SEW EURODRIVE

Addendum to the Operating Instructions

FS

Safety Encoders and Safety Brakes

DR.., DRN.., DR2.., EDR.., EDRN.. AC Motors

Functional Safety

Edition 08/2018

24766534/EN

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1 General information

1.1 How to use this documentation

The current version of the addendum to the operating instructions is the original.

This addendum to the operating instructions contains special information on functionally safe motor options (safety encoder and safety brake) of the DR.., DRN.., DR2.., EDR.., and EDRN.. motor series.

In addition to the addendum to the operating instructions at hand, the following operating instructions apply for motors with safety encoders and/or safety brakes:

- **AC motors with safety encoder and/or safety brake**
  - "DR..71 – 315, DRN63 – 315, DR2..63 – 80 AC Motors" operating instructions
- **Explosion-proof AC motors with safety encoder**
  - "Explosion-Proof EDR..71 – 315 AC Motors, EDRN80 – 315 – ATEX" operating instructions or "Explosion-Proof EDR..71 – 315 AC Motors, EDRN80 – 315 – IECEx" operating instructions

This documentation is an integral part of the product and contains important information on operation and service. The documentation is intended for all employees who assemble, install, start up, and service this product.

Make sure this documentation is accessible and legible. Ensure that persons responsible for the systems and their operation as well as persons who work on the product independently have read through the documentation carefully and understood it. If you are unclear about any of the information in this documentation, or if you require further information, contact SEW-EURODRIVE.

Make sure you always use the latest documentation and software version.

1.2 Content of the documentation

This documentation contains additional safety-related information and conditions for operation in safety-related applications.

1.3 Other applicable documentation

The following publications and documents have to be observed as well:

- "Project Planning for BE.. Brakes – DR.., DRN.., DR2.., EDR.., EDRN.. AC Motors – Standard Brake/Safety Brake" manual
- "DR.. Series AC Motors" catalog
- "DRN63 – 315, DR2S63 – 80 AC Motors" catalog

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2 Safety notes

2.1 Preliminary information

The following general safety notes serve the purpose of preventing injury to persons and damage to property. They primarily apply to the use of products described in this documentation. If you use additional components, also observe the relevant warning and safety notes.

2.2 Designated use

- DR.., DRN.., DR23.., EDR.., and EDRN.. motors with functionally safe motor options are intended for industrial systems.
- When installed in machines, start of the designated operation is prohibited until it is determined that the machine complies with the local laws and directives. The Machinery Directive 2006/42/EC is valid for the respective area of application.
- Air-cooled versions are designed for ambient temperatures of -20 °C to +40 °C and installation altitudes ≤ 1000 m above sea level. Any differing specifications on the nameplate must be observed. The ambient conditions must comply with all the specifications on the nameplate.
- In order to determine the safety integrity (performance level PL and/or safety integrity level SIL) of a system's safety functions, the system manufacturer must perform an overall evaluation. This document contains the product-related specifications necessary for the evaluation.
- Operation of DR.., DRN.., DR2.., EDR.., and EDRN.. motors with functionally safe motor options on third-party inverters is permitted.
- Before starting the designated use, make sure that the system complies with the specifications of this documentation, and in particular the technical data.

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2.2.1 Safety encoder

- The safety encoders described in this documentation are intended for use with DR.., DRN.., DR2.., EDR.., and EDRN.. motors. It is not permitted to mount them on other motors.
- When using a safety encoder in combination with a BE.. brake, the brake may only be used as a holding brake. Braking during operation is not permitted. The designated use of the brake is to activate the brake at standstill (< 20 min 1/min). Emergency stops from higher motor speeds are permitted. SEW-EURODRIVE recommends stopping the drive with stop category 1 in accordance with EN 60204-1.
- For AS7W, AG7W, AS7Y, and AG7Y safety encoders, the absolute interface is not part of the PL d/SIL 2 approval. The absolute interface may not be used solely for implementing safety functions.
- SEW-EURODRIVE recommends activating the monitoring functions lag error, speed, and encoder monitoring when configuring the inverter.

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2.2.2 Safety brake

- The safety brakes described in this documentation are intended for use with DR.., DRN.., DR2.., EDR.., and EDRN.. motors. It is not permitted to mount them on other motors.
- When using an AC motor in combination with a BE.. safety brake, the safety brake may be used only as a holding brake. The designated use is to activate the brake at standstill (< 20 min 1/min). Emergency stops from higher motor speeds are permitted.

  SEW-EURODRIVE recommends stopping the drive with stop category 1 in accordance with EN 60204-1.
- The BE.. safety brake may only be used at an ambient temperature of -20 °C to +40 °C.
- The dimensioning of drives with the BE.. safety brake considers a maximum of 1000 emergency stop braking operations in the life cycle. A minimum pause of 6 minutes must be allowed between 2 emergency stop braking operations. Project planning clearly defines how often the system can perform the emergency stop braking.
- When dimensioning the BE.. safety brake, observe the valid project planning specifications and the resulting application limits of SEW-EURODRIVE. If the application requirements or technical properties of the BE.. safety brake change, project planning and a check of the application limits must be performed again.
- It is not permitted to retrofit the BE.. safety brake or to replace an existing BE.. brake with a BE.. safety brake.
- The BE.. safety brake must not be exposed to the following substances/conditions:
  - Oils
  - Acids
  - Gases
  - Vapors
  - Radiation
- Motors with BE.. safety brake are not suitable for operation in areas with increased vibration stress of level 1 (vibration level 1).

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2.3 Inspection/maintenance

Work on a drive with functionally safe motor options – indicated by the FS logo on the motor nameplate – can be performed by the operator.

Any work on the safety encoder and/or the safety brake are carried out at your own risk. The operator is responsible and liable for the proper fulfillment of the work described in the relevant documentation.

The operator has to ensure the traceability of the performed work regarding functional safety. In case of proven compliance with the work described in the operating instructions, the characteristics regarding functional safety described by the manufacturer are maintained.

Use only genuine spare parts in accordance with the valid parts list for maintenance purposes.

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3 Functional safety (FS)

3.1 Functionally safe motor options

Drives from SEW-EURODRIVE are also optionally available with functionally safe motor options. These options are intended for implementation of safety functions in safety-relevant applications.

SEW-EURODRIVE assumes responsibility for the delivered drive in terms of compliance of the functionally safe motor options with the functional safety regulations. To indicate deviations from the delivery state, any safety-relevant connecting elements are sealed.

3.1.1 General

When implementing safety functions in machines, it is necessary to evaluate in particular whether the used components are suitable for performing a specific safety function. When using functionally safe motor options from SEW-EURODRIVE, the following safety-related requirements, e.g. in accordance with EN ISO 13849 – parts 1 and 2, are already taken into account:

- Application of basic safety principles
- Application of proven safety principles
- Specifications on failure probability (B_{10D}, $MTTF_D$, or PFH_D)
- Common Cause Failure (CCF)
- Determination of the category (Cat.)
- Production monitoring with 100% final inspection
- Retraceability by the unique motor assignment
- Notice of influences and ambient conditions
- Compliance with normative requirements regarding documentation

As an advantage for the machine designer, SEW-EURODRIVE has already fulfilled these safety-relevant requirements for functionally safe motor options. In the overall analysis of safety technology, the machine designer can rely on the manufacturer's confirmation, e.g. based on the product documentation or the German Technical Inspection Association (TÜV) certificate. The internal effort required for evaluation and documentation is reduced considerably.

If other components (standard components) are used for implementing safety functions, the machine designer has to evaluate the safety-related requirements.

3.1.2 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.

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3.1.3 Safety brake

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

Safety brakes allow you to increase the safety in your machines by implementing safety functions for deceleration and stopping. The safety brake represents the safety-relevant actuator in the intelligent interaction of sensor, control, and actuator.

The safety brakes cannot trigger a safe state at the machine autonomously. The brakes have to be supplemented with a suitable brake control and monitored by brake diagnostics, if necessary. The overall system triggers a suitable error response, e.g. the safe state, on request.

3.2 FS mark

Motors from SEW-EURODRIVE are optionally available with functionally safe motor options. These are designed for implementation of safety functions.

The documentation designates the respective functional safety design explicitly as safety encoder plus "type designation" or safety brake plus "type designation".

SEW-EURODRIVE labels a functionally safe motor option at the drive with an FS logo and a 2-digit number on the motor nameplate. The number is a code that indicates which components in the drive are safety-related. This allows to uniquely identify an available functionally safe motor option via the motor nameplate.

FS logo	Available functionally safe motor option		
	Decentralized inverters	Safety brake	Safety encoder
FS 01	X		
FS 02		X	
FS 04			X
FS 07	X		X
FS 11		X	X

If the FS logo, e.g. with the code "FS-11", is present on the motor nameplate, the combination of safety encoder and safety brake is available at the motor. If an FS logo is available, adhere to the information specified in the corresponding documentation.

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3.3 Retraceability

Functionally safe motor options can be retraced by SEW-EURODRIVE with the motor serial number and thus have a unique assignment to the motor.

If the SEW-EURODRIVE service replaces a safety encoder or a safety brake, the retraceability is ensured.

If you replace a functionally safe motor option on your own, you revoke this assignment. To continue the assignment, document the replacement yourself.

3.4 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) in accordance with IEC 62061 • Performance Level (PL) in accordance with EN ISO 13849-1

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

Safety brake

BE03 to BE32	
Safety class/ underlying standard	• Category (Cat.) in accordance with EN ISO 13849-1

Safety class SIL 3 or PL e can be achieved if a suitable functionally safe motor option is integrated into a safety system. The requirements, e.g. on the system architecture, diagnostics, and failure probabilities, are to be implemented in accordance with the normative specifications and with this documentation.

3.5 TÜV certification

The following certificate is available for the described safety brakes:

- Certificate of the TÜV NORD Systems GmbH & Co. KG

The TÜV certificate is available for download on the SEW-EURODRIVE website (www.sew-eurodrive.de).

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3.6 Safety functions

3.6.1 Safety functions safety encoder

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

The following safety functions in accordance with EN 61800-5-2 regarding speed, direction of rotation, idle state, 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

INFORMATION

For AS7W, AG7W, AS7Y, and AG7Y encoders, the absolute interface is not part of the PL d/SIL 2 approval. The absolute interface may not be used solely for implementing safety functions.

Built-in encoder EI7C FS

The following safety functions in accordance with EN 61800-5-2 regarding speed and direction of rotation can be implemented in functionally safe systems with the HTL interface of the safety encoder:

- SS1, SLS, SDI

3.6.2 Safety functions of the safety brake

The implementation of a safety function with brakes requires that the brake is applied on request. The safety function is activated when the brake is applied. The brake coil has to be de-energized and the energy stored in the brake coil reduced.

By adding a BE.. safety brake into a safe overall system, the following safety functions can be implemented:

- SBA (Safe Brake Actuation)
- SBH (Safe Brake Hold)

INFORMATION

Safety functions SBA and SBH are defined by SEW-EURODRIVE based on the standard EN 61800-5-2.

The implementation of the SBA and SBH safety functions additionally require the safety functions SBC and STO in the overall system. For safety-related requests of the brake, SBC and STO ensure that the brake applies and that the drive does not generate a torque against the applied brake.

The SBC and STO safety functions are not part of the brake and have to be additionally implemented in the overall safety system. The performance level (PL) of the SBC and STO safety functions must at least meet the required performance level (PLr) of the application.

SEW-EURODRIVE recommends to stop the drive using the stop category 1 according to EN 60204-1 prior to activating the SBC and STO safety functions.

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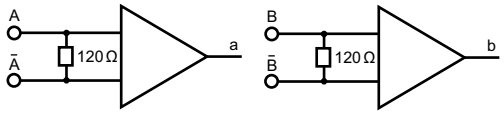
3.7 Requirements to the follow-up electronics

3.7.1 Add-on encoders: ES7S, EG7S, AS7W, AG7W, AS7Y, AG7Y

The monitoring of the sine/cosine signals for detecting the safe state is performed by the follow-up electronics. The follow-up electronics has to check the sine/cosine signals of the rotary encoder for validity. For safety-related use of the encoders, the following requirements have to be fulfilled by the follow-up electronics:

Designation	Requirement
Safety requirements	≥ SIL 2
Diagnostic coverage (DC)	≥ 90 %
Error presumptions	According to EN 61800-5-2:2016, table D.8
Monitoring of the phasor length "r"	$r = \sqrt{a^2 + b^2}$ with a = A – $\overline{A}$ for cosine signals and b = B – $\overline{B}$ for sine signals
Safe state	Phasor length "r" outside of the range 350 mV ≤ r ≤ 700 mV
Terminating resistance between A and $\overline{A}$ or B and $\overline{B}$	120 Ω ±10 % 
Terminating resistance between A, $\overline{A}$, B, $\overline{B}$ to the supply voltage and reference ground	> 1 kΩ
Scanning frequency	At least twice as high as the frequency maximally occurring in the application at the encoder signal outputs (Nyquist criterion)

If the safety encoders are connected with prefabricated encoder cables from SEW-EURODRIVE to the follow-up electronics from SEW-EURODRIVE, these requirements have been met.

3.7.2 Integrated encoders: EI7C FS

The built-in encoder EI7C FS is intended for operation with functionally safe encoder evaluation units from SEW-EURODRIVE, e.g. safety option S12 or safety card MOVISAFE® CSS..A. Operating the encoder with encoder evaluation units from other manufacturers is not permitted.

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3.8 Brake diagnostics

In applications with brakes, the braking torque represents an important criterion for the functionality of the brake. In the event of a reduction in or loss of braking torque, the correct functionality of the application is no longer ensured. As a result, the safety of the machine and/or even the safety of persons may be decreased. To prevent this from happening, the brake can optionally be checked using brake diagnostics. Brake diagnostics provides the user with information about the status and performance capability of the brake. This allows you to detect potential errors in time and initiate maintenance/repair.

Brake diagnostics may be required by standards, particularly in safety-related applications in accordance with EN ISO 13849 in which a safety function is implemented using a brake. The diagnostic coverage level (DC_{avg}) required by standards must be fulfilled depending on the required Performance Level (PL). The diagnostic coverage is a key figure of the implemented brake diagnostics.

Brake diagnostics must detect the following possible failures separately for each brake:

- Brake is not applied.
- Insufficient braking torque.

To prevent faulty diagnostic results, SEW-EURODRIVE recommends to additionally diagnose the potential failure "Brake does not release".

Brake diagnostics is not part of the brake and must be implemented within the system. SEW-EURODRIVE offers the brake diagnostics solution e.g. as software for the controller of the performance classes advanced/power. Brake diagnostics fulfills the regulatory requirements and allows for solutions in up to performance level e (PL e).

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3.9 Motor combinations

3.9.1 Safety encoders

The safety encoders described below are intended for use with DR.., DRN.., DR2.., EDR.., and EDRN.. motors. It is not permitted to mount them on other motors.

Safety encoders on the DR.., DRN.. AC motor

Motors	Encoder	Part number	
		without	with
		Connection cover	
DR..71 – DR..132 DRN80 – DRN132S	ES7S	13642715	13642898
	AS7W	13643878	13643916
	AS7Y	13643851	13643908
DR..160 – DR..280 DRN132M – DRN280	EG7S	13642782	13642952
	AG7W	13643886	13643924
	AG7Y	13643894	13643932

Motors	Encoder	Part number
DR..71 – DR..132 DRN71 – DRN132S DR2..71 – 80	EI7C FS	Ordering with part number not possible

Safety encoders on the EDR.., EDRN.. explosion-proof AC motor

Motors	En-coders	Part number	
		without	with
		connection cover	
EDR..71 – EDR..132 EDRN80 – EDRN132S	ES7S	13642715	13642898
	AS7W	13643878	13643916
	AS7Y	13643851	13643908
EDR..160 – EDR..280 EDRN132M – EDRN280	EG7S	13642782	13642952
	AG7W	13643886	13643924
	AG7Y	13643894	13643932

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3.9.2 Safety brake

Motor combinations with BE.. brake

Depending on the demands placed on the brake, different brake mounting sizes with different braking torque steps are available for mounting to the respective motor.

The following tables show the possible combinations of motor and brake as well as the braking torque steps for each brake to achieve the desired nominal braking torque:

DR.. EDR..	–	71	80	–	90 100	112 132	160	180	200 225	250 280	315
DRN.. EDRN..	63	71	80	90	100	112 132S	132M 132L	160 180	200 225	250 280	315
DR2..	63	71	80	–	–	–	–	–	–	–	–
BE03											
BE05											
BE1											
BE2											
BE5											
BE11											
BE20											
BE30											
BE32											
BE60											
BE62											
BE120											
BE122											

Design not available as safety brake.

Design available as safety brake.

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Braking torque graduations

Depending on the demands placed on the brake, different braking torque graduations are available depending on the brake size.

The following table shows the available graduations:

Brake (M_{Bmax})	BE03 (3.4 Nm)	BE05 (5 Nm)	BE1 (10 Nm)	BE2 (20 Nm)	BE5 (55 Nm)	BE11 (110 Nm)	BE20 (200 Nm)
Available stages for M_B							
0.9	X						
1.3	X						
1.7	X						
1.8		X					
2.1	X						
2.5		X					
2.7	X						
3.4	X						
3.5		X					
5		X	X	X			
7			X	X			
10			X	X			
14				X	X		
20				X	X	X	
28					X	X	
40					X	X	X
55					X	X	X
80						X	X
110						X	X
150							X
200							X

Brake (M_{Bmax})	BE30 (300 Nm)	BE32 (600 Nm)
Available stages for M_B		
75	X	
100	X	X
150	X	X
200	X	X
300	X	X
400		X
500		X
600		X

X	Available
X	Not available for BE.. safety brake.

INFORMATION

Note that for the BE.. safety brake, some of the reduced braking torque steps are not available in combination with the manual brake release option. It may be necessary to contact SEW-EURODRIVE.

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3.10 Validation

The system manufacturer has to perform an overall evaluation for determining the safety of a machine.

The effectiveness of each risk minimization must be checked. It must also be checked if the required safety integrity (SIL and/or PL) is reached for each implemented safety function.

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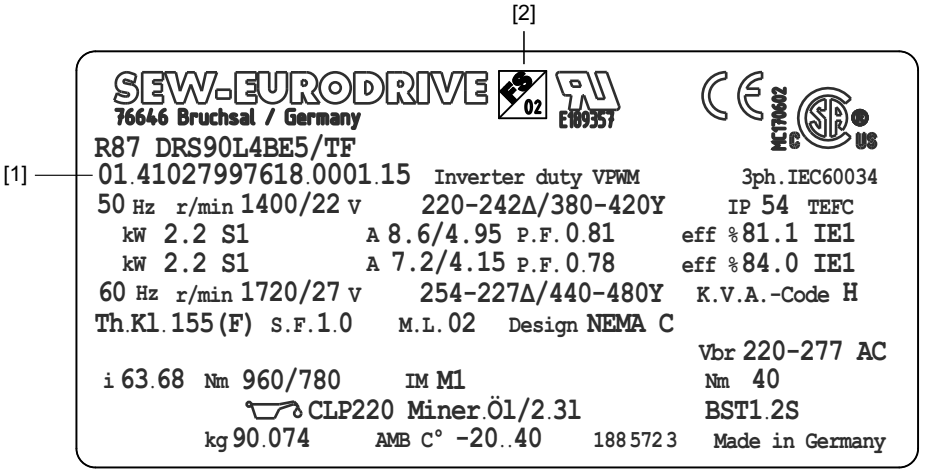
4 Motor structure

4.1 Nameplates

4.1.1 Motor

The following figure shows an example motor nameplate with FS logo:

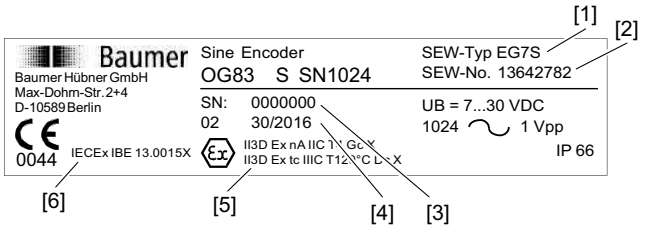


36028799560131851

[1] Motor serial number
[2] FS logo for functional safety

4.1.2 Safety encoder

The following figure shows an example encoder nameplate of a safety encoder:



20389449739

[1] Type designation
[2] Part number
[3] Serial number
[4] Date of manufacturing (ww/yyyy)
[5] IECEx information
[6] IECEx certificate number

The nameplate of a safety encoder does not show an FS logo. The design for functional safety has to be identified using the motor nameplate, see chapter "FS mark" (→ 🗎 11).

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4.1.3 Safety brake

The following figure shows an example self-adhesive label of a safety brake with FS logo:

9007203740398475

[1] Identification number of the brake:
- 0001.: Plant
- 123456789012.: Serial number of the brake
- 160112: Date of production (DDMMYY)

[2] Assembly order number
[3] Brake and brake size
[4] Data matrix
[5] FS logo

5 Mechanical installation

INFORMATION

Note that greases and oils must not be allowed on the mechanical connections of the safety components during assembly or operation.

5.1 Manual brake release

If the manual brake release was ordered, the manual brake release is installed and set at the factory.

INFORMATION

The brake option manual brake release /HF is not permitted and must not be retrofitted.

The manual brake release /HR must not be retrofitted, see corresponding operating instructions.

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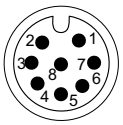
6 Electrical installation

INFORMATION

SEW-EURODRIVE recommends using prefabricated cables from SEW-EURODRIVE to connect the safety encoders.

6.1 Connecting the EI7C FS encoder

There is an 8-pin M12 plug connector on the terminal box for connection.

M12 AVRE				
male, A-coded 	Pin 1:	$+U_B$	Pin 5:	B
	Pin 2:	GND	Pin 6:	$\overline{B}$
	Pin 3:	A	Pin 7:	nc
	Pin 4:	$\overline{A}$	Pin 8:	nc

INFORMATION

Pins 7 and 8 must **not** be used.

The encoder cable must meet the following requirements:

- Maximum cable length: 100 m. The cable length may be limited by the encoder evaluation unit.
- Minimum core cross section: 0,25 mm^2.
- The cable must be shielded. The shield must be connected over a large surface area at both ends.
- The cable must have twisted-pair conductors.

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6.2 EI7C FS visual feedback

The LED display, which is visible when the fan guard is removed, provides visual feedback about the signal track state.

A red LED and a green LED are used as a status display for the EI7C FS safety encoder.

- The **green** LED indicates the current status.
- The **red** LED is used to display the error history by means of a flash code.

The error history always displays the most recent errors since the last time the encoder was switched on.

6.2.1 Indicating the normal state

During normal operation, the green status LED lights up constantly. Usually, no error has occurred and the red error history LED is off. If an error already occurred before the current normal operating state, this is indicated by the flash code on the red LED described below.

6.2.2 Indicating an internal diagnostics error

The EI7C FS encoder has a self-diagnostics system. If this diagnostics system has an error, the encoder enters an error status. The error can be reset by switching off the supply voltage and then switching it back on.

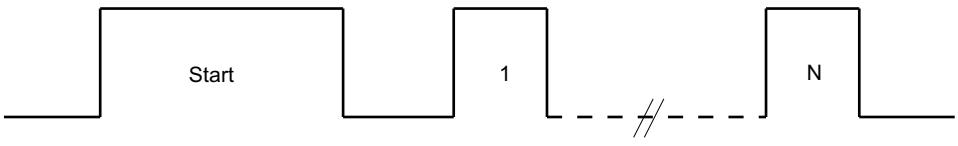
6.2.3 Indicating service mode

If the encoder is supplied with a defined voltage range below the regular supply voltage range during startup, the encoder automatically goes into service mode. The output drivers are switched off. The red error history LED indicates service mode by lighting up constantly. The green status LED reports the distance between the encoder module and the fan wheel.

Any service work necessary on the encoder may only be performed by SEW-EURODRIVE employees.

6.2.4 Indicating error statuses

The start of an error code is indicated by a long pulse (START). The number of brief flash pulses indicates the most recent error since the encoder was switched on. The long START signal does not count as part of this number. The figure shows the structure of the flash code. The "Normal operation" (→ 🗎 25) table provides an overview of possible error statuses and the defined LED signals for these statuses.



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6.2.5 LED codes for the operating statuses

Normal operation

Displayed status	Green LED (status)		Red LED (error)
No voltage or defective	OFF		OFF
Internal diagnostics error	ON		ON
No error	ON		OFF
No errors at the moment. Most recent error is displayed.	ON		Error code
An error has occurred. Most recent error is displayed.	OFF		Error code
		Temperature error	1×
		Supply voltage error	2×
		Analog signal error	3×
		Error in digital track A or B	4×
		Distance difference error	5×
		Output driver error	6×

Service operation/setup mode

Status	Meaning	Green LED	Red LED
Service operation/setup mode (Defined voltage range while switching on)	Amplitude OK	OFF	ON
	Amplitude is too high	Flashes (approx. 2 Hz)	ON
	Amplitude is too low	Flashes (approx. 0.5 Hz)	ON

6.3 Temperature sensor /TF

If you use a safety brake, you must also use and evaluate the temperature sensor /TF.

INFORMATION

If several motors with safety brake are operated with one frequency inverter (multi-motor operation), an external switching device for monitoring the temperature sensor /TF is necessary.

6.4 Brake control

The brake is released electrically. The brake applies after the voltage is switched off. The braking or stopping takes place mechanically.

These voltage disconnection types are distinguished:

- Functional control

  Control of the brake outside functional safety.

- Safe control

  Control of the brake for the use in functional safety.

6.5 Permitted brake controls

The supply of the safety brake must be achieved by a brake control. There are several designs for this purpose which are either designated for installation in the motor wiring space or for installation in the control cabinet. The following supply types are **not permitted** for BE.. safety brake:

- Operation without brake control (DC direct voltage supply)
- Operation with third-party control
- Supply via motor terminal board (direct wiring)

For permitted brake controls, refer to chapter "Technical data" (→ 🗎 41). Connection may only be performed according to the valid wiring diagram enclosed.

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7 Inspection/maintenance

7.1 Safety encoder

Certain demands on the mechanical coupling of the encoder system to the motor must be met so that the encoder can be used for safety-relevant tasks.

With the EI7C FS built-in encoder, no work may be performed on the encoder. Order the SEW-EURODRIVE service to perform any necessary work on the encoder.

The following options are available for performing work on all add-on encoders in safety design or on the motor when the sealed connections need to be opened:

- Order the SEW-EURODRIVE service to perform this work.
- You perform the work yourself.

  Note that all work on the safety encoder and its mechanical coupling is carried out at your own risk. The operator is responsible and liable for the proper fulfillment of the work. The operator has to ensure the traceability of the performed changes regarding functional safety. In case of proven compliance with the activities described in the operating instructions, the characteristics regarding functional safety described by the manufacturer are maintained.

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7.2 Removing/installing the encoder

⚠ WARNING

Loss of the safety functions due to a faulty mechanical connection between the motor and the encoder.

Severe or fatal injuries

- To ensure the exclusion of any errors in the mechanical connection between the drive component and the encoder, comply with the following points in accordance with EN 61800-5-2:

→ Proper (dis)assembly in accordance with this documentation.

→ Exchange of worn or damaged components.

→ Compliance with the tightening torques specified in this document.

7.2.1 Required tools

You need the following tools to assemble and disassemble the encoders. Make sure that all the tools are available before you remove/install an encoder.

- For the encoders ES7S, AS7W, AS7Y, a new expansion anchor (part number: 13617311)
- NOCO® fluid (part number: 09107819)
- Loctite® 241
- Various sizes of hollow hexagon wrenches
- Various sizes of external hexagon wrenches
- Torque wrench for tightening torques of 2.0 Nm to 8.0 Nm
- Sensor for measuring the wobble with a measuring range in the 1/100-mm range (for (E)DR..80 – 132, (E)DRN80 – 132S motors only)

7.2.2 Removing the encoder

A detailed description of the disassembly of the encoder can be found in the operating instructions of the motor.

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7.2.3 Reassembly

A detailed description can be found in the operating instructions of the motor. In the case of safety encoders, please note the following working steps and the tightening torques specified in the table.

- **.S7./.G7. encoders:** Apply NOCO® fluid to the encoder pins.
- **AS7./ES7. encoders:** Place a new expansion anchor [362] at the torque bracket of the encoder [220].
- **AG7./EG7. encoders:** Clean the threads of the retaining screw on the torque bracket [232] and apply Loctite® 241 to the screws.

Item no.	Description	ES7S AS7W AS7Y	EG7S AG7W AG7Y
		Tightening torque in Nm	
[B]	Central retaining screw	2.75 ±10 %	8 ±5 %
[A]/[232]	Retaining screws on the torque bracket	2.25 ±10 %	6 ±10 %
[619]	Connection cover screws	2.25 ±10 %	2.25 ±10 %

In the case of the ES7. and AS7. encoders, perform a wobble measurement in accordance with the section "Measuring wobbling" (→ 🗎 29).

7.3 Measuring wobbling

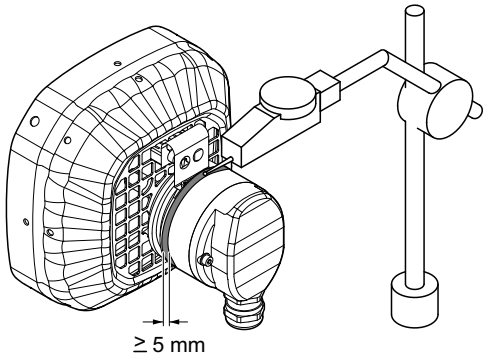
Fault exclusion of the mechanical motor-encoder connection according to EN 61800-5-2 requires that the encoder is seated properly. Wobbling must be measured each time an ES7S, AS7W, or AS7Y encoder is installed to ensure it is seated properly.

In the case of the EG7S, AG7W, and AG7Y encoders, no wobble measurement is necessary because the correct seating of the encoder is ensured by design.

Measure wobbling as described in the following section.

7.3.1 Encoders for (E)DR..71 – 132, (E)DRN80 – 132S

1. Place the sensor on the upper edge of the encoder as shown in the figure below.



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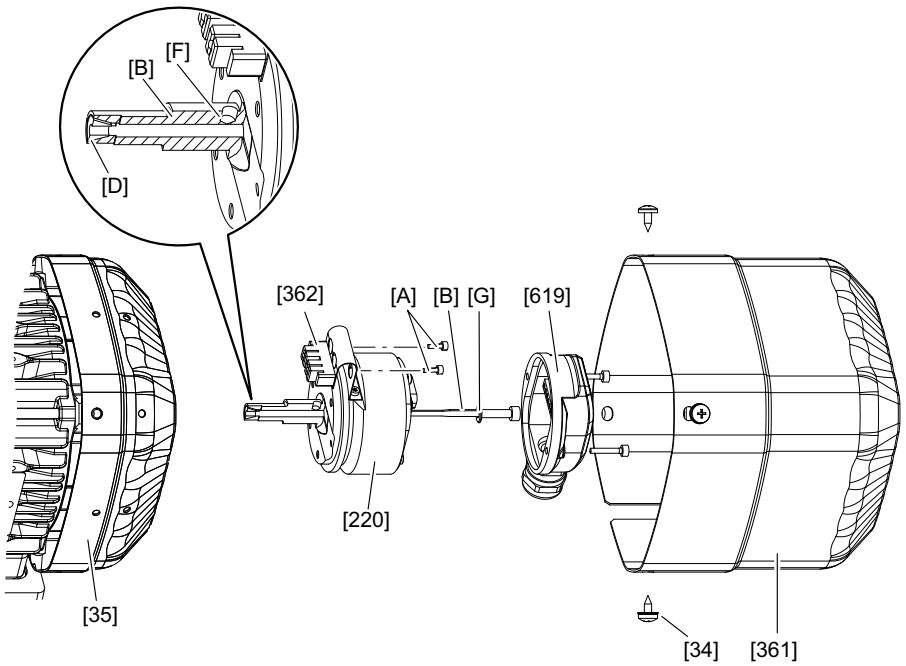
2. The measurement must be carried out within the marked zone (maximum width = 5 mm).

3. Turn the motor shaft. If required, start up the motor at low speed (< 60 min^{-1}).
4. Check the wobble on the sensor.
   ⇨ The maximum permitted wobble on the encoder must be ≤ 0.07 mm when turning the motor shaft.

Measured value exceeded



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[34] Tapping screw
[35] Fan guard
[220] Encoder
[361] Safety cover
[362] Expansion anchor
[619] Connection cover
[A] Retaining screws on the torque bracket
[B] Central retaining screw
[D] Cone
[F] Bore
[G] Tooth lock washer

Repeat the check if the measured value is exceeded. Proceed as follows:

1. Loosen the screws of the connection cover [619] and remove it. Do not disconnect the encoder cable.
2. Make sure the cone [D] doesn't fall out while the central retaining screw [B] is loosened. Loosen the central retaining screw [B] by 2 – 3 turns. Loosen the cone [D] by tapping lightly onto the screw head.
3. Turn the motor shaft or the encoder shaft at the bore [F] by 120°.
4. Tighten the central retaining screw [B] with the inserted tooth lock washer [G].
   ⇨ Tightening torque 2.75 Nm.
   ⇨ Tolerance ±10 %.
5. Screw on the connection cover [619].
   ⇨ Tightening torque 2.25 Nm.
   ⇨ Tolerance ±10 %.
6. Repeat the wobble measurement.

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INFORMATION

If it is not possible to carry out the measurement below the permitted wobble, contact the SEW-EURODRIVE Service.

7.4 Inspection and maintenance intervals

Inspect and service the safety brake according to the projected inspection and maintenance intervals or every 0.5 to 2 years depending on the load conditions.

If a diagnostic unit /DUE is used, the wear output of the evaluation unit indicates whether brake maintenance is required. You may use the analog signal which is proportional to the air gap to plan brake maintenance.

INFORMATION

The amount of wear depends on many factors and may therefore be high. The system manufacturer must determine the required inspection/maintenance intervals individually in accordance with the project planning documents.

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7.5 Safety brake

INFORMATION

SEW-EURODRIVE recommends ordering the SEW-EURODRIVE service to carry out the maintenance work.

If you perform maintenance work yourself, the responsibility and the liability for the proper fulfillment of the work described in the relevant documentation is passed to the user; see the section Functional safety.

Type of work	Work permitted?	Comments
Replacing safety brake.	Yes	Replacement with structurally identical safety brake incl. options. Deviating product designs require a check of the configuration as well as the suitability for the relevant application.
Replacing existing BE.. brake with BE.. safety brake.	No	Contact SEW-EURODRIVE.
Changing the braking torque.	Yes	Replacement of safety brake necessary.
Checking and correcting the air gap, if necessary.	Yes	Observe minimum permitted brake disk thickness. See the section "Working air gap" (→ 🗎 47).
Replacing individual parts of the BE.. safety brake.	Yes	Replacement of the following individual parts is permitted: • Sealing strip [66] • Clamping strap [157], if necessary • Sealing ring [95] • Hex nut [61]
Replacing driver.	Yes	–
Retrofitting manual brake release /HR.	No	Contact SEW-EURODRIVE.
Replacing manual brake release /HR.	Yes	–
Retrofitting diagnostic unit /DUE.[1)]	Yes	Replacement of safety brake necessary.
Replacing diagnostic unit /DUE.[1)]	Yes	–
Retrofitting brake monitoring /DUB.[1)]	Yes	Replacement of safety brake necessary.
Replacing brake monitoring /DUB.[1)]	Yes	–

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Type of work	Work permitted?	Comments
Setting brake monitoring /DUB (switching point).[1)]	Yes	–

1) Insofar as the option is available.

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7.6 Preliminary work for motor and brake maintenance

7.6.1 General information

Proceed as described in the respective documentation to remove and install the encoder/safety encoder and/or forced cooling fan.

Before you complete the maintenance work, restore all protection devices at the drive.

INFORMATION

Observe the following points for inspection and maintenance:

- When replacing the safety brake due to a defect of the brake coil, always replace the brake control as well.
- Observe the information in the respective operating instructions.

INFORMATION

For all numbers of spare parts needed during maintenance work (e.g. screws [900]), refer to the respective exploded view drawings in the relevant operating instructions.

7.6.2 Wearing parts

NOTICE

Use of incorrect wear parts or a brake differing from the original.

Loss of the safety function.

- Replace the brake only with an identical brake including all options as delivered from SEW-EURODRIVE.

If the brake is replaced, replace the following wear parts:

- Screws [900] (only (E)DRN71 with BE03, (E)DR..90 – 225, (E)DRN90 – 225)
- Gasket [392] (only (E)DR..71 – 80, (E)DNR71 – 80)
- Sealing ring [95]
- O-ring [901] (only (E)DR..160 – 225, (E)DRN132M – 225)

  Gasket [901] (only (E)DR..90 – 132, (E)DRN63 – 71, (E)DRN90 – 312S)
- Motor tie rods [13] (only (E)DR..71 – 80, (E)DRN71 – 80)

In case of visible wear or damage to the driver, also replace the following parts:

- Driver [70]
- Key [71]
- Retaining ring [62]

Order these wear parts from SEW-EURODRIVE prior to the brake replacement.

INFORMATION

To order the correct design of the brake and the wear parts, the item number of the spare and/or wearing parts and the serial number of the drive (see motor nameplate) are required.

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7.6.3 Order information for operating supplies and auxiliary material for maintenance

The following table lists the various operating supplies and auxiliary materials that are required for correct maintenance.

Use	Manufacturer	Operating supply/auxiliary material	Part number	Quantity	Place of use	Motors
Sealing compound	Marston-Domstel	SEW-L-Spezial	09112286	80 g	[550]	All designs
Thread locking compound	Henkel	Loctite® 241	–	–	[13]	(E)DR..71 – 80 (E)EDRN63 – 80 DR2..63 – 80
					[900]	(E)DR..90 – 160 (E)DRN90 – 132L
		Loctite® 243	–	–	[900]	(E)DR..180 – 225 (E)DRN160 – 225
Anti-corrosion agent	SEW-EURODRIVE	NOCO® fluid	09107819	5.5 g	[70]	All designs

Observe the operating instructions for the particular motor regarding the lubrication of the radial oil seals on the motor and of the motor rolling bearings.

7.6.4 Identification of safety encoder

If the drive is equipped with an encoder, you must remove it prior to the motor and brake maintenance.

Please note that the work steps for an encoder with safety technology (safety encoder) differ from an encoder without safety technology (standard encoder).

For this reason, check the FS logo on the motor nameplate, to find out if it is a safety encoder and observe the corresponding documentation:

- **Drive with safety encoder** = FS 04, FS 07, FS 11

  Proceed as described in this addendum to the operating instructions to remove and install the encoder.

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7.7 Working steps for inspecting (E)DR..71 – 315, (E)DRN63 – 315, DR2..63 – 80 brakemotors

INFORMATION

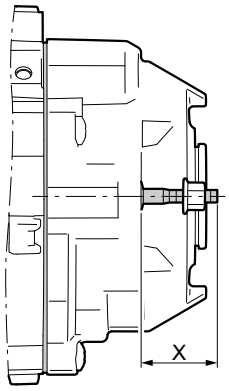
If the drive is equipped with surface protection and corrosion protection, you must reestablish those measures after any work on the drive.

7.7.1 Measuring the working air gap of BE03 brakes

The working air gap cannot be adjusted. The working air gap can only be measured via the stroke of the pressure plate when the brake is released.

✓ Disconnect the motor and all mounted options from the power supply before starting to work, and secure the motor against unintentional power-up.

1. Measure the working air gap X of the BE03 brake using a depth gauge or a slide gauge at the stroke of the studs.



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⇨ The maximum permitted working air gap is 0.65 mm. Replace the brake in case this value is exceeded.

7.7.2 Setting the working air gap of brakes BE05 – BE32

✓ Disconnect the motor and all mounted options from the power supply before starting to work, and secure the motor against unintentional power-up.

✓ First identify if a safety encoder is present. Refer to the section "Identification of safety encoder" (→ 🗎 35) for further information.

1. If present, remove the fan guard [35], the forced cooling fan [170], and the encoder [220].
2. Shift the sealing strip [66]. To do so, release the clamping straps [157] if necessary.

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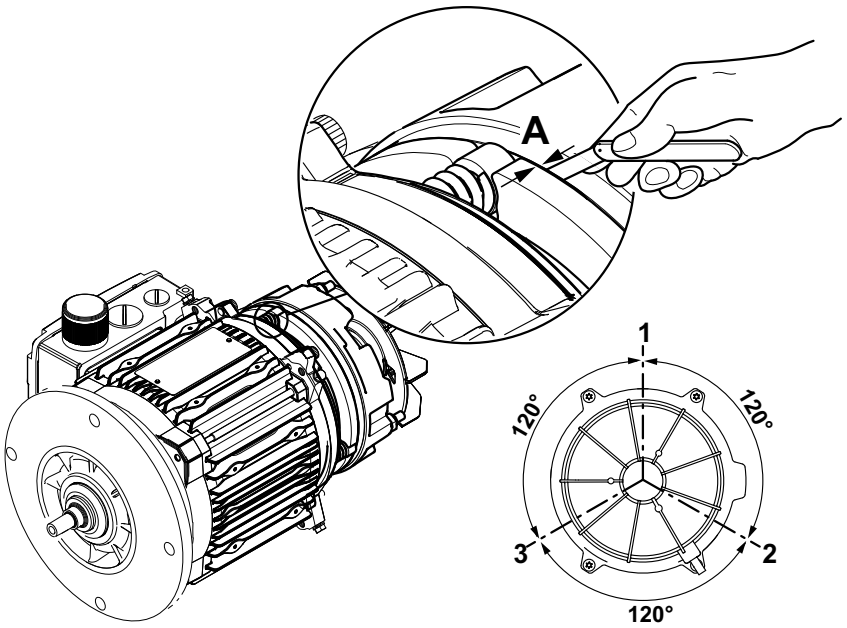
3. Measure the working air gap A with a feeler gauge according to the figure at 3 points offset by 120°.



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4. Gather the correct values from the section "Switching work, working air gap, braking torques of the safety brakes" (→ 🗎 47).
   ⇨ If the correct value for the working air gap is exceeded or too low, correct it according to the documentation or contact the SEW-EURODRIVE Service to set the working air gap correctly.
5. Remove the brake abrasion.
6. Install the sealing strip [66] and, if necessary, the clamping straps [157].
7. Install the fan guard [35] or the forced cooling fan [170].
8. Install the disassembled parts.

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7.8 Brake exchange

A precise description of the brake exchange can be found in the relevant operating instructions. In the case of safety brakes, observe the following tightening torques and use Loctite® to lock the threads.

Motors	Screw	Tightening torque in Nm[1)]	Loctite®
(E)DRN63 – 71 DR2..63 – 71	M5	5	241
(E)DR..71 – 80 (E)DRN80	M5	5	241
(E)DR..90 – 100 (E)DRN90 – 100	M6	10.3	241
(E)DR..112 – 132 (E)DRN112 – 132S	M8	25.5	241
(E)DR..160 (E)DRN132M/L	M8	25.5	241
(E)DR..180 (E)DRN160 – 180	M10	50	243
(E)DR..200 – 225 (E)DRN200 – 225	M12	87.3	243

1) Tolerance ±10 %

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7.9 Diagnostic unit /DUE for function and wear monitoring

The evaluation unit has a 5-pin DIP switch that is labeled with the numbers 1 to 5. Use it to set the measuring range and the maximum permitted wear limit (maximum working air gap).

To activate the DIP switch ≙1, push the switch upwards. To deactivate the DIP switch ≙ 0, push the switch downwards.

The table in the section "DIP switch setting values for option /DUE" (→ 🗎 40) shows the DIP switch settings of the evaluation unit for the maximum working air gap if a safety brake is present.

1. Check the set value. Correct the setting value according to the following tables, if necessary.
2. Check the setting values of the DIP switches and calibrate the infinite value again, if necessary. Refer to the corresponding operating instructions for detailed instructions.

INFORMATION

Set the DIP switch only in a de-energized state.

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7.9.1 DIP switch setting values for option /DUE

The following tables show the setting values of the DIP switches for the option /DUE when the brake is designed as a safety brake or in combination with a safety encoder.

S1	S2	S3	S4	S5	Wear limit	BE1 – 2	BE5
Sensor Ø 6 mm							
0	**0**	**0**	**0**	**0**	1.2 mm		
0	**0**	**0**	**0**	**1**	1.1 mm		
0	**0**	**0**	**1**	**0**	1.0 mm		
0	**0**	**0**	**1**	**1**	0.9 mm		
0	**0**	**1**	**0**	**0**	0.8 mm		
0	**0**	**1**	**0**	**1**	0.7 mm		X
0	**0**	**1**	**1**	**0**	0.6 mm	X	
0	**0**	**1**	**1**	**1**	0.5 mm		

S1	S2	S3	S4	S5	Wear limit	BE11 – 30	BE32
Sensor Ø 8 mm							
1	**0**	**0**	**0**	**0**	1.2 mm		
1	**0**	**0**	**0**	**1**	1.1 mm		
1	**0**	**0**	**1**	**0**	1.0 mm		
1	**0**	**0**	**1**	**1**	0.9 mm		
1	**0**	**1**	**0**	**0**	0.8 mm		X
1	**0**	**1**	**0**	**1**	0.7 mm	X	
1	**0**	**1**	**1**	**0**	0.6 mm		
1	**0**	**1**	**1**	**1**	0.5 mm		

S1	S2	S3	S4	S5	Wear limit	BE60	BE62 – 120	BE122
Sensor Ø 8 mm								
1	**0**	**0**	**0**	**0**	1.2 mm			
1	**0**	**0**	**0**	**1**	1.1 mm			
1	**0**	**0**	**1**	**0**	1.0 mm			
1	**0**	**0**	**1**	**1**	0.9 mm			X
1	**0**	**1**	**0**	**0**	0.8 mm		X	
1	**0**	**1**	**0**	**1**	0.7 mm	X		
1	**0**	**1**	**1**	**0**	0.6 mm			
1	**0**	**1**	**1**	**1**	0.5 mm			

X Factory setting

Setting possible in addition

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8 Technical data

8.1 Safety encoder

8.1.1 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 and the library are available for download from www.sew-eurodrive.de.

Characteristic safety values ES7S, EG7S

	Characteristic safety values according to	
	EN 62061/IEC 61508	**EN ISO 13849-1**
Classification/underlying standards	SIL2	PL d
System structure	HFT = 1	2-channel (Cat. 3)
PFH_d value[1)] (**without** mounting on 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 on the motor)	–	1306 years ($T_{amb} \leq 45$ °C) 895 years ($T_{amb} \leq 60$ °C)
PFH_d value[1)] (**with** mounting on the motor; takes into account 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 on the motor; takes into account 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**
Classification/underlying standards	SIL2	PL d
System structure	HFT = 1	2-channel (Cat. 3)
PFH_d value[1)] (**without** mounting on the motor)	9.3×10^{-9} 1/h = 9.3 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 on the motor)	–	1155 years ($T_{amb} \leq 45$ °C) 753 years ($T_{amb} \leq 60$ °C)
PFH_d value[1)] (**with** mounting on the motor; takes into account 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 on the motor; takes into account 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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8.1.2 Encoders

ES7S, EG7S, AS7Y, AG7Y, AS7W, AG7W

Designation		Value
Operating temperature of encoder		-30 °C – +85 °C
Ambient temperature of motor	DR.., EDR..	-30 °C – +40 °C
	DR2.., DRN.., EDRN..	-30 °C – +60 °C
Storage temperature		-15 °C – +70 °C
Maximum speed		6000 1/min
Vibration resistance (EN 60068-2-6)		≤ 100 m/s² ≈ 10 g (at 10 Hz to 2 kHz)
Maximum angular acceleration		10^4 rad/s²
Degree of protection (EN 60529)		IP66

ES7S, EG7S

Designation	Value
Operating voltage	DC 7 V – 30 V
Max. current consumption	ES7S: 140 mA
	EG7S: 140 mA
Resolution	sin/cos interface
	1024 periods/revolution
Accuracy	0.0194 ° (70 angular seconds)[1]
Shock resistance (EN 60068-2-27)	ES7S: ≤ 1000 m/s² ≈ 100 g (6 ms)
	EG7S: ≤ 2000 m/s² ≈ 200 g (6 ms)
Duration until fault message[2] (deactivated outputs)	25 ms

1) Due to the stiffness of the torque bracket, you have to take into account an automatically resetting ±0.6 ° twist (depending on the direction of rotation) of the encoder housing compared to the encoder shaft.
2) The ES7S and EG7S sine/cosine 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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AS7Y, AG7Y

Designation	Value
Operating voltage	DC 7 V – 30 V
Max. current consumption	AS7Y: 150 mA
	AG7Y: 150 mA
Resolution of the incremental section	sin/cos interface
	2048 periods/revolution
Accuracy of the incremental section	0.0194 ° (70 angular seconds)[1]
Resolution of the absolute section	SSI interface, gray-coded
	12 bit = 4096 revolutions (single-turn)
	12 bit = 4096 revolutions (multi-turn)
Accuracy of the absolute section	±1 LSB (Least Significant Bit)
Clock frequency of the absolute section	100 kHz to 800 kHz
Shock resistance (EN 60068-2-27)	AS7Y: ≤ 1000 m/s^2 ≈ 100 g (6 ms)
	AG7Y: ≤ 2000 m/s^2 ≈ 200 g (6 ms)
Duration until fault message[2] (deactivated outputs)	25 ms + 3/4 revolution

1) Due to the stiffness of the torque bracket, you have to take into account an automatically resetting ±0.6 ° twist (depending on the direction of rotation) of the encoder housing compared to the encoder shaft.
2) The AS7Y and AG7Y absolute 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.

AS7W, AG7W

Designation	Value
Operating voltage	DC 7 V – 30 V
Max. current consumption	AS7W: 140 mA
	AG7W: 140 mA
Resolution of the incremental section	sin/cos interface
	2048 periods/revolution
Accuracy of the incremental section	0.0194 ° (70 angular seconds)[1]
Resolution of the absolute section	RS485 interface
	13 bit = 8192 revolutions (single-turn)
	16 bit = 65 536 increments (multi-turn)
Accuracy of the absolute section	±1 LSB (Least Significant Bit)
Shock resistance (EN 60068-2-27)	AS7W: ≤ 1000 m/s^2 ≈ 100 g (6 ms)
	AG7W: ≤ 2000 m/s^2 ≈ 200 g (6 ms)
Duration until fault message[2] (deactivated outputs)	25 ms + 3/4 revolution

1) Due to the stiffness of the torque bracket, you have to take into account an automatically resetting ±0.6 ° twist (depending on the direction of rotation) of the encoder housing compared to the encoder shaft.
2) The AS7W and AG7W absolute 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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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.

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8.2 Safety brake

8.2.1 Braking work until maintenance

	Braking work BE.. brake until inspection (W_{insp}) 10^6 J		Braking work BE.. safety brake until inspection (W_{insp}) 10^6 J	
FS code	**–**	**FS04, FS07**	**FS02**	**FS11**
Brake				
BE03	200	200	200	200
BE05	120	120	120	120
BE1	120	120	120	120
BE2	180	180	180	180
BE5	390	270	270	270
BE11	640	285	285	285
BE20	1000	445	445	445
BE30	1500	670	670	670
BE32	1500	670	670	670
BE60	2500	1100	–	–
BE62	2500	1100	–	–
BE120	390	200	–	–
BE122	300	200	–	–

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8.2.2 Working air gap

The following values apply when the brake is designed as a safety brake or to brakes in combination with a safety encoder.

Brake	Working air gap mm		Brake lining carrier mm
	min.[1]	max.	min.
BE03	0.25	0.65	–[2]
BE05	0.25	0.6	11
BE1	0.25	0.6	11
BE2	0.25	0.6	11
BE5	0.25	0.7	11
BE11	0.3	0.7	12.5
BE20	0.3	0.7	12.5
BE30	0.3	0.7	12.5
BE32	0.4	0.8	12.5
BE60[3]	0.3	0.7	14.0
BE62[3]	0.4	0.8	14.0
BE120[3]	0.6	0.8	14.0
BE122[3]	0.8	0.9	14.0

1) When checking the working air gap, note: After a test run, parallelism tolerances on the brake lining carrier may give rise to deviations of ±0.15 mm.
2) The brake lining carrier of the BE03 cannot be replaced. Replace the brake when the maximum working air gap is reached.
3) Brake not available as a safety brake.

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8.2.3 Safety characteristics

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 and the library are available for download from www.sew-eurodrive.de.

Characteristic safety values for BE.. safety brakes

	Characteristic safety values according to EN ISO 13849-1	
Classification	Category 1	
System structure	1-channel (Cat. 1)	
Operating mode	High demand	
Safe state	Brake applied	
Safety functions	Safe brake actuation (SBA)	
	Safe brake hold (SBH)	
Service life	20 years or T_{10D} value (depending on which value occurs first)	
T_{10D} value	0.1 × $MTTF_D$	
$MTTF_d$ value	Calculation via B_{10D} value	
B_{10d} value	BE03	$24×10^6$
	BE05	$20×10^6$
	BE1	$16×10^6$
	BE2	$12×10^6$
	BE5	$10×10^6$
	BE11	$8×10^6$
	BE20	$5×10^6$
	BE30	$3×10^6$
	BE32	$3×10^6$

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8.2.4 Brake controls

Combinations of brake controls

The tables below show the standard and optional combinations of safety brake and brake rectifiers.

Installation in control cabinet

Type designation	Voltage range V	BE03	BE05 BE1	BE2	BE5	BE11	BE20	BE30 BE32
BST 0.6S	AC 460	X	X	X	X	X	X	X
BST 0.7S	AC 400	X	X	X	X	X	X	X
BST 1.2S	AC 230	X	X	X	X	X	X	X
BMS 1.4	AC 230 – 575	•	•	•	–	–	–	–
BMS 1.5	AC 150 – 500	•	•	•	–	–	–	–
BMS 3	AC 24 – 150	•	•	•	–	–	–	–
BME 1.4	AC 230 – 575	•	•	•	•	•	•	•
BME 1.5	AC 150 – 500	•	•	•	•	•	•	•
BME 3	AC 42 – 150	•	•	•	•	•	•	•
BMP 1.4	AC 230 – 575	•	•	•	•	•	•	•
BMP 1.5	AC 150 – 500	•	•	•	•	•	•	•
BMP 3	AC 42 – 150	•	•	•	•	•	•	•
BMK 1.4	AC 230 – 575	•	•	•	•	•	•	•
BMK 1.5	AC 150 – 500	•	•	•	•	•	•	•
BMKB 1.5	AC 150 – 500	•	•	•	•	•	•	•
BMK 3	AC 42 – 150	•	•	•	•	•	•	•
BMH 1.4	AC 230 – 575	•	•	•	•	•	•	•
BMH 1.5	AC 150 – 500	•	•	•	•	•	•	•
BMH 3	AC 42 – 150	•	•	•	•	•	•	•
BMV 5	DC 24	•	•	•	•	•	•	–

X Standard version
• Selectable
– Not permitted

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Installation in the motor wiring space

Type designation	Voltage range V	BE03	BE05 BE1	BE2	BE5	BE11	BE20	BE30 BE32
BG 1.2	AC 90 – 500	X	–	–	–	–	–	–
BG 1.4	AC 230 – 575	–	•	•	–	–	–	–
Size 1.5	AC 150 – 500	–	•	•	–	–	–	–
BG 2.4	AC 24 – 90	X	–	–	–	–	–	–
BG 3	AC 42 – 150	–	•	•	–	–	–	–
BGE 1.4	AC 230 – 575	–	•	•	•	•	•	•
BGE 1.5	AC 150 – 500	–	•	•	•	•	•	•
BGE 3	AC 42 – 150	–	•	•	•	•	•	•
BSG	DC 24	–	•	•	•	•	•	–
BS 24	DC 24	–	•	•	–	–	–	–

X Standard version
• Selectable
– Not permitted

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9 Checklists

The checklists allow you to document the performed and safety-related tasks when exchanging a safety brake or safety encoder. The checklist for brake assembly applies only to motors of size 80 or higher. The checklist for encoder assembly applies to motors of all sizes.

9.1 Checklist for encoder assembly

Drive and encoder data	
Technician:	
Date:	
Drive designation:	
Motor serial number:	
Encoder part number:	
Encoder serial number:	

Required resources:

- For the encoders ES7S, AS7W, AS7Y, a new expansion anchor (part number: 13617311)
- NOCO® fluid (part number: 09107819)
- Loctite® 241
- Various sizes of hollow hexagon wrenches
- Various sizes of external hexagon wrenches
- Torque wrench for tightening torques of 2.0 Nm to 8.0 Nm
- Sensor for measuring the wobble with a measuring range in the 1/100-mm range (for (E)DR..80 – 132, (E)DRN80 – 132S motors only)

Checklist for (E)DR..80 – 132/(E)DRN80 –132S motor	
Performed task	**Finished**
Encoder pin coated with NOCO® fluid	□
Central retaining screw [B] of the encoder tightened (tightening torque 2.75 Nm ±5 %)	□
Expansion anchor [362] pressed into the fan guard [35]	□
Retaining screws on the torque bracket [A] tightened into the expansion anchor [362] (tightening torque 2.25 Nm ±10 %)	□
Wobble measurement performed (tolerance ≤ 0.07 mm)	□
Connection cover [619] screwed in place (tightening torque 2.25 Nm ±10 %)	□
Safety cover [361] mounted	□

Checklist for (E)DR..160 – 280/(E)DRN132M – 280 motor	
Performed task	**Finished**
Encoder pin coated with NOCO® fluid	□
Central retaining screw [B] of the encoder tightened (tightening torque 8 Nm ±5 %)	□
Retaining screws on the torque bracket [232] moistened with Loctite® 241	□
Retaining screws on the torque bracket [232] tightened (tightening torque 6 Nm ±10 %)	□
Connection cover [619] screwed in place (tightening torque 2.25 Nm ±10 %)	□
Safety cover [361] mounted	□

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9.2 Checklist for brake assembly

Drive and brake data			
Technician:			
Date:			
Drive designation:			
Motor serial number:			
Brake:			
Brake identification number:			
Brake working air gap 3x:			

Motor size	Required wear parts	Quantity
All sizes	Brake premounted [550], key [71], driver [70], retaining ring [62]	1x each
(E)DR..80, (E)DRN80, DR2..80	Gasket [392]	1×
(E)DR..90 – 225, (E)DRN80 – 225	O-ring/gasket [901]	1×
(E)DR..80, (E)DRN80, DR2..80	Screws [13]	4×
(E)DR..90 – 225, (E)DRN90 – 225	Screws [900]	4×
(E)DR..80 – 225, (E)DRN80 – 225, DR2..80	Sealing ring [95]	1×

Performed task	(E)DR..80 (E)DRN80 DR2..80	(E)DR..90 – 132 (E)DRN90 – 132S	(E)DR..160 – 225 (E)DRN132M – 225
Key [71] installed in rotor	□	□	□
Driver [70] installed on rotor	□	□	□
Retaining ring [62] to secure the driver [70] installed	□	□	□
Gasket [392] placed on stator	□	–	–
O-ring/gasket [901] placed on stator	–	□	□
Brake cable of the brake [550] fed into terminal box	□	□	□
Brake [550] placed on motor	□	□	□
Screws [13] moistened with Loctite® 241 and secured; tightening torque 5 Nm	□	–	–
Screws [900] moistened with Loctite® 241/243 and secured (tightening torque: M6 = 10.3 Nm, M8 = 25.5 Nm, M10 = 50 Nm, M12 = 87.3 Nm)	–	□	□
Gasket [95] mounted	□	□	□
Brake connector [698] connected	–	–	□
Brake connected in terminal box	□	□	□

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10 Glossary

B_{10D}
Number of cycles until 10% of the components endanger through failure (for pneumatic and electromechanical components)

Cat.
Category

CCF
Common cause failure

DC
Diagnostic coverage

DC_{avg}
Average diagnostic coverage

FS
Functional safety

MTTFd
Mean time to dangerous failure

PFH_d
Mean probability of a dangerous failure per hour

PL
Performance level

PLr
Required Performance Level

SAR
Safe Acceleration Range safety function

SBA
Safe Brake Actuation safety function

SBC
Safe Brake Control safety function

SBH
Safe Brake Hold safety function

SBS
Safe brake system

SDI
Safe Direction safety function

SIL
Safety integrity level

SISTEMA
Software of the Institute for Occupational Safety and Health of the German Social Accident Insurance (IFA) for determining the performance level.

SLI
Safely Limited Increment safety function

SLS
Safely Limited Speed safety function

SS1
Safe Stop 1 safety function

SSM
Safe Speed Monitor safety function

STO
Safe Torque Off safety function

T_{10d}
Mean time until 10% of the parts have failed dangerously

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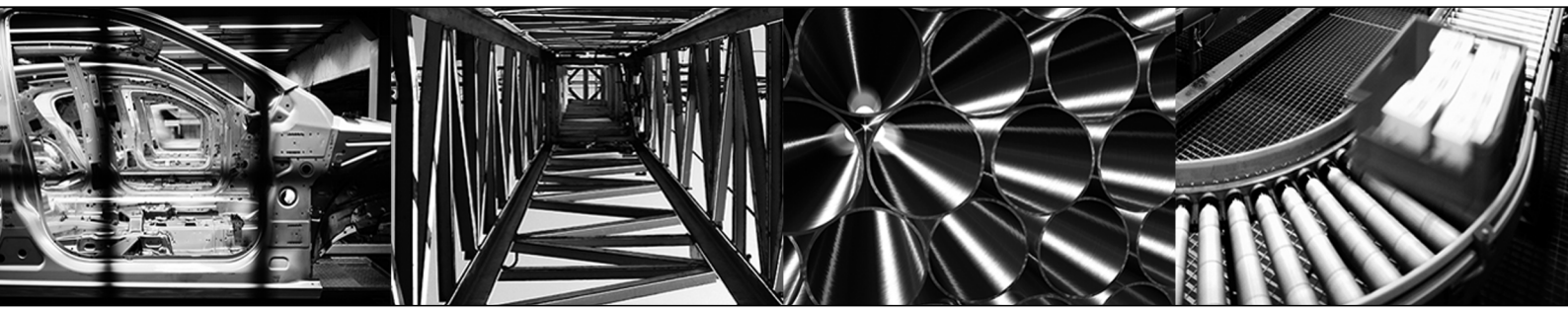

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