

Motor Controllers Dynamic Braking Types RTC 40 HD12-./RTO 12..



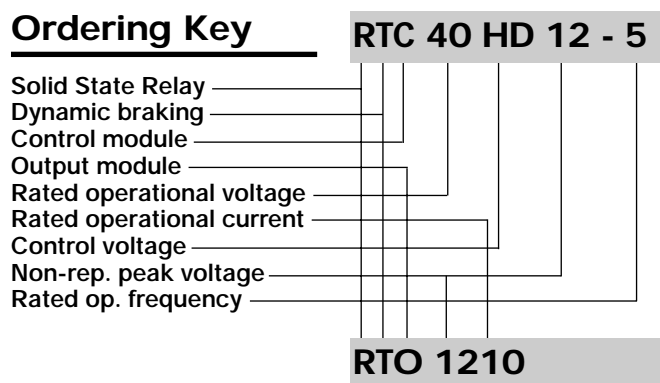
- Control and output modules for dynamic braking of 3-phase induction motors
- Rated operational current: 18.5, 30 and 60 A DC
- Rated operational voltage: Up to 400 VACrms
- Control voltage: 10 to 32 VDC
- LED indication for line ON and brake ON

Product Description

Dynamic braking is achieved by introducing a DC current, rectified from the mains, through the motor windings. The control module RTC 40 HD-12.. is used in combination with the output module RTO 12.. to achieve dynamic braking of 3-phase induction motors with braking current up to 60 A. The desired braking time and the required brake current can be adjusted

with the TIME and BRAKE CURRENT potentiometers. The control module, which is separately supplied from an external DC voltage source, has LED indications for LINE ON and BRAKE ON. The output signal from the control module is off 350 ms before the brake current is introduced. This signal can be used to take away the AC supply of the motor.

Ordering Key



Type Selection

Type	Rated operational voltage	Control voltage	Non-rep. peak voltage	Rated operational frequency
C: Control module	40: 120/208 VACrms 230/400 VACrms	HD: 10 to 32 VDC	12: 1200 V _p	5: 50 Hz ± 3 Hz 6: 60 Hz ± 3 Hz
Type	Non-rep. peak voltage	Rated operational current		
O: Output module	12: 1200 V _p	10: 2 x 18.5 A DC 25: 2 x 30 A DC 50: 2 x 60 A DC		

Selection Guide

Control module	Rated operational frequency		
	50 Hz	60 Hz	
230/400 VACrms	RTC 40 HD-12-5	RTC 40 HD-12-6	
Non-rep. voltage	Rated operational current		
	8.5 A	30 A	60 A
1200 V _p	RTO 1210	RTO 1225	RTO 1250



General Specifications Control Module

	RTC 40 HD12-5	RTC 40 HD12-6
Operational voltage range Line to line	190 to 440 VACrms	190 to 440 VACrms
Non-rep. peak voltage	$\geq 1200 V_p$	$\geq 1200 V_p$
Operational frequency range	47 to 52 Hz	57 to 63 Hz
Supply current @ RUN, no output @ BRAKE, no output	$\leq 30 \text{ mA @ 32 VDC}$ $\leq 110 \text{ mA @ 32 VDC}$	$\leq 30 \text{ mA @ 32 VDC}$ $\leq 110 \text{ mA @ 32 VDC}$
Approval	CSA	CSA
CE-marking	Yes	Yes

Control Input Specifications

Control voltage range	10 to 32 VDC
Motor running	$\geq 8 \text{ VDC}$
Motor stopped	$\leq 2 \text{ VDC}$
Adjust. braking current	Dependent on motor size
Adjust. braking time	1 to 40 s
Min. delay, stop to run	$\geq 1 \text{ cycle}$
Remanence delay	$\geq 350 \text{ ms}$

Thermal Specifications Control Mod.

Operating temperature	-20° to +80°C (-4° to +176°F)
Storage temperature	-40° to +100°C (-40° to +212°F)

Control Output Specifications

Minimum output voltage	Power supply less 3.5 VDC
Output current short-circuit protected	150 mA DC

Insulation Control Module

Rated insulation voltage Input to trigger outputs	$\geq 4000 \text{ VACrms}$
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Mode of Operation

The control module RTC 40 HD12-5 (50 Hz)/RTC 40 HD12-6 (60 Hz) is used with output module RTO 12.. to achieve dynamic braking of 3-phase induction motors.

Dynamic braking is achieved by passing direct current, rectified from the mains, through the motor windings. The DC-current will then produce a static field through the short-circuited rotor, and the induced rotor current will create a torque opposite to the direction of rotation.

Note:

This means that no braking takes place when the motor revolution is zero. The desired braking time can be set by means of the BRAKE TIME potentiometer. The

braking current can be adjusted by means of the BRAKE CURRENT potentiometer to achieve motor stop within the desired time.

Note:

Avoid excessive braking current after the motor has been stopped, as this will create unnecessary heating of the motor.

Since the RTC/RTO configuration is only capable of braking the motor, a starting device is needed. Either a Solid State Relay, e.g. Carlo Gavazzi RZ, or a motor controller RSC 40 HD12-./RSO 12.. can be connected to the application.

To ensure safe operation the starting device must be con-

trolled by the RTC output. When the control voltage (terminal C2) is removed, braking will take place.

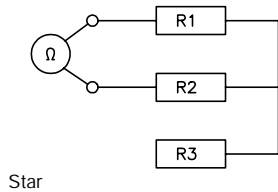
The control module has LED indication for line ON and brake ON. The control module also features remanence delay. To avoid torque shock, a delay of min. 350 ms passes from the moment the motor contactor has been released until DC voltage is reapplied to the motor windings.

To measure the braking current, always use a true rms ammeter with DC range.

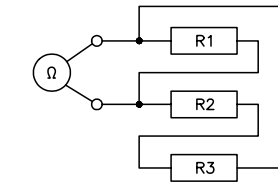
In order to define the size of the output module, it is necessary to find the resistance between the two termi-

nals from the motor where the brake module will be connected. This resistance is a combination of the resistances of the motor windings and is dependent on how the motor is connected. In star connection it is a series connection of two windings (see top of next page). In delta connection it consists of two windings connected in parallel to the third winding (see top of next page).

Mode of Operation (cont.)



Star



Delta

If the brake current is adjusted to max., full half waves are introduced to the motor, and

the DC voltage is calculated as follows:

$$U_{DC} = \frac{U_{max}}{\pi} = \frac{U_n \times \sqrt{2}}{3.14} = U_n \times 0.45$$

The max. current can be calculated as follows:

$$I_{max} = \frac{U_n \times 0.45}{\Sigma R}$$

where ΣR is a combination of the windings mentioned above.

Example: The resistance of the motor winding is 5 Ω .

The rated operational voltage is 400 VAC.

What is the max. current in star connection and in delta connection?

$$\Sigma R \text{ star is } R1 + R2 = 5 + 5 \Omega = 10 \Omega$$

$$\Sigma R \text{ delta is } R1 \text{ parallel to } R2 + R3 = 3.3 \Omega.$$

The current is:

$$\frac{400 \times 0.45}{10} = 18 \text{ A}$$

for the star connection, and

$$\frac{400 \times 0.45}{3.33} = 54 \text{ A}$$

for the delta connection.

The output module has to be selected accordingly (next higher power rating).

General Specifications Output Module

	RTO 1210	RTO 1225	RTO 1250
Operational voltage range Line to line	220 to 420 VACrms	220 to 420 VACrms	220 to 420 VACrms
Rated operational current AC1	18.5 ADC	30 ADC	60 ADC
Approval	CSA	CSA	CSA
CE-marking	Yes	Yes	Yes

Output Specifications Output Module

	RTO 1210	RTO 1225	RTO 1250
Non-rep. peak voltage	$\geq 1200 V_p$	$\geq 1200 V_p$	$\geq 1200 V_p$
Off-state leakage current	$\leq 10 \text{ mA}$	$\leq 10 \text{ mA}$	$\leq 10 \text{ mA}$
On-state voltage drop	$\leq 1.6 V_{rms}$	$\leq 1.6 V_{rms}$	$\leq 1.6 V_{rms}$
I^2t for fusing $t=1-10 \text{ ms}$	$\leq 130 \text{ A}^2\text{s}$	$\leq 310 \text{ A}^2\text{s}$	$\leq 1800 \text{ A}^2\text{s}$
Critical di/dt	$\geq 50 \text{ A}/\mu\text{s}$	$\geq 50 \text{ A}/\mu\text{s}$	$\geq 50 \text{ A}/\mu\text{s}$
Non-rep. surge current $t=20 \text{ ms}$	$160 A_p$	$250 A_p$	$600 A_p$

Thermal Specifications Output Module

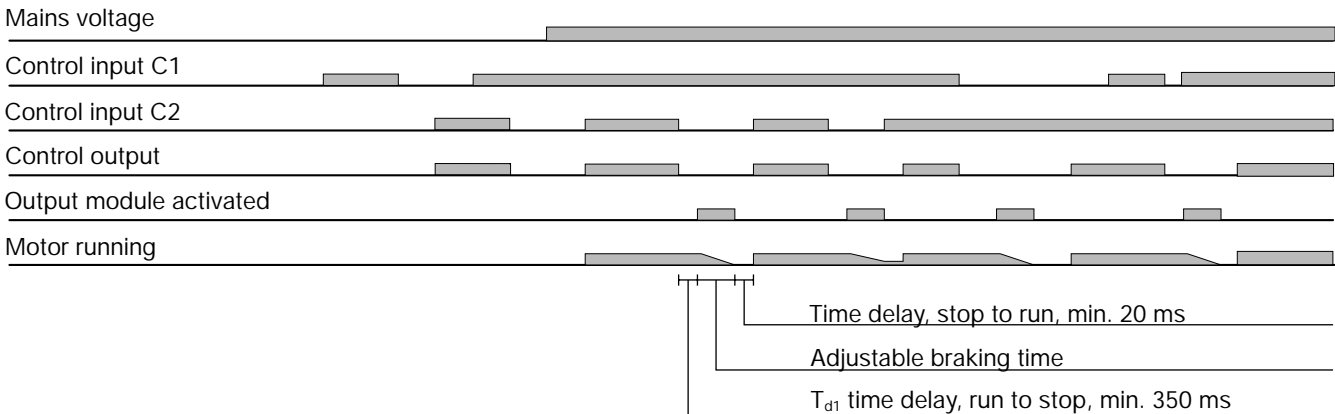
	RTO 1210	RTO 1225	RTO 1250
Operating temperature	-20° to +70°C (-4° to +158°F)	-20° to +70°C (-4° to +158°F)	-20° to +70°C (-4° to +158°F)
Storage temperature	-40° to +100°C (-40° to +212°F)	-40° to +100°C (-40° to +212°F)	-40° to +100°C (-40° to +212°F)
R_{th} junction to case	$\leq 1.4 \text{ K/W}$	$\leq 1.0 \text{ K/W}$	$\leq 0.5 \text{ K/W}$

Insulation Output Module

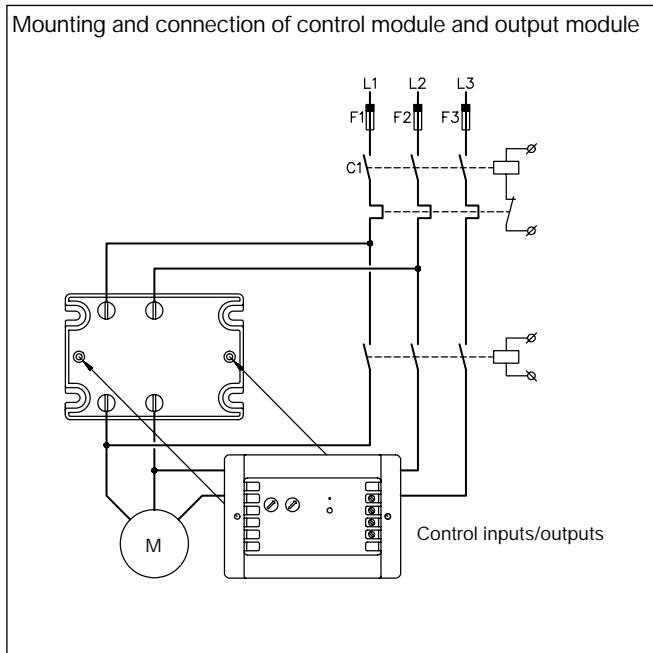
Rated insulation voltage Output to case	$\geq 4000 \text{ VACrms}$
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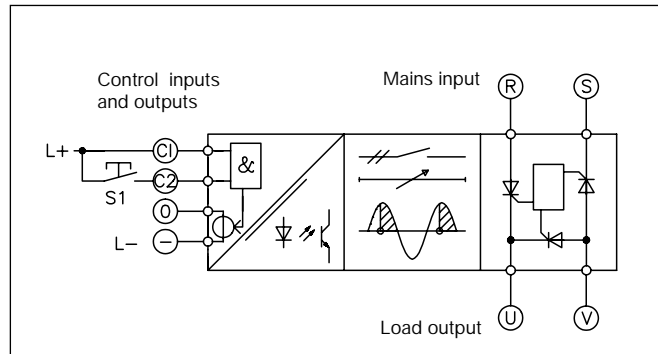
Operation Diagram



Wiring Diagram



Functional Diagram



Housing Specifications

Weight	Approx. 275 g
Housing material	Noryl, glass-reinforced
Colour	Black
Base plate	Aluminium, nickel-plated
Potting compound	Polyurethane, black
Relay	
Mounting screws	M5
Mounting torque	≤ 1.5 Nm
Control terminal	
Mounting screws	M3
Mounting torque	≤ 0.5 Nm
Power terminal	
Mounting screws	M5
Mounting torque	≤ 1.5 Nm

Accessories

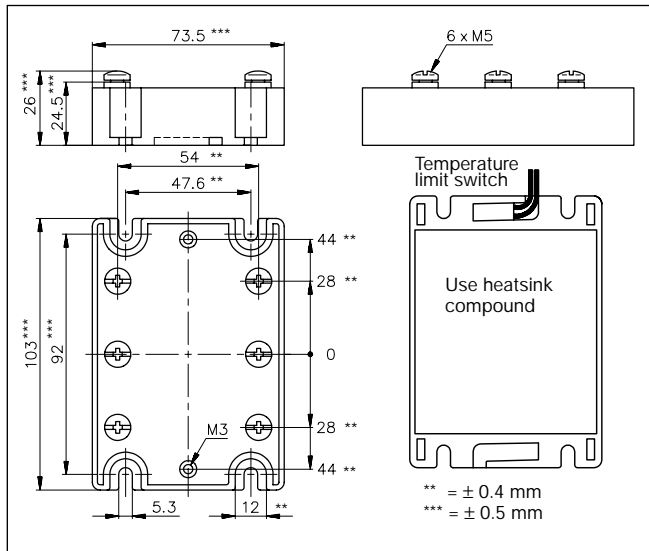
- Heatsinks
- Varistors
- Fuses
- Temperature limit switch
- Power supply

For further information refer to "General Accessories".

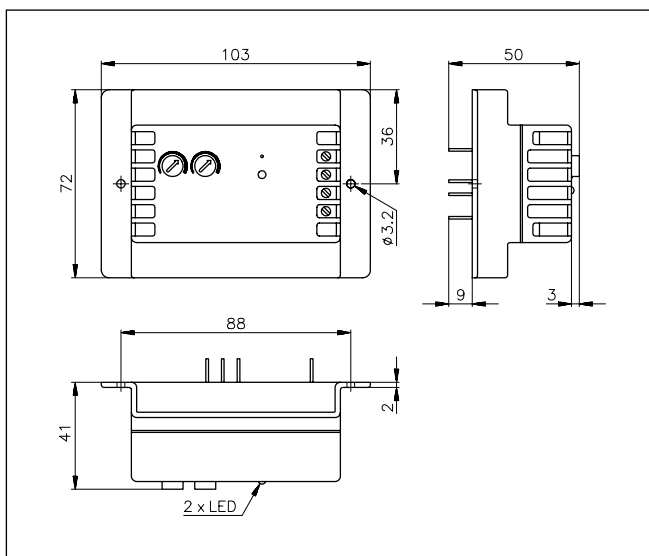


Dimensions

RTO 12..



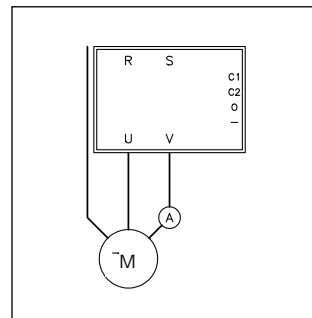
RTC 40 HD12-.



Applications

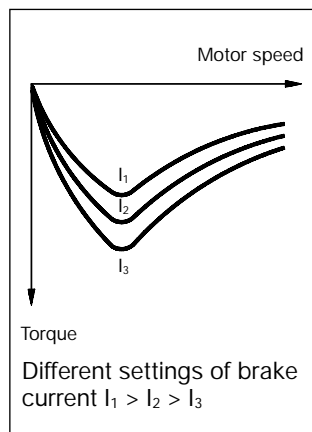
Measuring point for DC load current

Note: When using a clamp-meter, be sure that it is capable of measuring DC-current.



Brake current

Typical behaviour of braking torque as a function of motor speed: As will be seen from the curve, the braking torque will be relatively low at nominal motor speed. As the revolution speed decreases, the braking torque increases until the speed approaches zero. Then, the braking torque decreases. With zero speed the braking torque is at zero.



Protection of the motor

A possible way of protecting the motor against overheating where dynamic braking is used is to mount a temperature sensor, PTC or Klixon, between the motor windings.

Thermal relays will normally be sensitive to the current asymmetry occurring while braking. The thermal relay may trip undesirably.

Connection to the mains

As this type of brake relay has a semiconductor between two phases, it is always recommended to protect it against high surge currents as well as possible voltage transients.

The protection consists of two elements:

1. A semiconductor fuse rated below the max. load integral (I^2t) for the output module.
2. A voltage-dependent resistor (MOV) to prevent voltages higher than the blocking voltage of the output modules. Without MOV, voltage transients might trigger the output module and subsequently cause undesirable fuse blowing.

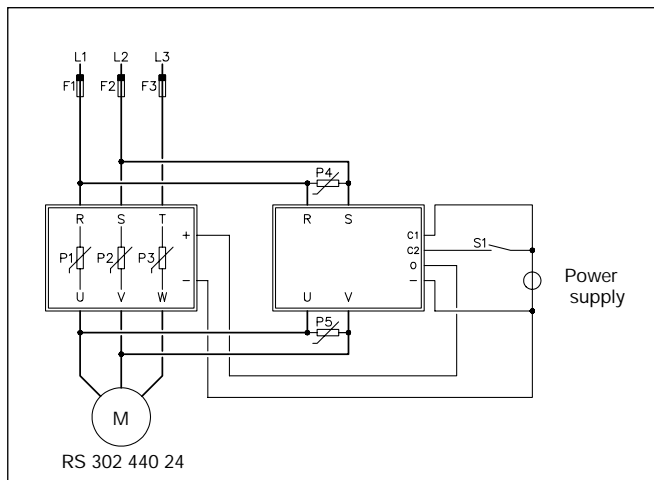
Connection to 3-phase SSR

F1 - F3: Ultrafast fuses with I^2t rated lower than the I^2t value of the output module.

P1 - P5: Varistors for 420 V mains with a diameter of 20 mm.



Applications (cont.)



Connection to a 3-phase mechanical relay

Special precautions should be taken where the driving element is a mechanical contactor. The electrical voltage peaks from the contactor must be damped by the use of RC snubbers.

The output of the braking module is disconnected from the motor terminals when the motor is running and is connected only when the motor is in brake or stop mode. This feature together with a mechanical and electrical interlock (dotted line) between motor and brake relay will help to reduce the risk of malfunction.

Varistor: 520 K 420 Siemens
 RC: PMR 209 Rifa 47Ω/0.1 μF
 d1: Feme MZP
 Fuse: See "General Accessories".

S1 closed: The motor is running.

S1 opens: The adjusted current brakes the motor within the adjusted time.

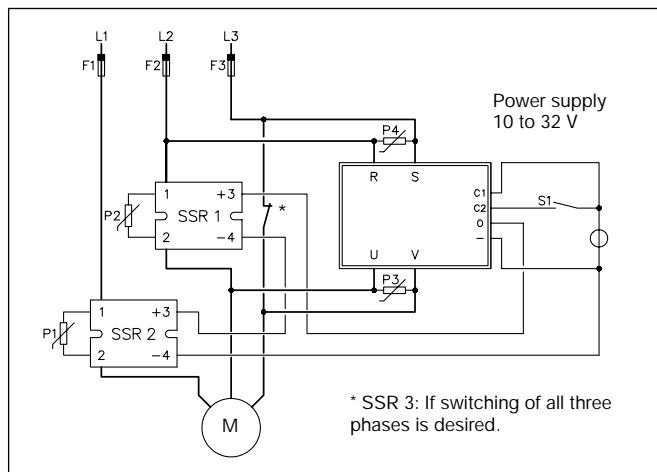
If S1 is closed before the end of a braking cycle, the relays will return to RUN mode within 0.1 s.

Connection to two 1-phase SSRs

Note: Motor protecting relay is not shown.

F1 - F3: Ultrafast fuses with I²t rated lower than the I²t value of the output.

P1 - P4: Varistors for 420 V mains with a diameter of 20 mm.



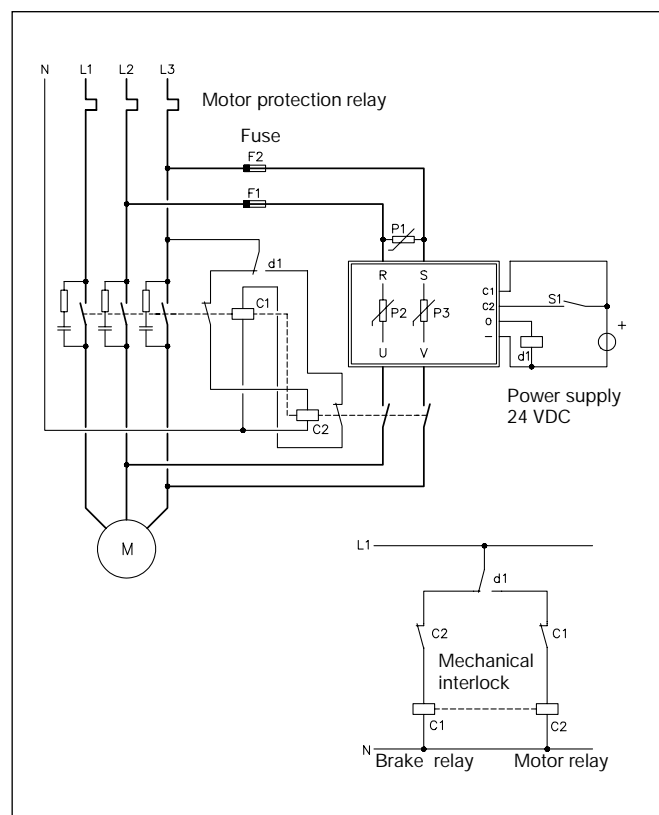
SSR 1, SSR 2: Carlo Gavazzi type RA 48 xx-D 12 (1200 V blocking voltage).

S1 closed: The motor is running.

S1 opens: The adjusted current brakes the motor within the adjusted time.

If S1 is closed before the end of a braking cycle, the relays will return to RUN mode within 0.1 s.

* SSR 3: If switching of all three phases is desired.



F1 - F3: Ultrafast fuses with I²t rated lower than the I²t value of the output module. F3 is optional since there is no semiconductor in L3.

P1 - P3: Varistors for 420 V mains with a diameter of 20 mm.

When S1 is closed, the motor is running.

When S1 is opened, the motor brakes and stops.

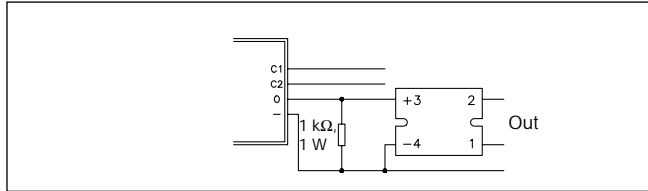
Note: The max. allowable delay time for switching off is 350 ms. Do not use more than one auxiliary relay.

The d1 relay could also be a Solid State Relay, e.g. Carlo Gavazzi relay type RP 130 240-2-0.

Applications (cont.)

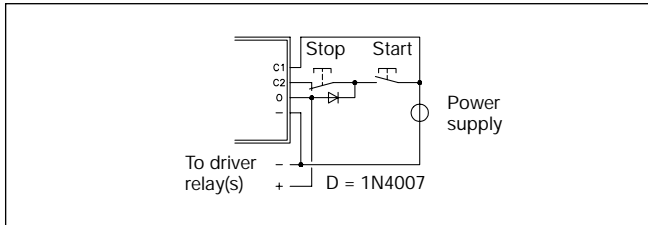
When using Solid State Relays, a resistor of 1 kΩ should be connected between output (0) and negative (-) on the RTC control unit to ensure

that the output voltage from the RTC control unit is lower than the drop-out voltage for the Solid State Relay.

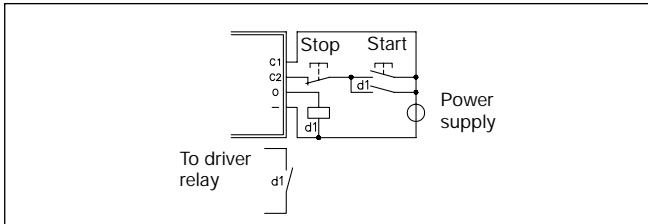


Start - stop function

(only control circuit is shown)

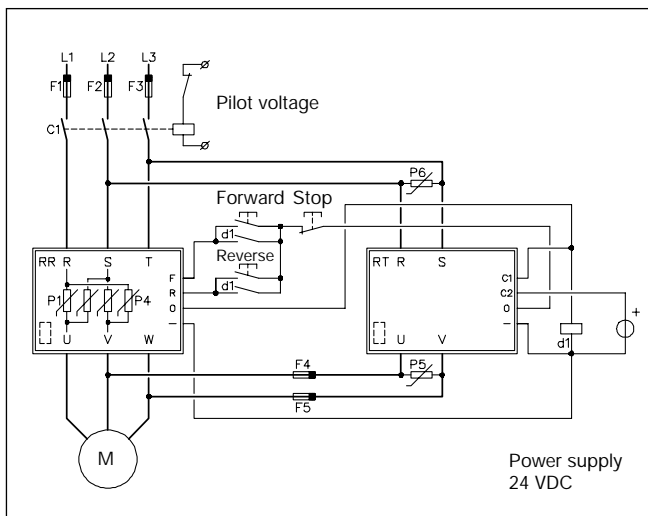


With auxiliary diode



With auxiliary relay

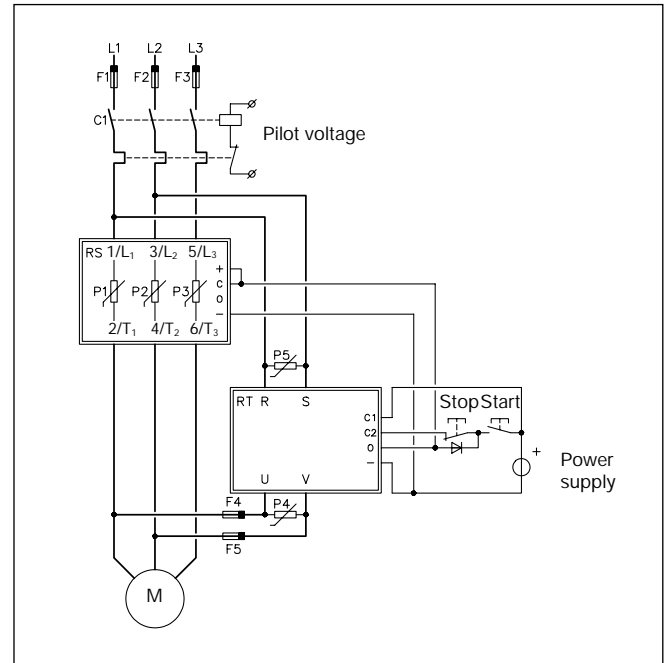
Interconnection of braking and reversing SSRs



F1 - F5: Ultrafast fuses with I²t rated lower than the I²t value of the relevant output modules.

P1 - P6: Varistors for 420 V mains with a diameter of 20 mm.

Interconnection of soft starting and braking SSRs



F1 - F5: Ultrafast fuses with I²t rated lower than the I²t value of the relevant output modules.

P1 - P5: Varistors for 420 V mains with a diameter of 20 mm.

Solid State Relay

Due to the relatively high power dissipation in the motor the RUN and BRAKE mode ratio is normally less than 0.1.

$$\frac{\text{Brake time}}{\text{Run} + \text{Brake time}} < 0.1$$

This gives negligible power dissipation in the braking Solid State Relay. Under normal conditions it will be sufficient to mount the relay on to the chassis. If no metal backplate is available, a heatsink must be used:

- RTO 1210 R_{th} = 2.5 K/W
- RTO 1225 R_{th} = 2.5 K/W
- RTO 1250 R_{th} = 1 K/W

The heatsinks are sufficient for ambient temperatures up to 60°C (140°F).

Thermal considerations

Motor

Dynamic braking of 3-phase induction motors creates power dissipation in the motor. The DC current dissipates power in the stator windings, and the stored energy in the rotating machine is dissipated in the rotor during braking. Consequently, the best way of protecting the motor will be to install temperature sensors in the motor windings.