

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

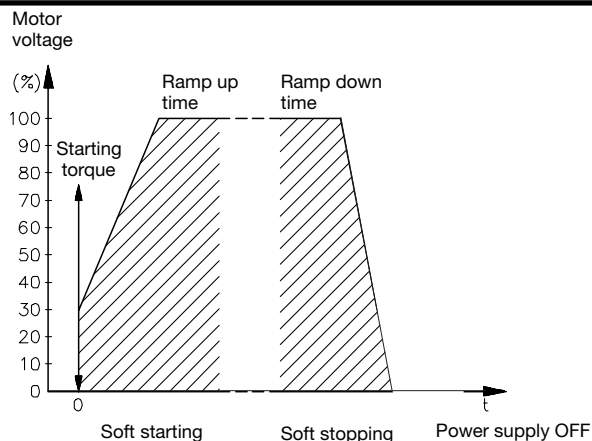
Insulation Control Module

Rated insulation voltage Input to trigger outputs	≥ 4000 VACrms
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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 AC 3	16 Arms 3 Arms	25 Arms 5 Arms	50 Arms 15 Arms	90 Arms 30 Arms	110 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/ μ s	≥ 50 A/ μ s	≥ 50 A/ μ s	≥ 50 A/ μ s	≥ 50 A/ μ s
Non-rep. surge current t=20 ms	160 A _p	250 A _p	600 A _p	1000 A _p	1500 A _p

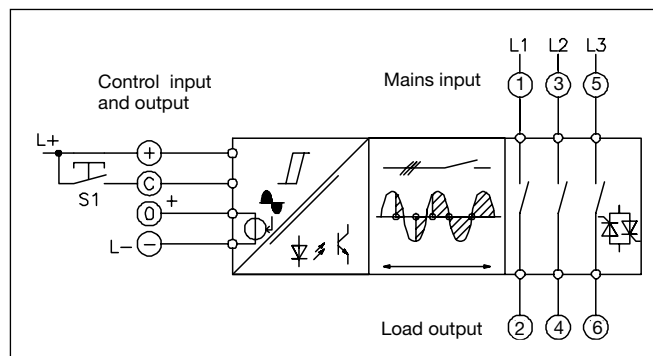
Thermal Specifications Output Module

	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

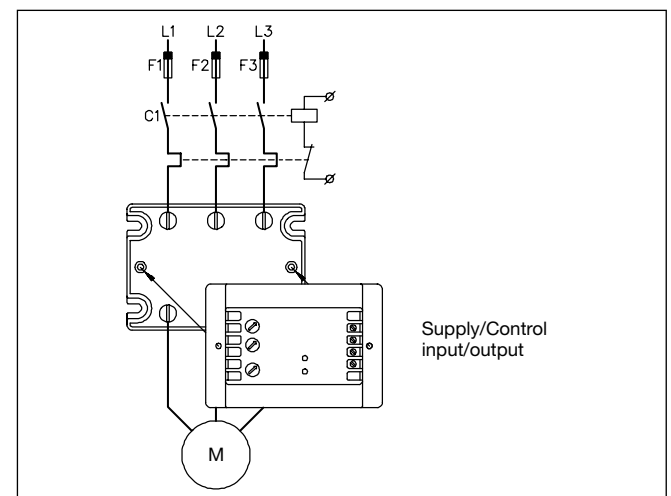
Rated insulation voltage
Output to case ≥4000 VACrms

Functional Diagram



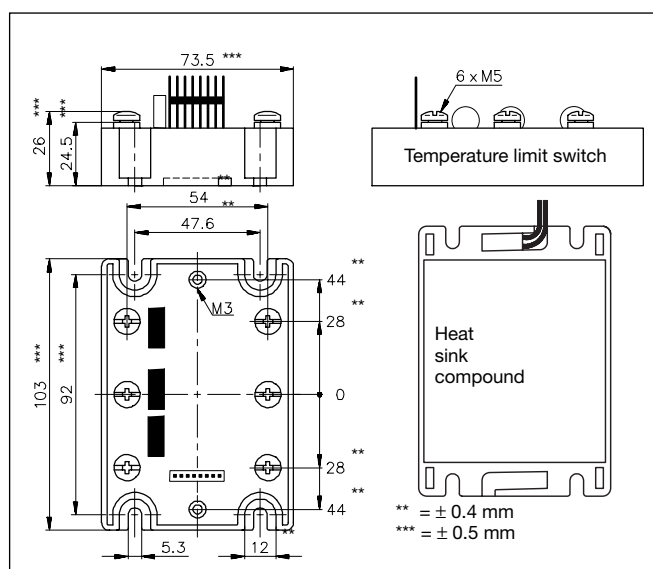
Wiring Diagram

Mounting and connection of control module

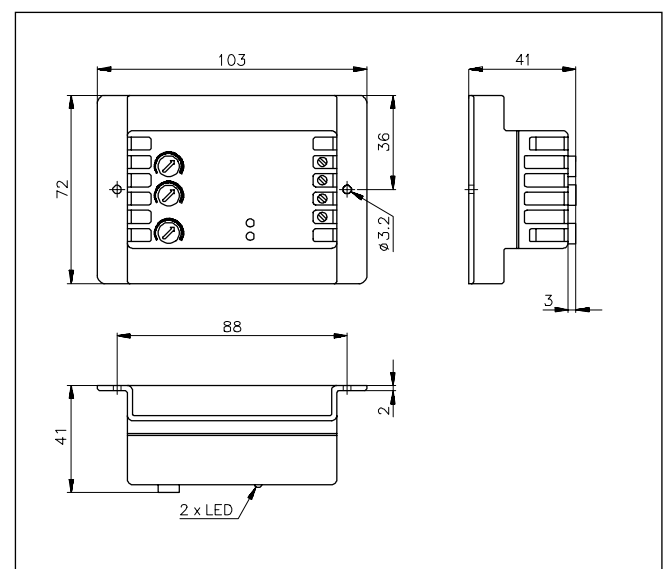


Dimensions

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]
	20	30	40	50	60		
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	
1	23.8	19.8	15.9	11.9	7.9	3	

T_A
Ambient temp. [°C]

RSO ..25

Load current [A]	Thermal resistance [K/W]					Power dissipation [W]	Temp. protection [°C]
	20	30	40	50	60		
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	

T_A
Ambient temp. [°C]

RSO ..50

Load current [A]	Thermal resistance [K/W]					Power dissipation [W]	Temp. protection [°C]
	20	30	40	50	60		
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	

T_A
Ambient temp. [°C]

RSO ..90, RSO ..110

Load current [A]	Heatsink/Thermal resistance [K/W]					Power dissipation [W]	Temp. protection [°C]
	20	30	40	50	60		
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
Ambient temp. [°C]

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

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, $n_s = 1500 \text{ rpm}$,
3 x 400 VAC, 4-pole
 $T_A: 50^\circ\text{C}$
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.

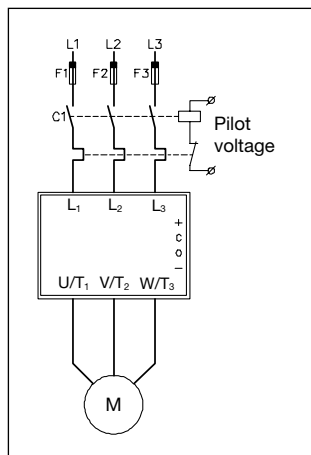
This gives:
Control module:
RSC-HD.M60
Output module: RSO 4010
Heatsink: 1K/W

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

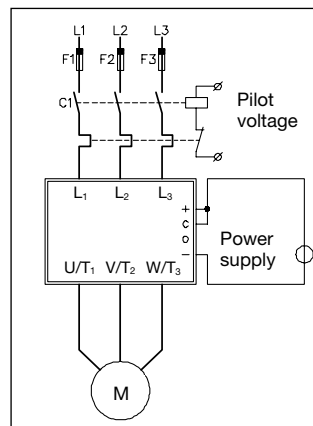
Since no motor protective circuitry is included in the RSC/RSO, the motor must be protected in the usual way, i.e. either by a thermal relay, a PTC-resistor or a Klixon bimetal temperature switch near the motor windings.

If short circuit protection is required, fuses F1 to F3 should be ultrafast and selected according to the load integral (I^2t) of the RSO output module and the motor load.



Overload protection by thermal relay

Mains-controlled soft starting

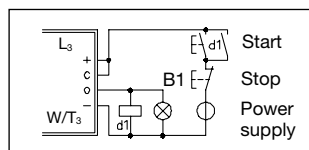


When the main contactor C1 switches on, the motor will soft-start. When C1 switches off, the SSR automatically resets.

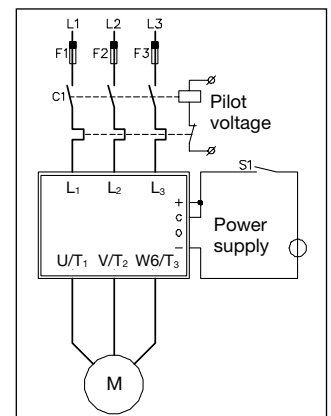
Note: The induced voltage from the motor will prolong the reset, depending on motor type and load.

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.

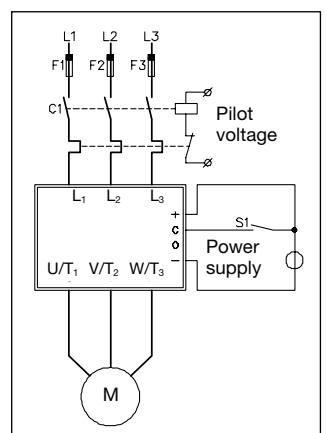


Input-controlled soft starting



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.)

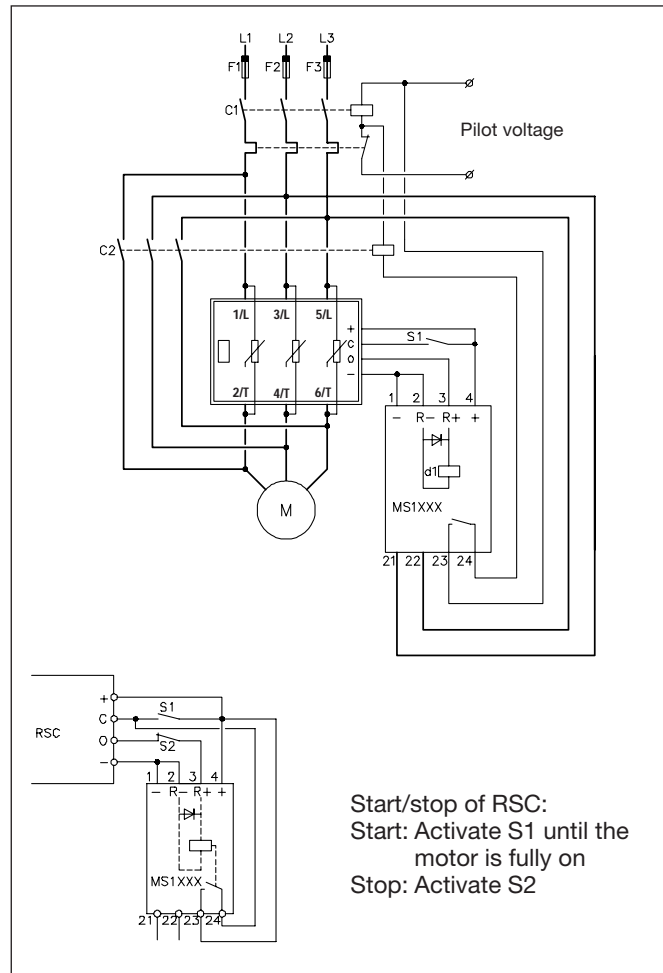
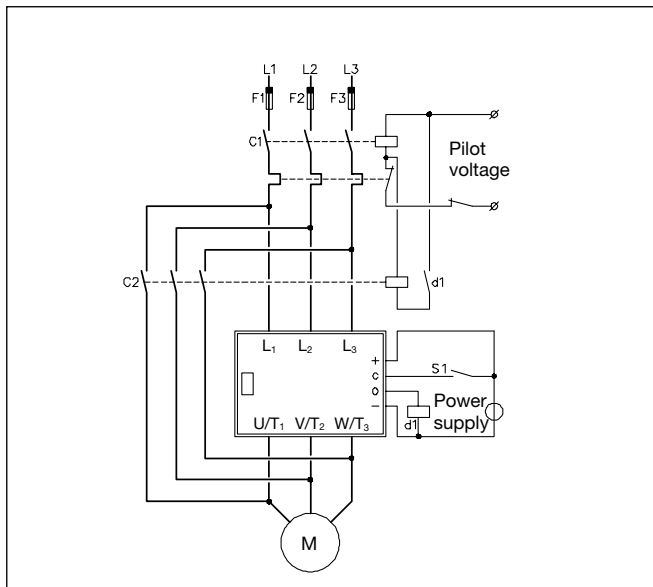
Shunting the output module

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.



Start/stop of RSC:
Start: Activate S1 until the motor is fully on
Stop: Activate S2

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