Motor Controllers
Soft Starting/Soft Stopping
Types RSC-AAM60/RSO .....

- **Control and output modules for analogue control of 3-phase induction motors or heaters**
- **Rated operational current: 3 x 10, 25, 50, 90, 110 AACrms**
- **Rated operational voltage: Up to 600 VACrms**
- **Supply voltage range: 10 to 32 VDC**
- **Control current range: 0 to 20 mA/4 to 20 mA**
- **LED-indication for line ON and load ON**
- **Varistor protection**

Product Description

The micro processor based control module RSC-AAM60 is used with output modules RSO 22..., RSO 4. ..., RSO 60 ... to achieve a voltage controlled soft start/soft stop of 3-phase motors and a possibility for energy reduction when e.g. a fan is running with a variable capacity. This function is achieved by controlling the control module with a current between 4 and 20 mA (0 and 20 mA). The output module can be selected according to the rated operational voltage and the size of the load.

This phase angle controlled soft-start unit can be used for pumps, fans, heaters, lights and many other applications.

LED indications for line ON and load ON gives a clear status indication.

Ordering Key

RSC-AA M 60

- **Solid State Relay**
- **Soft starting/stopping**
- **Control module**
- **Output module**
- **Control input type**
- **Multivoltage**
- **Rated operational voltage**
- **Rated operational current**

RSO 4050

Type Selection, Control Module

Control current	Mains	Max. operational voltage	Type Number
0-20 mA/4-20 mA	Multivoltage	600 VAC	**RSC-AA 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
Supply voltage range	10 to 32 VDC
CE-marking	Yes
Approvals	UL, CSA

Control 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)

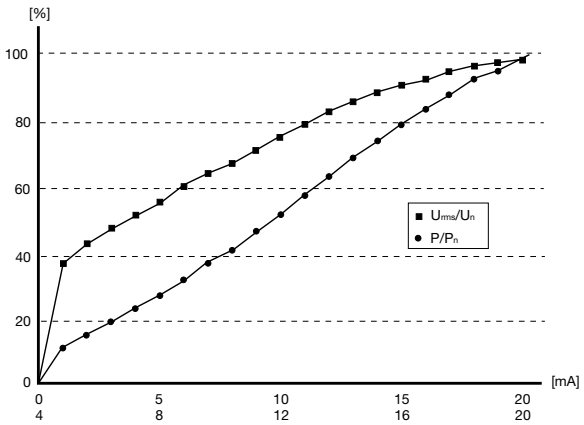
Control Input Specifications

Control current	
A-input	0 to 20 mA
B-input	4 to 20 mA
Input impedance	250 Ω
Power supply reset time	≤ 300 ms
Response time (input to trigger outputs)	≤ 1 cycle

Insulation Control Module

Rated insulation voltage	
Input to trigger outputs	≥ 4000 VACrms

Operation Diagram



Output as a function of control current @cos(ø) = 0.9

Mode of Operation

The control module RSC-AAM60 is used with the output module RSO..... to achieve analog control of 3-phase induction motors.

Soft starting is achieved by increasing the motor voltage in accordance with the input current. Soft stopping is achieved by decreasing the motor voltage in accordance with the input current.
When the motor is running idle, the motor voltage can be reduced by lowering the input current, whereby energy is saved.

Heating elements can also be controlled with the RSC/RSO with the use of appropriate filters.

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

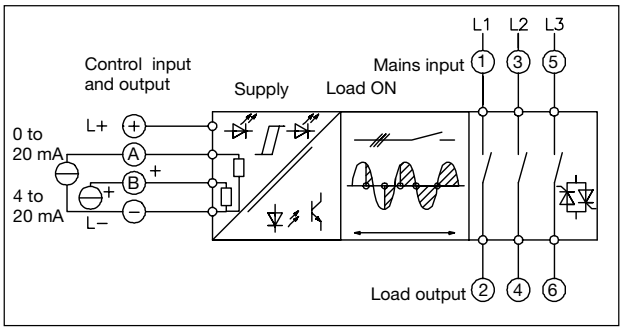
Output Specifications, Output Module

	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^2t for fusing t=1-10 ms	≤ 130 A^2s	≤ 310 A^2s	≤ 1800 A^2s	≤ 5000 A^2s	≤ 11250 A^2s
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

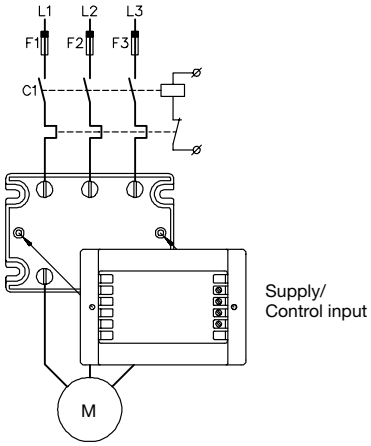
	RSO ..10	RSO ..25	RSO ..50	RSO ..90	RSO ..110
Operating temperature	-20° to +70°C (-4° to +158°F)	-20° to +70°C (-4° to +158°F)	-20° to +70°C (-4° to +158°F)	-20° to +70°C (-4° to +158°F)	-20° to +70°C (-4° to +158°F)
Storage temperature	-40° to +100°C (-40° to +212°F)	-40° to +100°C (-40° to +212°F)	-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

Functional Diagram



Wiring Diagram

Mounting and connection of control module



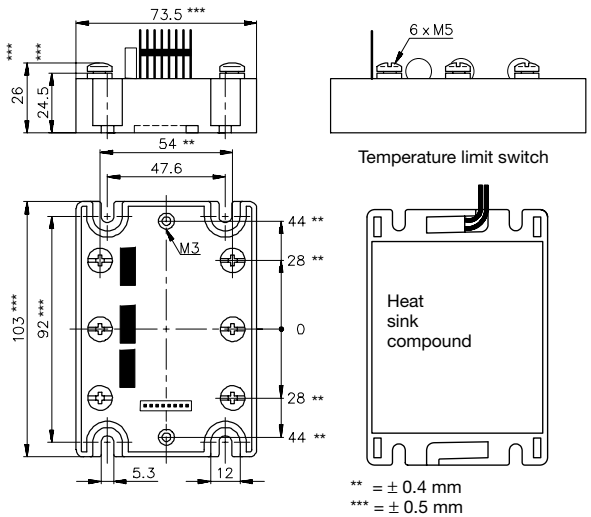
Accessories

Heatsinks
Fuses
Temperature limit switch
Power supply

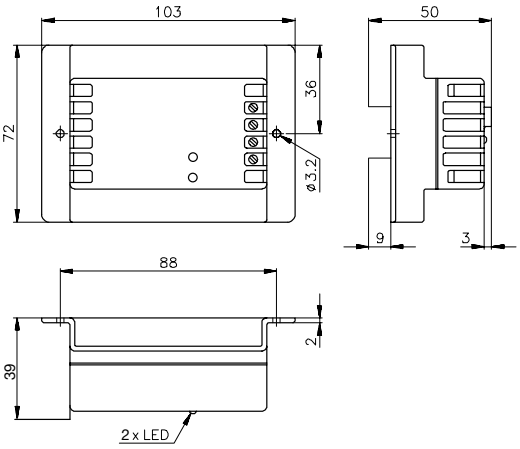
For further information refer to “General Accessories”.

Dimensions

RSO .....



RSC-AAM60



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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
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
	20	30	40	50	60	T_A

80°C

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
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	T_A

80°C

Ambient temp. [°C]

RSO ..50

Load current [A]	Thermal resistance [K/W]				Power dissipation [W]	Temp. protection [°C]
50	0.33	0.28	-	-	-	181
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	T_A

80°C

Ambient temp. [°C]

RSO ..90, RSO ..110

Load current [A]	Heatsink/Thermal resistance [K/W]				Power dissipation [W]	Temp. protection [°C]
90	-	-	-	-	-	304
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
	20	30	40	50	60	T_A

80°C

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.

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	Approx. 275 g
RSO ..90, ..110	Approx. 385 g
Housing material	Noryl, glass-reinforced
Colour	Black
Base plate	
@ ≤ 50 A	Aluminium, nickel-plated
@ ≥ 90 A	Copper, 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 x 6
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 relays 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 Arms = 111 W
See previous page.

Example 2:
Motor: 3 kW, 4 HP
3 x 400 VAC, 4-pole
T_A: 50°C
Starting time: ≤ 5 s

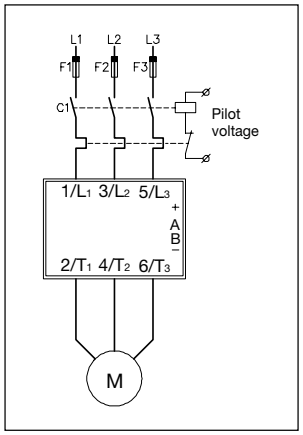
For this application RSC-AAM60 must be used. The output module RSO4025 is selected according to the Selection Guide.

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

This gives:
Control module:
RSC-AAM60
Output module: RSO 4025
Heatsink:1K/W

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.

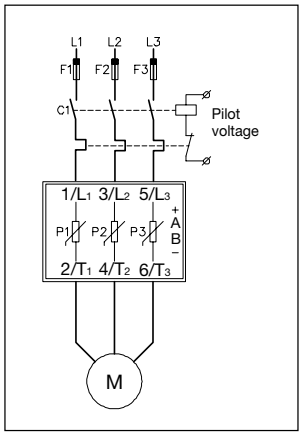
If short circuit protection is required, fuses F1 to F3 should be ultrafast and selected according to the load integral (I^2t) of the RSO output module and the motor load.



Overload protection by thermal relay

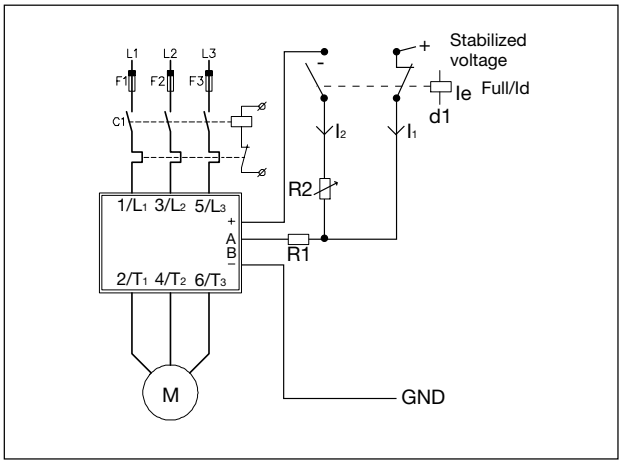
Transient voltage protection
With an unfiltered main supply, voltage transient may occur. Since these transients could have a high energy content, it is advisable to use varistors to protect the output module.

The varistors are already mounted in the RSO output module and they are selected according to the rated operational voltage.



Energy saving for motors in idle mode
When motors are running idle, it not necessary to maintain a full magnetic field, as is the case when the motor has to produce full torque. By lowering the motor voltage, power losses inside the motor are also reduced.

When the motor is idle, d1 will switch the control current from I_1 > 20 mA to I_2, which is adjusted to a value at which the motor is still running at full speed, but at a lower voltage. Please remark that this type of phase-angle controlled voltage reduction, demands additional filtering to fulfill EMC regulations.



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Applications (cont.)

In order to achieve a 4 to 20 mA signal from a 12 or 24 VDC source, a resistor and a potentiometer should be connected in series with the voltage source and the RSC controller.

We define the $I_{max.}$ to be e.g. 24 mA, which means that the series resistors must be:

R_1 (12 V) = U/I - Rint =
12 V/24 mA - 250 Ω = 250 Ω

R_1 (24 V) = U/I - Rint =
24 V/24 mA - 250 Ω = 750 Ω

If the minimum current is defined to be e.g. 2.4 mA and the 250 Ω Rint input resistance of the RSC is also calculated in:

R_2 (12 V) = U/I - R_1 - Rint =
12/2.4 - 250 - 250 = 4500 Ω

R_2 (24 V) = U/I - R_1 - Rint =
24/2.4 - 750 - 250 = 9000 Ω

Selection Guide

400 VACrms and 480 VACrms motors

Output module	RSO ..10	RSO ..25	RSO ..50	RSO ..90	RSO ..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