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SIRIUS contactors in combination with SIMATIC control outputs (pp and pm-switching)

SIRIUS Industrielle Schalttechnik

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1 Tasks

How can SIRIUS contactors be operated in combination with SIMATIC controllers?

2 Solution

2.1 Using SIRIUS contactors on "standard" controller modules

Standard controllers' electronic outputs do not possess any diagnostics functions such as wire break detection/overload. Therefore, it is possible to use SIRIUS 3RT1/2 contactors (sizes S00 to S3 - 3RT1.1/3RT2.1, 3RT1.2/3RT2.2, 3RT1.3/3RT2.3, 3RT1.4/3RT2.4 (except 3RT2.4.-.N..)) without restriction on standard modules with 2 A semiconductor outputs.

Due to the high switch-on power, sizes S6 to S12 (3RT1.5 to 3RT1.7) must be controlled by coupler (3RH1/2, 3TX7, 3RQ, 3RS18, etc.) or via the optional PLC input. For that the switch must be taken to the corresponding position.

In case of multiple series connection, attention only must be paid to the modules' maximum (short-time) current carrying capacity, because depending on the size switching ON the contactors can result to an inrush current.

2.2 Using SIRIUS contactors on modules with fail-safe outputs

- **Using SIRIUS 3RT1 contactors, sizes S00 to S3 (3RT1.1, 3RT1.2, 3RT1.3, 3RT1.4):**

SIRIUS 3RT1 contactors in the sizes S00 to S3 can be used without restriction on both semiconductor and relay outputs of fail-safe modules.

- **Using SIRIUS 3RT1 contactors, sizes S6 – S12 (3RT1.5 to 3RT1.7):**

Due to the high switch-on power, sizes S6 to S12 must be controlled by coupler (3RH1/2, 3RQ, 3TX7, 3RS18, etc.), or via the PLC-Input on the contactor. In that case the switch must be put in the correct position.

The alternative within S6-S12 contactors is using the versions with a failsafe PLC-Input (3RT1...-S...).

- **Using SIRIUS 3RT2 contactors, sizes S00 and S0 (3RT2.1, 3RT2.2):**

SIRIUS 3RT2 contactors in sizes S00 and S0 (with AC or DC-drive) can be used without restriction on both semiconductor (only DC-drives) and relay outputs of fail-safe modules.

- **Using SIRIUS 3RT2 contactors, size S0/ S2 / S3 (3RT2.2.-.N, 3RT2.3, 3RT2.4):**

Generally, contactors with DC-drive are recommended when using SIRIUS contactors size S0 on fail-safe modules

When using SIRIUS 3RT2.3 or SIRIUS 3RT2.4 contactors on fail-safe modules, generally the type 3RT2.3.-.KB4. / 3RT2.4.-.KB4. is recommended. These

contactors have been optimized for use on fail-safe semiconductor and relay outputs.

When SIRIUS 3RT203.-.NB3./ 3RT204.-.NB3. contactors are used, various fault states can arise in the controller in combination with fail-safe semiconductor outputs. The use of a 3RH2914-.GP11 coupling module is recommended on fail-safe relay outputs.

2.3 Using SIRIUS 3RT202.-.NB3.contactors

SIRIUS 3RT202.-.NB3. contactors can be used on fail-safe modules without restriction under the following conditions:

- Dark period of the fail-safe module $\geq 3\text{-}5$ ms
- Resistor (1.2 k Ω) in parallel with the contactors drive

Resistor must be connected to the contactors contacts A1 and A2.

If it is not possible to use a resistor, alternatively you can deactivate the wire break on a fail-safe module (as far as it is permissible for the application) or use a coupling module 3RH2914-.GP11 / coupling relay (3RH1/2, 3RQ, 3TX7, 3RS18, etc.).

If a resistor is not used, wire break faults can be signaled in the fail-safe module due to the basic operating principle of electronic contactor drives (pulsing of the input voltage).

Note

Excluding of wire break faults must be ensured by protected laying of the cabling or by placing the contactors in a control cabinet.

2.4 Using SIRIUS 3RT203.-.KB4. or 3RT204.-.KB4. coupling contactors

2.4.1 SIRIUS coupling contactors 3RT203.-.KB4.

SIRIUS 3RT203.-.KB4. coupling contactors can be used on fail-safe modules without any restriction under the following conditions.

- **Contactors 3RT203.-.KB4. with versions E01 und E02:**
Dark period of the fail-safe module $\geq 3\text{-}5$ ms (recommended setting for SIMATIC modules: 10 ms)

Resistor (1.2 k Ω) in parallel with the contactors drive. Contactors with version E02 have a plugged-in resistor on the frontside and should not be removed.

If a resistor is not used with version E01, wire breaks faults can be signaled in the fail-safe module due to the basic operating principle of electronic contactor drives (pulsing of the input voltage).

When using a contactor with version E01, it is recommended to use a 3RH2914-.GP11 coupling module for use on fail-safe relay outputs.

- **Contactors 3RT203.-.KB4. with version E03:**

The recommended dark period of the fail-safe modules with contactors with version E03 is 1 ms.

Version E03 has an integrated resistor which is not visible from the outside.

For contactors up to version E03 and a date of manufacture before 12. Feb 2018 (displayed on contactor G/JJMMTT *E03* e.g. G/180212*E03*) in combination with relay contacts with high bouncing times, faults can happen which can be solved by an additional RC-Element (3RT2936-1CB00). As of manufacturing date 12. Feb 2018 the firmware of the contactor is adapted and can be used without RC-Element in applications with relay contacts with high bouncing times.

- **Contactors 3RT203.-.KB4. with version E04:**

Contactors with version E04 and a date of manufacturing later than 23. Nov 2018 (displayed on contactor G/JJMMTT *E04* e.g. G/181123*E04*) prevent, that the contactor switches off and on during dark tests with 10 ms (dark period of the fail-safe module).

The residual ripple of the power supply should be max. 50%. Only then a secured switching can be guaranteed. Valid for version E01 until E04.

When using contactors 3RT203.-.KB4. during the first 200 ms increased starting currents occur (2,2 A on average).

Note

Excluding of wire break faults must be ensured by protected laying of the cabling or by placing the devices in a control cabinet.

2.4.2 SIRIUS coupling contactors 3RT204.-.KB4.

SIRIUS 3RT204.-.KB4. coupling contactors can be used on fail-safe modules without any restriction under the following conditions.

- **Contactors 3RT204.-.KB4. with version E01:**

The recommended dark period of the fail-safe modules with contactors with version E01 is 1 ms.

For contactors with version E01 and a date of manufacture before 17. May 2018 (displayed on contactor G/JMMTT *E01* e.g. G/180517*E01*) in combination with relay contacts with high bouncing times, faults can happen which can be solved by an additional RC-Element (3RT2936-1CB00). As of manufacturing date 17. May 2018 the firmware of the contactor is adapted and can be used without RC-Element in applications with relay contacts with high bouncing times.

- **Contactors 3RT204.-.KB4. with version E02:**
Contactors with version E02 and a date of manufacturing later than 29. March 2019 (displayed on contactor G/JMMTT *E02* e.g. G/190329*E02*) prevent, that the contactor switches off and on during dark tests with 10 ms (dark period of the fail-safe module).

The residual ripple of the power supply should be max. 50%. Only then a secured switching can be guaranteed. Valid for version E01 and E02.

When using contactors 3RT204.-.KB4. during the first 200 ms increased starting currents occur (2,2 A on average).

Note

Excluding of wire break faults must be ensured by protected laying of the cabling or by placing the devices in a control cabinet.

2.5 Using SIRIUS 3RT203.-.NB3. / 3RT204.-.NB3. contactors

When the 3RT203.-.NB.. / 3RT204.-.NB.. is used, wrong error messages (wire break, short-circuit or overload) can occur if it is connected to fail-safe PLC outputs. Unfortunately, there is no external possibility to protect against the peak currents on activation of the contactor that would enable operation on fail-safe modules with overload detection.

Notice: only the 3RT20.-.KB4. variant should be used with fail-safe PLCs connected directly on the fail-safe digital output module F-DQ.

However if the 3RT203.-.NB.. / 3RT204.-.NB.. contactor is already installed in the control cabinet, the following solutions as described in 2.5.1 until 2.5.3 are possible.

2.5.1 Solution 1

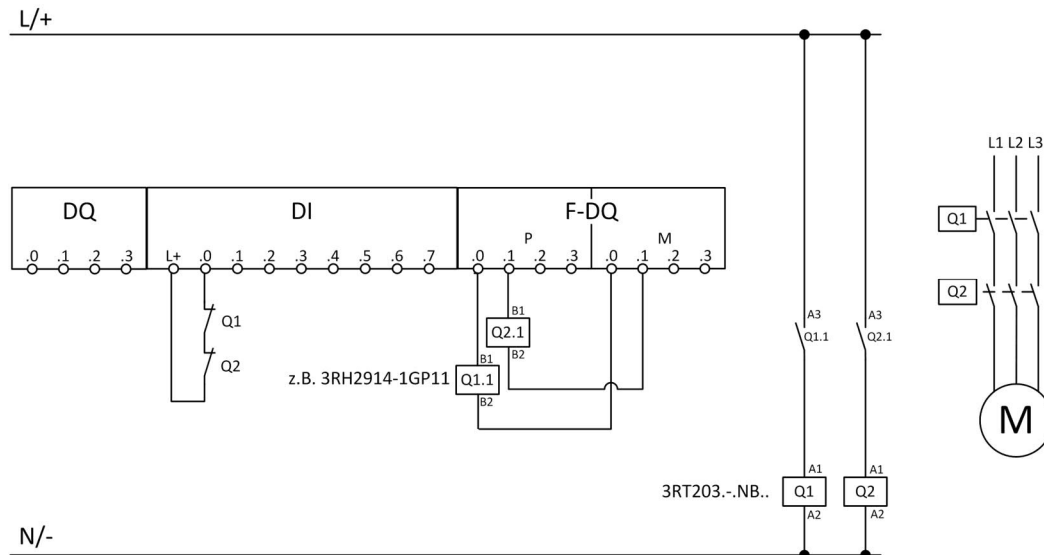
The 3RH2914-.GP11 coupling relay is mounted onto the contactor 3RT203.-.NB.. / 3RT204.-.NB... Therefore, the contactor will be controlled via the coupling relay.

Note: this is only possible if a front auxiliary switch block is not already mounted on the contactor.

In case of this configuration, please note that the contactors in version E01 and E02 generate an inrush peak of up to 25 A (<20 μs), which must be compensated by the upstream power supply unit. When using relay contacts, the switching capacity of the contact must be high enough. Moreover, the current during the first

200 ms is much higher than the drives later holding current (approx. 2.6 A at 24 V DC for contactor 3RT203.-.NB.. and 6,5 A for contactor 3RT204.-.NB..).

Circuit example:



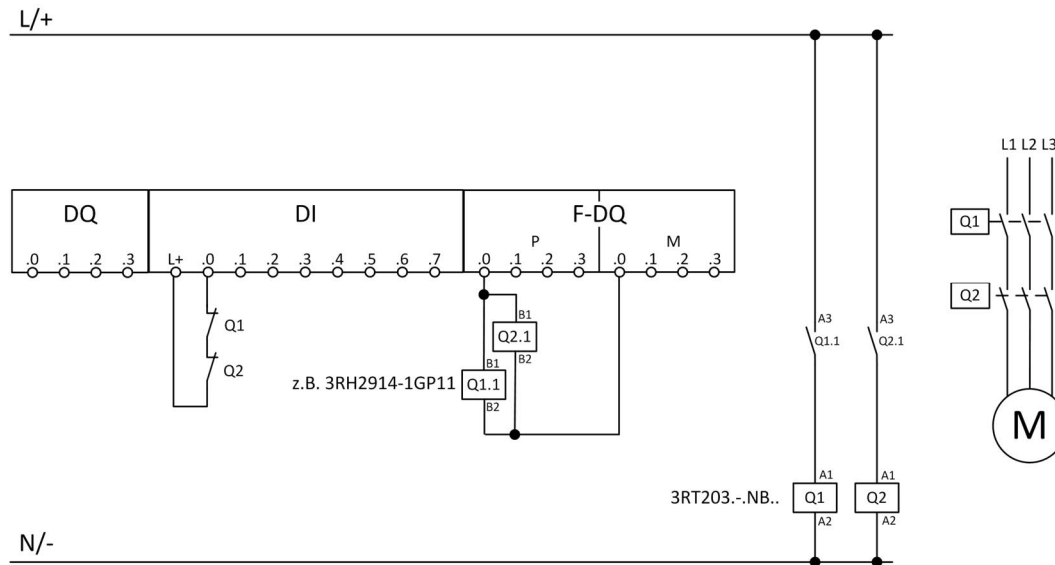
A fail-safe module switches the coupling relays Q1.1 and Q2.1, through which the power contactors Q1 and Q2 are controlled.

The coupling relays are thus part of the safety function and must be considered when calculating the probability of hazardous failures.

The function of the main contactors is monitored in the feedback loop of the fail-safe module. The coupling relays do not need to be monitored because faults are detected by the mirror contacts of the main contactors in the feedback loop.

The coupling relays diagnostic coverage level can therefore be assumed to have the same value as that of the power contactors.

For a two-channel installation there is the possibility to switch the auxiliary contactors in parallel. For that, see the following picture.



Note

Dynamic feedback circuit monitoring by the fail-safe controller is required for SIL 3 or PL e. This can be achieved with an FDBACK component, for example, which is available for Distributed Safety and Safety Advanced. If dynamic monitoring is not possible, the feedback circuit must be read in through a fail-safe input.

To avoid short circuits to other wires it is recommended to use isolated wires or put them in an own cable duct.

2.5.2 Solution 2

If an auxiliary switch block is already mounted on the 3RT203.-.NB.. / 3RT204.-.NB.. contactor and/or there is sufficient mounting space in the control cabinet, an additional coupling relay / fail-safe coupling relay (e.g. 3RH2) can be used to control the contactor.

In case of this configuration, please note that the contactors in version E01 and E02 generate an inrush current up to 25 A (<20 μs), which must be compensated by the upstream power supply unit.

When using relay contacts, the switching capacity of the contact must be high enough. Moreover, the current during the first 200 ms is much higher than the contactors holding current (approx. 2.6 A at 24 V DC for contactor 3RT203.-.NB.. and 6,5 A for contactor 3RT204.-.NB..).

The outlined wiring examples under chapter 2.5.1 also apply to this solution.

2.5.3 Solution 3

If there are any doubts about the short-time power of the power supply unit's, the 3RT203.-.NB.. / 3RT204.-.NB.. variant must be replaced with the 3RT203.-.KB.. / 3RT204.-.KB.. variant. They have an improved response during power up (lower inrush current peaks) of the contactor to ensure fault-free operation.

Hinweis

The coupling relays are thus part of the safety function and must be considered when calculating the probability of hazardous failures.
The technical data of SIEMENS low-voltage controls can be found in the Service & Support Portal (support.industry.siemens.com).

3 Additive SIMATIC S7 recommendations

3.1 SIMATIC S7-1200

If using SIMATIC S7-1200 output modules in combination with SIRIUS 3RT2 contactors with wiring lengths of 100 m and 2 ms dark period error messages are possible. An increase of the dark period to > 5 ms clears this error message. It doesn't appear in case of short wiring lengths (approx. 1 m).

3.2 SIMATIC S7-1500

If using SIMATIC S7-1500 with a dark period of 10 ms a "double switching" is possible. The output module already starts sporadically a dark test with the activation of the output. The supply voltage for the microcontroller breaks down during the closing procedure, so that the contactor switches shortly off and on.

If a "double switching" occurs, it is recommended to check the dark period. The value should be adjusted to < 10 ms or to the default level of the module.

4 Contact

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