

Motor Controllers Soft Starting/Soft Stopping Types RSC -HD.M60/RSO22..., RSO4..., RSO60...

CARLO GAVAZZI



- Control and output modules for soft starting/stopping of 3-phase induction motors
- Rated operational current: 3 x 10, 25, 50, 90, 110 A
- Rated operational voltage: Up to 600 VACrms
- Control voltage range: 10 to 32 VDC
- LED-indication for line ON and load ON
- Varistor protection

Product Description

The microprocessor based control module RSC-HD0M60 is used with output modules RSO22..., RSO4.. and RSO60.. to achieve full wave soft starting and soft stopping 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 with the output module, thereby limit-

ing the power dissipation of the device and eliminating the need for a large heatsink. The power supply unit MS1 has a built-in control relay for shunting the motor controller when soft starting is performed. The standard control module is multivoltage compatible and features LED indication for line ON and load ON.

Ordering Key

- Solid State Relay
- Soft starting/stopping
- Control module
- Output module
- Control input type
- Shape of ramp
- Multivoltage
- Max. operational current
- Max. operational voltage

RSC-HD 0 M 60

RSO 4050

Type Selection, Control Module

| Control voltage | Shape of Ramp | Mains | Max. operational voltage | Type Number |
|-----------------|---------------|--------------|--------------------------|---------------|
| 10 - 32 VDC | Linear | Multivoltage | 600 VAC | RSC-HD 0 M 60 |

Type Selection, Output Module

| Rated operational voltage | Rated operational current | | | | |
|---------------------------|---------------------------|----------|----------|----------|-----------|
| | 10 A | 25 A | 50 A | 90 A | 110 A |
| 3 x 220 VAC | RSO 2210 | RSO 2225 | RSO 2250 | RSO 2290 | RSO 22110 |
| 3 x 400 VAC | RSO 4010 | RSO 4025 | RSO 4050 | RSO 4090 | RSO 40110 |
| 3 x 480 VAC | RSO 4810 | RSO 4825 | RSO 4850 | RSO 4890 | RSO 48110 |
| 3 x 600 VAC | | | RSO 6050 | RSO 6090 | RSO 60110 |

General Spec., Control Module

| | |
|--|---------------------|
| Operational voltage range Line to line [VACrms] | 150 to 660 VACrms |
| Operational frequency range | 45 to 65 Hz |
| Supply current @ no output current @ max. output current | < 30 mA < 180 mA |
| CE-marking | Yes |

Control Output Specifications

| | |
|---|--------------------------|
| Minimum output voltage | Power supply minus 8 VDC |
| Output current short-circuit protected | ≤ 150 mA DC |

Thermal Specifications

| | |
|-----------------------|--------------------------------|
| Operating temperature | -20° to +70°C (-4° to +158°F) |
| Storage temperature | -40° to +100°C (-40° to 212°F) |



Control Input Specifications

| | |
|--|-----------------|
| Control voltage range | 10 to 32 VDC |
| Ramp up function | ≥ 8 VDC |
| Ramp down function | ≤ 3 VDC |
| Input current | ≤ 1 mA @ 32 VDC |
| Adjust. starting torque | 10 to 75% |
| Adjust. ramp up time | 0.5 to 30 s |
| Adjust. ramp down time | 0.5 to 30 s |
| Response time (input to trigger outputs) | ≤ 50 ms |
| Time to initialize after powerloss | < 300 ms |

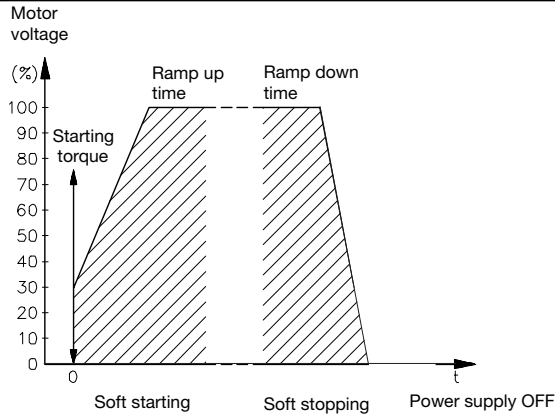
Insulation Control Module

| | |
|--------------------------|---------------|
| Rated insulation voltage | ≥ 4000 VACrms |
| Input to trigger outputs | |

Accessories

| | |
|--------------------------|---|
| Heatsinks | For further information refer to "General Accessories". |
| Fuses | |
| Temperature limit switch | |
| Power supply | |

Operation Diagram



Mode of Operation

The control module RSC-HD0M60 is used with the output module RSO.. to achieve soft starting and soft stopping of 3-phase induction motors. Soft starting is achieved by increasing the motor voltage in accordance with the setting of the ramp up time potentiometer within the range of 0.5 to 30 s. Soft stopping is achieved by decreasing the motor voltage in accordance with the setting of the ramp down time potentiometer within the range of 0.5 to 30 s.

The starting torque potentiometer makes it possible to adjust the starting level of the motor voltage to a value at which the motor starts to rotate immediately when soft starting is initiated. When the motor is fully operating, an output signal appears which can be used to connect a bypassing relay or contactor in parallel to the output module, thus limiting the need for cooling. Note: Only delta/star without neutral.

General Specifications, Output Module

| | RSO 22... | RSO 40... | RSO 48... | RSO 60... |
|---------------------------|---------------------|---------------------|---------------------|---------------------|
| Operational voltage range | | | | |
| Line to line | 150 to 250 VACrms | 220 to 420 VACrms | 400 to 510 VACrms | 400 to 625 VACrms |
| Non-rep. voltage | 1200 V _p | 1200 V _p | 1200 V _p | 1600 V _p |
| Varistor voltage | 275 VAC | 420 VAC | 510 VAC | 625 VAC |
| CE-marking | Yes | Yes | Yes | Yes |

Output Specifications, Output Module

| | RSO ..10 | RSO ..25 | RSO ..50 | RSO ..90 | RSO ..110 |
|---------------------------------------|------------------------|------------------------|-------------------------|-------------------------|--------------------------|
| Rated operational current | | | | | |
| AC 1 | 16 Arms | 25 Arms | 50 Arms | 90 Arms | 110 Arms |
| AC 3 | 3 Arms | 5 Arms | 15 Arms | 30 Arms | 40 Arms |
| Off-state leakage current | ≤ 10 mArms | ≤ 10 mArms | ≤ 10 mArms | ≤ 25 mArms | ≤ 25 mArms |
| On-state voltage drop | ≤ 1.6 Vrms | ≤ 1.6 Vrms | ≤ 1.6 Vrms | ≤ 1.8 Vrms | ≤ 1.8 Vrms |
| I ² t for fusing t=1-10 ms | ≤ 130 A ² s | ≤ 310 A ² s | ≤ 1800 A ² s | ≤ 5000 A ² s | ≤ 11250 A ² s |
| Critical di/dt | ≥ 50 A/μs | ≥ 50 A/μs | ≥ 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 | 1000 A _p | 1500 A _p |

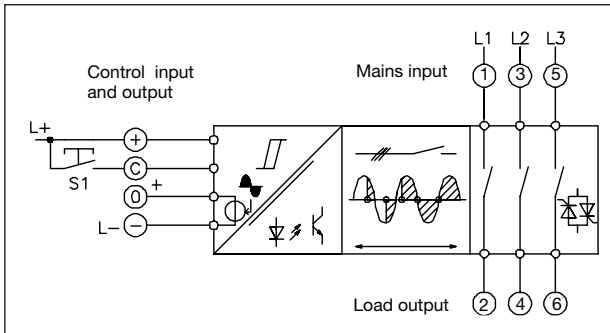
Thermal Specifications Output Module

| | RSO ..10 | RSO ..25 | RSO ..50 | RSO ..90 | RSO ..110 |
|----------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|
| 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) | -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) | -40° to +100°C (-40° to +212°F) | -40° to +100°C (-40° to +212°F) |
| Junction temperature | ≤ 125°C | ≤ 125°C | ≤ 125°C | ≤ 125°C | ≤ 125°C |
| R _{th} junction to case | ≤ 0.7 K/W | ≤ 0.5 K/W | ≤ 0.25 K/W | ≤ 0.1 K/W | ≤ 0.09 K/W |

Insulation Output Module

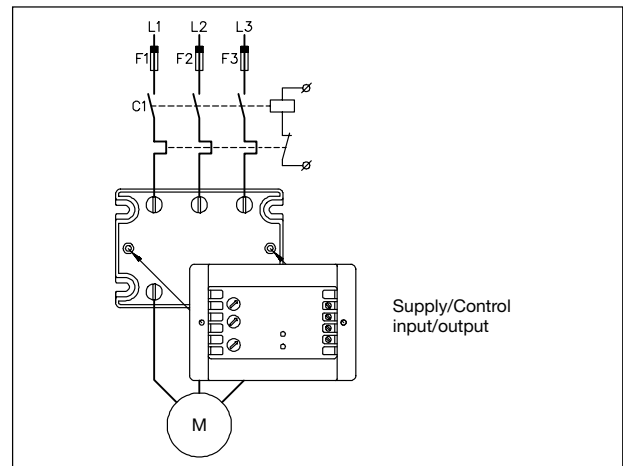
Rated insulation voltage
Output to case ≥4000 VACrms

Functional Diagram



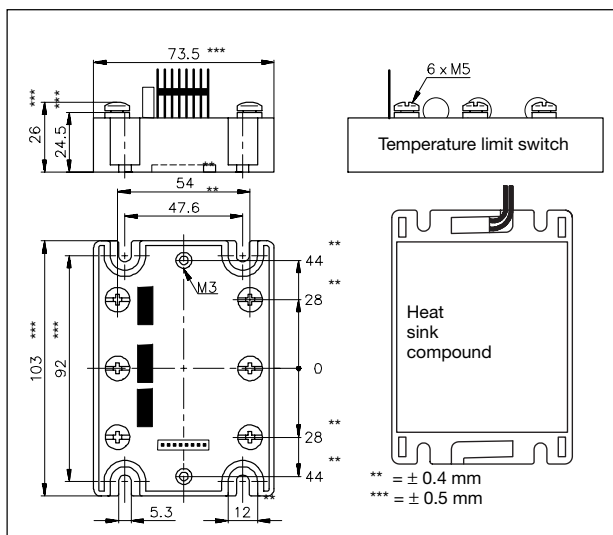
Wiring Diagram

Mounting and connection of control module

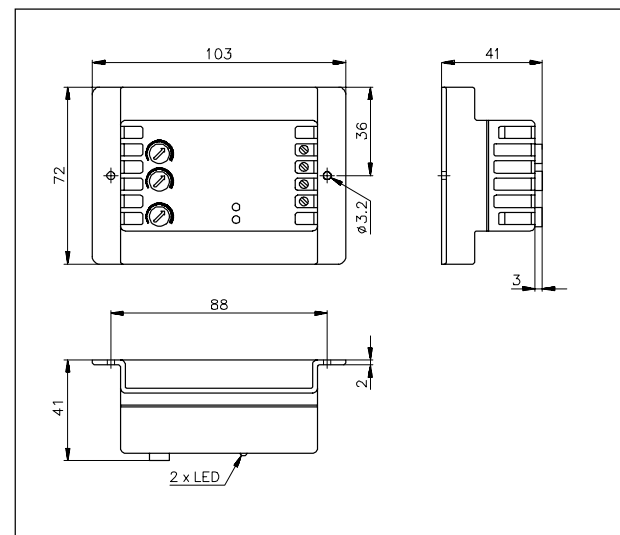


Dimensions

RSO



RSC .. HD...-





Heatsink Dimensions (load current versus ambient temperature)

RSO ..10

| Load current [A] | Thermal resistance [K/W] | | | | | Power dissipation [W] | Temp. protection [°C] |
|------------------|--------------------------|------|------|------|------|-----------------------|-----------------------|
| 16 | 0.97 | 0.81 | 0.65 | 0.48 | 0.32 | 62 | 80°C |
| 15 | 1.1 | 0.88 | 0.71 | 0.53 | 0.35 | 57 | |
| 14 | 1.2 | 0.97 | 0.77 | 0.58 | 0.39 | 52 | |
| 13 | 1.3 | 1.1 | 0.85 | 0.64 | 0.43 | 47 | |
| 12 | 1.4 | 1.2 | 0.95 | 0.71 | 0.47 | 42 | |
| 11 | 1.6 | 1.3 | 1.1 | 0.80 | 0.53 | 38 | |
| 10 | 1.8 | 1.5 | 1.2 | 0.90 | 0.60 | 33 | |
| 9 | 2.1 | 1.7 | 1.4 | 1 | 0.69 | 29 | |
| 7 | 2.8 | 2.3 | 1.9 | 1.4 | 0.93 | 21 | |
| 5 | 4.2 | 3.5 | 2.8 | 2.1 | 1.4 | 14 | |
| 3 | 7.4 | 6.2 | 4.9 | 3.7 | 2.5 | 8 | T _A |
| 1 | 23.8 | 19.8 | 15.9 | 11.9 | 7.9 | 3 | |
| | 20 | 30 | 40 | 50 | 60 | | Ambient temp. [°C] |

RSO ..25

| Load current [A] | Thermal resistance [K/W] | | | | | Power dissipation [W] | Temp. protection [°C] |
|------------------|--------------------------|------|------|------|------|-----------------------|-----------------------|
| 25 | 0.66 | 0.55 | 0.44 | 0.33 | - | 91 | 80°C |
| 22.5 | 0.76 | 0.63 | 0.51 | 0.38 | 0.25 | 79 | |
| 20 | 0.88 | 0.74 | 0.59 | 0.44 | 0.29 | 68 | |
| 17.5 | 1.1 | 0.87 | 0.70 | 0.52 | 0.35 | 57 | |
| 15 | 1.3 | 1.1 | 0.85 | 0.63 | 0.42 | 47 | |
| 12.5 | 1.6 | 1.3 | 1.1 | 0.79 | 0.53 | 38 | |
| 10 | 2.1 | 1.7 | 1.4 | 1 | 0.69 | 29 | |
| 7.5 | 2.9 | 2.4 | 1.9 | 1.4 | 0.96 | 21 | |
| 5 | 4.5 | 3.8 | 3 | 2.3 | 1.5 | 13 | |
| 2.5 | 9.4 | 7.8 | 6.3 | 4.7 | 3.1 | 6 | |
| | 20 | 30 | 40 | 50 | 60 | | Ambient temp. [°C] |

RSO ..50

| Load current [A] | Thermal resistance [K/W] | | | | | Power dissipation [W] | Temp. protection [°C] |
|------------------|--------------------------|------|------|------|------|-----------------------|-----------------------|
| 50 | 0.33 | 0.28 | - | - | - | 181 | 80°C |
| 45 | 0.38 | 0.32 | 0.25 | - | - | 158 | |
| 40 | 0.44 | 0.37 | 0.29 | - | - | 136 | |
| 35 | 0.52 | 0.43 | 0.35 | 0.26 | - | 116 | |
| 30 | 0.63 | 0.52 | 0.42 | 0.31 | - | 96 | |
| 25 | 0.78 | 0.65 | 0.52 | 0.39 | 0.26 | 77 | |
| 20 | 1 | 0.84 | 0.67 | 0.50 | 0.34 | 60 | |
| 15 | 1.4 | 1.2 | 0.93 | 0.69 | 0.46 | 43 | |
| 10 | 2.2 | 1.8 | 1.4 | 1.1 | 0.72 | 28 | |
| 5 | 4.5 | 3.8 | 3 | 2.3 | 1.5 | 13 | |
| | 20 | 30 | 40 | 50 | 60 | | Ambient temp. [°C] |

RSO ..90, RSO ..110

| Load current [A] | Heatsink/Thermal resistance [K/W] | | | | | Power dissipation [W] | Temp. protection [°C] | |
|------------------|-----------------------------------|------|------|------|------|-----------------------|-----------------------|----------------|
| 90 | - | - | - | - | - | 304 | 80°C | |
| 80 | - | - | - | - | - | 260 | | |
| 70 | 0.27 | - | - | - | - | 219 | | |
| 60 | 0.33 | 0.28 | - | - | - | 181 | | |
| 50 | 0.41 | 0.35 | 0.28 | - | - | 145 | | |
| 40 | 0.54 | 0.45 | 0.36 | 0.27 | - | 111 | | |
| 30 | 0.75 | 0.63 | 0.50 | 0.38 | 0.25 | 80 | | |
| 20 | 1.2 | 0.99 | 0.79 | 0.59 | 0.39 | 51 | | |
| 10 | 2.5 | 2.1 | 1.7 | 1.2 | 0.83 | 24 | | T _A |
| | 20 | 30 | 40 | 50 | 60 | | | |

Heatsink Selection

| Carlo Gavazzi Heatsink (see Accessories) | Thermal resistance |
|--|-------------------------|
| No heatsink required | $R_{th\ s-a} > 8.0$ 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.

It is recommended to protect the solid state relay against overheating. Therefore the chart also states the maximum switching temperature (70°, 80° or 90°C) for the optional temperature limit switch.

Housing Specifications

| | | | |
|----------------------|--------------------------|------------------|----------|
| Weight | | Relay | |
| RSO ..10, ..25, ..50 | Approx. 275 g | Mounting screws | M5 |
| RSO ..90, ..110 | Approx. 385 g | Mounting torque | ≤ 1.5 Nm |
| Housing material | Noryl, glass-reinforced | Control terminal | |
| Colour | Black | Mounting screws | M3 |
| Base plate | | Mounting torque | ≤ 0.5 Nm |
| @ ≤ 50 A | Aluminium, nickel-plated | Power terminal | |
| @ ≥ 90 A | Copper, nickel-plated | Mounting screws | M5 x 6 |
| Potting compound | Polyurethane, black | Mounting torque | ≤ 1.5 Nm |

Applications

The output module RSO ..110 is recommended for motors up to 22 kW @ 400 V. The RSO ..110 is designed for use in applications with high surge current conditions. Care must be taken to ensure proper heat-sinking when the output modules are to be used at high nominal currents. Adequate electrical connection between relay terminals and cable must be ensured.

Example 1: Power dissipation - RSO 40110:

$I_{load} = 40 \text{ Arms} = 111 \text{ W}$
See previous page.

Example 2:

Motor: 3 kW, ns = 1500 rpm,
3 x 400 VAC, 4-pole
T_A: 50°C
Starting time: ≤ 5 s

The RSC-HD0M60 is used for both applications. The RSO ..50, RSO ..25, RSO ..10 modules can be used: RSO ..50, if the starting current is unknown for 5 s (starting time) and a large safety margin is required, RSO ..25/..10, if during starting the current is lower. For RSO ..10 the maximum current is 17 A for 5 s, and for RSO ..25 the maximum current is 39 A for 5 s. In this application the starting current is measured to be only 17 A with a starting time of 5 s. Consequently, an RSO ..10 is selected.

The min. heatsink is 1K/W, and the power dissipation is 25 W.

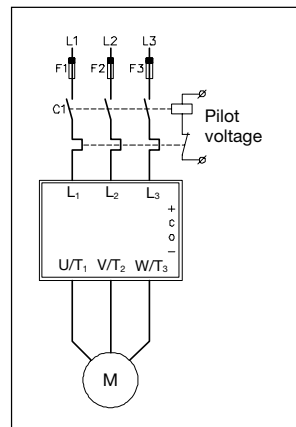
This gives:
Control module:
RSC-HD.M60
Output module: RSO 4010
Heatsink: 1K/W

Note: The thermal conditions have now been designed for the nominal motor current. This means that the starting time should be less than 10% of the operating time of the motor.

Connection to the mains

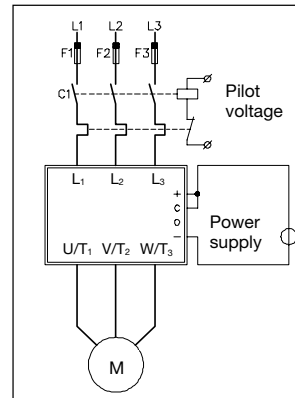
Since no motor protective circuitry is included in the RSC/RSO, the motor must be protected in the usual way, i.e. either by a thermal relay, a PTC-resistor or a Klixon bimetal temperature switch near the motor windings.

If short circuit protection is required, fuses F1 to F3 should be ultrafast and selected according to the load integral (I²t) of the RSO output module and the motor load.



Overload protection by thermal relay

Mains-controlled soft starting

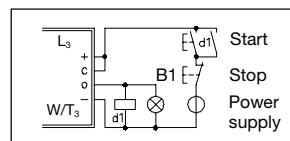


When the main contactor C1 switches on, the motor will soft-start. When C1 switches off, the SSR automatically resets.

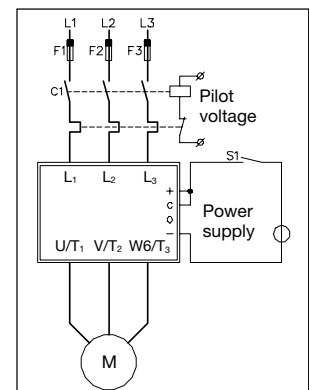
Note: The induced voltage from the motor will prolong the reset, depending on motor type and load.

Manual start - stop function

If desired, an external control circuit for manual starting and stopping can be created by using push buttons. When the start button is pressed and held until the lamp B1 is lit (indicating that the motor is now running), a holding contact is made. The motor will stop after activating the stop button.

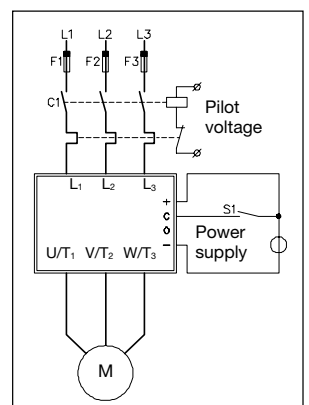


Input-controlled soft starting



When the main contactor C1 switches ON, and the control switch S1 is closed, the motor will soft-start. When either C1 or S1 switches OFF, the SSR will automatically reset.

Soft-starting and soft stopping



When the main contactor C1 switches on, and the control switch S1 is closed, the motor will soft-start. When S1 is opened, the motor will soft-stop.



Applications (cont.)

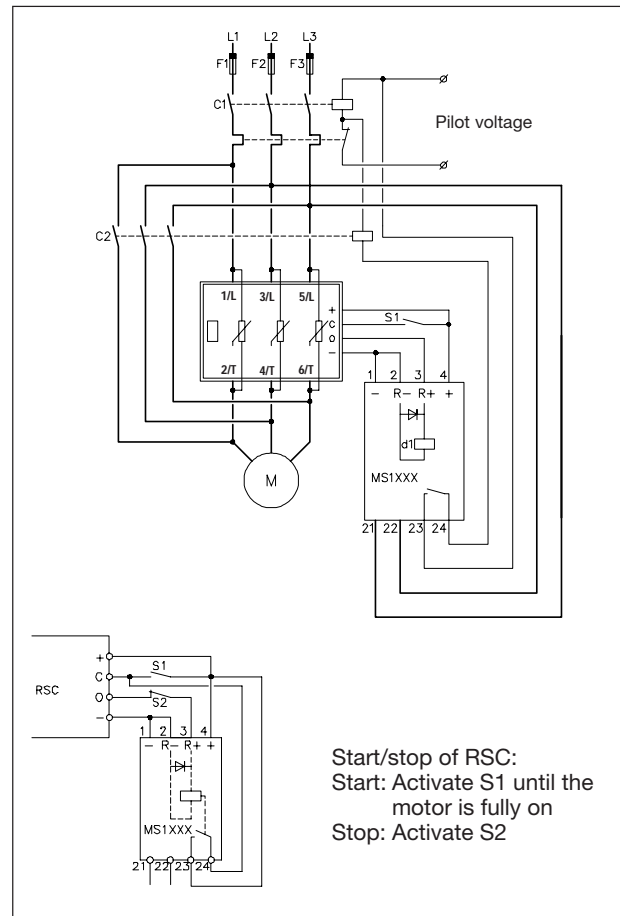
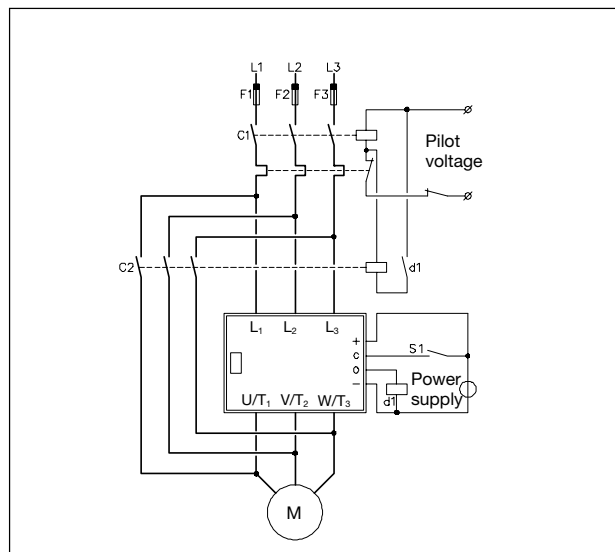
Shunting the output module

This circuit limits the power dissipation of the SSR and consequently eliminates the need for a large heatsink, i.e. the power dissipation is limited to the starting and stopping periods. This is achieved by switching a contactor with the output signal from the control module RSC. In this case C2 is carrying - not switching - the current and can therefore be rated on the basis of the thermal cur-

rent data of the contacts, which will result in a smaller contactor.

Note: However, if C2 fails, the temperature on the output module RSO heatsink may rise to an unacceptable level. It is therefore advisable to protect the RSO by means of an optional temperature limiting switch T1, which can be inserted in the housing of the output module.

The MS1 .. Power Supply connected to a motor controller (RSC) for soft starting/soft stopping of an induction motor.



Selection Guide

400 VACrms and 480 VACrms motors

| Output module | RSO 4.10 | RSO 4.25 | RSO 4.50 | RSO 4.90 | RSO 4.110 |
|-----------------|-------------|-----------|-------------|-------------|-------------|
| Max. motor size | 3 HP/2.2 kW | 5 HP/4 kW | 15 HP/11 kW | 20 HP/15 kW | 30 HP/22 kW |

600 VACrms motors

| Output module | | RSO 6050 | RSO 6090 | RSO 60110 |
|-----------------|--|----------|----------|-----------|
| Max. motor size | | 15 HP | 30 HP | 40 HP |