APPLICATION GUIDE

Trip Circuit Supervision (TCS) in EuroProt+ devices

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PROTECTION, AUTOMATION AND CONTROL FOR POWER INDUSTRY

VERSION INFORMATION

VERSION	DATE	MODIFICATION	COMPILED BY
1.0	2019-03-11	First edition	Erdős
1.1	2019-05-10	Notes for parallel-connected circuits added	Erdős
1.2	2019-08-07	Additional technical data, withstand voltage raised for TRIP+/2101, corrections	Erdős

CONTENTS

USED SYMBOLS

Additional information

Useful information for settings.

Important part for proper usage.

1 Introduction

This document describes the applicable hardware and provides guidelines for usage in the device configuration.

1.1 Operation principle

The trip circuit supervision is utilized for checking the integrity of the circuit between the trip coil and the tripping output of the protection device.

This is realized by injecting a small DC current (around 1-5 mA) into the trip circuit. If the circuit is intact, the current flows, causing an active signal to the opto coupler input of the trip contact.

The state of the input is shown on the devices' binary input listing among the other binary inputs, and it can be handled like any other of them (it can be added to the user logic, etc.)

1.2 Applicable modules

The following modules contain trip outputs with trip circuit supervision. The information here is restricted to the trip circuit supervision only. For more details please refer to the EuroProt+ Hardware description from which these were extracted. Note that there are other modules without trip circuit supervision, those are not listed here.

Table 1-1 Modules with Trip Circuit Supervision

MODULE TYPE	TRIP+4201	TRIP+2101	TRIP+2201	PSTP+4201	PSTP+2101
CHANNEL NUMBER	4	4	4	2	2
RATED VOLTAGE	24 V DC and 48 V DC	110 V DC	220 V DC	24 V DC and 48 V DC and 60 V DC	110 V DC and 220 V DC
THERMAL WITHSTAND VOLTAGE	72 V DC	150 V DC	242 V DC	72 V DC	242 V DC

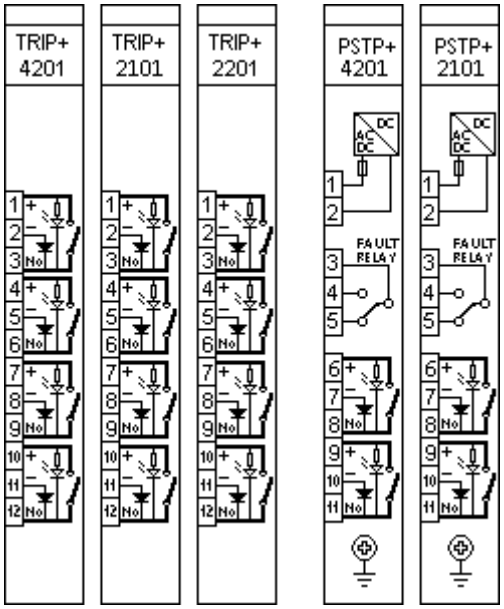

Figure 1-1 I/O arrangement of the modules with TCS

2 Hardware application

2.1 Wiring

The wiring of these modules can be 2-wire or 3-wire. The TCS – **T**rip **C**ircuit **S**upervision function is active with both methods.

The voltage of the "No" contact is maximized at 15 V by a Zener-diode. Make sure that the voltage caused by the resistance of the circuit breaker and the injected current from the TRIP+ module does not reach 10 V. In case of PSTP+ modules, this voltage is 8 V (PSTP+/4201) and 13 V (PSTP+/2101).

Our TRIP+ modules are made to switch DC circuits. **Using reversed polarity or AC voltage can cause the damage of the internal circuits.**

2.1.1 3-wire TRIP+ wiring methods

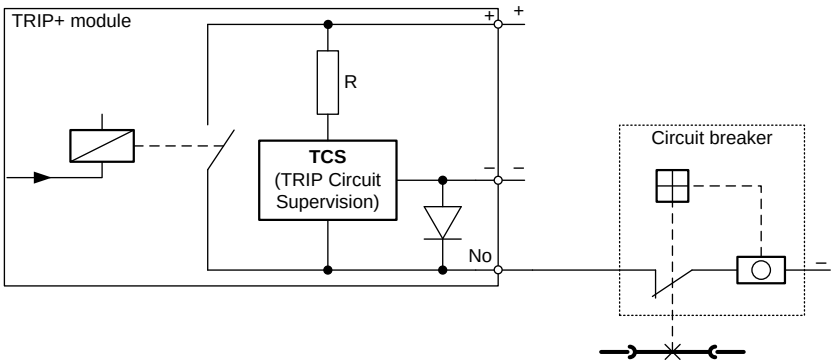

Figure 2-1 3-wire TRIP+ wiring

It is possible to use parallel connected TRIP+ modules. In this case the negative contacts must be common.

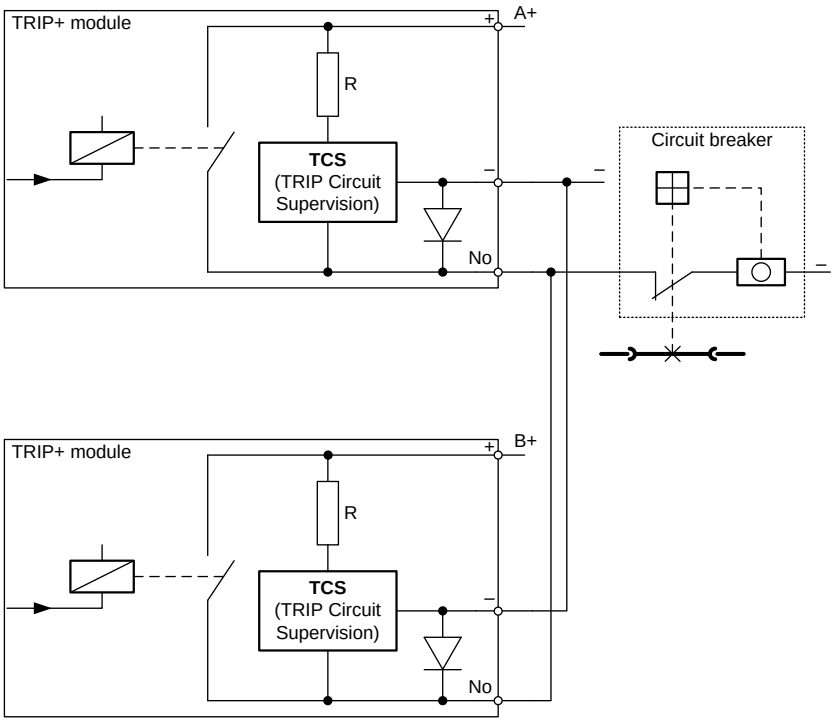

Figure 2-2 3-wire TRIP+ wiring using parallel connected TRIP+ modules

2.1.2 2-wire TRIP+ wiring methods

If it is necessary, you can also wire the TRIP+ modules using only the “+” and the “No” contacts.

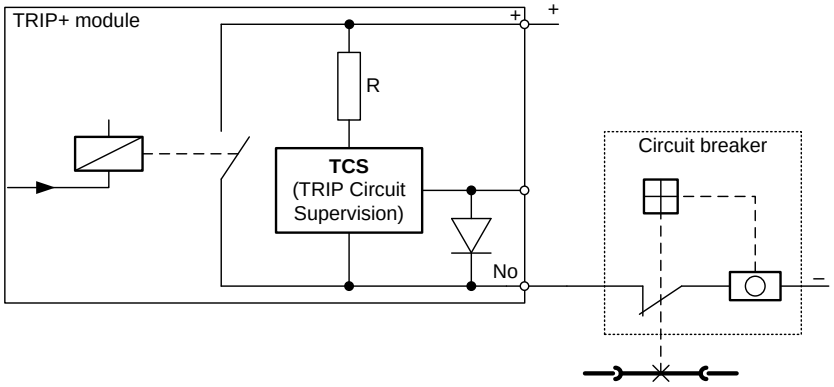

Figure 2-3 2-wire TRIP+ wiring

It is possible to use parallel connected TRIP+ modules.

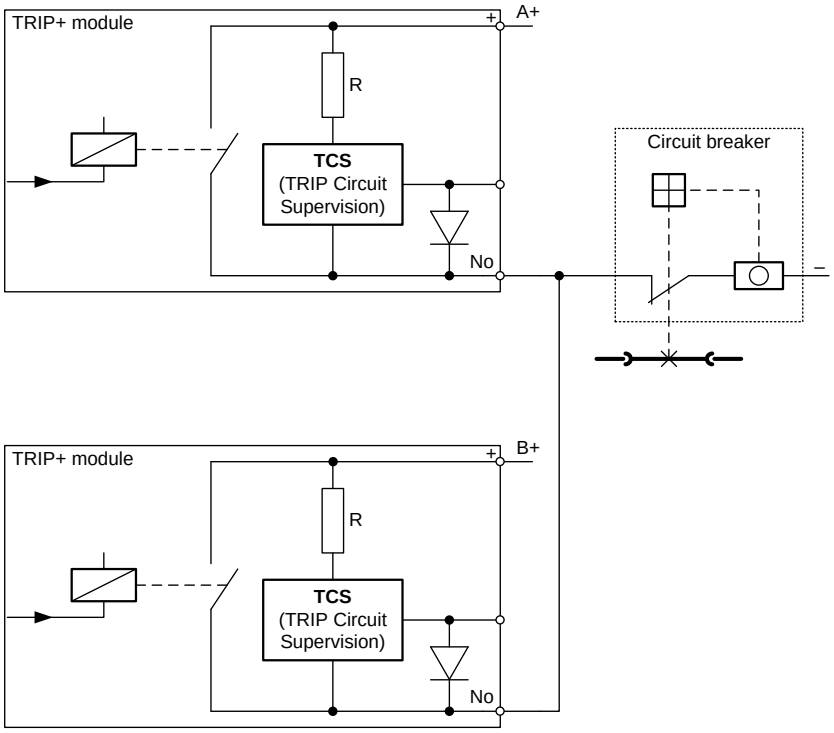

Figure 2-4 2-wire TRIP+ wiring using parallel connected TRIP+ modules

If the circuit breaker needs two-pole switching, TRIP+ modules can be connected series as you can see in Figure 2-5.

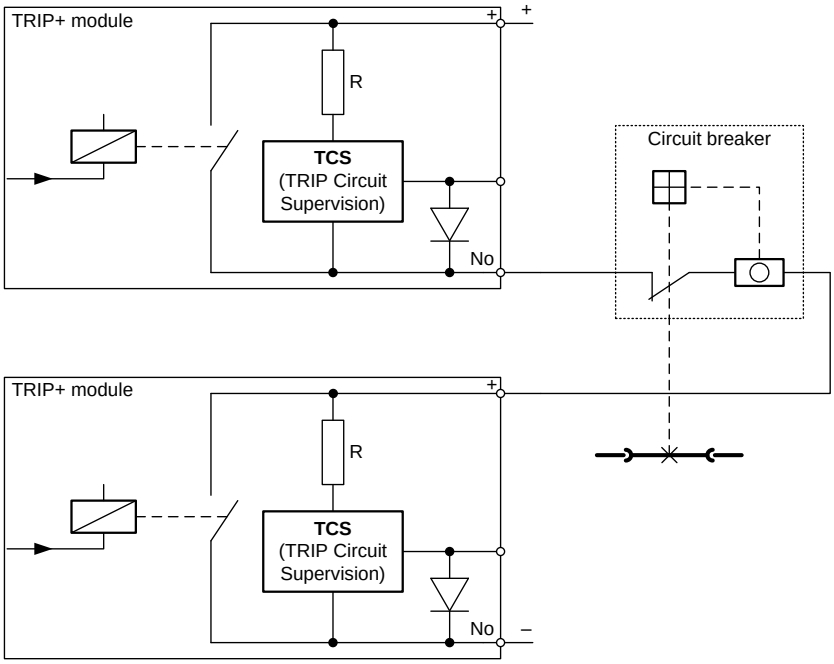

Figure 2-5 2-wire TRIP+ wiring using series connected TRIP+ modules

2.2 TCS signal handling

The Trip Circuit Supervision detects broken trip circuit if the current flowing through the trip coil is below 1 mA or (in case of 3-wire wirings) the voltage on it is above 8-10-13 V (depending on the module).

In Chapter 2.3 there are calculated maximum values for the resistance of the trip coil. If these values are exceeded, the TCS might consider the trip circuit broken even if it is intact.

To solve this, there are two ways:

a) **Using the 2-wire wiring method*:** leaving out/disconnecting the DC- part of the TRIP wiring may solve the issue.
Note that in this case the voltage is not maximized on 15 V, so **the used voltage (up to 220 Vdc) will appear on the "NO" pin.** Caution is advised when touching the wiring in this case.

b) **Usage of modules without TCS:** if the TCS is not a requirement (e.g. in backup protections), it can be simply left out by opting for the appropriate modules (such as PSTP+/2131 or TRIP+/21F1) while ordering.

**The inputs of some relay testers might sense the states of the Trip contacts active even if they are not. In such cases the "–" pin must be wired in for the tests.*

2.3 Technical data

The following tables contain information according to the wiring connections described in Chapter 2.1.

Table 2-1 Technical data for the TRIP+ modules

	Module type	TRIP+4201	TRIP+2101	TRIP+2201
	Value of R resistor (± 10 %)	10 kΩ	73 kΩ	130 kΩ
	Injected current at "NO" contact	2.4 mA @ 24 V DC 4.8 mA @ 48 V DC	1.5 mA @ 110 V DC	1.7 mA @ 220 V DC
Maximum resistance of the trip coil	3-wire wiring (max. 10 V)	**11.8 kΩ** @ 24 V DC **3.7 kΩ** @ 48 V DC	**9.7 kΩ** @ 110 V DC **8.4 kΩ** @ 125 V DC	**8.1 kΩ** @ 220 V DC
	3-wire wiring with in parallel (max. 10 V)	**5.9 kΩ** @ 24 V DC **1.8 kΩ** @ 48 V DC	**4.8 kΩ** @ 110 V DC **4.2 kΩ** @ 125 V DC	**4 kΩ** @ 220 V DC
	2-wire method (1 mA min. current)	**14 kΩ** @ 24 V DC **38 kΩ** @ 48 V DC	**37 kΩ** @ 110 V DC **52 kΩ** @ 125 V DC	**90 kΩ** @ 220 V DC

The PSTP+ modules work based on current generator principle, so the calculations for these are based on the necessary minimum current and the allowed maximum voltage.

Table 2-2 Technical data for the PSTP+ modules

	Module type	PSTP+4201	PSTP+2101
	Injected current at "NO" contact	1.5 mA	1.5 mA
Maximum resistance of the trip coil	3-wire wiring (1 mA current)	**8 kΩ** (max. 8 V)	**13 kΩ** (max. 13 V)
	3-wire wiring in parallel	**4 kΩ** (max. 8 V)	**6.5 kΩ** (max. 13 V)
	2-wire method (1 mA min. current)	**24 kΩ** @ 24 V DC **48 kΩ** @ 48 V DC **60 kΩ** @ 60 V DC	**110 kΩ** @ 110 V DC **220 kΩ** @ 220 V DC

3 Software application

3.1 Binary inputs

The **TCS input is active if the trip circuit is intact**, so the logical '0' or FALSE signal of the input means that either the trip circuit is broken, or it connects to high resistance.

The TCS signals are shown the same way as other binary inputs are in the device: they can be seen in the **on-line data** menu on the local HMI or the device web page, and they can be utilized just like any other binary input when editing the device configuration with EuroCAP software.

The names/titles of the inputs follow the occupied slot of the TRIP module (if it is in Slot **N**, the TCS contact is named BIn_**N**##).

3.2 The TCS macro

In most cases the trip circuit is tripped along with the circuit breaker as well. In situations like this the TCS input would signal a broken trip circuit (logical '0' or FALSE) unnecessarily. To avoid this, the status signals of the CB are to be used combined with the TCS input signal so that it will be evaluated only when the CB is closed.

The TCS macro incorporates this logic for two separate TCS inputs for one CB (see Figure 3-2 for the two TCS inputs and the CB status signal inputs). The outputs are the failure signals for each connected TCS input.

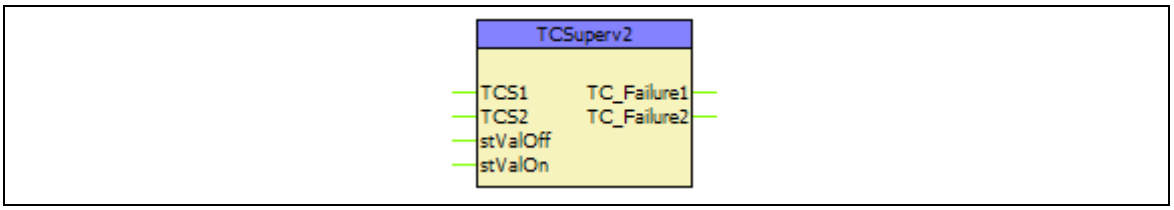

Figure 3-1 Graphic appearance of the Trip Circuit Supervision macro

The internal logic of the macro can be seen on Figure 3-2 below. Both outputs have a fixed pick delay of 1000 ms. Note that **here the outputs are active if the trip circuit is broken**. For a CB with only 1 trip circuit it is enough to simply leave the **TCS2** input open (naturally in this case the TC_Failure2 output cannot be used).

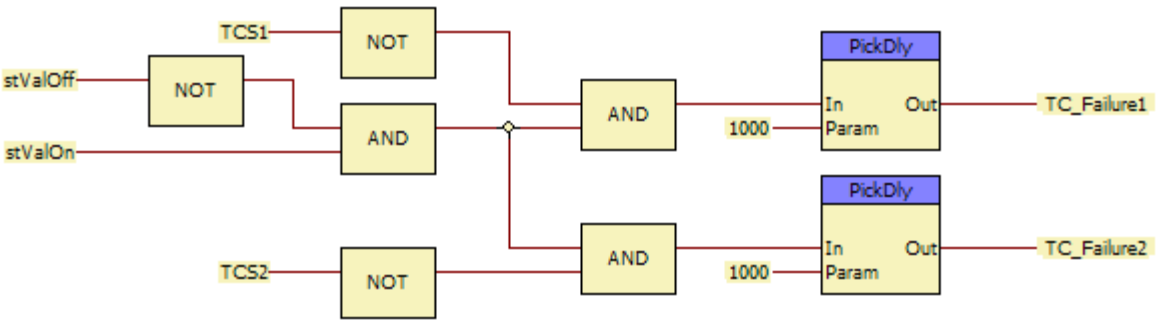

Figure 3-2 Internal logic of the Trip Circuit Supervision macro

3.2.1 Binary input signals

The following table explains the binary input signals of the macro.

Table 3-1 Binary input signals of the Trip Circuit Supervision macro

BINARY INPUT SIGNAL	EXPLANATION
TCS1	Connect here the first TCS binary input
TCS2	Connect here the second TCS binary input
stValOff	CB Off/Open signal
stValOn	CB On/Closed signal

3.2.2 Binary output signals

The following table explains the binary output signals of the macro.

Table 3-2 Binary output signals of the Trip Circuit Supervision macro

BINARY OUTPUT SIGNAL	EXPLANATION
TC_Failure1	Failure on the first circuit
TC_Failure2	Failure on the second circuit

Note that these are the outputs of a macro, and not a function block, so they must be connected to a physical or a logical output (ConnOut, create status) to make them usable in other parts of the configuration. For further information please refer to the EuroCAP software description.