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Connection of inductive, clocked safety switches to an F-CPU

S7-1200/1500 F-CPU / Safety Advanced V13 SP1



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1 Introduction

What is it about?

This document describes how to use the F block FB F_IND_CL (Fail-safe_Inductive_Clocking), which is available for downloading on the same internet page as this document.

The F block F_IND_CL is for connecting inductive, clocking safety switches to a fail-safe SIMATIC CPU (F-CPU). Here, one block is assigned to one safety switch.

The function of the FB F_IND_CL is to evaluate the switching status of the safety switch. For this it provides the safety switch with a clock signal and evaluates its signal status. With correct attenuation the FB F_IND_CL outputs a release signal, otherwise the release is reset.

The FB F_IND_CL has no know-how protection, which means that you can change it if need be to suit your requirements.

Note

The FB F_IND_CL can be used for switch types that expect a clock output of the controller and the timing can be read back when operated. In the present case, the setting of the FB F_IND_CL is based on the safety switch GM504S from the company ifm electronic GmbH. This safety switch complies with the following requirements:

EN ISO 13849-1: 2015 PL e
IEC 61508: SIL 3

For this, the signal feed from the standard DQ and the feedback to the F DI must be configured so that they are protected against short-circuits with each other.

When using the inductive, clocking safety switch, observe the normal or reasonably foreseeable conditions of use, safety instructions, assembly instructions and the technical data of the manufacturer.

In addition to the block description, at the beginning you receive information about connecting the safety switch to a fail-safe SIMATIC automation system (chapter [2](#)) and about parameterizing the fail-safe input module F-DI (chapter [3](#)).

Options software required

You need the options software STEP 7 Safety Basic for using the block in a fail-safe CPU S7-1200 respectively STEP 7 Safety Advanced for using the block in a fail-safe CPU S7-1500.

Required basic knowledge

To understand this documentation you need basic knowledge of the following:

- S7-1200/1500 Automation Systems
- Fail-safe Automation Systems
- Distributed IO Systems

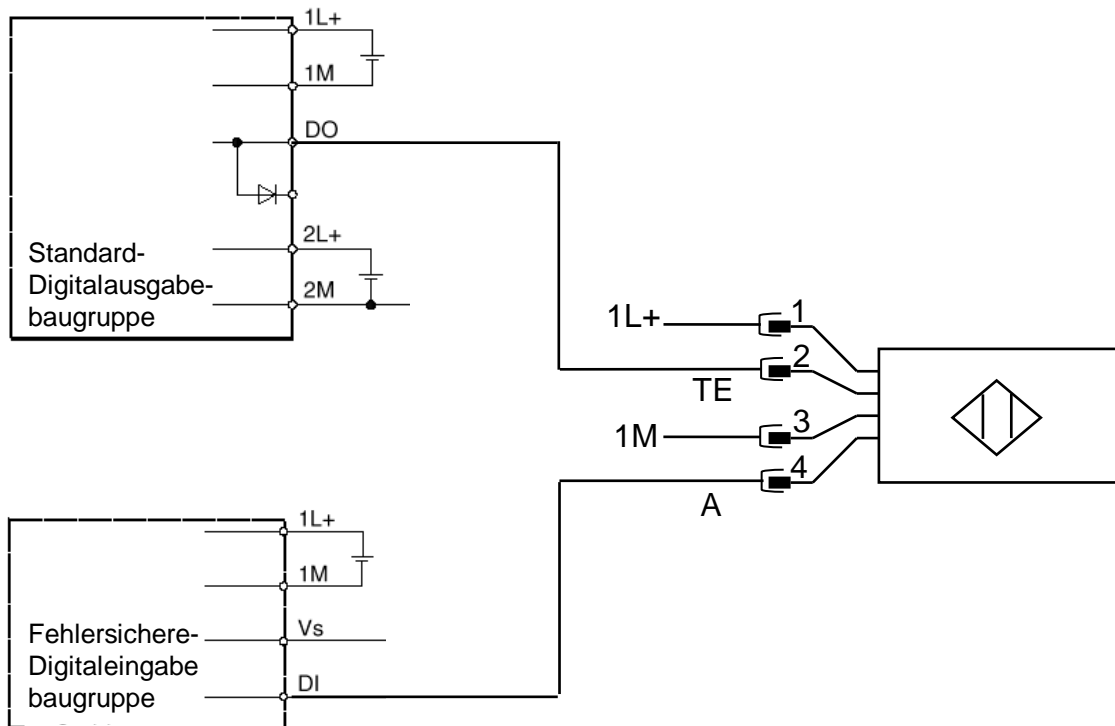
Validity

This document is an addition to the STEP 7 Safety documentation and refers to the given FB F_IND_CL with the CRC number 0x41982BB5.

2 Connecting a Safety Switch

The figure below shows the connection of an inductive safety switch to a fail-safe SIMATIC automation system. The switching output A of the safety switch is configured as single-channel to an F-DI. The timing input TE is supplied via the output of a standard module.

Figure 2-1 Connection of an inductive safety switch to modules of the ET 200MP

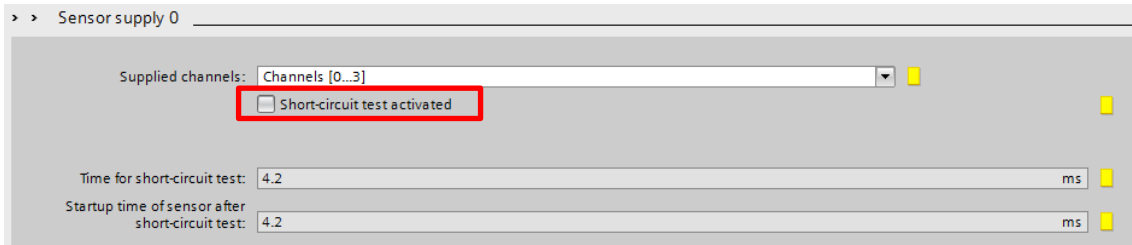


3 Parameterizing the F-DI

Below we describe how to parameterize the fail-safe input module (F-DI) in the hardware configuration of STEP 7.

The inductive safety switch itself does a short-circuit test. Therefore you should disable the short-circuit test of the F-DI.

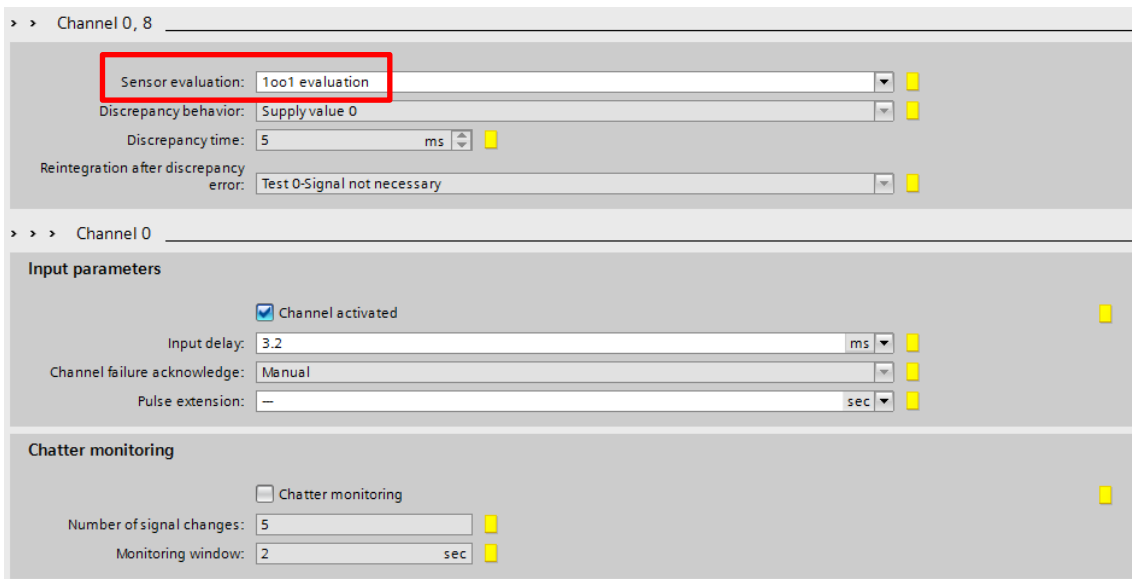
Figure 3-1 Disabled short-circuit test of the F-DI 16x24V DC



If you are using an external encoder supply, there can be no short-circuit test.

The inductive safety switch is connected via a single channel to the F-DI. Therefore you should set a 1oo1 evaluation on the connected channel of the F-DI.


Figure 3-2 1oo1 evaluation on the channel of the F-DI 16x24V DC



4 Description of the Function Block F_IND_CL

4.1 General Information

The FB F_IND_CL is available in the block library of the same name and is suitable for fail-safe applications up to PL e in compliance with ISO 13849 and SIL 3 in compliance with IEC 62061.

 WARNING	Using the FB F_IND_CL does not automatically imply compliance with statutory regulations.
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4.2 Block Parameters

The table below shows the input and output parameters of the FB F_IND_CL.

Table 4-1 Input and output parameters of the FB F_IND_CL

Name	Declaration	Data type	Explanation
sensorSignal	INPUT	BOOLEAN	Switching output of the safety switch
pulseWidthLow	INPUT	TIME	Off-state pulse width
pulseWidthHigh	INPUT	TIME	On-state pulse width
monTolerance	INPUT	TIME	Tolerance time of the clock evaluation
ackNec	INPUT	BOOLEAN	Acknowledgement mode after unoperated state of the sensor 0: automatic 1: manual via ackRei
ackRei	INPUT	BOOLEAN	Acknowledgement input
enable	OUTPUT	BOOLEAN	Release signal
pulse	OUTPUT	BOOLEAN	Timing input of the safety switch
ackReq	OUTPUT	BOOLEAN	Acknowledgement request

4.3 Function Description

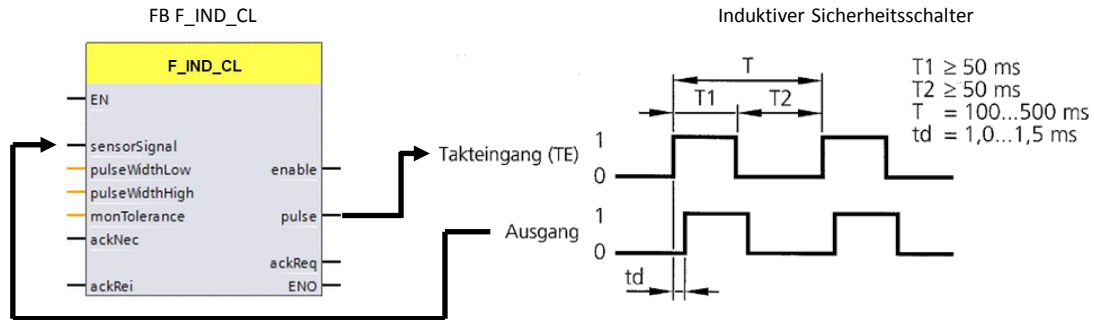
The FB F_IND_CL is called once for each safety switch with its own instance DB in the F runtime group.

For controlling and evaluating the safety switch the FB F_IND_CL supplies the safety switch with a clocked signal. You should choose the frequency of the clock signal according to the specifications of the sensor manufacturer. The following holds for clock times T1 and T2:

- They can be set at the input parameters "pulseWidthLow" and "pulseWidthHigh".
- They are to be set significantly higher than the cycle time of the safety program.

The clock signal is available at the block output "pulse" for the safety switch. The output signal of the safety switch is interconnected to the block input "sensorSignal" (see figure below).

Figure 4-1 Clock signals of the inductive safety switch on the FB F_IND_CL



The "monTolerance" time must be changed according to the module cycle time of the IO modules used and is calculated as follows:

Reaction time F-DI + Reaction time DO + Safety program cycle time

Here, "monTolerance" must be less than the pulse widths (T1 and T2).

If the safety switch is correctly attenuated and operational, a falling edge at the block input "sensorSignal" sets the release signal at the block output "enable". If the safety switch is not attenuated correctly or in case of failure, the release signal is reset.

After clearing the fault and if the safety switch is correctly attenuated again, the release signal is set again automatically or after acknowledgement depending on "ackNec".