



Three-phase motor

for safety-related applications

Functional safety information

E TAM00697.07

**Read the Instruction handbook
before starting any work!**

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Motor components

Ostendstr. 80 - 90
90482 Nuremberg
Germany

Tel. +49 9 11 54 32 - 0

Fax: +49 9 11 54 32 - 1 30

Email : mail@baumueller.com

Internet: www.baumueller.com



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INTENDED USE OF ELECTRIC MOTORS IN FUNCTIONAL SAFETY

1.1 Basic technical information with safety instructions for electric motors in functional safety

Electric motors themselves or their integrated parts such as gearboxes, brakes, pinions, etc. are not safety components within the meaning of the Machinery Directive/Regulation.

The 06xxxxxx Baumüller motor part number is an identifying feature that indicates that these motors contain safety functions within the meaning of functional safety.

National and international legal regulations on safety and health protection requirements apply in principle to the assembly/disassembly, commissioning, and use in operation of the “electric motor in functional safety” as well as to recurring technical inspections.

The following apply in particular:

- EN ISO 13849 on functional safety in the overall system “Plant and machinery construction”.
These electric motors, which are subject to the “Requirements for fault exclusion of the mechanically safe encoder interface,” comply with the safety-related standard EN 61800-5-2 in this regard.
In addition, the product-specific EU declarations of conformity and/or EU declarations of incorporation also apply to electric motors.
- Machinery Directive/Regulation
- Work Equipment Directive
- Accident prevention regulations
- Other relevant safety regulations according to the areas of application

It must be taken into account that the Baumüller motor subsystem is part of a safety chain for a certified overall system in terms of functional safety.

In order to assess and guarantee the necessary safety functions, the person responsible for the overall system must define the necessary safety-related requirements for the subsystems. In this regard, the manufacturers and operators of the systems or machines must ensure that all applicable safety regulations/instructions are complied with in a timely manner, on their own responsibility and with the involvement of the competent authorities. This must explicitly include the entire design of the drive system in terms of functional safety, taking into account the relevant technical information, including safety

instructions from manufacturers of converters, encoders, connection technology, and motors.

In this context, the electric motor may only be used for the motor/encoder data, limits, and operating modes specified in the technical documentation. All safety instructions, including the present safety information on functional safety, must be observed. The general and product-specific operating instructions with safety information are also applicable to this electric motor.

In particular, the following electric motor documentation (including rotary encoders) must be followed, see Baumüller download structure

<https://www.baumueller.com/en/company/downloads/download-filter-en>

- This TAM00697 “Three-phase motor for safety-related applications” in accordance with EN ISO13849 applies to systems and machines in the field of functional safety.
Exception:
For motors that fall within other functional safety application areas, e.g., within the ISO 26262 automotive application area. The necessary safety information is preferably already integrated in the corresponding “product-specific operating instructions with safety information.”
- TAM00552 “General operating instructions with safety information for three-phase motors” in plant and machine construction.
- “Product-specific operating instructions with safety information” (originally “Commissioning and maintenance instructions” or, for further developed/newer products, “Instruction handbook with safety information”)
- Specific encoder manufacturer product documentation, in particular regarding functional safety, such as installation and operating instructions, implementation manual with safety instructions, and all other related encoder documentation must be requested from the encoder manufacturers in order to comply with mandatory encoder specification limits!

1.2 Explanation of symbols relating to functional safety

To prevent accidents, always read and follow safety instructions carefully!



DANGER!

Manufacturer specifications for motors, including integrated encoders, must be strictly adhered to.

They must not be exceeded even under unfavorable fault or operating conditions, as this could compromise fault exclusion/safety functions in terms of functional safety in particular! Electric motors may only be handled throughout their entire life cycle by trained personnel who have received appropriate training and have access to this TAM00697.

**PROHIBITION**

For safety reasons, any unauthorized modifications or alterations to the electric motor are not permitted! In particular, safety repairs and any associated work on the motor must be carried out exclusively by Baumüller! If necessary, consult the motor manufacturer.

No safety devices may be removed or disabled for the operation of the electric motor.

Any deviation from the intended use or intervention in the electric motor will void any warranty claims against the motor manufacturer. Violations could compromise safety functions in terms of functional safety!

In particular, the applicable safety-related specifications from encoder, motor, and drive manufacturers must not be disregarded. It must always be taken into account that, for example, encoder limit values may be further restricted by motor operation on the respective machine or system. This must not be overlooked in general and particularly in the present TAM00697 documentation, so as not to compromise safety functions.

**DANGER!**

Dangerous electrical voltages, including harmful voltage pulses!

When using encoders with bearings, it is particularly important to ensure functional safety by preventing harmful current flows through the encoder bearings caused by voltage pulses.

Violations could compromise fault exclusion/safety functions in terms of functional safety; see the respective encoder specifications for more information!

All electrical work must be performed by qualified personnel only!

The safety regulations for working on electrical systems must be observed!



Use in safety-related applications in accordance with functional safety as defined in EN ISO 13849 as product labeling.

1.3 Checking the scope of delivery

- If transport damage is detected upon delivery, this must be reported immediately to the transport company and Baumüller's main plants. The defective products must be blocked to prevent potential impairment of necessary safety functions.
- Check the completeness of the delivery and its documents.
- In both cases, commissioning of the motor is prohibited until the existing defects have been professionally and verifiably completely remedied. The risk posed by the product must not have been increased, "in particular in terms of functional safety."

SAFETY FUNCTIONS OF MOTORS WITH SUITABLE ENCODERS IN FUNCTIONAL SAFETY

2.1 Safety instructions for fault exclusion “mechanically safe encoder connection in the electric motor”

The Baumüller motor subsystem with “fault exclusion for mechanically safe encoder connection” is part of a certified overall system. To ensure the electric motor-related safety functions in functional safety, the person responsible for the overall system must include the other subsystems involved.

Baumüller motors with suitable encoders installed/integrated for use in functional safety must have a “certified encoder connection” for the associated “mechanically safe fault exclusion.” In principle, the applicable regulations/specifications for motors, encoders, and evaluation electronics must be taken into account.



PROHIBITION

In the application, the technical data and safety instructions of the motor and encoder manufacturers must be observed, especially with regard to functional safety.

For example, the actual acceleration of the motor used must not exceed the maximum permissible encoder angular acceleration according to the specifications of the encoder manufacturer and Baumüller.

Failure to comply with this requirement may compromise the fault exclusion for mechanically safe encoder connection!

2.2 Use of certified encoders in motors as “safe motor feedback systems”

2.2.1 Safety encoder from Heidenhain

- Use in combination with the mechanically safe encoder interface on the Baumüller electric motor

**NOTE!**

According to the encoder manufacturer:

Heidenhain ENDAT 2.1 standard encoders ECN1313 and EQN425 can only be equipped with mechanically safe encoder interfaces “with regard to Heidenhain MTTFd calculation >30 years.”

This means that ECN1313 and EQN425 are not certified Heidenhain encoders with SIL/PL level.

**PROHIBITION**

In particular, the applicable safety requirements, as well as the limit values and exception conditions specified by the encoder manufacturer for safety-related functions, must be strictly adhered to, provided that “due to the intended use within the overall system” no further restrictions regarding the encoder specifications are required.

According to the respective encoder manufacturer's specifications, no moisture (including condensation) may penetrate safe optical Heidenhain encoders, for example, as this can lead to unsafe encoder failures! The motor specifications, including operating/environmental conditions, must also be observed in this regard.

Violations may compromise error exclusions/safety functions!

2.2.2 Safety encoder from Sick

- Use in combination with the mechanically safe encoder interface on the Baumüller electric motor

The specifications provided by the sensor manufacturer apply, in particular with regard to the respective SIL/PL level classification!



PROHIBITION

The limit values and exceptions to safe functions specified by the encoder manufacturer must be strictly observed, provided that no further encoder specification restrictions are required “due to the intended use within the overall system.”

For the EDS35-2 and EDM35-2 encoder types with bearings, when used in combination with Baumüller motors, a specification limit on the maximum encoder angular acceleration of 160,000 rad/s² must not be exceeded!

According to the respective encoder manufacturer’s specifications, for example, the encoder bearing service life must not be exceeded for certain Sick encoder types in order to avoid potential bearing seizure (including locking)! In this context, the harmful effects of current surges in the encoder bearing or overload - e.g., due to dynamic motion profiles in which the rolling elements enter into harmful sliding - must be ruled out.

Near the encoder’s resonance frequencies, physical conditions may cause deviations from the safety-related positional accuracy specified by Sick. This accuracy defines the maximum positional error limit!

If these disruptive resonance frequencies cannot be reliably ruled out, appropriate tests of the entire drive system must be performed before the initial commissioning of the system/machine. If necessary, appropriate safety corrective measures are mandatory!

Exceeding the specified service life of the Safety-Sick encoders is not permitted. Similarly, their condensation is prohibited.

In case of non-compliance, fault exclusion / safety functions may be compromised!

2.2.3 Safety resolver with Baumüller part No. 06 and external certificate

The following is a list of examples of “properties of two certified BM resolver sizes” used in functional safety, which must always be taken into account.

However, if further restrictions on the resolver specification are required “due to its intended use within the overall system,” these restrictions must be applied.

2.2.3.1 Certified BM resolvers with regard to size, such as RE21

Certified BM resolvers in combination with mechanically safe encoder interface on Baumüller electric motors.

Resolver characteristics	Technical data that must be observed
SIL-Level	Up to SIL 3 depending on the overall system design in terms of functional safety
MTTF _d value	8320 years (example type RE21 from LTN)
Max. permitted speed	≤ 6.000 min ⁻¹
Max. permitted angular acceleration	Certified: ≤ 100.000 rad/s ²
Operating temperature	-55 °C to +155 °C

Motor characteristics	Technical data that must be observed
Permissible vibration resistance	radial 3g / axial 1g 10 Hz to 100 Hz (EN 60068-2-6)

The resolver data sheets and motor specifications also apply, provided that no further resolver specification restrictions are required "due to the intended use within the overall system".



PROHIBITION

In particular, the resolver specification for operation in functional safety described here must be strictly observed. For example, due to the safe mechanical resolver connection, the maximum permissible angular acceleration and maximum permissible speed must not be exceeded, and only certified resolvers with a Baumüller item number starting with 06 may be used.

Violations may compromise fault exclusion/safety functions!

2.2.3.2 Certified BM resolvers with regard to size, such as RE15

Certified BM resolvers in combination with mechanically safe encoder interface on Baumüller electric motors.

Resolver characteristics	Technical data that must be observed
SIL-Level	Up to SIL 3 depending on the overall system design in terms of functional safety
MTTF _d value	30720 years (example type RE15 from LTN)
Max. permitted angular acceleration	Certified: $\leq 200.000 \text{ rad/s}^2$
Operating temperature	-55 °C to +155 °C

Motor characteristics	Technical data that must be observed
Permissible vibration resistance	radial 3g / axial 1g 10 Hz to 100 Hz (EN 60068-2-6)

The resolver data sheets and motor specifications also apply, provided that no further resolver specification restrictions are required "due to the intended use within the overall system".



PROHIBITION

In particular, the resolver specification for operation in functional safety described here must be strictly observed. For example, due to the safe mechanical resolver connection, the maximum permissible angular acceleration must not be exceeded and only certified resolvers with a Baumüller item number starting with 06 may be used.

Violations may compromise fault exclusion/safety functions!

SAFETY-RELATED RECOMMENDATIONS REGARDING COMMISSIONING AND OPERATION

The following safety-related recommendations relating to commissioning and operation with a potential influence on functional safety must be observed.



DANGER!

When performing work related to motors, always observe the safety instructions in the relevant chapters of the product-specific operating, commissioning, and maintenance instructions.

In addition to the aforementioned chapters of this TAM00697, we strongly recommend that you refer to the following safety information, particularly with regard to the commissioning and operation of motors in functional safety.



PROHIBITION

The electric motor must not be operated without reliable safety devices/functions, including the safety inverter functions “safe detection and shutdown of drives with safety functions.”

The motor-specific operating instructions and the safety instructions described in this TAM00697, particularly those relating to functional safety, must be observed.

This includes, in particular, the following safety-related recommendations for commissioning and operation.

Violations may compromise fault exclusion/safety functions!

Recommended check for potential encoder notch position losses:

During commissioning/intended use, regular checking for potential notch position losses is strongly recommended.

A notch position loss detected by the inverter could indicate a dangerous fault in functional safety, namely a “detached mechanical encoder interface.”

General recommendations for electric motors with integrated “holding brakes including emergency stop function”:

Optionally, holding brakes with an emergency stop function (such as PE or SB brakes) can be integrated into electric motors, but these are not safety or service brakes.

Full braking function must always be guaranteed, i.e., even during commissioning, when stationary, and during emergency stops. With PE brakes in particular, axial forces on the motor shaft end are always prohibited throughout the entire life cycle, as this could invalidate the “safe hold in de-energized braking state.”

Baumüller recommends monitoring the brake air gap, the braking torque, or indirectly the brake release voltage to ensure a “sufficient holding function.”

These integrated brakes may only be operated as holding brakes (speed 0 rpm) within their permissible specifications.

The optional manual release on SB brakes must not be blocked during machine operation. Any transport locks must be removed before commissioning/operation.

Recommendation for the operation of “electric motors with integrated holding brakes and certified encoders” in functional safety:

The holding brakes integrated in Baumüller motors “in combination with certified encoders” are not to be used as service brakes, but must be operated as follows:

Since brake wear (including conductive wear) is always generated, e.g., by emergency stops, starting against a closed brake, or grinding in, and cannot be completely prevented from reaching the rotary encoder by seals (sealing gap), safety functions are potentially at risk. This can distort encoder signals and also have a safety-relevant impact on the function (blocking) and service life of potentially existing encoder bearings. Especially in the case of strong electromagnetic fields in combination with certified resolvers, the feedback signals may be disturbed depending on the application.

SB brakes should not be operated with overexcitation, as this could cause increased potential brake interference fields to have an impermissible effect on the rotary encoders. We therefore explicitly recommend the use of certified encoder systems that are bearingless and resistant to electromagnetic interference, depending on the application. To this end, the downstream evaluation electronics must be capable of reliably detecting faults in the safe motor feedback system and, if necessary, safely shutting down the drive.

The respective regulations of the motor, encoder, and evaluation electronics manufacturers (such as operating instructions, implementation manuals, safety instructions) must be strictly observed.

We recommend using certified Baumüller evaluation electronics for functional safety.

SAFETY-RELATED RECOMMENDATIONS REGARDING TROUBLESHOOTING AND MAINTENANCE

The following safety-related recommendations regarding troubleshooting, maintenance, servicing, and cleaning must be observed.



PROHIBITION

Maintenance/repair work on the motor, including the encoder system, that affects functional safety may only be carried out at the manufacturer's plants or by a BM organizational unit authorized by Baumüller (BM). BM repair shops and BM service centers must also provide evidence of comprehensive safety qualifications in order to be allowed to repair safety motors professionally!

If safety functions on the electric motor are defective or suspected to be defective, operation is prohibited. It is strongly recommended that the drive be stopped immediately and then removed. The motor with the functional safety malfunction must be returned immediately to the BM repair shop or BM service center for fault analysis and potential safety assessment.

The repair of these "safety motors" by the customer is prohibited.

Unauthorized tampering with the product will result in immediate exclusion from liability and the associated warranty claims against Baumüller will be void.

Only maintenance/repair work on the electric motor approved by Baumüller may be carried out by the customer; e.g., relubricating bearings (if a relubrication device is available) or ensuring suitable cooling conditions. In doing so, the safety-related information in this document and the specifications and safety instructions in the applicable operating instructions/commissioning and maintenance instructions must be observed.

In particular, after replacing or repairing the motor, it is always necessary to perform a notch position run and, optionally, to check the brake function.

Cleaning the motor surface with high pressure or steam is generally not permitted in order to prevent condensation or moisture from entering the encoder system.



Revision Survey

Version	Status	Changes
TAM00697.05	28-Oct-2025	Revision
TAM00697.06	05-Feb-2026	Note Sick safety encoder
TAM00697.07	08-Apr-2026	Restrictions on intended use

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All data/information in this documentation are non-binding customer information, subject to constant further development and are constantly updated by our permanent modification service. Warranty and liability claims against the company Baumüller Nürnberg GmbH are excluded if in particular one or more of the following causes have caused the damage:

- You disregarded instructions in this documentation.
- The system wasn't used for the intended use.
- The system
 - was incorrectly mounted, connected, put into operation, operated as well as not maintained,
 - was mounted, connected, put into operation, and operated and / or maintained by unqualified personnel,
 - is overloaded,
 - is operated with
 - defective safety equipment,
 - not properly fixed or without safety equipment,
 - not functioning safety and protective equipment,
 - is not operated within the specified environmental conditions.
- You modified the system without having a written approval of the company Baumüller Nuremberg.
- You disregarded the instructions referring to the maintenance in the component descriptions.
- You monitored the parts, which are subject to wear, inadequately.
- You performed a repair incorrectly.
- You combined the system incorrectly with products of other manufacturers.
- You combined the drive system with faulty and / or incorrect documented products of other manufacturers.

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These were provided at the latest upon conclusion of contract.

HOUSE OF AUTOMATION



Baumüller Nürnberg GmbH

Ostendstraße 80-90 · 90482 Nürnberg · Germany
 Phone: +49 (0) 911 5432-0 · Fax: +49 (0) 911 5432-130
www.baumueller.com

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