Motor Controllers
Reversing with Interlock
Types RRC 40 HD12/RRO 12..

- **Control and output modules for starting/ reversing of 3-phase induction motors**
- **Rated operational current: 3 x 10, 25 and 50 AACrms**
- **Rated operational voltage: Up to 400 VACrms**
- **Control voltage range: 10 to 32 VDC**
- **LED indication for line ON and direction of motor rotation**

Product Description

The control module RRC 40 HD12 is used with output module RRO 12.. to achieve starting and/or reversing of 3-phase induction motors. When the motor is fully operating, the module delivers a signal which can be used to connect a contactor in parallel to the output module thereby limiting the power dissipation of the device and eliminating the need for a large heatsink. The control module also features LED indication for line ON and direction of motor rotation.

Ordering Key

RRC 40 HD 12

Solid State Relay
Reversing
Control module
Output module
Rated operational voltage
Rated operational current
Control voltage
Non-rep. peak voltage

RRO 1210

Type Selection

Type	Rated operational voltage	Control voltage	Non-rep. voltage
C: Control module	40: 120/208 VACrms 230/400 VACrms	HD: 10 to 32 VDC	12: 1200 Vp

Type	Non-rep. voltage	Rated operational current
O: Output module	12: 1200 Vp	10: 3 x 10 AACrms 25: 3 x 25 AACrms 50: 3 x 50 AACrms

Selection Guide for Output Modules

Non-rep. voltage	Rated operational current 10 AACrms	25 AACrms	50 AACrms
1200 Vp	**RRO 1210**	**RRO 1225**	**RRO 1250**

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General Specifications

Operational voltage range Line to line	120 to 420 VACrms
Non-rep. peak voltage	≥ 1200 V_p
Operational frequency range	25 to 70 Hz
Supply current 32 VDC @ 150 mA output current @ no output current	 ≤ 200 mArms ≤ 35 mArms
Approval	CSA

Control Input Specifications

Control voltage range Forward or reverse	10 to 32 VDC
Control current (no output) Active input @ 32 VDC Inhibit input @ 32 VDC	 ≤ 35 mArms ≤ 16 mArms
Adjustable dead time F→R	0.02 to 1.5 s
Adjustable dead time R→F	0.02 to 1.5 s
Response time Input to trigger outputs	 ≤ 1/2 cycle

Control Output Specifications

Minimum output voltage	power supply less 3.0 VDC
Output current short-circuit protected	 150 mA DC

Thermal Specifications

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

Insulation Control Module

Rated insulation voltage Input to trigger outputs	 ≥ 4000 VACrms

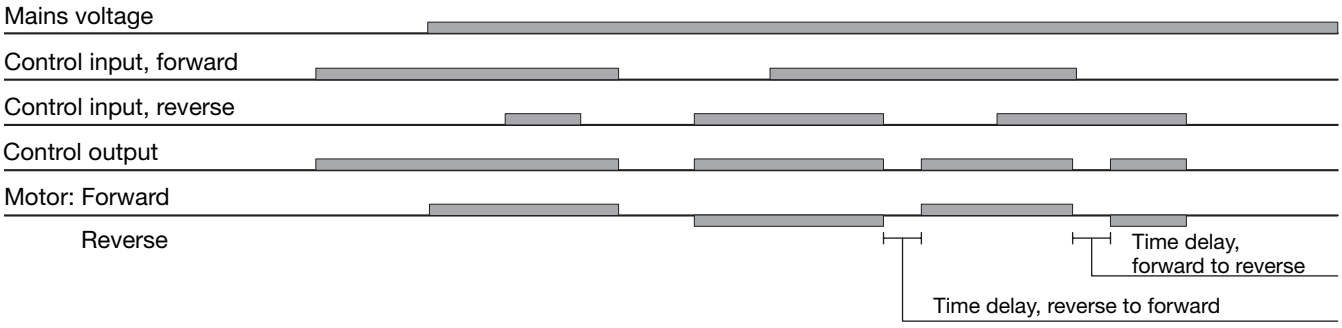
Mode of Operation

The control unit RRC 40 HD12 is used together with output module type RRO 12.. to achieve starting and/or reversing of 3-phase induction motors.

The control unit has built-in interlocking and adjustable delay time between forward and reverse.
The motor is switched off during the delay time before starting in the opposite direction. This time allows the remanence field in the motor to be reduced before the field is reapplied, thereby reducing the reversing current.

The control unit has LED indication for line ON and direction of motor rotation (forward or reverse). A short circuit protected output indicates relay ON.

Operation Diagram



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General Specifications Output Module

	RRO 1210	RRO 1225	RRO 1250
Operational voltage range	120 to 420 VACrms	120 to 420 VACrms	120 to 420 VACrms
Approval	CSA	CSA	CSA

Output Specifications Output Module

	RRO 1210	RRO 1225	RRO 1250
Rated operational current AC 1 AC 3	3 x 10 Arms 3 x 3 Arms	3 x 25 Arms 3 x 5 Arms	3 x 50 Arms 3 x 15 Arms
Non-rep. peak voltage	≥ 1200 V_p	≥ 1200 V_p	≥ 1200 V_p
Off-state leakage current	≤ 10 mArms	≤ 10 mArms	≤ 10 mArms
On-state voltage drop	≤ 1.6 Vrms	≤ 1.6 Vrms	≤ 1.6 Vrms
I^2t for fusing t=1-10 ms	≤ 130 A^2s	≤ 310 A^2s	≤ 1800 A^2s
Critical dI/dt	≥ 50 A/µs	≥ 50 A/µs	≥ 50 A/µs
Non-rep. surge current t=20 ms	160 A_p	250 A_p	600 A_p

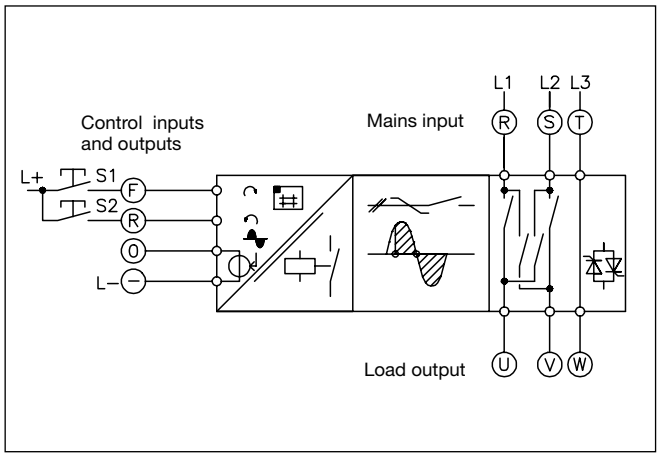
Thermal Specifications Output Module

	RRO 1210	RRO 1225	RRO 1250
Operating temperature	-20 to +80°C (-4 to +176°F)	-20 to +80°C (-4 to +176°F)	-20 to +80°C (-4 to +176°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)
Rth junction to case	≤ 1 K/W	≤ 0.75 K/W	≤ 0.35 K/W

Insulation Output Module

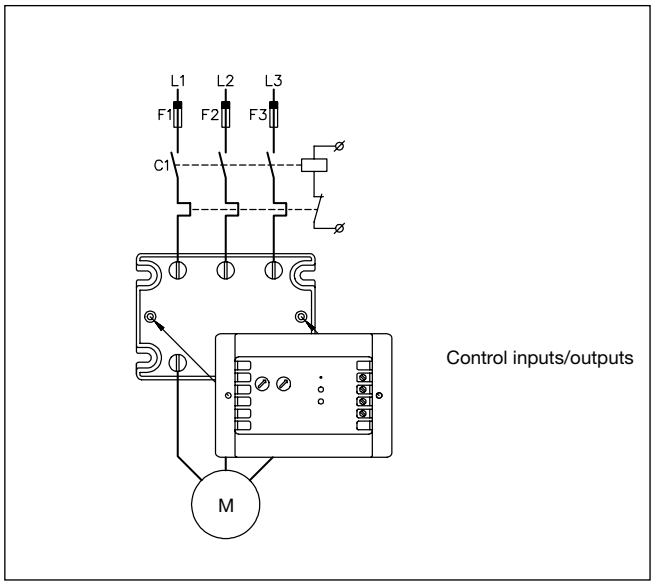
Rated insulation voltage
Output to case ≥ 4000 VACrms

Functional Diagram



Wiring Diagram

Mounting and connection of control module and output module



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Heatsink Dimensions (load current versus ambient temperature)

RRO 1210

Load current [A]	Thermal resistance [K/W]					Power dissipation [W]
16	1.4	1.1	0.91	0.68	0.46	44
15	1.5	1.3	1	0.75	0.50	40
14	1.7	1.4	1.1	0.82	0.55	36
13	1.8	1.5	1.2	0.91	0.61	33
12	2	1.7	1.4	1	0.68	30
11	2.3	1.9	1.5	1.1	0.76	26
10	2.6	2.2	1.7	1.3	0.86	23
9	3	2.5	2	1.5	0.99	20
7	4	3.4	2.7	2	1.4	15
5	6.1	5.1	4.1	3.1	2	10
3	10.9	9.1	7.3	5.5	3.6	5
1	-	29.6	23.7	17.8	11.8	2
	20	30	40	50	60	T_A

Ambient temp. [°C]

RRO 1225

Load current [A]	Thermal resistance [K/W]					Power dissipation [W]
25	0.92	0.76	0.60	0.44	0.28	63
22.5	1.1	0.91	0.73	0.55	0.37	55
20	1.3	1.1	0.85	0.64	0.43	47
17.5	1.5	1.3	1	0.76	0.51	39
15	1.9	1.5	1.2	0.93	0.62	32
12.5	2.3	1.9	1.6	1.2	0.77	26
10	3	2.5	2	1.5	1	20
7.5	4.2	3.5	2.8	2.1	1.4	14
5	6.7	5.6	4.4	3.3	2.2	9
2.5	14	11.7	9.4	7	4.7	4
	20	30	40	50	60	T_A

Ambient temp. [°C]

RRO 1250

Load current [A]	Thermal resistance [K/W]					Power dissipation [W]
50	0.48	0.40	0.32	-	-	126
45	0.55	0.46	0.37	0.27	-	109
40	0.64	0.53	0.43	0.32	-	94
35	0.76	0.63	0.50	0.38	0.25	79
30	0.91	0.76	0.61	0.46	0.30	66
25	1.1	0.95	0.76	0.57	0.38	53
20	1.5	1.2	0.99	0.74	0.49	41
15	2.1	1.7	1.4	1	0.68	29
10	3.2	2.7	2.1	1.6	1.1	19
5	6.7	5.6	4.5	3.4	2.2	9
	20	30	40	50	60	T_A

Ambient temp. [°C]

Heatsink Selection

Carlo Gavazzi Heatsink (see Accessories)	**Thermal resistance**
No heatsink required	$R_{th\ S\text{-}A}$ > 8.0 K/W
RHS 300 Assy or backplate	5.0 K/W
RHS 301 Assy	0.8 K/W
RHS 301 F Assy	0.25 K/W
Consult your distributor	< 0.25 K/W

Compare the value found in the load current versus temperature chart with the standard heatsink values and select the heatsink with the next lower value.

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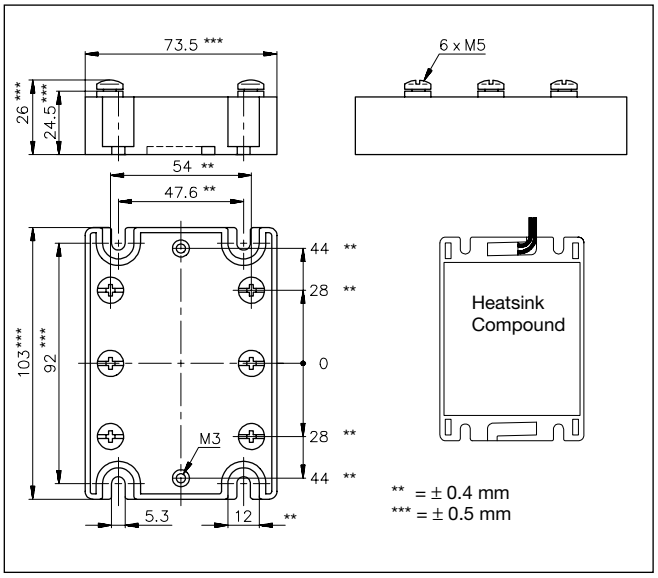
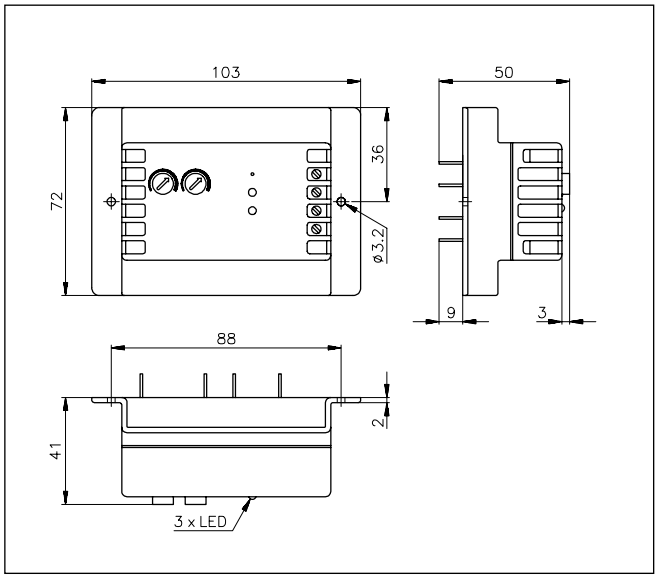
Dimensions

RRO 12..



RRC 40 HD 12



Housing Specifications

Weight	Approx. 275 g
Housing material Colour	Noryl, glass-reinforced Black
Base plate	Aluminium, nickel-plated
Potting compound	Polyurethane, black
Relay Mounting screws Mounting torque	 M5 ≤ 1.5 Nm
Control terminal Mounting screws Mounting torque	 M3 ≤ 0.5 Nm
Power terminal Mounting screws Mounting torque	 M5 x 6 ≤ 1.5 Nm

Accessories

Heatsinks
Varistors
Fuses
Temperature limit switch
Power supply

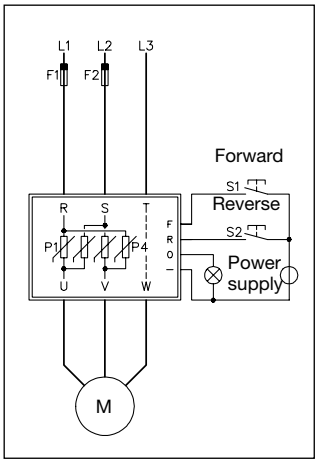
For further information refer to “General Accessories”.

Applications

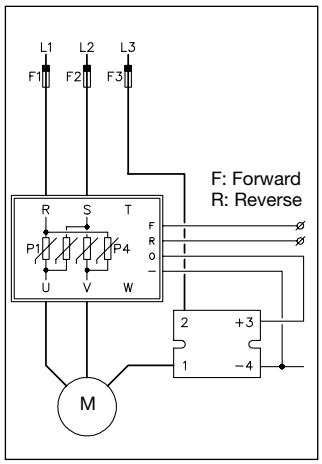
Normal use

When S1 is closed, the motor starts in forward direction. Closing S2 when S1 is already closed has no effect. When S1 is opened again, the motor stops.

When closing S2, the motor starts in reverse direction. Closing S1 when S2 is already closed has no effect due to the built-in interlocking function.



Switching the 3rd phase by means of a 1-phase SSR



F1 - F2: Ultrafast fuses with I^2t rated lower than the I^2t value for the output module.

F3: Ultrafast fuse with I^2t rated lower than the corresponding value for the single-phase relay.

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

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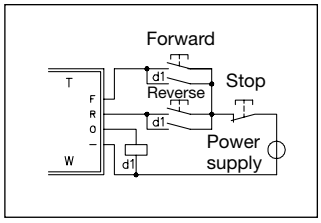
Applications (cont.)

Start forward, start reverse and stop
(only control circuit is shown)



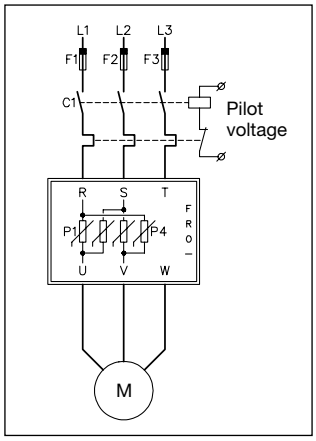
Connection to the mains

As this type of SSR has a semiconductor path between 2 of the 3 lines through which a short circuit may occur, it is always recommended to protect the relay against surge current and voltage transients.

The protection consists of 2 elements:

1. An ultrafast fuse with I^2t rated lower than the max. load integral (I^2t) of the output module.

2. A voltage-dependent resistor (MOV) to prevent voltages higher than the blocking voltage of the out-put modules. Higher voltages will switch the output module on for a short period of time causing undesirable fuse blowing.

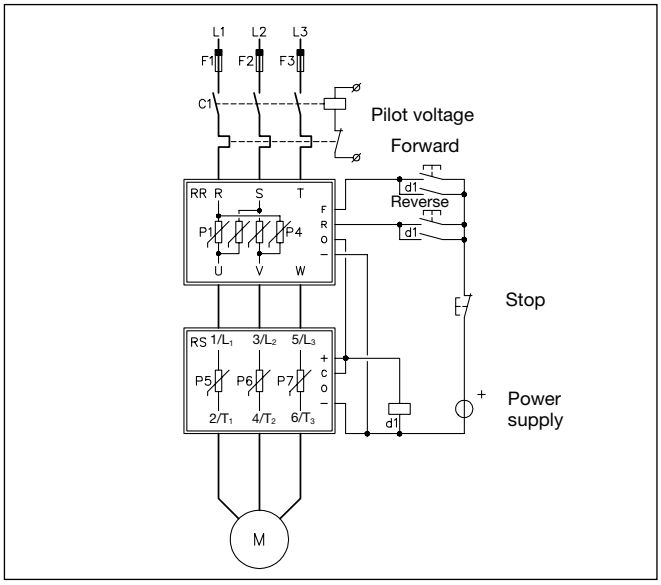


F1 - F3: Ultrafast fuses with I^2t rated lower than the I^2t value for the output module. F3 is optional since there are no semiconductors in phase T to W.

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

Since there is no protective circuitry in RRC 40 HD 12, the motor must be protected in the usual way, i.e. either by a theremal relay, a PTC-resistor or a Klixon bimetal temperature switch in the motor windings.

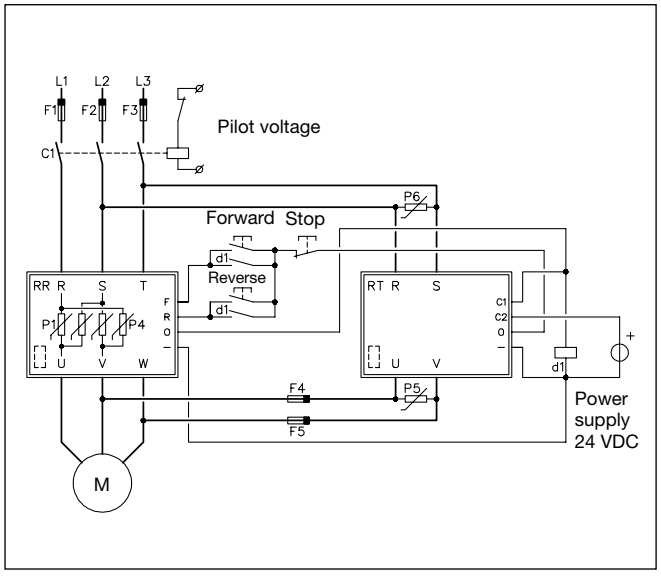
Interconnection of soft starting and reversing SSRs



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

P1 - P7: Varistors for 420 V mains with a diameter of 20 mm.

Interconnection of braking and reversing SSRs



F1 - F5: Ultrafast fuses with I^2t rated lower than the I^2t value of the output module.

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

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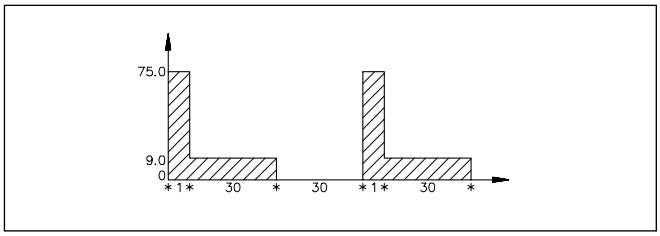
Applications (cont.)

Thermal considerations
Normally the maximum load is limited by the thermal relay protecting the motor. If the heatsink is calculated on the basis of this value, overcurrent will make the thermal relay trip before over-temperature appears on the heatsink. The heatsink is selected according to the chart showing maximum ambient temperature versus load current. The power dissipation can also be seen from the chart.



Intermittent use
If a motor is stopped and started frequently and with full load, the output module must be selected accordingly. It might also be useful to consult the motor manufacturer for further motor specifications.

Power dissipation in the SSR can be found on the basis of the effective load current:

$$I_{rms} = \sqrt{\frac{I^2_{start} \times t_{start} + I_n^2 \times t_{oper}}{t_{start} + t_{oper} + t_{pause}}}$$

Example:
2-pole motor: 5.5 kW
I_{start} = 75 A, I_n = 9 A, T_a = 50°C
t_{start} = 1 s, $t_{operating}$ = 30 s,
t_{pause} = 30 s

$$I_{rms} = \sqrt{\frac{75^2 \times 1 + 9^2 \times 30}{1 + 30 + 30}}$$

I_{rms} = 11.5 Arms

Overload table

Time [s]	Type of relay		
	10 A relay [Arms]	25 A relay [Arms]	50 A relay [Arms]
0.2	35	92	141
0.4	30	78	115
0.6	27	68	100
0.8	25.5	65	94
1.0	24	60	86
2	20	46	76
4	18	40	62
6	16	38	59
8	14	35	53
10	13	34	50
12	13	32	47
14	12.5	31	46
16	12.5	31	46
18	12	30	45
20	12	30	45

Load current versus time

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Applications (cont.)

Selection Guide

400 VACrms motors
50/60 Hz
$I_{operating}/I_{start}$ [A_{rms}]

Size of motor [kW]	2-pole ns = 3000 rpm	4-pole ns = 1500 rpm	6-pole ns = 1000 rpm	Start time [s]
1,1	2.6/14.3	2.9/13	3.4/12	0,5 1 2 4 6 8 10
1,5	3.5/22.75	3.7/18	4.2/17	0,5 1 2 4 6 8 10
2,2	4.7/32.9	5.2/26	5.6/28	0,5 1 2 4 6 8 10
3	6.2/43.4	6.9/38	7.6/41	0,5 1 2 4 6 8 10
4	8.1/55.9	9/60	9/48	0.5 1 2 4 6 8 10
5,5	10.7/74.9	12/84	12.7/60	0.5 1 2 4 6 8 10