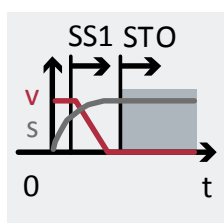


Application Note

FESTO

Safety Sub-Functions SS1-t: STO, Cat. 4, up to PL e Servo Drive CMMT-AS-...-S1



Application Note
CMMT-AS-...-S1,
SS1-t: STO Category
4, up to PL e

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This document is only suitable for persons with sufficient expertise for machine safety based on EN ISO 12100 and EN ISO 13849. In addition, the following qualifications are required in the project team:

- Specialist in electrical engineering
- Specialist for the programming of control systems and safety switching devices

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Table of Content

| | | |
|----------|---|----------|
| 1 | Example Circuits | 4 |
| 1.1 | SS1-t: STO with servo drive CMMT-AS-...-S1..... | 5 |
| 1.1.1 | Circuit Diagram | 5 |
| 1.1.2 | Components..... | 5 |
| 1.1.3 | Description..... | 6 |
| 1.1.4 | Safety Considerations | 7 |
| 2 | Literature | 7 |

1 Example Circuits

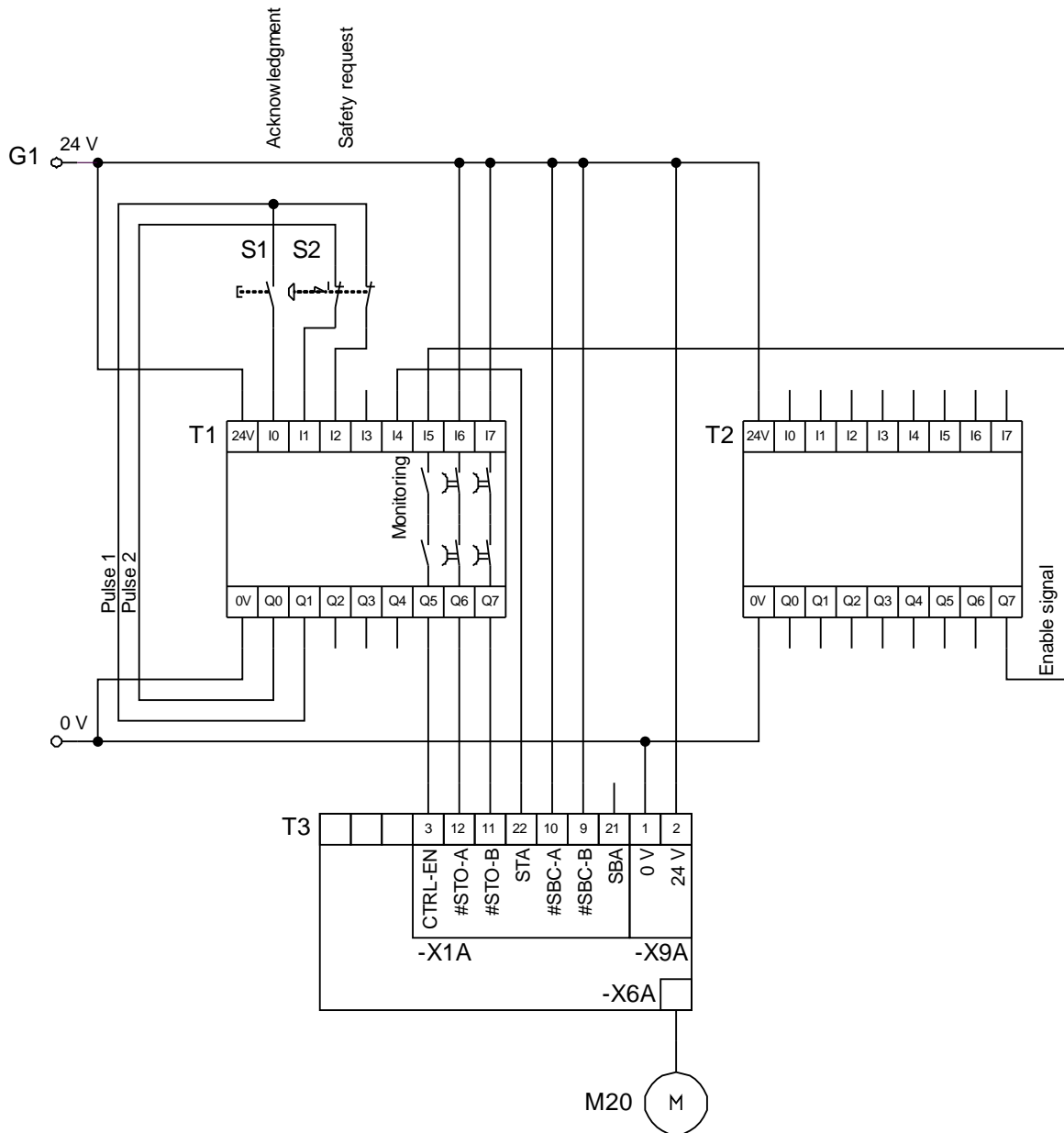
- The circuits specified in this document are principle circuits which cannot be complete due to their clarity and scope. Safety commanding device and safety switching device are not part of this document and are given for information only.
- The abbreviations used for the safety sub-functions refer to the definitions in EN 61800-5-2 [1] for electrical power drive systems:
 - SS1-t: Safe stop 1 time controlled
 - STO: Safe Torque Off
- Category 4, up to PL e according EN ISO 13849-1 [2].
- To understand this application note, are following documents necessary:
 - Description “Servo drive CMMT-AS-C2/C4-3A-...”. This description is available on the Internet https://www.festo.com/net/en-gb_gb/SupportPortal/Downloads/466851/573769/CMMT-AS-C2_C4-3A_2018-10a_8095049g1.pdf
 - Description “Safety sub-function STO, SBC, SS1” for servo drive CMMT-AS-...-S1. This description is available on the Internet https://www.festo.com/net/en-gb_gb/SupportPortal/Downloads/466859/573777/CMMT-AS-_-S1_2018-10a_8096257g1.pdf
- The circuits and the procedure described are recommendations which do not exclude other possibilities.

1.1 SS1-t: STO with servo drive CMMT-AS-...-S1

SS1-t and STO according EN 61800-5-2 [1].

1.1.1 Circuit Diagram

Only relevant contacts are shown!



1.1.2 Components

| Component | Type (Part Number) | Description / Remarks | Qty. | Mssr. |
|-----------|--------------------|--|------|-------|
| M20 | EMM...-AS | Servo motor | 1 | Festo |
| S1 | | Acknowledge push button | 1 | |
| S2 | | Safety commanding device, e.g. emergency stop switch | 1 | |
| T1 | | Safety switching device | 1 | |
| T2 | | Functional PLC | 1 | |
| T3 | CMMT-AS-...-S1 | Servo drive | 1 | Festo |

1.1.3 Description

| | |
|-----------------------------------|---|
| Application | Servo drive with servo motor without external forces, e.g. horizontal axis |
| Triggering event | Safety request (S2), e.g. by emergency stop switch, safety gate |
| Reaction (Safety sub-function) | <p>Safe stop 1 (SS1)</p> <p>Safety sub-function safe torque off (STO), category 4, PL e</p> |
| Safe state | <p>The servomotor (M20) is functionally stopped and after an application-specific time no energy is supplied to the servomotor (M20) that can generate a force and a movement. It is presumed that this state of the servomotor (M20) is the safe state.</p> <p>Notes:</p> <ul style="list-style-type: none"> Stopping the servo motor (M20) is functional and is not safety-rated, i.e. if the movement is not stopped in the event of a fault, additional measures may be required, e.g. end position damping for linear axes. If external forces act on the servomotor, e.g. in the case of vertical axes, the request for the safety sub-function STO can result in a dangerous movement. Then additional measures may be necessary, e.g. a holding brake. |
| Function of the circuit | <p>Due to the safety request (S2)::</p> <ul style="list-style-type: none"> The input circuit of the safety switching device (T1) is interrupted. The output (Q5) of the safety switching device (T1) is then switched off. The input “output stage enable (CTRL-EN)” of the servo drive (T3) is no longer controlled. This causes the servo drive (T3) to functionally decelerate the motor with the braking ramp. This corresponds to a behaviour of stop category 1 according to EN 60204-1 [3]. After the end of the braking ramp, the output stage is functionally switched off. The outputs (Q6, Q7) of the safety switching device (T1) are then switched off with a time delay. The required time delay must be determined depending on the specific application. The inputs “Safe torque off, channel A and B (#STO-A, #STO-B)” of the servo drive (T3) are no longer controlled. This switch off the control of the output stage and requests the safety sub-function STO. |
| Manual reset function | <p>After resetting the safety request (S2), e.g. by mechanically unlocking the emergency stop switch or closing the safety gate, the start or restart can be made possible by actuating the acknowledgement button (S1).</p> <p>The safety switching device (T1) controls via the outputs (Q6, Q7) the servo drive (T3). This makes it possible to control the power output stage again and the STO safety sub-function is no longer active.</p> <p>The safety switching device (T1) permits the control of the “output stage enable (CTRL-EN)” via the functional control (T2) again via the output (Q5), so that normal operation is possible again.</p> |
| Diagnosis | <p>The diagnostic output STA reports the status of the safety sub-function STO to the safety switching device (T1). Diagnosis is performed via the safety switching device (T1):</p> <ul style="list-style-type: none"> If the outputs (Q6, Q7) of the safety switching device (T1) are switched off with a time delay, the safety sub-function STO is requested via the inputs (#STO-A, #STO-B) of the servo drive (T3). After the typical time for the servo drive, the output (STA) is switched on. This diagnostic feedback delay must be monitored for a minimum and maximum permissible time by the safety switching device (T1). If the outputs (Q6, Q7) of the safety switching device (T1) are switched on, the safety sub-function STO is disabled via the inputs (#STO-A, #STO-B) of the servo drive (T3). After the typical time for the servo drive, the output (STA) is switched off. This diagnostic feedback delay must be monitored for a minimum and maximum permissible time by the safety relay (T1). |

| | |
|--|--|
| | If a fault is detected by the diagnosis, a suitable fault reaction must be carried out by the safety switching device (T1). It is common that the machine is brought into a safe state and further operation is prevented. |
|--|--|

1.1.4 Safety Considerations

| | |
|--------|--|
| Input | Safety considerations must be carried out in accordance with the selected safety commanding device (S2). |
| Logic | Safety considerations must be carried out in accordance with the selected safety switching device (T1). |
| Output | <p>The intended use of the servo drive (T3) includes the safety sub-function STO with category 4, up to PL e. The PFH_D value required to determine the reliability of the overall circuit must be available.</p> <p>Note:</p> <ul style="list-style-type: none"> • For the circuit shown in this document, the safety indices "with high test pulses and with STA evaluation" can be selected. |

2 Literature

- [1] DIN EN 61800-5-2:2017-11 - Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional (IEC 61800-5-2:2016); German version EN 61800-5-2:2017
- [2] DIN EN ISO 13849-1:2016-06 - Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1:2015); German version EN ISO 13849-1:2015
- [3] DIN EN 60204-1:2007-06 - Safety of machinery - Electrical equipment of machines - Part 1: General requirements (IEC 60204-1:2005, modified); German version EN 60204-1:2006