Encoder		ES7C	EV7C	EG7C	EH7C
Sizes	DRN..	80 – 132S	80 – 280	132M – 280	315
Supply voltage	V_B	DC 4.75 V – 30 V		DC 4.75 V – 30 V	DC 10 V – 30 V
Max. current consumption	I_{in}	240 mA_{RMS}			225 mA_{RMS}
Max. pulse frequency	f_{max}	120 kHz			300 kHz
Periods per revolution	A, B	1024			
	C	1			
Output amplitude per track	V_{high}	U_B -2.5 V		U_B -2.5 V	U_B -2 V
	V_{low}	≤ DC 1.1 V		≤ DC 1.1 V	≤ DC 2.5 V
Signal output		HTL/TTL (RS422)		HTL/TTL (RS422)	HTL
Output current per track	I_{out}	60 mA_{RMS}			30 mA_{RMS}
Pulse duty factor		1 : 1 ± 10%			1 : 1 ± 20%
Phase angle A: B		90 ° ± 20 °			
Vibration resistance according to EN 60088-2-6		≤ 100 m/s^2			
Shock resistance according to EN 60088-2-27		≤ 1000 $/s^2$		≤ 2000 m/s^2	
Maximum speed	n_{max}	6000 1/min			6000 1/min 2500 1/min at 60 °C
Degree of protection according to EN 60529		IP66			IP65
Connection		Terminal box on incremental encoder			12-pin plug connector
Ambient temperature	°C	-30 to +60		-30 to +60	-40 to +60

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Absolute encoders A.7Y – SSI (multi-turn) + sin/cos or TTL (RS422)

Encoder		AS7Y	AV7Y	AG7Y	AH7Y
Sizes	DRN..	80 – 132S	80 – 280	132M – 280	315
Supply voltage	V_B	DC 7 V – 30 V			DC 9 V – 30 V
Max. current consumption	I_{in}	140 mA_{RMS}			150 mA_{RMS}
Max. pulse frequency	f_{limit}	200 kHz			120 kHz
Periods per revolution	A, B	2048			2048
	C	–			–
Output amplitude per track	V_{high}	1 V_{PP}			≥ DC 2.5 V_{SS}
	V_{low}				≤ DC 0.5 V_{SS}
Signal output		Sin/cos			TTL (RS422)
Output current per track	I_{out}	10 mA_{RMS}			20 mA_{RMS}
Pulse duty factor		Sin/cos			1:1 ± 20%
Phase angle A: B		90° ±3°			90° ±20°
Accuracy of the incremental section[1)]		0.0194°			–
Accuracy of the absolute section		±1 LSB (Least Significant Bit)			–
Scanning code		Gray code			
Single-turn resolution		4096 increments/revolution (12 bits)			
Multi-turn resolution		4096 revolutions (12 bits)			
Data transfer		synchronous, serial (SSI)			
Serial data output		Driver to EIA RS422			Driver to EIA RS485
Serial pulse input		Recommended receiver to EIA RS422			Optocoupler, recommended driver to EIA RS485
Clock frequency		Permitted range: 100 – 800 kHz (max. 100 m cable length with 300 kHz)			
Clock-pulse space period		12 – 30 µs			12 – 30 ms
Vibration resistance according to EN 60088-2-6		≤ 100 m/s^2			
Shock resistance according to EN 60088-2-27		≤ 1000 m/s^2		≤ 2000 m/s^2	
Maximum speed	n_{max}	6000 1/min			3500 1/min
Duration until error message (disabled outputs)[2)]		25 ms + 3/4 revolution			–
Degree of protection according to EN 60529		IP66			IP56
Connection		Terminal strip in pluggable connection cover			Terminal strip on encoder
Ambient temperature	°C	-30 to +60			-20 to +40

1) Due to the stiffness of the torque bracket, you have to take into account an automatically resetting ±0.6° twist (depending of the direction of rotation) of the encoder housing compared to the encoder shaft.

2) Absolute encoders AS7Y, AV7Y, and AG7Y have a self-diagnostics function. If an error is detected, the sensor reports it by deactivating the output signals to the encoder evaluation unit.

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Absolute encoders A.7W – RS485 (multi-turn) + sin/cos

Encoder		AS7W	AV7W	AG7W
Sizes	DRN..	80 – 132S	80 – 280	132M – 280
Supply voltage	V_B	DC 7 V – 30 V		
Max. current consumption	I_{in}	150 mA_{RMS}		
Max. pulse frequency	f_{max}	200 kHz		
Periods per revolution	A, B	2048		
	C	–		
Output amplitude per track	V_{high}	1 V_{PP}		
	V_{low}			
Signal output		Sin/cos		
Output current per track	I_{out}	10 mA_{RMS}		
Pulse duty factor		Sin/cos		
Phase angle A: B		90° ± 3°		
Accuracy of the incremental section[1)]		0.0194°		
Accuracy of the absolute section		±1 LSB (Least Significant Bit)		
Scanning code		Binary code		
Single-turn resolution		8192 increments/revolution (13 bits)		
Multi-turn resolution		65536 revolutions (16 bits)		
Data transfer		RS485		
Serial data output		Driver to EIA RS485		
Serial pulse input		Recommended driver to EIA RS422		
Clock frequency		9600 baud		
Clock-pulse space period		–		
Vibration resistance according to EN 60088-2-6		≤ 100 m/s^2		
Shock resistance according to EN 60088-2-27		≤ 1000 m/s^2		≤ 2000 m/s^2
Maximum speed	n_{max}	6000 1/min		
Duration until error message (disabled outputs)[2)]		25 ms + 3/4 revolution		
Degree of protection according to EN 60529		IP66		
Connection		Terminal strip in pluggable connection cover		
Ambient temperature	°C	-30 to +60		

1) Due to the stiffness of the torque bracket, you have to take into account an automatically resetting ±0.6° twist (depending of the direction of rotation) of the encoder housing compared to the encoder shaft.

2) Absolute encoders AS7W, AV7W, and AG7W have a self-diagnostics function. If an error is detected, the sensor reports it by deactivating the output signals to the encoder evaluation unit.

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Incremental rotary encoders E..T – TTL (RS422) at V_B= 5 V

Encoder		EH7T
Sizes	DRN..	315
Supply voltage	V_B	DC 5 V
Max. current consumption	I_{in}	>140 mA
Max. pulse frequency f_{max}	kHz	300
Periods per revolution	A, B	1024
	C	1
Output amplitude	V_{high}	≥ DC 2.5 V
	V_{low}	≤ DC 0.5 V
Signal output		TTL (RS422)
Output current per track	I_{out}	>20 mA
Pulse duty factor		1 : 1 ± 20%
Phase angle A: B		90° ± 20°
Vibration resistance according to EN 60088-2-6 at 10 Hz – 2 kHz		≤ 100 m/s²
Shock resistance according to EN 60088-2-27		≤ 2000 m/s²
Maximum speed	n_{max}	6000 1/min 2500 1/min at 60 °C
Degree of protection according to EN 60529		IP65
Connection		12-pin plug connector
Ambient temperature	°C	-40 to +60

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8.5 Encoder mounting adapter

An encoder mounting adapter allows for mounting an encoder, which is not part of the standard delivery, at a later time. SEW-EURODRIVE distinguishes between 2 types of encoder mounting adapters:

- Encoder mounting adapters for encoders from SEW-EURODRIVE
- Encoder mounting adapters for encoders of other manufacturers

8.5.1 Encoder mounting adapters for encoders from SEW-EURODRIVE

For the various mechanical interfaces (depending on the size) for an encoder mounting adapter for encoders from SEW-EURODRIVE, refer to chapter "Add-on encoder" (→ 🗎 304).

Encoder mounting adapters are available for all standard encoders from SEW-EURODRIVE:

Identification	Description
ES7A	for spread-shaft encoders from SEW-EURODRIVE on DRN80 – 132S
EG7A	for plug-in shaft encoders with end thread from SEW-EURODRIVE on DRN132M – 280
EV7A	for spread-shaft encoders from SEW-EURODRIVE on DRN80 – 225
EH7A	for hollow-shaft encoders from SEW-EURODRIVE on DRN315

Notes on selection

For dimensions of mounting adapters of SEW-EURODRIVE encoders, refer to chapter "Dimension sheets for motors/brakemotors" (→ 🗎 147).

INFORMATION

DRN250/280 motors are available with EG7A encoder mounting adapter, and brakemotor sizes 250/280..BE are available with EV7A encoder mounting adapter.

Order information

Type designation /ES7A, /EG7A, /EV7A, /EH7A

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8.5.2 Encoder mounting adapters for XV.A encoders according to customer specifications

With this type of encoder mounting adapter, the AC motor is equipped with a mechanical interface that can be mounted to an encoder specified by the customer. This encoder is not a product of SEW-EURODRIVE and must be purchased separately. Third-party encoders are installed by SEW-EURODRIVE solely by means of special solutions. Contact SEW-EURODRIVE in such cases.

Technical details

Refer to the following table for dimensions of XV.A encoder mounting adapters.

Mounting adapter	Design	
	Encoder shaft	Centering
XV0A	according to customer specification	
XV1A	6 mm	50 mm
XV2A	10 mm	50 mm
XV3A	12 mm	80 mm
XV4A	11 mm	85 mm
XV5A	12 mm	45 mm
XV6A	10 mm	36 mm

A fan guard with encoder mount allows the encoder to be mounted on the motor shaft. These encoders are usually attached using three encoder clamps (bolts with eccentric disks).

The encoder shaft is connected to the motor shaft via coupling.

The dimensions of the customized encoder mounting adapters are not shown in the "Motor/brakemotor dimension sheets" chapter. Please request the necessary dimension sheets from SEW-EURODRIVE, if required.

INFORMATION

The combinations with forced cooling fan requires knowledge of the installation space of the encoder to be mounted. Several forced cooling fan guards with different lengths are available. Contact SEW-EURODRIVE for more information.

Order information

Type designation /XV0A, /XV1A, /XV2A, /XV3A, /XV4A, XV5A, XV6A

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8.6 Safety encoders

Safety encoders from SEW-EURODRIVE are characterized by their exceptional reliability as well as electronic and mechanical load capacity.

Safety encoders allow you to increase the safety in your machines by implementing safety functions regarding speed, direction of rotation, idle state and relative position. The safety encoder provides the safety-relevant signals in the intelligent interaction of sensor, control and actuator.

The safety function requires a reliable mechanical connection between encoder and motor. At SEW-EURODRIVE, this connection is dimensioned in such a way that fault exclusion is achieved.

The safety encoders cannot trigger a safe state at the machine autonomously. Therefore, they have to be monitored in the overall system. The overall system will trigger a suitable error response, e.g. the safe state, on request.

8.6.1 Available safety encoders

Add-on encoders:

Encoder type	Interface
ES7S EG7S	Safe sin/cos interface
AS7W AG7W	RS485 interface (multi-turn) + safe sin/cos interface
AS7Y AG7Y	SSI interface (multi-turn) + safe sin/cos interface

Built-in encoder:

Encoder type	Interface
EI7C FS	Safe HTL interface

8.6.2 Underlying standards

The safety assessment of safe motor options is based on the following standards and safety classes:

Safety encoders

Add-on encoders: ES7S, EG7S, AS7W, AG7W, AS7Y, AG7Y	
Safety class/ underlying standard	• Safety Integrity Level (SIL) according to IEC 62061 • Performance Level (PL) according to EN ISO 13849-1

Built-in encoder: EI7C FS	
Safety class/ underlying standard	• Safety Integrity Level (SIL) according to EN 61800-5-2 • Performance Level (PL) according to EN ISO 13849-1

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8.6.3 Safety functions of safety encoders

ES7S, EG7S, AS7W, AG7W, AS7Y, AG7Y add-on encoders

The following safety functions regarding speed, direction of rotation, standstill, and relative position can be implemented in functionally safe systems with the sine/cosine interface of the safety encoders:

- SS1, SS2, SOS, SLS, SDI, SLI, SSR, SAR, SSM

Built-in encoder EI7C FS

The following safety functions regarding speed and direction of rotation can be implemented in functionally safe systems with the HTL interface of the safety encoder:

- SS1, SLS, SDI

8.6.4 Technical details

Operating ambient temperature for the motor

ES7S/EG7S add-on encoders:

Mounted to the motor, safety encoders may be operated up to a maximum ambient operating temperature of the motor of -20 °C to +60 °C.

AS7W, AG7W, AS7Y, AG7Y add-on encoders:

Mounted to the motor, safety encoders may be operated up to a maximum ambient operating temperature of the motor of -20 °C to +40 °C.

Add-on encoders

For technical details on the functionally safe add-on encoders ES7S, EG7S, AS7W, AG7W, AS7Y, and AG7Y, refer to chapter "Incremental encoders" (→ 🖹 305).

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Built-in encoder EI7C FS

Supply		min.	Typ.	max.	Unit
Operating voltage[1)]	V_B	19.2	24	30	V
Max. current consumption (with no load)	I_{max} (V_B = 24 V, I_{out} = 0)			120	mA

1) The voltage supply must come from SELV/PELV circuits in accordance with DIN EN 61131-2

Name		Value
Max. speed	n_{max}	≤ 3600 min^{-1}
HTL periods per revolution	$N_{periods}$	24
Ambient temperature	T_A	0 °C to +60 °C
Vibration resistance	Acc. to EN 60068-2-6:2008	10 g (98.1 m/s^2); 5 – 2000 Hz
Shock resistance	Acc. to EN 60068-2-27:2009	100 g (981 m/s^2); 6 ms
Degree of protection	Acc. to EN 60529	IP66
Connection		M12 (8-pole)
Maximum angular acceleration		3000 rad/s^2
Permitted magnetic interference field on the outer contour of the motor	B_{extmax}	25 mT
	H_{extmax}	20 kA/m

Signal tracks		min.	Typ.	max.	Unit
Output amplitude per track	V_{high} (I_{out} = I_{out_max})	V_B – 3.5		V_B	V
	V_{low} (I_{out} = I_{out_max})	0		+3	V
Max. output current per track	I_{out_max}			±30	mA
Tolerance signal period (corresponds to the speed tolerance)	$\varphi_{Period.tol}$ (n = constant)	-4		+4	%
Track A:B phase offset	$\varphi_{Phase.A:B}$ (n = constant)	70	90	110	Degree
Pulse duty factor (DIN IEC 60469-1)	$t = t_{log\_1}/(t_{period})$ (n = constant)	30	50	70	%
Pulse frequency for maximum speed (maximum speed × periods)	f_{max}		1.44		kHz
Output leakage current in deactivated state (= error message)[1)]	I_{Error}			+250	µA
Start-up time (undefined outputs)	From V_B > 9 V			300	ms
Duration until error message (deactivated outputs)[1)]		100		300	ms

1) The EI7C FS built-in encoder has a self-diagnostics function. If an error is detected, the system reports it by deactivating the output signals to the encoder evaluation unit.

Characteristic safety values

INFORMATION

In addition to the documentation, you can also obtain the characteristic safety values of components by SEW-EURODRIVE in the SEW-EURODRIVE library for the SISTEMA software tool. The documentation as well as the library are available for download at http://www.sew-eurodrive.de/.

Characteristic safety values ES7S, EG7S

	Characteristic safety values according to	
	EN 62061/IEC 61508	**EN ISO 13849-1**
Safety class/underlying standards	SIL2	PL d
System structure	HFT = 1	2-channel (cat. 3)
PFH_d value[1)] (**without** mounting to the motor)	8.5×10^{-9} 1/h = 8.5 FIT ($T_{amb} \leq 45$ °C) 1.3×10^{-8} 1/h = 13 FIT ($T_{amb} \leq 60$ °C)	
$MTTF_d$ value[1)] (**without** mounting to the motor)	–	1306 years ($T_{amb} \leq 45$ °C) 895 years ($T_{amb} \leq 60$ °C)
PFH_d value[1)] (**with** mounting to the motor, considers a derating due to motor reheating)	5.0×10^{-8} 1/h = 50 FIT ($T_{amb} \leq 60$ °C)	
$MTTF_d$ value[1)] (**with** mounting to the motor, considers a derating due to motor reheating)	–	212 years ($T_{amb} \leq 60$ °C)
Service life/proof test interval	20 years	
Motor/encoder connection (only for drives **with** FS logo)	Fault exclusion according to EN 61800-5-2	

1) The specified values are valid if the requirements to the evaluation unit according to section "Requirements to the follow-up electronics" are adhered to.

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Characteristic safety values AS7W, AG7W, AS7Y, AG7Y

	Characteristic safety values according to	
	EN 62061/IEC 61508	**EN ISO 13849-1**
Safety class/underlying standards	SIL2	PL d
System structure	HFT = 1	2-channel (Cat. 3)
PFH_d value[1)] (**without** mounting to the motor)	6.4×10^{-9} 1/h = 6.4 FIT ($T_{amb} \leq 45$ °C) 1.4×10^{-8} 1/h = 14 FIT ($T_{amb} \leq 60$ °C)	
$MTTF_d$ value[1)] (**without** mounting to the motor)	–	1155 years ($T_{amb} \leq 45$ °C) 753 years ($T_{amb} \leq 60$ °C)
PFH_d value[1)] (**with** mounting to the motor, considers a derating due to motor reheating)	5.0×10^{-8} 1/h = 50 FIT ($T_{amb} \leq 60$ °C)	
$MTTF_d$ value[1)] (**with** mounting to the motor, considers a derating due to motor reheating)	–	212 years ($T_{amb} \leq 60$ °C)
Service life/proof test interval	20 years	
Motor/encoder connection (only for drives **with** FS logo)	Fault exclusion according to EN 61800-5-2	

1) The specified values are valid if the requirements to the evaluation unit according to section "Requirements to the follow-up electronics" are adhered to.

Characteristic safety values for EI7C FS

	Characteristic safety values according to	
	EN 61800-5-2	**EN ISO 13849-1**
Safety class/underlying standards	SIL 2	PL d
System structure	HFT = 0	Category 2 (cat. 2)
PFH_d value	8.0×10^{-8} 1/h = 80 FIT ($T_{amb} \leq 60$ °C)	
$MTTF_d$ value	–	202 years ($T_{amb} \leq 60$ °C)
Service life/proof test interval	20 years	
Safe fault coverage (SFF)	95%	

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8.7 General information on drive selection

8.7.1 Speed sensors

Speed sensors, which can be mounted to the motors in series, can be combined with a range of motor designs and options, such as brakes and forced cooling fans.

If you have any questions, please contact SEW-EURODRIVE.

8.7.2 Encoder connection

When connecting the encoders to the inverters, follow the operating instructions for the inverter and the wiring diagrams supplied with the encoders.

- The maximum line length (inverter – encoder) is 100 m for the following cable capacitance:
  - < 83 nF/km (core/core) according to DIN VDE 0472 part 504
  - < 110 nF/km (core/shield)
- The clamped core cross section is 0.20 – 0.5 mm^2
- Use shielded cables with twisted pair cores. Connect the shield over a wide area at both ends:
  - At the encoder in the cable gland or in the encoder plug
  - To the inverter on the electronics shield clamp and/or to the housing of the sub D plug
- Install the encoder cables separately from the power cables, maintaining a distance of at least 200 mm.
- Encoder with cable gland: Observe the permitted diameter of the encoder cable to ensure that the cable gland functions correctly.

8.7.3 Connection alternatives

The encoders of types /ES7, /EG7, /EV7 and /AS7, /AG7, /AV7 can be supplied in three connection variants:

- With connection cover
- With connection cover, cable length 0.3 m and M23 connector
- Without connection cover

SEW-EURODRIVE recommends to use prefabricated encoder cables.

When using assembled cables from SEW-EURODRIVE, you can order the encoders without a connection cover because this cover is part of the cable.

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