RSHL, RSHP, RSHR

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Motor Controllers
AC Semiconductor Motor Controller
Type RSHL MIDI SMART

- Soft starting and stopping of 3-phase induction squirrel cage motors
- 2-phase control with integral bypassing of semiconductors
- Low inrush and reduced vibration during starting
- Rated operational voltage: up to 600 VAC, 50/60Hz
- Rated operational current: up to 18A AC-53b
- LED status indicators
- Integrated device over-temperature protection*
- Integrated motor over-temperature protection
- Integrated auxiliary relays for end of ramp and alarms
- DIN rail mounting
- Current limit setting for 150%, 250%, 350%, 450% of full load current.
- Integrated overload protection with options for class 10 or class 20
- Monitoring of phase sequence, phase loss and phase-imbalance

Product Description

The RSHL Midi Smart is a compact easy-to-use AC semiconductor motor controller with which 3-phase motors with nominal currents up to 18A can be soft started and/or soft stopped.
The RSHL Midi Smart controls 2 phases only, while the third phase is continously connected to the load. Soft starting and soft stopping is achieved by controlling the motor voltage. During normal running operation (<20A) the semiconductors are bypassed by internal electromechanical relays. Ramp profile, overload trip class, current limit settings and alarm parameters are user adjustable via the front panel.
Eight LEDs on the front panel indicate the states and alarms of the softstarter. The RSHL MIDI Smart includes an End of ramp auxiliary relay, Alarm auxiliary relay, and overtemperature protection. The RSHL Midi Smart has an integrated Current Limit and Overload Protection. The RSHL Midi Smart comes with an integrated heatsink and is ready to mount on DIN rail.

Ordering Key

RSH L 48 18 C V21

- **H-line Motor Controller**
- **Current limit & overload protection**
- **Rated operational voltage**
- **Rated operational current**
- **Control voltage**
- **Options**

Type Selection

Type	Rated Operational Voltage Ue	Rated Operational Current Ie	Control Voltage Uc	Options
RSHL: H-line motor controller with current limit and motor overload protection	22: 127/220VACrms, 50/60Hz 48: 230/400VACrms, 50/60Hz 277/480VACrms, 50/60Hz 60: 346/600VACrms, 50/60Hz	02: 0.6 - 2 A AC-53b 05: 2 - 5 A AC-53b 12: 4.5 - 12 A AC-53b 18: 5 - 18 A AC-53b	C: 24 - 550 VAC/DC	V21: End of Ramp Relay, Motor Over-Temperature Protection and Alarm Auxiliary Relay. Internal over-temperature protection*

* Internal over-temperature protection is only for RSHL...18CV21

Selection Guide

Rated operational voltage U_e	Rated operational current I_e 2A AC-53b	5A AC-53b	12A AC-53b	18A AC-53b
220VACrms	**RSHL2202CV21**	**RSHL2205CV21**	**RSHL2212CV21**	**RSHL2218CV21**
400/ 480VACrms	**RSHL4802CV21**	**RSHL4805CV21**	**RSHL4812CV21**	**RSHL4818CV21**
600VACrms	**RSHL6002CV21**	**RSHL6005CV21**	**RSHL6012CV21**	**RSHL6018CV21**

Conductor Data

Line conductors: **L1, L2, L3, T1, T2, T3**	
according to EN 60947-1	
flexible	2.5 ..... 10mm²
	2.5 ..... 2 x 4mm²
rigid (solid or stranded)	2.5 ..... 10mm²
flexible with ferrule	2.5 ..... 10mm²
UL/CSA rated data	
flexible	AWG14…8
	AWG14…2 x 10
rigid (solid or stranded)	AWG14…8
Terminal screws	6xM4 (cage clamp)
Tightening torque	2.0Nm (22lb.in) with Posidrive bit 2
Stripping length	8.0mm

Secondary conductors: **A1, A2, A3, A4, P1, P2, 34, 31/41, 42**	
according to EN 60998	
flexible	0.5 ..... 1.5mm²
flexible with ferrule	0.5 ..... 1.5mm²
rigid (solid)	0.5 ..... 2.5mm²
UL/CSA rated data	AWG22…12
Terminal screws	9xM3 (cage clamp)
Tightening torque	0.5Nm (4.5lb.in) with Philips bit 0
Stripping length	6.0mm

General Specifications

Form designation	1
Weight	620g (approx.)
Mounting	DIN Rail 35mm
Housing material	Polyamide (conforms to UL 94 V0)

Status Relays

Auxiliary relay	
End of ramp	Normally Closed (21 : 22)
	Normally Open (21 : 24)
Alarm relay output	Normally Closed (95 : 96)
Auxiliary relay contact capacity	2A, 250VAC
	2A, 30VDC

Supply Specification

Rated operational voltage		
Ue through L1, L2 L3	RSHL22..	127/220VAC -15% / +10%
	RSHL48..	230/400VAC -15% / +10%
		277/480VAC -15% / +10%
	RSHL60..	346/600VAC -15% / +10%
Blocking voltage	RSHL 22...	800 V_p
	RSHL 48...	1200 V_p
	RSHL 60...	1600 V_p
Rated AC frequency		50/60Hz ±10%
Rated insulation voltage		630V, accord. to EN 60947-1
Dielectric strength		
Dielectric withstand voltage		
Supply to input		2.5 kVrms
Supply to heatsink		2.5 kVrms
Supply to external supply		2.5 kVrms
Integrated varistor		yes

Input Specifications

Rated control input voltage Uc A1: A2	24 - 550 VAC/DC
Rated AC frequency	50/60Hz ±10%
Max. control input current	3mA
Response time input to output	400 ms
Dielectric strength	
Dielectric withstand voltage	
Input to supply	2.5 kVrms
Input to heatsink	2.5 kVrms

External Supply Specifications

External supply voltage Us, A3:A4	24VAC/DC -15% / +10%
Rated AC frequency	50/60Hz ±10%
Rated supply current	250mAAC/DC
Dielectric strength	
Dielectric withstand voltage	
Supply to input	2.5 kVrms
Supply to heatsink	2.5 kVrms

Load Ratings

		RSHL22..CV21 / RSHL48..CV21	RSHL60..CV21
IEC rated operational current Ie (AC-53b)	RSHL..02CV21	2A	2A
	RSHL..05CV21	5A	5A
	RSHL..12CV21	12A	12A
	RSHL..18CV21	18A	18A
Overload cycle according to EN/IEC 60947-4-2[1]			
@ 40˚C surrounding temp.	RSHL..02CV21	2: AC-53b : 4-5 : 0	2: AC-53b : 4-5 : 0
	RSHL..05CV21	5: AC-53b : 4-5 : 2.4	5: AC-53b : 4-5 : 2.4
	RSHL..12CV21	12: AC-53b : 4-5 : 21	12: AC-53b : 4-5 : 26
	RSHL..18CV21	18: AC-53b : 4-5 : 62	18: AC-53b: 4-5 : 62
Number of starts per hour @40˚C[2]	RSHL..02CV21	360	360
	RSHL..05CV21	290	290
	RSHL..12CV21	116	100
	RSHL..18CV21	50	50
Minimum full load current	RSHL..02CV21	0.6 AAC rms	0.6 AAC rms
	RSHL..05CV21	1.5 AAC rms	1.5 AAC rms
	RSHL..12CV21	4.5 AAC rms	4.5 AAC rms
	RSHL..18CV21	5 AAC rms	5 AAC rms

[1] Applicable with the overload profile specified in Overload Cycle and Starting Duty section
[2] Taken from tables referring to 45mm spacing.

Motor Ratings

IEC rated operational current Ie (AC-53b)		2A	5A	12A	18A
Assigned motor rating @60˚C/UL rating @60˚C	220VACrms	0.5kW/ 0.5HP	1.1kW/ 1.5HP	3kW/ 3HP	4kW/ 5HP
	400 VACrms	0.75kW/ 0.75HP	2.2kW/ 3HP	5.5kW/ 7.5HP	7.5kW/ 10HP
	480VACrms	1.1kW/ 1HP	2.2kW/ 3HP	5.5kW/ 7.5HP	7.5kW/ 10HP
	600VACrms	1.1kW/ 1HP	3kW/ 5HP	7.5kW/ 10HP	11kW/ 15HP

Environmental Specifications

Operating temperature	-20°C to +60°C (-4°F to +140°F)
Storage temperature	-50°C to +85°C (-58°F to +185°F)
Relative humidity	<95% non-condensing @40°C
Pollution Degree	2
Degree of Protection	IP20 (EN/IEC 60529)
Installation category	III
Installation Altitude	Above 1000m derate linearly by 1% of unit FLC per 100m to a maximum altitude of 2000m

Current Limit Feature

% of full Load Current	Suitable for type of load	Time inrush current is limited (t_{inrush})	Function after (t_{inrush}) and RSHL is not fully ON
150%	Light	5s	Device continue with the Standard Profile settings (Parameter 1)
250%	Light	5s	
350%	Slightly heavy	10s	
450%	Heavy	20s	

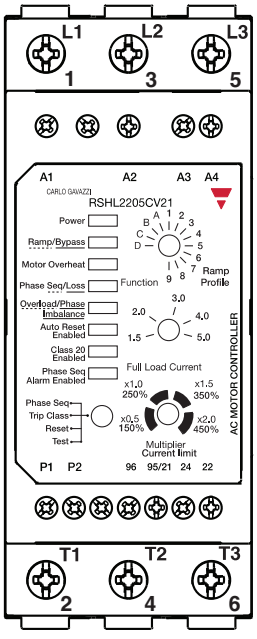
Note: In Current Limit Operation, no soft stop is offered. The motor is left coasting when control is removed.

Standards

Approvals	UL (E172877), cUL
CE Marking LVD	IEC/ EN 60947-4-2
EMCD : Immunity	IEC/ EN 61000-6-4
Emission	IEC/ EN 61000-6-2
Electrostatic Discharge ESD Immunity	IEC/ EN 61000-4-2 8kV, PC2 Air discharge 4kV, PC2 Contact
Electrical fast transient/ Burst Immunity	IEC/ EN 61000-4-4
Output	2kV, PC2
Input	2kV, PC2
Electrical Surge Immunity	IEC/ EN 61000-4-5, PC2
Outpt, line to line	1kV
Output, line to earth	2kV
Input, line to line	1kV
Input, line to earth	1kV
Radiated Radio Frequency (Does not meet EN61000-6-2-2005 requirements requesting tests up to 2.7GHz)	EN 61000-4-3, PC1 10V/m, 80-1000MHz
Conducted radio-frequency immunity	IEC/ EN 61000-4-6, PC1 10V/m, 0.15-80MHz
Voltage dips & interruptions EN60947-4-2	IEC/ EN 61000-4-11 100% Ue dip, 20ms, PC2 60% Ue dip, 200ms, PC2 30% Ue dip, 500ms, PC3 100% Ue interruption, 5000ms, PC3 60% Ue dip, 100ms, PC2 60% Ue dip, 1000ms, PC2 30% Ue dip, 10ms, PC2 100% Ue interruption, 5000ms,PC3
Radio interference field emissions (radiated)	CISPR 11 IEC/ EN 55011, Class A
Radio interference voltage emissions (conducted)	CISPR 11 IEC/ EN 55011, Class A

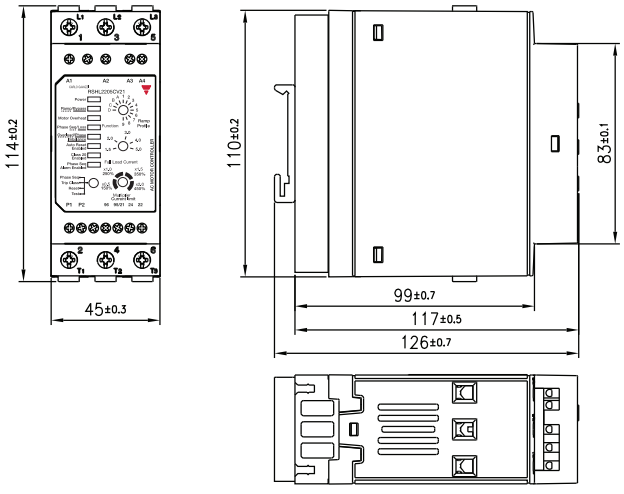
Note: EMC testing was performed with the RSHL connected to representative motor loads of 1.1/ 4.0kW. The EMC performance of the controller would eventually have to be evaluated with the controller connected and fitted as part of the complete system in the end application.

Terminal Diagram



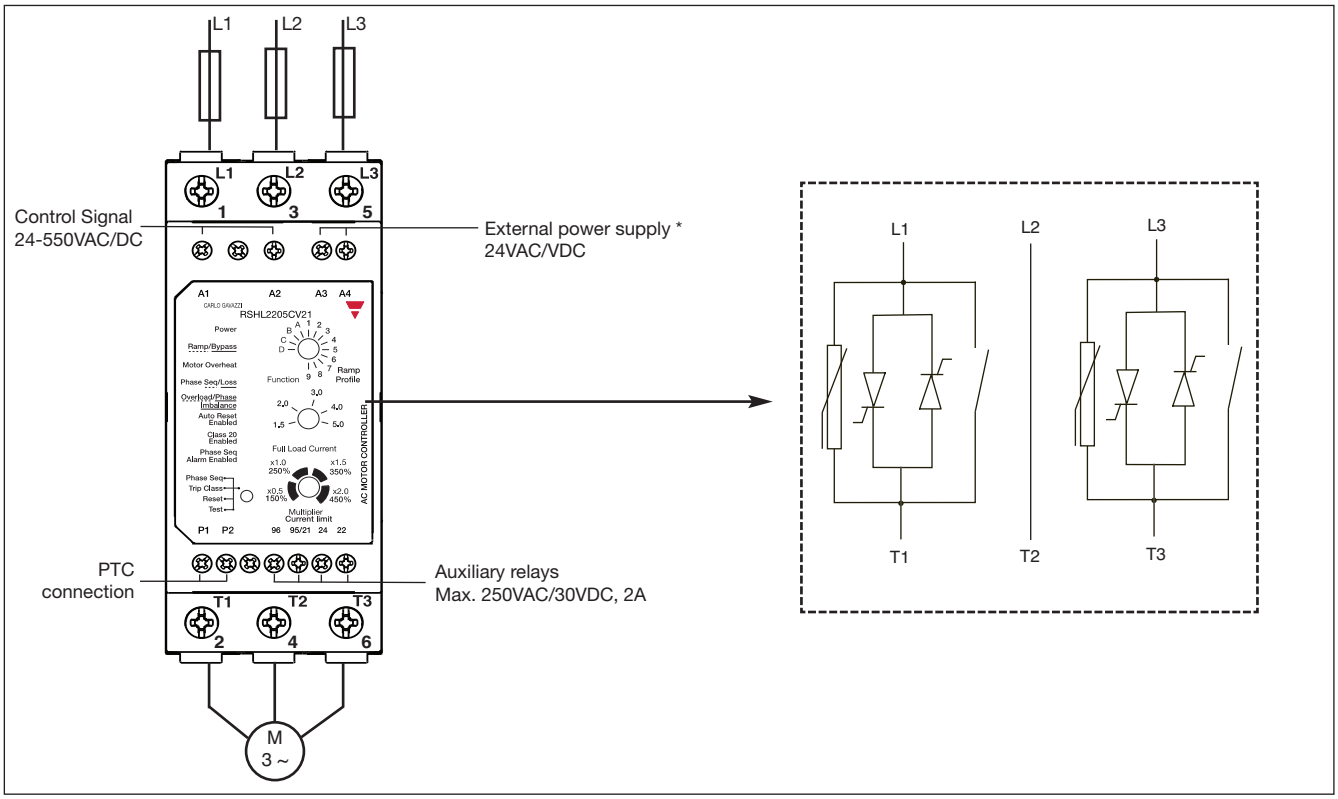
L1, L2, L3: Mains supply
T1, T2, T3: Motor supply
A1, A2: Control input
A3, A4: External supply
P1, P2: PTC connection from motor
22: End of Ramp (Normally Closed)
24: End of ramp (Normally Open)
95/ 21: Common
96: Alarm (Normally closed)

Dimensions



All dimensions in mm

Connection Diagram



* For the 24VDC external supply, CG power supply model SPD24051 can be used

Short circuit Protection (according to EN/IEC 60947-4-2) & UL508

	RSHL..02CV21	RSHL..05CV21	RSHL..22/ 40/ 48 12CV21	RSHL..22/ 40/ 48 18CV21
Type of coordination: 1 Rated short circuit current	10kA when protected by RK5 fuses TRS 15R (15A)	10kA when protected by RK5 fuses TRS 15R (15A)	10kA when protected by RK5 fuses TRS 40R (40A)	10kA when protected by RK5 fuses TRS 40R (40A)
			RSHL6012CV21	**RSHL6018CV21**
Type of coordination: 1 Rated short circuit current			10kA when protected by RK5 fuses TRS 35R (35A)	10kA when protected by RK5 fuses TRS 35R (35A)

	RSHL..02CV21	RSHL..05CV21	RSHL..12CV21	RSHL..18CV21
Type of coordination: 2 Rated short circuit current	10kA when protected by semiconductor fuses	10kA when protected by semiconductor fuses	10kA when protected by semiconductor fuses	10kA when protected by semiconductor fuses
Semiconductor fuse	Ferraz Shawmut 16A, Class URC Art. No. 6.9 CP gRC 14.51.16	Ferraz Shawmut 25A, Class URC Art. No. 6.9 CP gRC 14.51 25	Ferraz Shawmut 50A, Class A70QS Art. No. A70QS50-4	Ferraz Shawmut 60A, Class A70QS Art. No. A70QS60-4

Electronic Overload Relay

Overload Trip Class in accordance to IEC 60947-4-1

Overload Condition	Class 10 (default)	Class 20 (user selected)
@ 1.05xIe (cold condition)	trip cannot be within 2 hrs	trip cannot be within 2 hrs
@ 1.2xIe (hot condition)	trip has to be within 2 hrs	trip has to be within 2 hrs
@ 1.5xIe (hot condition)	trip has to be within 240s	trip has to be within 480s
@ 7.2xIe (cold condition)	trip has to be within 4 to 10s	trip has to be within 6 to 20s

Note: Device remembers settings on loss of power but not overload condition.

Over-temperature Protection

Motor Overheat Protection

Motor PTC connection	P1:P2

PTC Resistance

< 500Ω	No Trip:	Normal Running
> 1000Ω	Trip:	Overheat Alarm LED & Alarm Relay Activated
< 300Ω	Reset	

Soft Starter Protection

Only available for RSHL..18CV21 units. In other models, the overload protection becomes active before the internal temperature protection

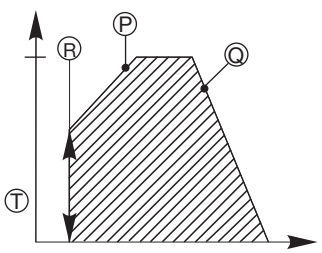
Alarms

Auxiliary Relays Connection 95/21: 96[1]	Alarm Output (Normally Closed).
Phase Sequence Alarm	Available when Phase Sequence Alarm is enabled. In such condition device is disabled and alarm indicated.[2]

Phase Loss Alarm Ramping	Not present
Idling (when power supply is ON and Control Input is OFF)	All three phases must be present for the device to operate. If any phase is missing, alarm is indicated.
Bypass Mode	Device will switch off motor, and alarm is indicated
Phase Imbalance Alarm Bypass Mode[3]	In Bypass mode, the device will trip if the amplitude of the current in one phase is greater than 50% of one of the other two phases for 3 seconds.

Notes:
1 Activated in case of phase loss, phase sequence, phase imbalance, overheat and overload conditions, and shorted power devices. The respective LED indicates the type of alarm. During alarm conditions, if RSHL is in the running mode, it will cease to operate or if in the idling mode it will not start.
2 To operate the device in reversing mode the Phase Sequence Alarm should be disabled.
3 Manual resettable only.

Operational Diagram



(P) Ramp-up time: time from zero load voltage to full load voltage.

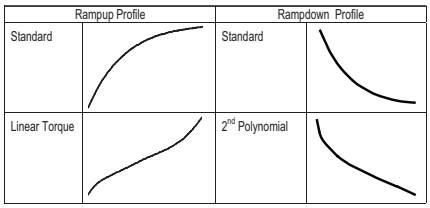
(Q) Ramp-down time: time from full load voltage to zero load voltage.

(R) Initial voltage: voltage at the start of the ramp-up function..

(T) Initial Torque

Operational Diagram

Ramp Profiles



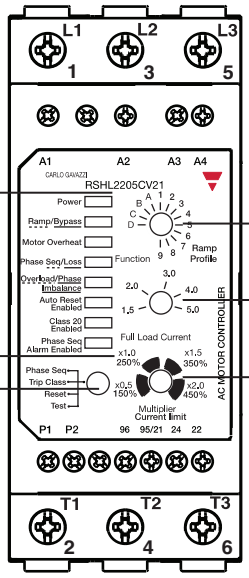
Parameter Settings

Selector (Knob 1)	Type of Load	Ramp-up			Ramp-down	
		Time (s)	Profile	Initial Voltage	Time (s)	Profile
1	General Purpose 1*	2	Standard Up	30%	0	No Ramp Down
2	General Purpose 2	10	Standard Up	30%	0	No Ramp Down
3	General Purpose 3	2	Standard Up	30%	10	Standard Down
4	General Purpose 4	10	Standard Up	30%	10	Standard Down
5	General Purpose 5	5	Standard Up	30%	0	No Ramp Down
6	General Purpose 6	5	Standard Up	40%	10	Standard Down
7	General Purpose 7	5	Standard Up	50%	10	Standard Down
8	Pump	5	Standard Up	30%	10	2nd Polynomial Down
9	Screw compressor	0.5	Linear Torque Up	20%	0	No Ramp Down
D	Current limit					
A	Auto/Man. Reset					
B	Trip Class 10/20					
C	Phase sequence alarm					

* Default

Push Button

Push (Button 4)
Default MANUAL (Hold Button: RESET) Default 10 (Hold Button: TEST) ENABLE or DISABLE: Default ENABLE



Current Settings

Part No.	Current Range (Knob 2)
RSHLxx**02**CV21	0.6 - 2A
RSHLxx**05**CV21	1.5 - 5A
RSHLxx **12**CV21	4.5 - 12A
RSHLxx **18**CV21	5 - 18A

Default: min. value

LED Nomenclature

xxxx	ON
xxxx	Flashing

Multiplier/ Current Limit

Multiplier/ Current Limit (Knob 3)
Ramp-up Time Multiplier by either 0.5, 1.0, 1.5, 2.0 (Default x1)
Either 150%, 250% 350%, 450%

LED indications

LED	STATUS		
	OFF	Flashing	ON
Green	Power OFF	N/A	Power ON
Yellow	Idle / Setup	Ramping*	Bypass ON
Red	N/A	Internal Overheat Alarm*	Motor Overheat Alarm
Red	N/A	Phase Sequence Alarm*	Phase Loss Alarm
Red	N/A	Overload Alarm*	Phase Imbalance Alarm
Yellow	Manual	N/A	Auto
Yellow	Class 10 Protection	N/A	Class 20 Protection
Yellow	Phase Sequence Alarm disabled	N/A	Phase Sequence Alarm Enabled

* Will flash simultaneously in case of fault

CARLO GAVAZZI

Mode of Operation

1. Connections

1.1 Power supply

In order to energize the RSHL an **external power supply** (24V AC/DC, 50/60Hz) should be connected between terminals **A3:A4**.

1.2 Control input

The **control input** is to be applied between connections **A1:A2**. The RSHL soft starter supports a control input signal rating of 24-550V AC/DC

1.3 Mains supply

The three wires of the **three-phase mains supply** is to be connected in terminals marked **L1**, **L2** and **L3** respectively.

1.4 Motor Connections: windings

The **three-phase motor** (load) is to be connected with terminals marked **T1**, **T2** and **T3**. The configuration of inside-delta is not supported in this device.

1.5 Motor Connections: PTC

If the motor is equipped with a **PTC** device (for the measurement of temperature) it can be connected between terminals **P1:P2**. PTC Characteristics should be as per DIN44081/2. If motor PTC is not connected, terminals P1 and P2 should be bridged with the link provided. Unconnected P1 and P2 terminals will trigger the motor over temperature alarm.

1.6 End of Ramp and Alarms

The device is equipped with two **auxiliary relay** outputs as follows:
(i) End of Ramp Normally Closed Terminals **21 : 22**, Normally Open Terminals **21 : 24**
(ii) Alarm Normally Closed Terminals **95 : 96**

2. Getting Started

Please refer to the "Operational Diagram"

2.1 Setting the Motor Full Load Current (Ie)

This is set to the desired level by adjusting the **Full Load Current Knob 2**. Caution should be taken to set the correct value as this might cause damage in either the device and/or the motor. Unless changing the motor this setting should never be changed.

2.2 Soft Start/Stop Settings

The user can chose either one of the **nine Standard ramping profiles** or a **Start with Current limit profile**. Please refer to the **"Operational Diagram"**

2.2.1 Selecting a Standard Ramping Profile

The selection of one of the nine Standard Ramping Profiles is made easy by turning the **Ramp Profile/Function (Selector Knob 1)** to the desired position according to the selection that is made after referring to **Parameter Setting Table** in the **"Operational Diagram"**.
Example: The desired profile is [ramp up=5s, ramp down=10s, initial torque=30%]. Select **Pump** by setting the **Selector Knob 1** to position **8**. Then proceed to set the Multiplier as explained in the next step.

2.2.2 Changing the Ramp-up Time of a Standard Ramping Profile

The **Multiplier/Current Limit Knob 3** allows an increase or reduction of the ramp-up time of the selected Standard Ramping Program.
Example: The **selector knob 1** has been set to position **8** and a ramp up time of **10s** is desired. The default ramp up of this program is **5s**. By setting the Multiplier to position **x2.0** the ramp up is time changed to **10s**.

2.2.3 Selecting and Setting the Current Limit profile

If **Current Limit profile** is desired instead of a **Standard Ramping Profile**, this is **selected by setting the Ramp Profile/Function Selector Knob 1** to position **D**. In Current Limit profile the device limits the inrush current during ramp-up to the current limit set by the user. The current limit level is set by turning the **Multiplier/Current Limit knob 3** to the desired percentage of Full Load Current (Ie).
Example: The Full Load Current (Ie) is 10A. The desired current limit is ≤40A. The Ramp Profile/Function selector knob 1 is turned to position **D**. The Multiplier knob 3 is turned to 350%. This will set the current limit to 35A which is within the desired range.

2.3 Overload Settings

The **overload functions** are set by using the **selector knob 1** in combination with the **push button 4**.

2.3.1 Selecting the Trip Class

This device can operate to either Trip Class 10 or Trip Class 20. The overload trip conditions are according to IEC 60947-4-1. These are summarised in the section entitled **Electronic Overload Relay**. Trip Class 10 is the default setting. To change to Trip Class 20, the Ramp Profile/Function **selector knob 1** is turned to position **B** and the **push button 4** is pressed once. The yellow LED marked **Class 20** goes ON. To change back to Trip Class 10, the **selector knob 1** is turned to position B and the **push button 4** is pressed once. The yellow LED marked Class 20 goes OFF.

2.3.2 Setting the Overload Reset Mode (Manual or Automatic)

Manual Reset is the default setting. To change to **Automatic Reset**, the **Selector Knob 1** is turned to position **A** and the push button 4 is pressed once. The yellow LED marked Auto Reset goes ON. To change back to Manual Reset, the **Selector Knob 1** is turned to position **A** and the **push button 4** is pressed once. The yellow LED marked Auto Reset goes OFF.

2.3.3 Overload Function Test

The **overload function test** works only when the device is idle. This function is not available if the device is either in the running (ramping or bypass) or in the alarm mode. To perform an overload function test, the **Selector Knob 1** is turned to position **B** and the **push button 4** is pressed and held down until the device enters the Overload Function Test (approximately 2 seconds). In this condition the red LED marked **Overload/Phase Imbalance** starts flashing. Further the load is disconnected and the Alarm Relay becomes active.
To exit the **overload function test** the user would need to turn **Selector Knob 1** to any Parameter Setting from 1 to 9 or to Position **D**, and **push button 4** is pressed and held down for approximately 2 seconds until the device exits the Overload Function Test.

2.4 Enabling and Disabling Phase Sequence Monitoring

Phase Sequence monitoring Enabled is the default setting. The yellow LED marked **Phase Seq Enable** is ON. To disable this function, the **Selector Knob 1** is turned to position **C** and the **push button 4** is pressed once. The yellow LED marked Phase Seq Enable goes OFF. To enable this function, the Selector Knob 1 is turned to position **C** and the **push button 4** is pressed once. The yellow LED marked Phase Seq Enable goes ON. When using a reversing relay in combination with this device, this function should be disabled.

3. LED Indication

Refer to the section entitled **LED indication**

4. Alarms

Refer to the section entitled **Alarms**. Reset of alarms are the same as for the overload as in 2.3.2.

5. Over-temperature Protection

Refer to the section entitled **Over-temperature Protection**.

6. Short-circuit Protection

Refer to the section entitled **Short-circuit Protection**, as in figure 1 of the wiring diagram.

7. Device Malfunction

In the case where the supply LED is ON and the four LED under it are flashing, this would indicate that the device is Faulty and should be returned for servicing.

Wiring Diagram

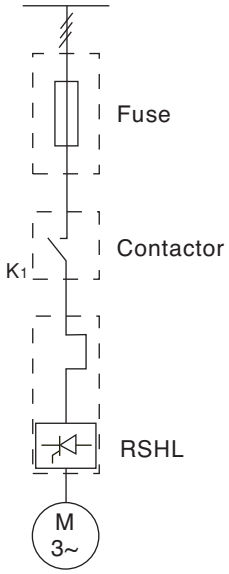


Fig. 1a

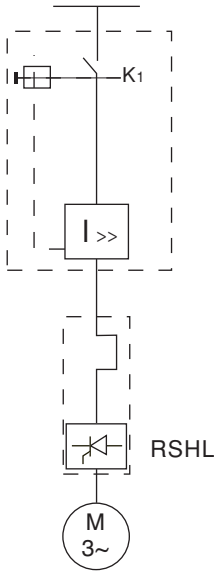


Fig. 2a

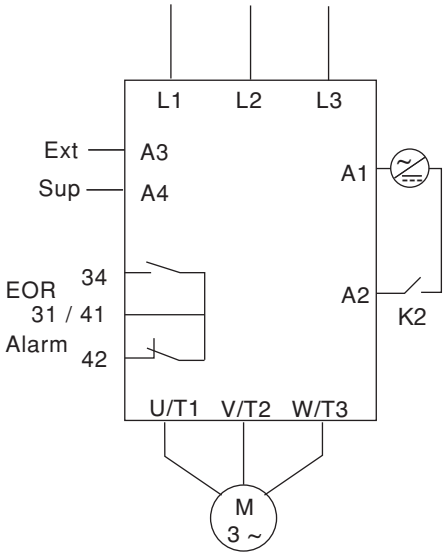


Fig. 3a

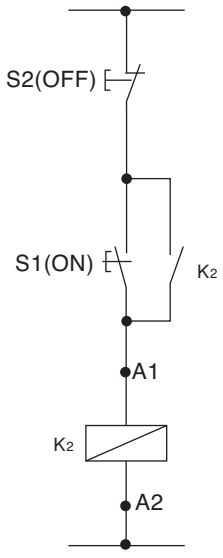


Fig. 4a

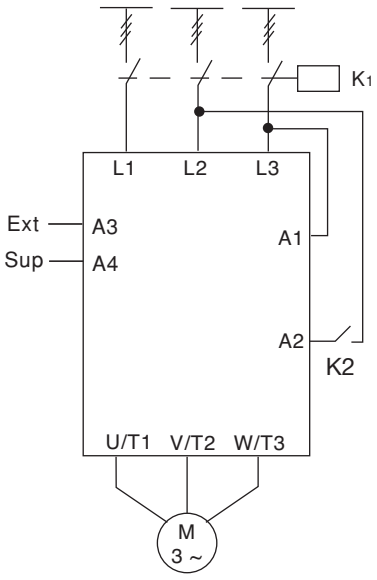


Fig. 5a

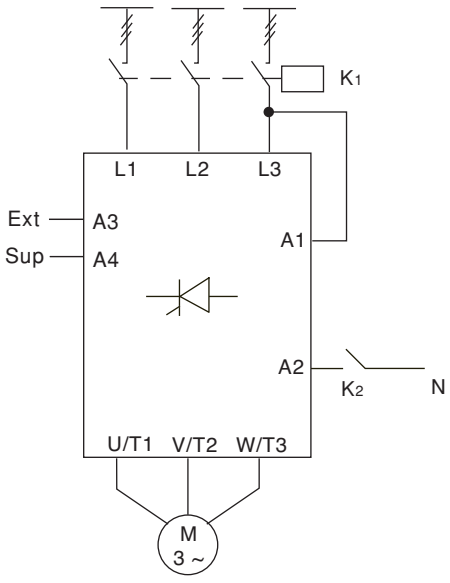


Fig. 6a

IEC

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Wiring Diagram (cont.)

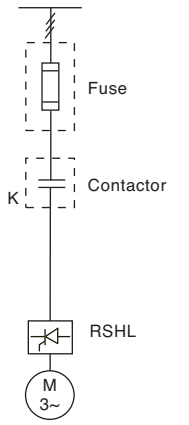


Fig. 1b

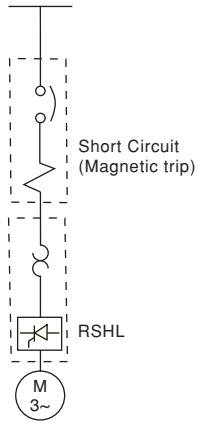


Fig. 2b

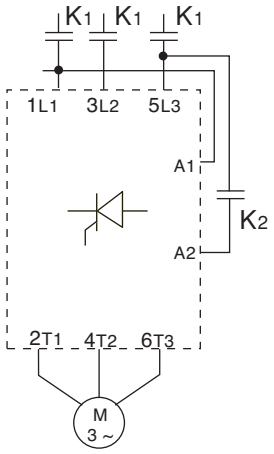


Fig. 5b

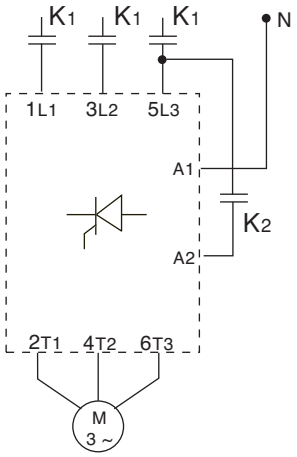


Fig. 6b

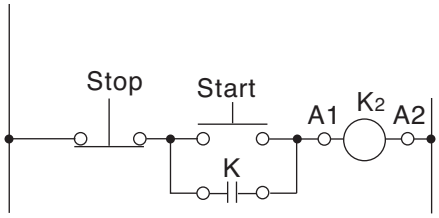


Fig. 4b

NEMA

On normal conditions the motor controller provides bypassing of the semiconductors during running operation. In case of Overload Conditions (current exceeds 20A) while in bypass mode, semi-conductors are again activated and bypass relays deactivated. Therefore the semiconductors can only be damaged by short-circuit currents during ramping (in normal conditions) or while in overload conditions. **Please note that the motor controller does not isolate the motor from the mains.**

Figure 1: Protection of the device when using fuses.
Protection with semiconductor fuses is intended to protect the motor feeder and motor controller from damage due to short-circuit. RSHL protects motor load in overload conditions.

Figure 2: Protection using a magnetic trip.
In this configuration, the motor and its feeder are protected for the overload condition by the internal overload protection of the RSHL. However, due to the relatively slow response of the magnetic trip and the in the absence of semiconductior fuses, damage to the motor controller can occur in this circuit topology.

Figure 3: Secondary conductors.
3.1: Control using a 2-position switch.
When K_2 is closed, the control input is supplied to A1 and A2 and soft starting of the motor is performed. When K_2 is opened, soft stopping is performed.

3.2: Auxiliary Relay
The End of Ramp (EOR) relay 34: 31/ 41 (Normally Open). If EOR is issued to activate external bypass contactors overload protection will be deactivated as current is shunted away from RSHL. Auxiliary alarm relay 31/ 41 : 42 is NC.
This relay is activated in case of any alarm.

Figure 4: Control using ON and OFF push buttons
Pushing S1 soft starts the RSHL. Pushing S2 soft stops the RSHL. K_2 is an auxiliary contact of the mains contactor.

Figure 5: Control using 2 phases
Connecting input A1, A2 to two of the incomming lines will soft start the motor when K_2 is operated. When K_2 is switched off, the motor will soft stop. This configuration does not apply to the RSHL60.CV21 versions.

Figure 6: Control when using operational voltage greater than 550V
Connecting A1 to Neutral and A2 to one of the incoming phases (or vice-versa) will soft start the motor when K_2 is closed. When K_2 is opened, the motor will soft stop.

Timing Diagram

Diagram 1: Normal Operation (Factory Defaults)

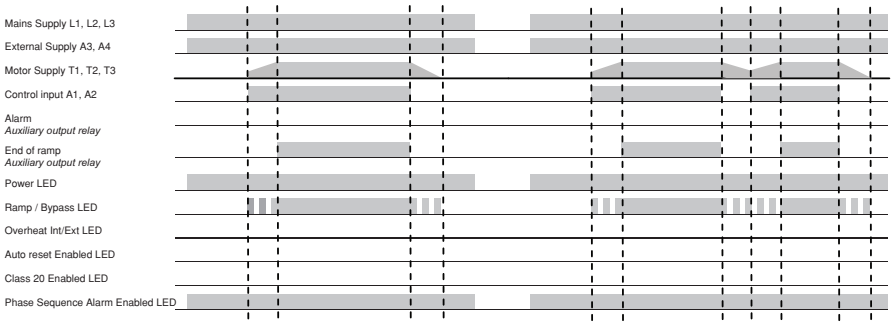


Diagram 2a: Over-temperature alarm during ramping mode

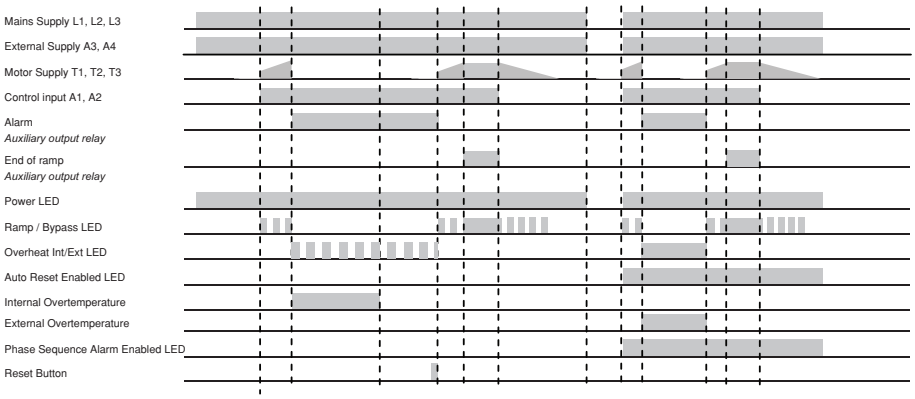
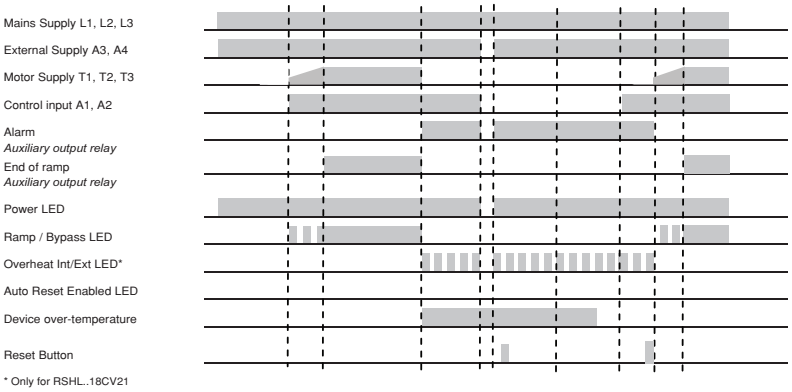
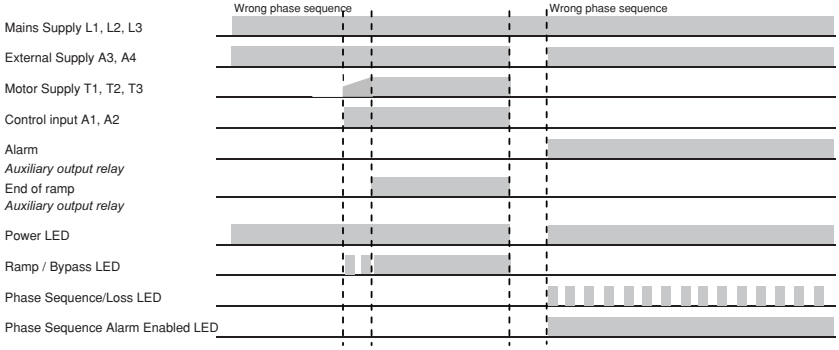


Diagram 2b: Over-temperature during bypass mode.



* Only for RSHL..18CV21

Diagram 2c: Wrong phase sequence alarm



Note:

1. If Phase Sequence Alarm is disabled (Phase Sequence Enabled LED is off); motor will rotate in the reverse direction, if any two phases are interchanged
2. Phase Sequence Alarm can either be reset manually or automatically

Timing Diagram (cont.)

Diagram 2d: Phase Loss during idling mode

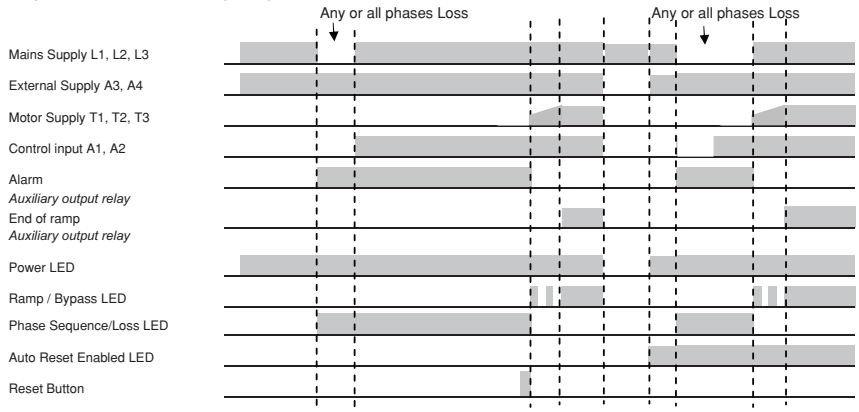


Diagram 2e: Phase Loss during bypass mode

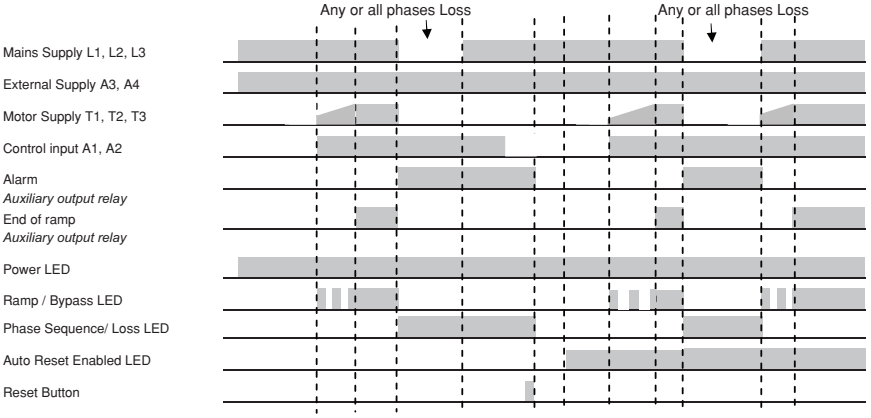
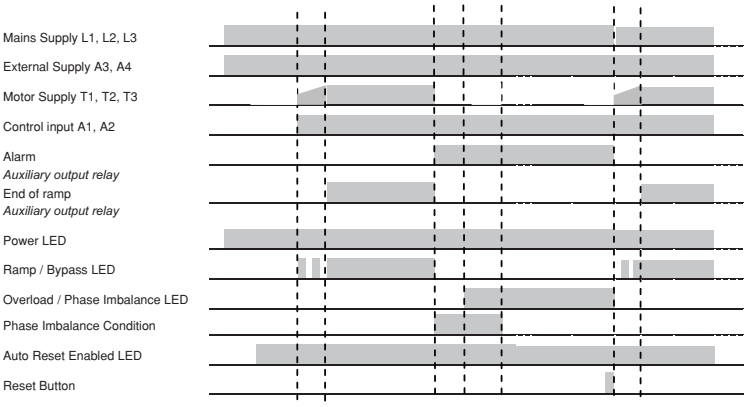


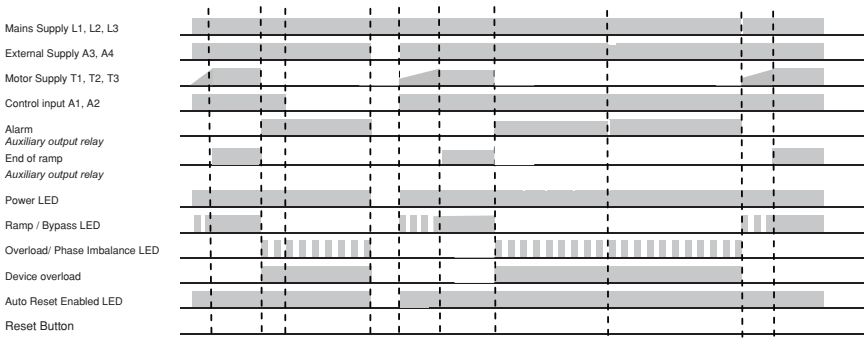
Diagram 2f: Phase Imbalance while in bypass mode



Note:
1. Phase Imbalance Alarm is indicated when the difference in current magnitude between respective phases is greater than 50% for more than 3s
2. Phase Imbalance Alarm can only be resetted manually.

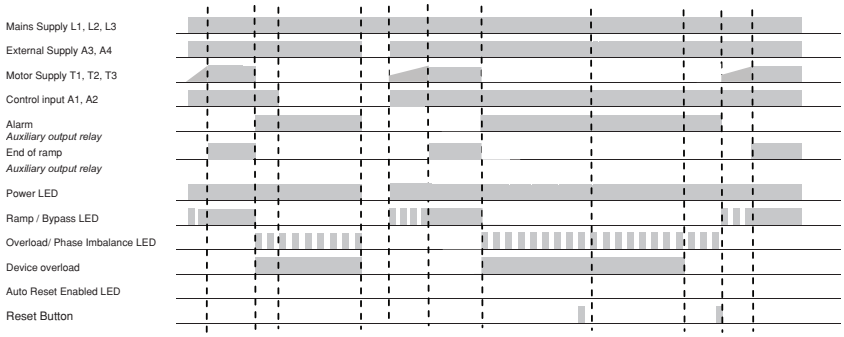
Timing Diagram (cont.)

Diagram 2g: Overload alarm (Automatic Reset)



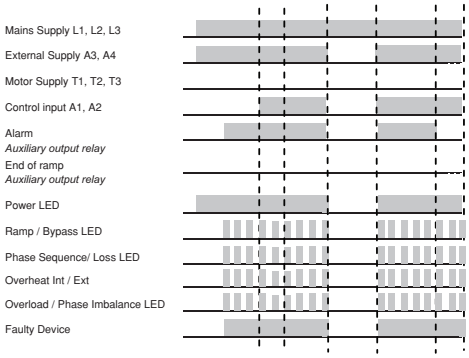
Note:
1. RSHL will only automatically reset Overload and resume normal running when sufficient cooling down time has passed.
2. In case of external supply cycling; user has to make sure that sufficient time for cooling is allowed.
   In case of insufficient cooling time motor and/or device may be damaged.

Diagram 2h: Overload alarm (Manual Reset)



Note:
1. After an current overload occures; a manual reset is only executed after sufficient time has passed for motor to cool down.
2. This precaution can be bypassed by power cycling.
3. In case of power cycling; user has to be sure that sufficient time for cooling is allowed.
   In case of insufficient cooling time motor and/or device may be damaged.

Diagram 2i: Faulty Device



Note:
1. This alarm can only be reset through External Power Supply Cycling. If Alarm does not reset with External Power Cycling, device is permanently damaged.

General Notes

Note 1: When a motor PTC is connected, electromagnetic noise may be conducted into the unit. Thus if abnormal function is obsereved, the use of ferrite beads on the PTC wire (at the end) is recommended.

Note 2: The overload alarm is determined by the Motor Current (Knob 2) setting and selection of the trip class. Please refer to operational diagram.

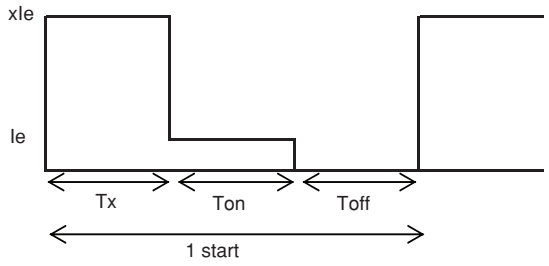
Note 3: Delay time between the moment of pressing the push button until the actual response is 2s.

Note 4: Since the RSHL Smart is a two-phase control the third-phase (L2 - T2) is always connected, and caution should be always observed.

Overload Cycle & Starting Duty

Overload profile

In: AC-53b: x-Tx: OFF time
where: Ie = nominal current through RSHL
x = overload current as a multiple of Ie
Tx = duration time for the controlled overload currents during starting
OFF time = minimum OFF time before a subsequent start may be initaiated



The following tables indicate the max. allowable no. of starts for Overload Profile:
Ie: AC-53b: 4-5: OFF time, Ton = 5sec

Example: To find the maximum no. of starts for RSHL4005CV21 at a nominal current of 10A at 50°C with 0mm spacing.
According to Table 1, the maximum no. of starts = 85, hence Overload Profile for this application would be:
10: AC-53b: 4-5: 32, i.e. an OFF time of 32s is required before any subsequent start may be initated

Spacing: 0mm

Table 1: RSHRxxyyCV21, where xx = 22 or 48, yy = 02 or 05

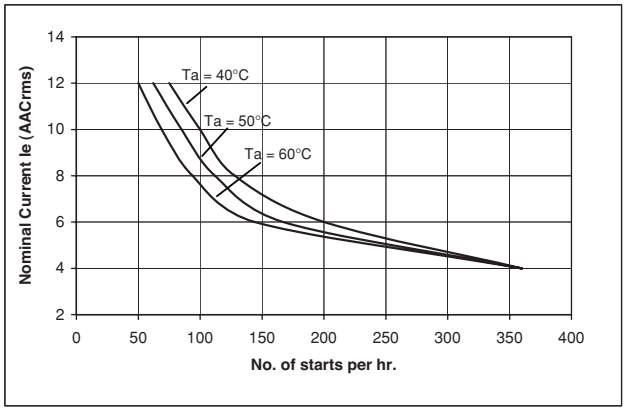


Table 2: RSHRxxyyCV21, where xx = 22 or 48, yy = 12 or 18

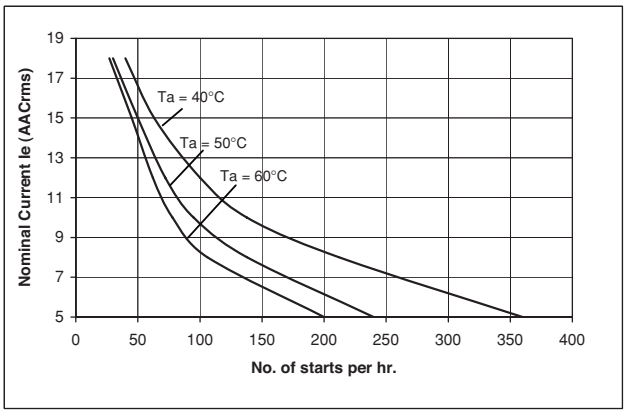
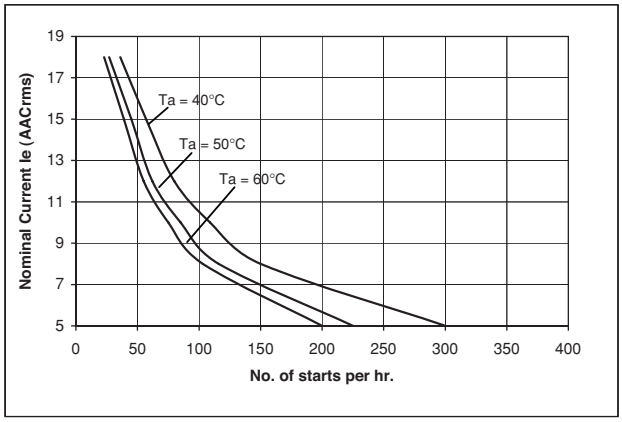


Table 3: RSHR60yyCV21, where yy = 02, 05, 12 or 18



Overload Cycle & Starting Duty (cont.)

Spacing: 45mm

Table 4: RSHRxxyyCV21, where xx = 22 or 48, yy = 02 or 05

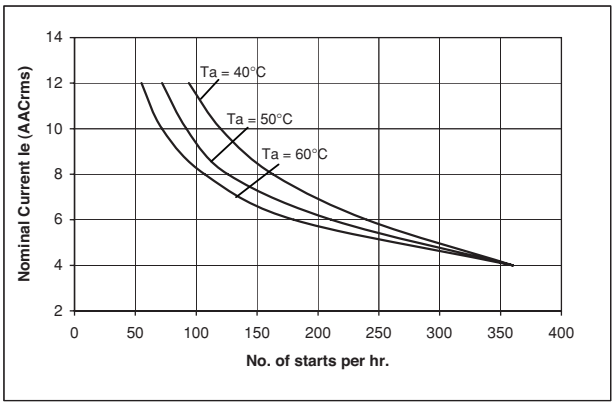


Table 5: RSHRxxyyCV21, where xx = 22 or 48, yy = 12 or 18

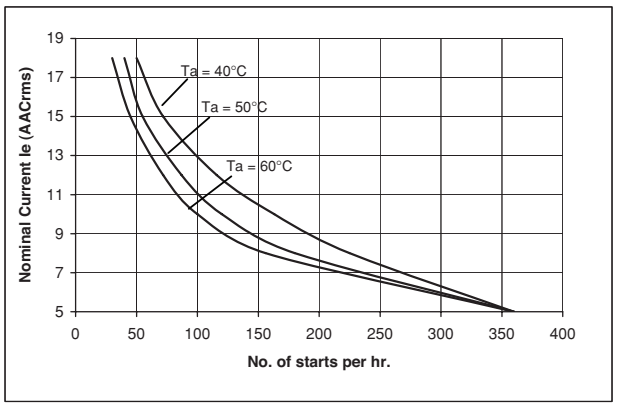
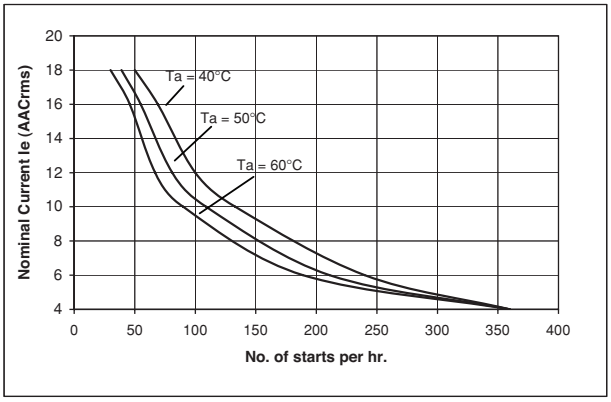


Table 6: RSHR60yyCV21, where yy = 02, 05, 12 or 18



Accessories - External Power Supply 24VDC - SPD 24051

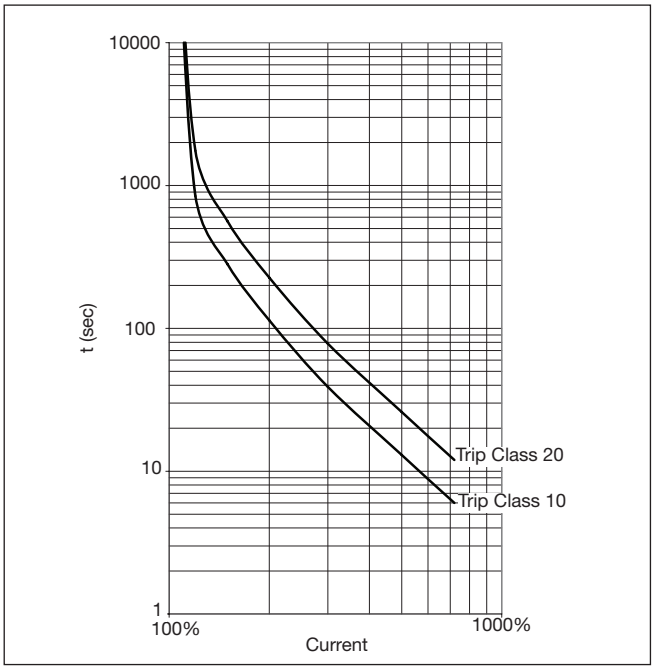
Rated input voltage		100-240
Voltage range	AC	90 - 265VAC
	DC	120 - 370VDC
Frequency range		47 - 63Hz

Voltage trim range	21.6 - 28.8VDC
Output voltage accuracy	± 1%
Output current	0.21A

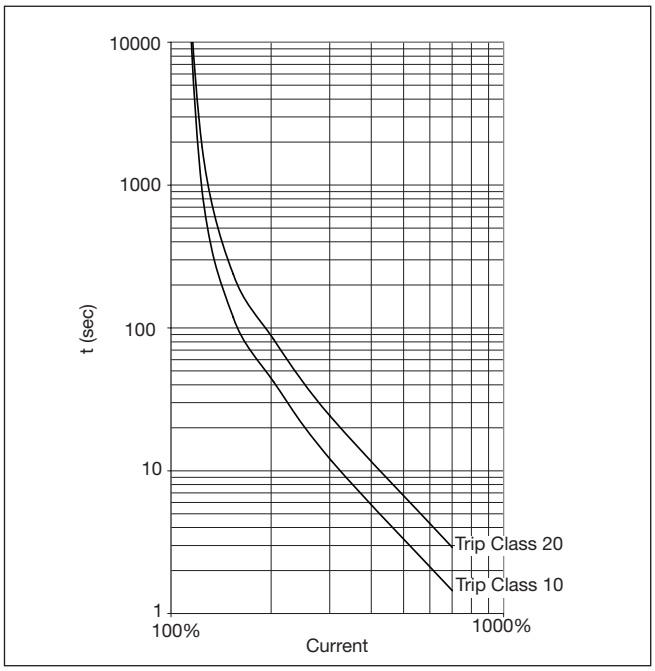
For further details refer to Carlo Gavazzi SPD series datasheet

Overload Characteristics

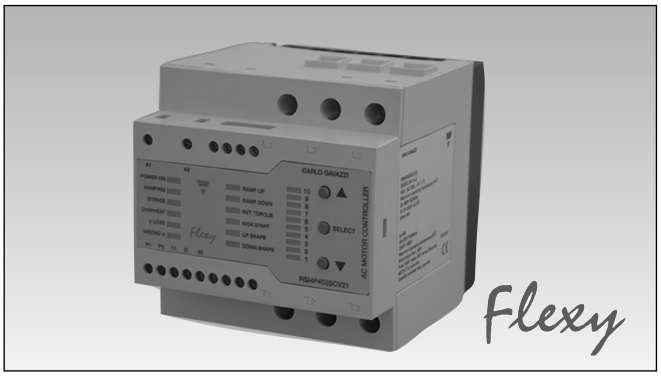
Cold Trip



Hot Trip



Motor Controllers
AC Semiconductor Motor Controller
Type RSHP Flexy



- **Soft starting and stopping of 3-phase induction squirrel cage motors**
- **2-phase control with integral bypassing of semi-conductors**
- **Low inrush and reduced vibration during starting**
- **User-selected ramping profiles**
- **Rated operational voltage: up to 600VAC, 50/60 Hz**
- **Rated operational current up to 45A AC-53b**
- **LED status indicators**
- **Device over-temperature protection**
- **Motor PTC protection**
- **Kickstart option for high torque loads**
- **Auxiliary relay for top of ramp and alarms**
- **DIN rail or panel mounting**

Product Description

The RSHP Flexy is a micro-processor-based softstarter for 3-phase induction motors in a compact new format. While offering versatile ramping features, Flexy is also very easy to configure. It is possible to match the start/stop ramping profiles with the functional requirements of specific motor loads. A clever push-button and LED user interface eliminates the added cost of an alphanumeric display. The RSHP Flexy uses an in-house designed system that ensures efficient power management.

Ordering Key

RSH P 40 25 C V21

- **H-line Motor Controller**
- **Push button selector**
- **Rated operational voltage**
- **Rated operational current**
- **Control voltage**
- **Options**

Selection Guide

Rated operational voltage U_e	Rated operational current I_e 25A AC-53b	38A AC-53b	45A AC-53b
220VACrms	**RSHP2225CV21**	**RSHP2238CV21**	**RSHP2245CV21**
400VACrms	**RSHP4025CV21**	**RSHP4038CV21**	**RSHP4045CV21**
480VACrms	**RSHP4825CV21**	**RSHP4838CV21**	**RSHP4845CV21**
600VACrms	**RSHP6025DV21**	**RSHP6038DV21**	**RSHP6045DV21**

Supply Specification

Rated operational voltage Ue through L1, L2, L3	RSHP22..	127/220 VAC-15% /+10%
	RSHP40..	230/400 VAC-15% /+10%
	RSHP48..	277/480 VAC-15% /+10%
	RSHP60..	346/600 VAC-15% /+10%
Rated AC frequency		50/60 Hz±10%
Dielectric strength		
Dieletric voltage		2 kV (rms)
Rated impulse withstand volt.		4 kV (1.2/50µs)

Input Specifications

Rated control input voltage Uc, A1-A2:	C:24-550 VAC/DC
	D:24-600 +10% VAC/DC
Rated control input current	<1.5 mA
Rated AC frequency	50/60 Hz±10%
Dielectric strength	
Dielectric voltage	2kVAC (rms)
Rated impulse withstand volt.	4kV (1.2/50 µs)

Load Ratings

		RSHP..25.V21	RSHP..38.V21	RSHP..45.V21
IEC rated operational current Ie (AC-53b)		25 A	38A	45 A
Assigned motor rating @ 60°C/ UL rating @ 60°C				
	RSHP22..	5.5kW / 10HP	11kW / 10HP	11kW / 15HP
	RSHP40..	11kW / 15HP	18.5kW / 20HP	22kW / 25HP
	RSHP48..	15kW / 20HP	22kW / 25HP	30kW / 30HP
	RSHP60..	18.5kW / 25HP	22kW / 30HP	30kW / 40HP
Overload cycle according to IEC/EN 60947-4-2	@ 40°C	25A:AC-53b:4-5:65	38A: AC-53b: 4-5:85	45A: AC-53b: 4-5: 115
	@ 50°C	25A:AC-53b:4-5:85	38A:AC-53b:4-5:175	45A: AC-53b: 4-5: 135
	@ 60°C	25A:AC-53b:4-5:175	38A:AC-53b:4-5:355	45A: AC-53b: 4-5: 175
Number of starts per hour @ 40°C/50°C/60°C		50/35/20	40/20/10	30/25/20
Minimum load current		500mA	500mA	500mA

CARLO GAVAZZI

General Specifications

Pollution Degree	3
Weight	800g (approx.)
Degree of protection	IP20 (IEC 60 529)
Relative humidity	<95% non-condensing
Ramp up time	1...20s
Ramp down time	1...20s
Initial torque	0...70%
Kickstart	0...300ms
Status indicator LEDs:	
Power supply ON	LED, green (continuous)
Ramping	LED, yellow (intermittent)
Bypass relay ON	LED, yellow (continuous)
Over-temperature alarm	
Device alarm	LED, red (intermittent)
Motor PTC alarm	LED, red (continuous)
Wrong phase sequence*	LED, red (intermittent)
Phase loss	
Phase loss alarm*	LED, red (blinking at 4Hz)
Under voltage alarm	LED, red (blinking at 1.3Hz)
Function Parameters (ramp up etc.)	LED, yellow
Bargraph (1...10)	LED, red
Motor PTC alarm input P1, P2	Acc. to DIN 44081 and DIN 44082-1
Form designation	Form 1
Auxiliary relays:	
Bypass relay activation	Normally open (21,22)
Over-temperature, phase sequence phase loss alarm	Normally closed (11, 22)
Auxiliary relay contact capacity	3 A, 250 VAC 3 A, 30 VDC
Installation altitude	Above 1000m derate linearly by 1% of unit FLC per 100m to a maximum altitude of 2000m

* detection of these alarm conditions is made during power-up of the device

Conductor Data

Line conductors: **L1, L2, L3/T1, T2, T3**	
according to IEC 60947	0.75...16mm²
maximum size	
solid	1.5...16mm²
finely stranded with end sleeve	1.5...16mm²
stranded	1.5...25mm²
UL rated data	AWG 14...4
CSA rated data	AWG 10...6
Terminal screws	6xM5 (cage clamp)
Tightening torque	1.5...2.5 Nm /13...22 lb.in
CSA data	max. 3.0 Nm/ 26.5 lb. in
Stripping length	10 mm
Secondary conductors: **A1, A2, 11, 21, 22, P1, P2**	
according to IEC 60947	0.75...2.5mm²
maximum size	0.5...2.5mm²
UL/CSA rated data	AWG 22...14
Terminal screws	7xM3 (cage clamp)
Tightening torque	0.3...0.5 Nm/2.7...4.5 lb.in
Stripping length	6 mm

Thermal Specifications

Operating temperature	-20° to +60°C (-4° to +140°F)
Storage temperature	-50° to +85°C (-58° to +185°F)

Standards

Approvals	UL, cUL, CSA
Markings	CE
Norms	IEC/EN 60947-4-2

Recommended Protection according to IEC/EN 60 947-4-2

	RSHP..25.V21	**RSHP ..38.V21**	**RSHP..45.V21**
Type of coordination: 2 Semiconductor fuse	Ferraz Shawmut 63A, Class URQ, Art.No. 6.621 CP URQ27x60/63	Ferraz Shawmut 80A, Class URQ, Art.No. 6.621 CP URQ27x60/80	Ferraz Shawmut 100A, Class URQ, Art.No. 6.621 CP URQ27x60/100
Type of coordination: 1 Motor protection circuit breaker	ABB: MS325 -25 Telemecanique: GV2-M22 Sprecher+Schuh: KTA3-25-25A	ABB: MS450 -40 Telemecanique: GV3-ME40 Sprecher+Schuh: KTA3-100-40A	ABB: MS450 -45 Telemecanique: GV3-ME63 Sprecher+Schuh: KTA3-100-63A
RK5 fuse	TRS45R 45A	TRS70R 70A	TRS90R 90A

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Wiring Diagram

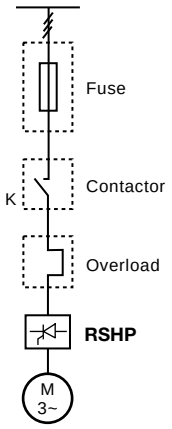


Fig. 1a

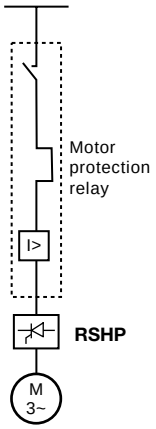


Fig. 2a

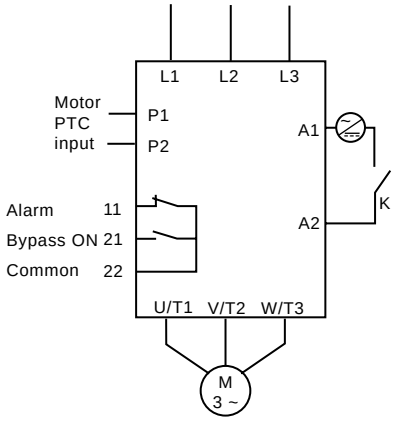


Fig. 3a

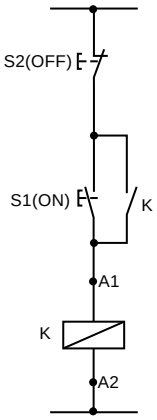


Fig. 4a

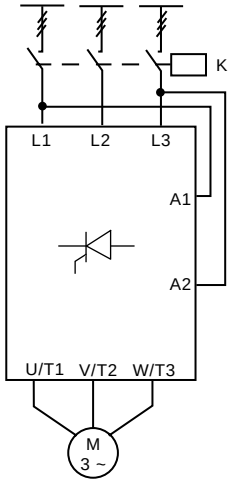


Fig. 5a

IEC

The motor controller provides by-passing of the semiconductors during running operation. Therefore the semiconductors can only be damaged by short-circuit currents during ramp-up and ramp-down. Please note that the motor controller does not isolate the motor from the mains.

Figure 1: Protection of the device when using fuses.
Protection with semiconductor fuses is intended to protect the motor feeder and motor controller from damage due to short-circuit.

Figure 2: Protection using a thermal-magnetic motor protection relay.
The motor feeder is protected but damage to the motor controller is possible. When motor failure occurs, if part of the motor winding limits the fault current and the motor feeder is protected, this type of protection can be considered acceptable.

Figure 3: Secondary conductors.
3.1: Control using a 2-position switch.
When K is closed, the control input is supplied to A1, A2 and soft starting of the motor is performed. When K is opened, soft stopping is performed.
3.2: Motor PTC input
When the motor PTC sensor is connected to P1, P2 the motor controller detects overheating of the motor windings.
3.3: Auxiliary Relays.
The Alarm relay 11, 22 (NC) can be connected in series with the supply to the coil of a mains contactor. The Bypass ON relay 21, 22 (NO) can be used in series with the supply to the coil of an external bypass contactor.

Figure 4: Control using ON and OFF push buttons
Pushing S1 soft starts the RSHP. Pushing S2 soft stops the RSHP. K is an auxiliary contact of the mains contactor.

Figure 5: Control using 2 phases
Connecting input A1, A2 to two of the incomming lines will soft start the motor when K is operated. When K is switched off, the motor will stop (no soft stop).

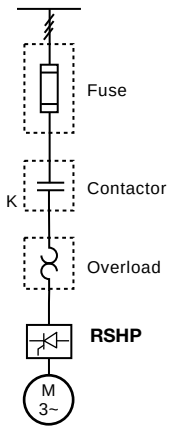


Fig. 1b

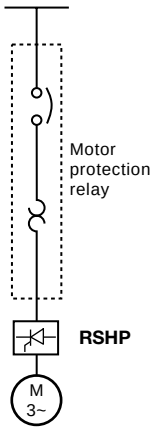


Fig. 2b

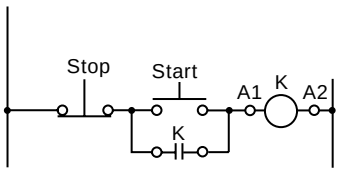


Fig. 4b

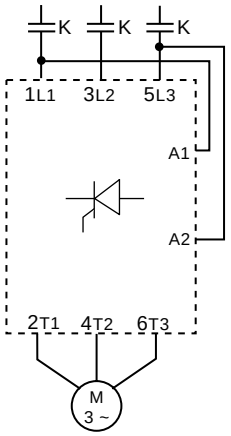
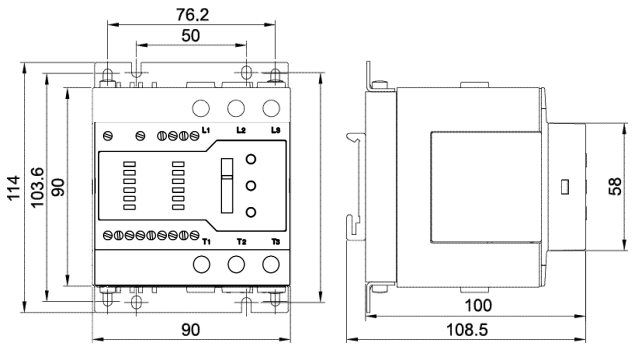


Fig. 5b

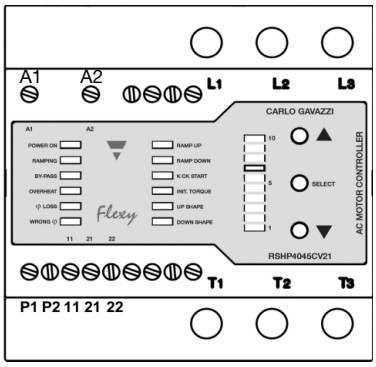
NEMA

Dimensions



All dimensions in mm

Terminal Diagram



A1, A2: Control input

21,22: Bypass relay activation (NO)

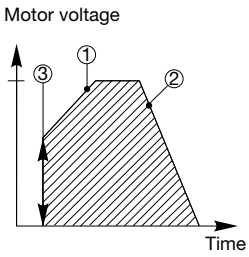
11,22: alarms (NC)

P1, P2:PTC input

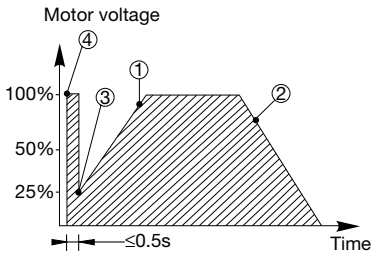
Operation Diagram

Multi ramp starting strategies suitable for all applications are designed into the RSHP

Excluding setup position [9]



Setup position [9]



① Ramp-up time: time from zero load voltage to full load voltage.

② Ramp-down time: time from full load voltage to zero load voltage.

③ Initial voltage: voltage at the start of the ramp-up function.

④ Kickstart: constant initial voltage delay before ramp-up.

Table 1: Level 1 Parameters

Bargraph LED pos.	Selection switch	Ramp-up time s	Initial voltage	Ramp-down time s
1	Default: Standard	05	30%	10
2	Pump	05	40%	15
3	Light conveyor	02	40%	10
4	Heavy conveyor	15	60%	10
5	Low inertia fan	10	30%	00
6	High inertia fan	15	50%	00
7	Piston compressor	01	50%	00
8	Screw compressor	10	40%	00
9	Kick-start	05	50%	15
10*	High Torque	05	60%	05

* These settings can be changed

Operation Diagrams for RSHP

Diagram 1: Normal Operation

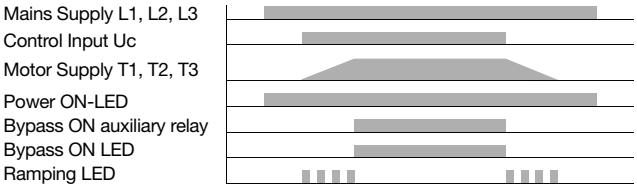


Diagram 2a: Device over-temperature alarm

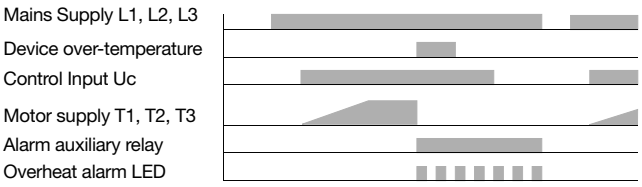


Diagram 2b: Motor PTC alarm

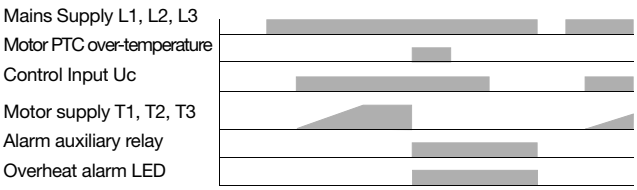


Diagram 2c: Phase loss during power up

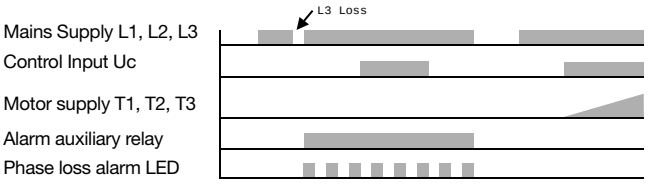


Diagram 2d: Phase loss during ramping

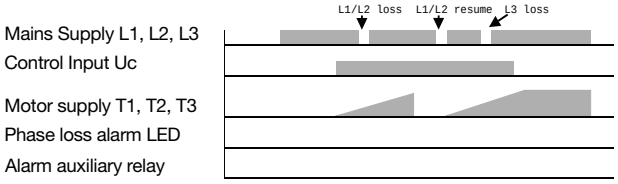


Diagram 2e: Phase loss while bypass is ON

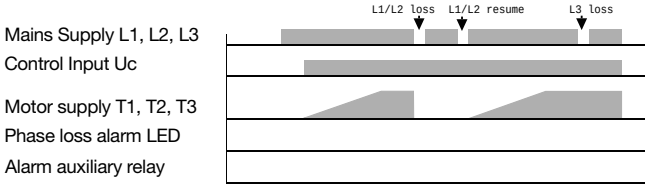
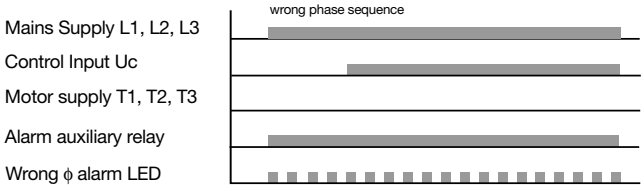


Diagram 2f: Phase loss while bypass is being activated

Diagram 2g : Wrong phase sequence alarm



Notes

Note1: After activation of the by-pass relay, there is a delay of 1 sec, during which removal of the control input will not initiate the ramp-down function.

Note 2: Cycling of the control input should be limited to a rate not exceeding 3 seconds ON and 3 seconds OFF. At faster cycling times, it is not guaranteed that the output of the unit will respond to the given input.
Important: The number of starts per hour and Overload Cycle values should always be taken into consideration when cycling is used.

Note 3: A phase loss on L1 or L2 causes the device to reset as these phases provide the internal power supply.

Note 4: Phase sequence and phase loss alarms are only detected if they occur during power up, when L1, L2, L3 are switched ON.

Note 5: When a motor PTC is connected, electromagnetic noise may be conducted into the unit. Thus if abnormal function is observed, the use of ferrite beads on the PTC wire (at the unit end) is recommended.

Note 6: Repetitive voltage dips on phase L1 and/or L2 during operation may lead to overheating of the motor. In case the by-pass relays are activated and the repetition rate of these dips is such that the internal supply voltage falls below a preset limit, the by-pass relays will be automatically switched off. This state is indicated by blinking of the phase loss led at 1.3Hz. Reset of the supply L1, L2 and L3 is necessary to resume normal function.

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Ramp setting procedure

Factory DEFAULT - Plug and Play
The ramp selector is set to bargraph position 1, according to Table 1: "Level 1 Parameters".The product will be shipped with this standard ramp setting. If this setting is considered suitable, no other settings are required.

Level 1 - FACTORY PRE-DEFINED RAMP PARAMETERS
For this mode, the 3-phases L1,L2,L3 must be present but control A1,A2 must not be present. In this level, the user may select from 10 pre-defined ramps by selecting one of the 10 bargraph positions: 1,2,3……..9 or 10, according to Table 1: "Level 1 Parameters". Position 1 is the same as the factory DEFAULT described above. In each pre-defined ramp, the values for all parameters (ramp up, ramp down, initial torque, kickstart, ramp up shape and ramp down shape) are fixed by the factory against each bargraph LED position. Position 10 is factory set for "High Torque Load" (see Table 1) but can be re-programmed according to Level 2 instructions. The bargraph LED will remain ON at the selected position during operation as long as L1,L2,L3 are present, to show which ramp parameters are being used.

To enter Level 1 mode:
Press SELECT once. One bargraph LED will start flashing at the position that has been previously programmed (position 1 if the product is just out of the box).

To select the factory pre-defined ramp:
Use the UP and DOWN arrow buttons to move the flashing LED up or down on the bargraph.

To save and exit Level 1 mode:
To fix the new settings, press SELECT. This stores the selected ramp position and causes the device to exit Level 1. The bargraph LED remains ON at the selected position during operation as long as L1,L2,L3 are present. (If no button is pressed for several seconds, the device goes out of this setting mode automatically and above steps must be repeated).

Level 2 - RAMP CUSTOMISATION
In this level, a new combination of parameters settings (ramp up, ramp down, initial torque, kickstart, ramp up shape and ramp down shape) can be made that is not included in the pre-defined ramps of Level 1 (In Level 1 these settings have been fixed by the factory. See Table 1: Level 1 Parameters).In Level 2, each parameter of "position 10" can be re-defined individually by first selecting the parameter and then setting the bargraph level in accordance with Table 2: "Level 2 Parameters".

To enter Level 2 mode:
Press SELECT and move flashing bargaph LED to position 10. With the bargraph flashing at position 10, press and hold SELECT until the parameter LEDs scroll down twice. The Ramp Up LED will light up. Press SELECT and one bargraph LED will start flashing. Position 10 parameters can now be redefined.

To re-define position 10 parameters:
The Ramp up parameter LED must be flashing. The bargraph LED must be flashing at the position that has been previously programmed (position 7 if the product is just out of the box). Use the UP/DOWN arrow keys to move the flashing bargraph LED to the required position according to Table 2: "Level 2 Parameters" and then press SELECT. The next parameter LED (Ramp down) will start flashing to indicate that it can be adjusted.
The bargraph LED will also start flashing at the position that has been previously programmed (position 7 if the product is just out of the box).
Use the arrow keys to move the flashing bargraph LED to the required position according to Table 2: "Level 2 Parameters" and then press SELECT. These steps are repeated until all parameters have been set. Ramp shapes can be selected in the same way.

To save and exit Level 2 mode:
To save and exit Level 2 selection procedure, press and hold SELECT until the parameter LEDs scroll down twice.

Running with the customised ramp:
After Level 2 procedure has been completed the device will store the parameters in position 10. The bargraph LED in position 10 will light up continuously during operation.

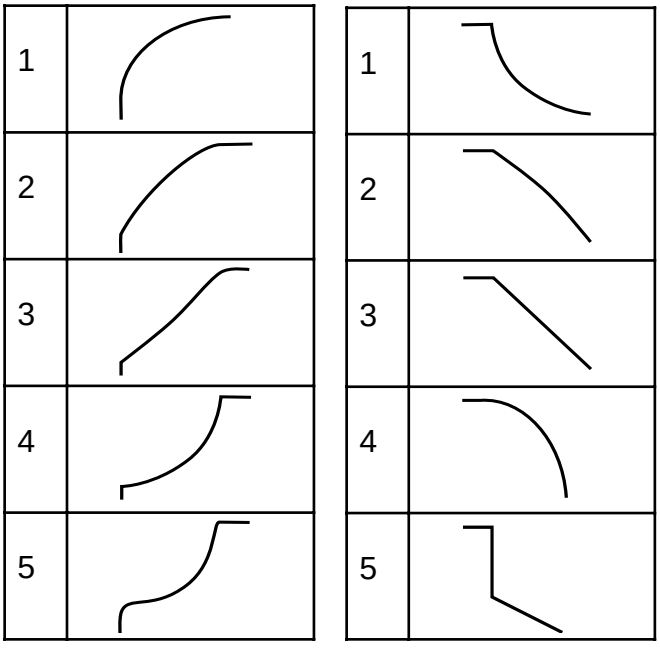
Defaults:
Enter Level 2 mode as previously described. When the bargraph LED is flashing, press and hold the UP and DOWN arrow buttons simultaneously until the parameter LEDS scroll twice. This resets all the ramp settings to factory default.

Attention!
If no button is pressed for several seconds during Level 1 or Level 2 procedures, the product goes out of the Level setting mode back to the previous ramp parameter combination.

Table 2: Level 2 Parameters

Bargraph LED pos.	Ramp up times	Rampdown times	Initial voltage	Kickstart ms	Ramp up shape	Rampdown shape
1	0.5	0.5	0%	0	1	1
2	1	1	10%	20	2	2
3	1.5	1.5	20%	40	3	3
4	2	2	30%	60	4	4
5	3	3	40%	80	5	5
6	4	4	50%	100	-	-
7	5	5	60%	150	-	-
8	10	10	70%	200	-	-
9	15	15	-	250	-	-
10	20	20	-	300	-	-

Ramp Shapes



Motor Controllers
AC Semiconductor Motor Controller
Type RSHR

- **Soft starting and stopping of 3-phase squirrel cage motors**
- **Low inrush and reduced vibration during starting**
- **Integrated bypassing of semiconductors**
- **Rated operational voltage: up to 600 VAC, 50/60 Hz**
- **Rated operational current up to 45A AC-53b**
- **LED status indicators**
- **Motor PTC protection**
- **Device over-temperature protection**
- **DIN rail or panel mounting**

Product Description

Compact easy-to-use AC semiconductor motor controller. With this controller 3-phase motors with nominal load currents up to 45 A can be soft-started and/or soft-stopped. Starting and stopping time as well as initial torque can be independently adjusted by built-in potentiometers.

Ordering Key

RSH R 48 45 C V20

- **H-line Motor Controller**
- **Rotary Ramp profile setting**
- **Rated operational voltage**
- **Rated operational current**
- **Control voltage**
- **Options**

Selection Guide

Rated operational voltage U_e	Rated operational current I_e 25A AC-53b	38A AC-53b	45A AC-53b	Options
220VACrms	**RSHR2225CV20**	**RSHR2238CV20**	**RSHR2245CV20**	**V20: Basic**
400VACrms	**RSHR4025CV20**	**RSHR4038CV20**	**RSHR4045CV20**	**V21: 2 auxiliary relays**
480VACrms	**RSHR4825CV20**	**RSHR4838CV20**	**RSHR4845CV20**	
600VACrms	**RSHR6025DV20**	**RSHR6038DV20**	**RSHR6045DV20**	

Supply Specification

Rated operational voltage Ue through L1, L2, L3	RSHR22..	127/220 VAC -15% /+10%
	RSHR40..	230/400 VAC -15% /+10%
	RSHR48..	277/480 VAC -15% /+10%
	RSHR60..	346/600 VAC -15% /+10%
Rated AC frequency		50/60 Hz±10%
Dielectric strength		
Dielectric voltage		2 kV (rms)
Rated impulse withstand volt.		4 kV (1.2/50µs)

Input Specifications

Rated control input voltage Uc, A1-A2:	C:24-550 VAC/DC D:24-600 +10% VAC/DC
Rated control input current	<1.5 mA
Rated AC frequency	50/60 Hz±10%
Dielectric strength	
Dielectric voltage	2kVAC (rms)
Rated impulse withstand volt.	4kV (1.2/50 µs)

Load Ratings

		RSHR..25....	RSHR..38....	RSHR..45....
IEC rated operational current Ie (AC-53b)		25 A	38A	45 A
Assigned motor rating @ 60°C/ UL rating @ 60°C				
	RSHR22..	5.5kW / 10HP	11kW / 10HP	11kW / 15HP
	RSHR40..	11kW / 15HP	18.5kW / 20HP	22kW / 25HP
	RSHR48..	15kW / 20HP	22kW / 25HP	30kW / 30HP
	RSHR60..	18.5kW / 25HP	22kW / 30HP	30kW / 40HP
Overload cycle according to IEC/EN 60947-4-2	@ 40°C	25A:AC-53b:4-5:65	38A: AC-53b: 4-5:85	45A: AC-53b: 4-5: 115
	@ 50°C	25A:AC-53b:4-5:85	38A:AC-53b:4-5:175	45A: AC-53b: 4-5: 135
	@ 60°C	25A:AC-53b:4-5:175	38A:AC-53b:4-5:355	45A: AC-53b: 4-5: 175
Number of starts per hour @ 40°C/50°C/60°C		50/35/20	40/20/10	30/25/20
Minimum load current		500mA	500mA	500mA

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Conductor Data

Line conductors:	
L1, L2, L3/T1, T2, T3	
according to IEC 60947	0.75...16mm²
maximum size	
solid	2.5...16mm²
finely stranded with end sleeve	2.5...16mm²
stranded	2.5...25mm²
UL/CSA rated data	
UL rated data	AWG 14...4
CSA rated data	AWG 14...6
Terminal screws	6xM5 (cage clamp)
Tightening torque	1.5...2.5 Nm /13...22 lb.in
CSA data	max. 3.0Nm/ 26.5 lb/in
Stripping length	10 mm
Secondary conductors:	
A1, A2, 11, 21, 22, P1, P2	
according to IEC 60947	0.75...2.5mm²
maximum size	0.5...2.5mm²
UL/CSA rated data	AWG 22...14
Terminal screws	7xM3 (cage clamp)
Tightening torque	0.3...0.5 Nm/2.7...4.5 lb.in
Stripping length	6 mm

Thermal Specifications

Operating temperature	-20° to +60°C (-4° to +140°F)
Storage temperature	-50° to +85°C (-58° to +185°F)

Standards

Approvals	UL, cUL, CSA
Markings	CE
Norms	IEC/EN 60947-4-2

General Specifications

Pollution degree	3
Weight	800g (approx.)
Degree of protection	IP20 (IEC 60529)
Relative humidity	<95% non-condensing
Ramp up time	1…10s
Ramp down time	1…30s
Initial torque	0…70%
Status indicator LEDs	
Power supply ON	LED, green (continuous)
Ramping	LED, yellow (intermittent)
Bypass relay ON	LED, yellow (continuous)
Over-temperature alarm	
Device alarm	LED, red (intermittent)
Motor PTC alarm	LED, red (continuous)
Wrong phase sequence*	LED, red (intermittent)
Phase loss	
Phase loss alarm*	LED, red (blinking at 4Hz)
Under voltage alarm	LED, red (blinking at 1.3Hz)
Motor PTC alarm input P1, P2	Acc. to DIN 44081 and DIN 44082-1
Form designation	Form 1
Auxiliary relays: (V21 option)	
Bypass relay activation	Normally open (21,22)
Over-temperature, phase sequence, phase loss alarm	Normally closed (11, 22)
Auxiliary relay contact capacity	3 A, 250 VAC 3 A, 30 VDC
Installation altitude	Above 1000m derate linearly by 1% of unit FLC per 100m to a maximum altitude of 2000m

* detection of these alarm conditions is made during power-up of the device

Recommended Protection according to IEC/EN 60 947-4-2

	RSHR..25....	RSHR ..38....	RSHR..45....
Type of coordination: 2 Semiconductor fuse	Ferraz Shawmut 63A, Class URQ, Art.No. 6.621 CP URQ27x60/63	Ferraz Shawmut 80A, Class URQ, Art.No. 6.621 CP URQ27x60/80	Ferraz Shawmut 100A, Class URQ, Art.No. 6.621 CP URQ27x60/100
Type of coordination: 1 Motor protection circuit breaker	ABB: MS325 -25 Telemecanique: GV2-M22 Sprecher+Schuh: KTA3-25-25A	ABB: MS450 -40 Telemecanique: GV3-ME40 Sprecher+Schuh: KTA3-100-40A	ABB: MS450 -45 Telemecanique: GV3-ME63 Sprecher+Schuh: KTA3-100-63A
RK5 fuse	TRS45R 45A	TRS70R 70A	TRS90R 90A

Wiring Diagram

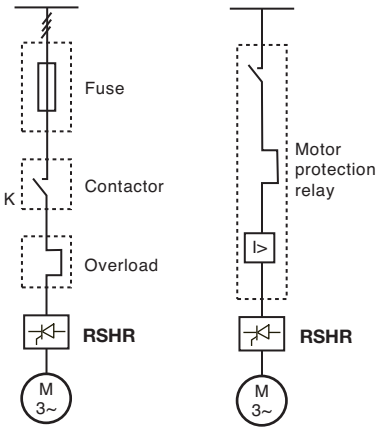


Fig. 1a

Fig. 2a

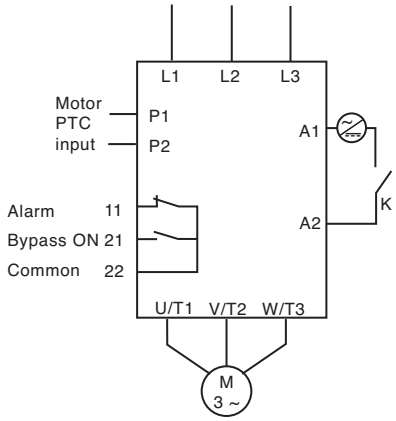


Fig. 3a

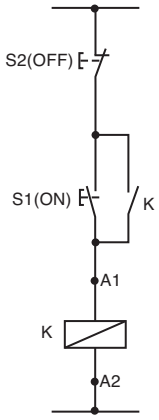


Fig. 4a

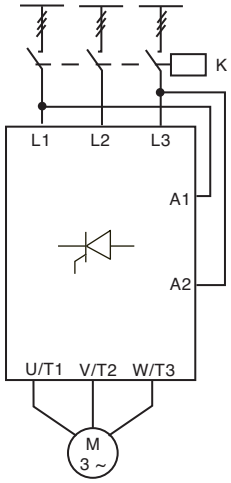


Fig. 5a

IEC

The motor controller provides by-passing of the semiconductors during running operation. Therefore the semiconductors can only be damaged by short-circuit currents during ramp-up and ramp-down. Please note that the motor controller does not isolate the motor from the mains.

Figure 1: Protection of the device when using fuses.
Protection with semiconductor fuses is intended to protect the motor feeder and motor controller from damage due to short-circuit.

Figure 2: Protection using a thermal-magnetic motor protection relay.
The motor feeder is protected but damage to the motor controller is possible. When motor failure occurs, if part of the motor winding limits the fault current and the motor feeder is protected, this type of protection can be considered acceptable.

Figure 3: Secondary conductors.
3.1: Control using a 2-position switch.
When K is closed, the control input is supplied to A1, A2 and soft starting of the motor is performed. When K is opened, soft stopping is performed.
3.2: Motor PTC input
When the motor PTC sensor is connected to P1, P2 the motor controller detects overheating of the motor windings.
3.3: Auxiliary Relays (Available on RSHR…V21 types only!)
The Alarm relay 11, 22 (NC) can be connected in series with the supply to the coil of a mains contactor. The Bypass ON relay 21, 22 (NO) can be used in series with the supply to the coil of an external bypass contactor.

Figure 4: Control using ON and OFF push buttons
Pushing S1 soft starts the RSHR. Pushing S2 soft stops the RSHR. K is an auxiliary contact of the mains contactor.

Figure 5: Control using 2 phases
Connecting input A1, A2 to two of the incomming lines will soft start the motor when K is operated. When K is switched off, the motor will stop (no soft stop).

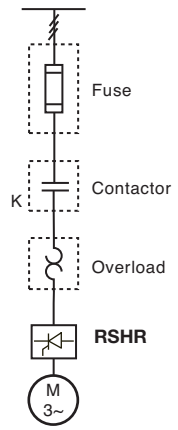


Fig. 1b

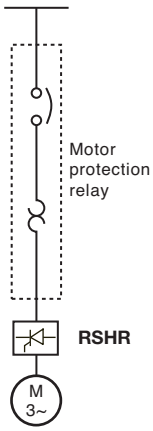


Fig. 2b

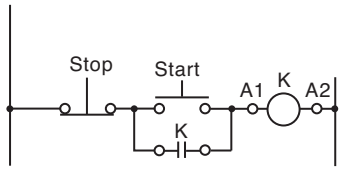


Fig. 4b

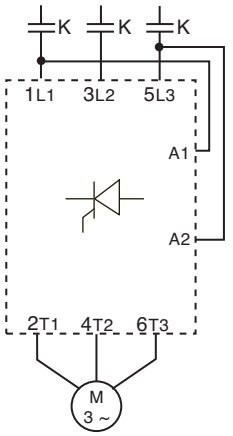
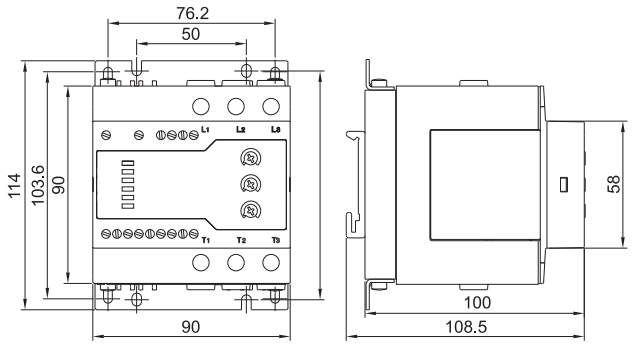


Fig. 5b

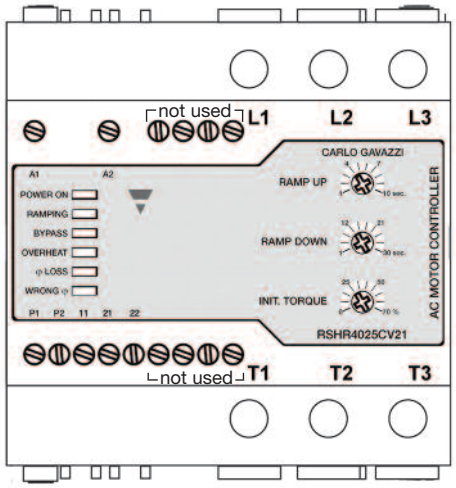
NEMA

Dimensions



All dimensions in mm

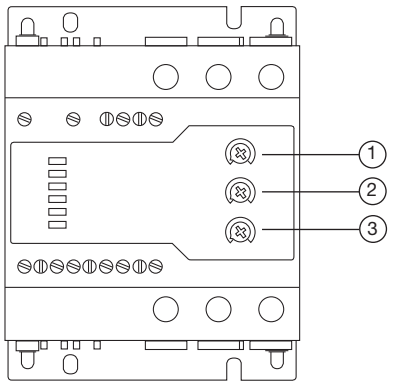
Terminal Diagram

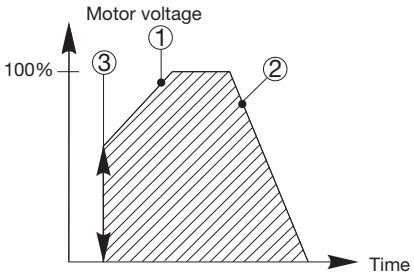


A1, A2:Control input
P1, P2:PTC input
11, 22: Alarms (NC)
21, 22: Bypass relay activation (NO)

Note: Relay terminals 11,21,22 are not used in RSHR...V20

Operation Diagram





(1) Ramp-up time 1 to 10 s. Time from zero load voltage to full load voltage.

(2) Ramp-down time 1 to 30 s. Time from full load voltage to zero load voltage.

(3) Initial torque 0 to 70% voltage at the start of the ramp-up function.

Operation Diagrams for RSHR

Diagram 1: Normal Operation

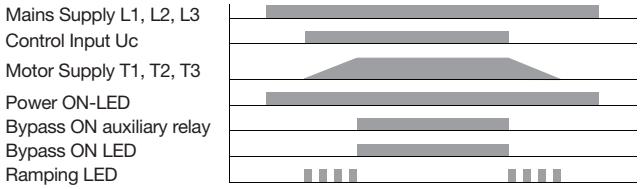


Diagram 2a: Device over-temperature alarm

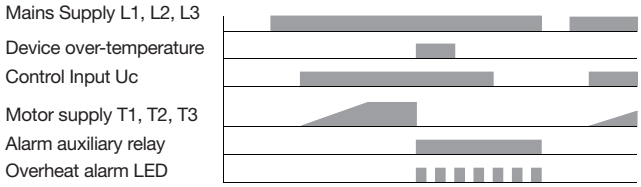


Diagram 2b: Motor PTC alarm

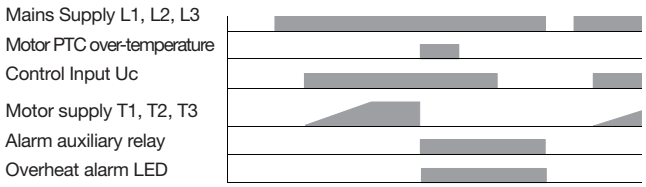


Diagram 2c: Phase loss during power up

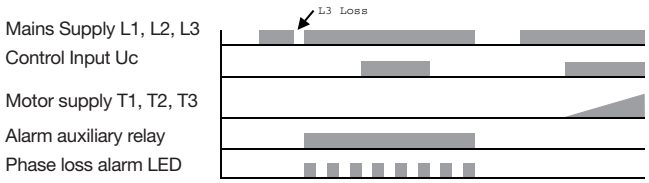


Diagram 2d: Phase loss during ramping

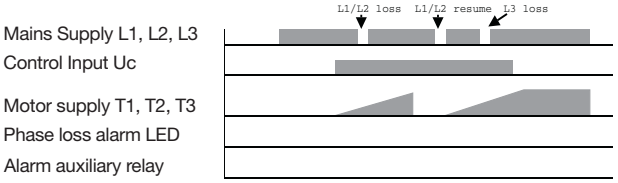


Diagram 2e: Phase loss while bypass is ON

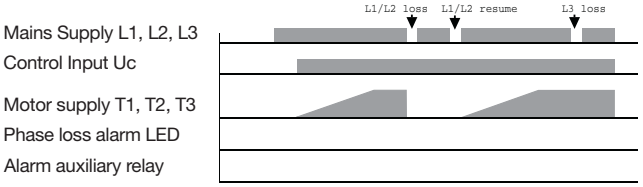


Diagram 2f: Phase loss while bypass is being activated

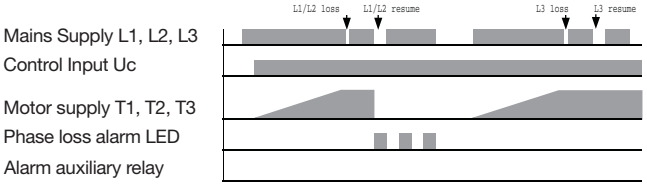
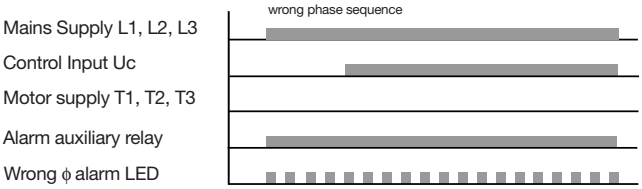


Diagram 2g : Wrong phase sequence alarm



Notes

Note1: After activation of the by-pass relay, there is a delay of 1 sec, during which removal of the control input will not initiate the ramp-down function.

Note 2: Cycling of the control input should be limited to a rate not exceeding 3 seconds ON and 3 seconds OFF. At faster cycling times, it is not guaranteed that the output of the unit will respond to the given input.
Important: The number of starts per hour and Overload Cycle values should always be taken into consideration when cycling is used.

Note 3: Auxiliary relays available only on RSHR...V21 types

Note 4: A phase loss on L1 or L2 causes the device to reset as these phases provide the internal power supply.

Note 5: Phase sequence and phase loss alarms are only detected if they occur during power up, when L1, L2, L3 are switched ON.

Note 6: When a motor PTC is connected, electromagnetic noise may be conducted into the unit. Thus if abnormal function is observed, the use of ferrite beads on the PTC wire (at the unit end) is recommended.

Note 7: Repetitive voltage dips on phase L1 and/or L2 during operation may lead to overheating of the motor. In case the by-pass relays are activated and the repetition rate of these dips is such that the internal supply voltage falls below a preset limit, the by-pass relays will be automatically switched off. This state is indicated by blinking of the phase loss led at 1.3Hz. Reset of the supply L1, L2 and L3 is necessary to resume normal function.

Motor Controllers
AC Semiconductor Motor Controller
Type RSHR 3-Phase

- **Soft starting and stopping of 3-phase squirrel cage motors**
- **Control of all 3 phases**
- **In Line or In Delta motor connection**
- **Low inrush and reduced vibration during starting**
- **External power supply option for a wide operational voltage range**
- **Rated operational voltage: up to 600 VAC, 50/60 Hz**
- **Rated operational current: up to 32A AC-53a**
- **LED status indicators**
- **Motor PTC protection**
- **Device over-temperature protection**
- **DIN rail mounting***

*** Accessory for panel mounting available**

Product Description

Compact, digital AC semi-conductor motor controller. When used on a typical 400VAC supply, this controller can soft-start and soft-stop 3-phase motors up to 22kW (30HP) when connected In Delta and up to 15kW (20HP) when connected In Line. All 3-phases are switched. Starting and stopping time as well as initial torque can be independently adjusted by potentiometers on the facia. A version adapted for starting Scroll Compressors is also available.

This device does not include internal bypass relays but provides a relay contact to help energise an external bypass contactor.

Ordering Key

RSHR 48 32 C V33

- **H-line Motor Controller**
- **Rotary Ramp profile setting**
- **Rated operational voltage**
- **Rated operational current**
- **Control voltage**
- **Options**

Type Selection

Type	Rated Operational Voltage Ue	Rated operational Current Ie	Control Voltage Uc	Options
RSHR: H-line motor controller with rotary settings	22: 127/220VACrms, 50/60Hz 40: 230/400VACrms, 50/60Hz 48: 277/480VACrms, 50/60Hz 60: 346/600VACrms, 50/60Hz M: 220-480VACrms, 50/60Hz* 400-480VACrms, 50/60Hz*	25: 25A AC-53a 32: 32A AC-53a	C: 24 - 550VAC/DC D: 24 - 660VAC/DC	V32: In Line V33: In Delta V34: In Line with external supply V35: In Delta with external supply V38: In Line, Scroll Compressors

* requires external supply

Selection Guide

Rated operational voltage Ue	Control Voltage Uc	Supply Voltage Us	Connection	Rated operational current Ie @ 40°C 25A AC-53a	32A AC-53a
220VACrms	24-550VAC/DC	-	In Line	RSHR2225CV32	RSHR2232CV32
			In Delta	RSHR2225CV33	RSHR2232CV33
400VACrms	24-550VAC/DC	-	In Line	RSHR4025CV32	RSHR4032CV32
			In Line (Scroll Compressors)	RSHR4025CV38	RSHR4032CV38
		-	In Delta	RSHR4025CV33	RSHR4032CV33
480VACrms	24-550VAC/DC	-	In Line	RSHR4825CV32	RSHR4832CV32
		-	In Delta	RSHR4825CV33	RSHR4832CV33
600VACrms	24-660VAC/DC	-	In Line	RSHR6025DV32	RSHR6032DV32
		-	In Delta	RSHR6025DV33	RSHR6032DV33
400-480VACrms	24-550VAC/DC	24VAC/DC	In Line	RSHRM25CV34	RSHRM32CV34
220-480VACrms	24-550VAC/DC	24VAC/DC	In Delta	RSHRM25CV35	RSHRM32CV35

Motor Ratings - In Line

	RSHR..25.V3.	RSHR..32.V3.
Assigned motor rating / UL rating @ 40°C		
220VACrms	5.5kW / 7.5HP	9kW / 10HP
400VACrms	11kW / 10HP	15kW / 20HP
480VACrms	11kW / 15HP	18.5kW / 25HP
600VACrms	18.5kW / 20HP	22kW / 30HP
Assigned motor rating / UL rating @ 50°C		
220VACrms	5.5kW / 7.5HP	5.5kW / 7.5HP
400VACrms	11kW / 10HP	11kW / 15HP
480VACrms	11kW / 15HP	15kW / 20HP
600VACrms	15kW / 20HP	20kW / 25HP
Assigned motor rating / UL rating @ 60°C		
220VACrms	4kW / 5HP	4kW / 5HP
400VACrms	7.5kW / 10HP	7.5kW / 10HP
480VACrms	9kW / 10HP	9kW / 10HP
600VACrms	11kW / 15HP	11kW / 15HP

Motor Ratings - In Delta

	RSHR..25.V3.	RSHR..32.V3.
Assigned motor rating / UL rating @ 40°C		
220VACrms	11kW / 15HP	15kW / 20HP
400VACrms	20kW / 20HP	22kW / 30HP
480VACrms	22kW / 30HP	30kW / 40HP
600VACrms	30kW / 40HP	45kW / 50HP
Assigned motor rating / UL rating @ 50°C		
220VACrms	11kW / 10HP	11kW / 15HP
400VACrms	18.5kW / 20HP	22kW / 25HP
480VACrms	22kW / 25HP	22kW / 30HP
600VACrms	30kW / 30HP	30kW / 40HP
Assigned motor rating / UL rating @ 60°C		
220VACrms	7.5kW / 10HP	7.5kW / 10HP
400VACrms	11kW / 15HP	11kW / 15HP
480VACrms	15kW / 20HP	15kW / 20HP
600VACrms	22kW / 25HP	22kW / 25HP

Load Ratings

	RSHR2225CV3. RSHR4025CV3.	RSHR4825CV3. RSHR6025DV3. RSHRM25CV3.	RSHR..32.V3.
Rated operational current Ie (AC-53a)			
@ 40°C surrounding temp.	25 A	25 A	32 A
Overload cycle according	25A: AC-53a: 4-4:	25A: AC53a: 4-4:	32A: AC-53 a: 4-4:
to EN/IEC 60947-4-2 @ 40°C	50-7	50-3	50-50
Number of starts per hour @ 40°C *	7	3	50
Rated operational current Ie (AC-53a)			
@ 50°C surrounding temp.	23 A	23 A	27 A
Overload cycle according	23A: AC-53a: 4-4:	23A: AC-53a: 4-4:	27A: AC-53a: 4-4:
to EN/IEC 60947-4-2 @ 50°C	50-6	50-3	50-70
Number of starts per hour @ 50°C *	6	3	70
Rated operational current Ie (AC-53a)			
@ 60°C surrounding temp.	18 A	18 A	18 A
Overload cycle according to	18A: AC-53 a: 4-4:	18A: AC-53 a: 4-4:	18A: AC-53 a: 4-4:
EN/IEC 60947-4-2 @ 60°C	50-50	50-30	50-215
Number of starts per hour @ 60°C *	50	30	215
Minimum load current	500 mA	500 mA	500 mA

* Refer to Overload Cycle and Starting Duty Section for the allowable no. of starts at various load currents

Conductor Data

Line conductors:	
L1, L2, L3/T1, T2, T3	
according to IEC 60947	0.75...16mm^2
maximum size	
solid	2.5...16mm^2
finely stranded with end sleeve	2.5...16mm^2
stranded	2.5...25mm^2
UL/CSA rated data	AWG 14...4
Terminal screws	6xM5 (cage clamp)
Tightening torque	1.5...2.5 Nm /13...22 lb.in
Stripping length	10 mm
Secondary conductors:	
A1, A2, A3, A4, 11, 21, 22, P1, P2	
according to IEC 60947	0.75...2.5mm^2
maximum size	0.5...2.5mm^2
UL/CSA rated data	AWG 22...12
Terminal screws	9xM3 (cage clamp)
Tightening torque	0.3...0.5 Nm/2.7...4.5 lb.in
Stripping length	6 mm

Standards

Approvals	UL, cUL (E172877), CCC
Markings	CE
Norms	LVD; EN 60947-4-2 EMCD; EN 60947-4-2

Environmental Specifications

Operating temperature	-20°C to +60°C (-4°F to +140°F)
Storage temperature	-50°C to +85°C (-58°F to +185°F)
Relative humidity	<95% non-condensing @40°C
Pollution Degree	3
Degree of Protection	IP20 (EN/IEC 60529)
Installation Category	III
Installation Altitude	Above 1000m derate linearly by 1% of unit FLC per 100m to a maximum altitude of 2000m

External Supply Specifications*

External supply voltage	24VDC/AC +/-20%
Rated AC frequency	50/60Hz +/-10%
Dielectric strength	
Dielectric withstand voltage	
Supply (A3, A4) to output	2.5 kV
Supply (A3, A4) to input	4 kV
Supply (A3, A4) to heatsink	4 kV

* Applies to RSHRM models only

Supply Specification

Rated operational voltage Ue through L1, L2 L3	
RSHR22..	127/220VAC -15% / +10%
RSHR40..	230/400VAC -15% / +10%
RSHR48..	277/480VAC -15% / +10%
RSHR60..	346/600VAC -15% / +10%
RSHRM...V34	400-480VAC -15% / +10%
RSHRM…V35	220-480VAC -15% / +10%
Rated AC frequency	50/60Hz +/-10%
Rated insulation voltage	630V
Dielectric strength	
Dielectric withstand voltage	
Supply to input	4 kVrms
Supply to heatsink	4 kVrms
Rated impulse witshtand voltage	6 kV (1.2/50µs)

Input Specifications

Rated control input voltage Uc, A1:A2	
RSHR….CV3.	24 - 550VAC/DC
RSHR60..DV3.	24-600 +10% VAC/DC
Max. control input current	3.0 mA
Rated AC frequency	50/60Hz +/-10%
Response time input to output*	100 ms
Dielectric strength	
Dielectric withstand voltage	
Input to heatsink	4 kVrms
Rated impulse witshtand voltage	6 kV (1.2/50µs)

* During idling condition

General Specifications

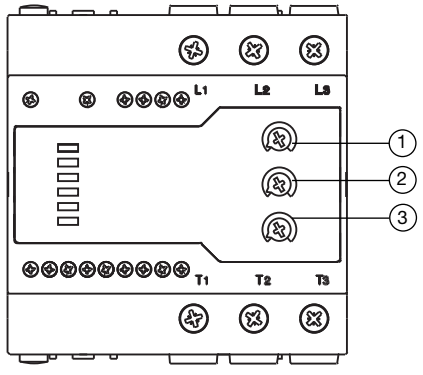
Ramp up time	1…10s
RSHR...V38	0...1s
Ramp down time	0…30s
RSHR...V38	0...1s
Initial torque	0…70%
Status indicator LEDs	
Power supply ON	LED, green (continuous)
Ramping	LED, yellow (intermittent)
End of ramp	LED, yellow (continuous)
Ramp/ End*1 (RSHR...V38)	LED, yellow (intermittent/continuous)
Delay*1 (RSHR...V38)	LED, yellow (continuous)
Over-temperature alarm	
Device alarm	LED, red (intermittent)
Motor PTC alarm	LED, red (continuous)
Wrong phase sequence*2	LED, red (intermittent)
Phase loss	
Phase loss alarm*2, 3	LED, red (blinking at 2Hz)
Motor PTC alarm input P1, P2	Acc. to DIN 44081 and DIN 44082-1
Form designation	Form 1
Auxiliary relays:	
End of ramp relay activation	Normally open (21,22)
Over-temperature, phase sequence, phase loss alarm	Normally closed (11, 22)
Auxiliary relay contact capacity	3 A, 250 VAC 3 A, 30 VDC
Weight	approx. 1.3kg
Housing material	conforms to UL 94 V0
Mounting	DIN Rail 35 mm

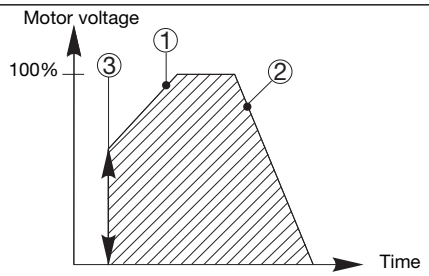
*1 In the RSHR..V38 versions, the same LED is used to indicate both Ramping and End Ramp status. When the RSHR is in ramping mode, the LED will be intermittently ON. Once the Ramping is completed, the same LED will go fully ON indicating End of Ramp. The delay feature available in the RSHR...V38 does not allow the compressor to start prior to 5 mins. from last ramp down. During this waiting period the Delay LED will be intermittently ON.

*2 Detection of these alarm conditions is made during power-up of the device.

*3 Phase loss alarm applies on loss of L3 only. For RSHRM, phase loss alarm applies on loss of any of the 3 phases (L1, L2 or L3). During operation, the RSHRM will issue an alarm and performs shut down in case ALL 3 phases are lost. This will prevent a DOL start when the supply is restored, in case the 24V external supply remains present.

Operation Diagram



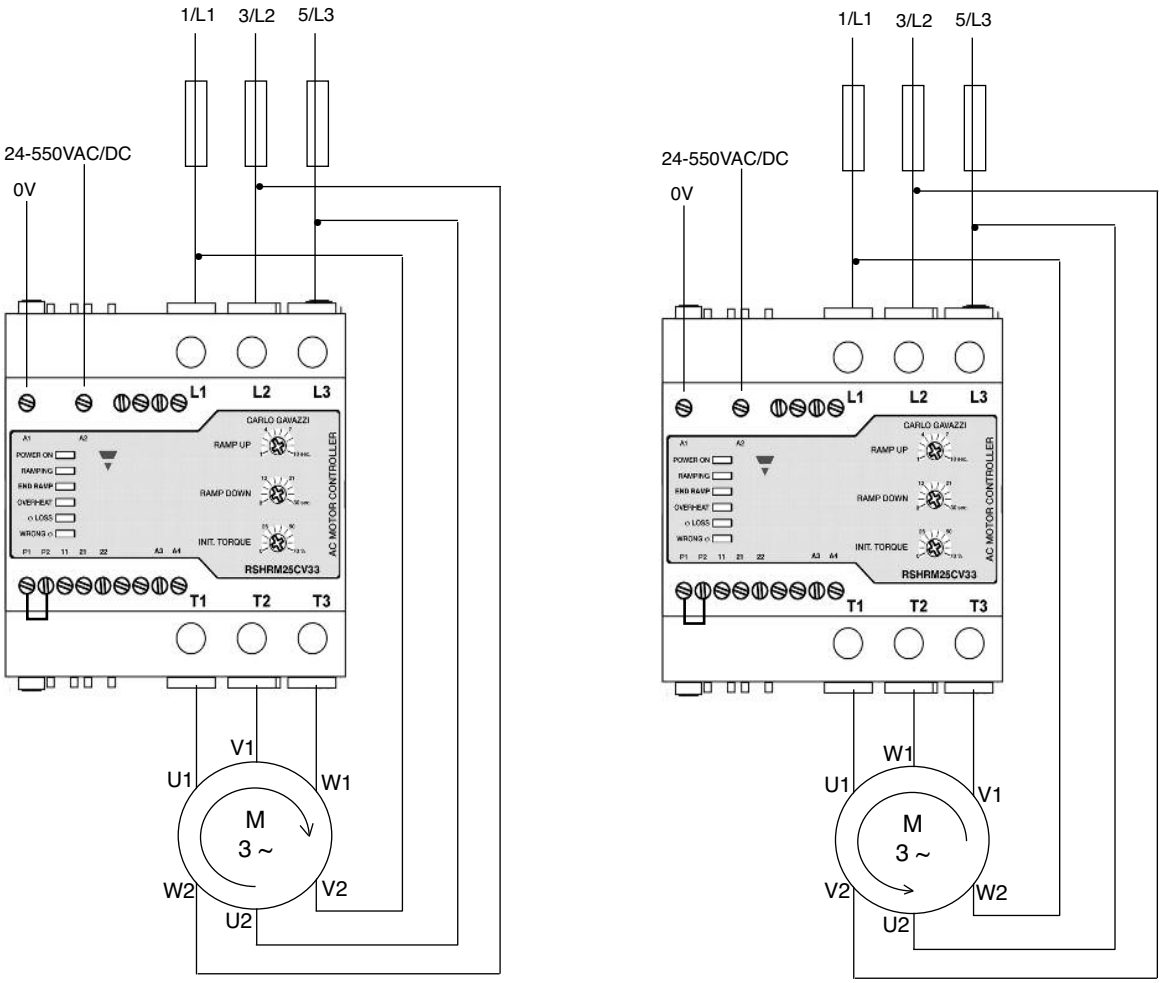


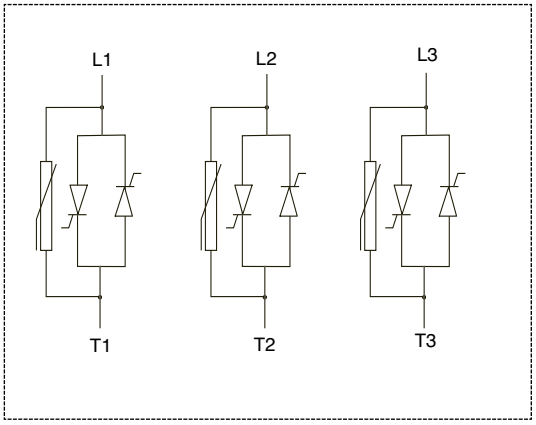
(1) Ramp-up time 1 to 10 s. Time from zero load voltage to full load voltage. Ramp-up time 0 to 1s for RSHR...V38

(2) Ramp-down time 0 to 30 s. Time from full load voltage to zero load voltage. Ramp-down time 0 to 1s for RSHR...V38

(3) Initial torque 0 to 70% voltage at the start of the ramp-up function.

Connection Diagram - In Delta

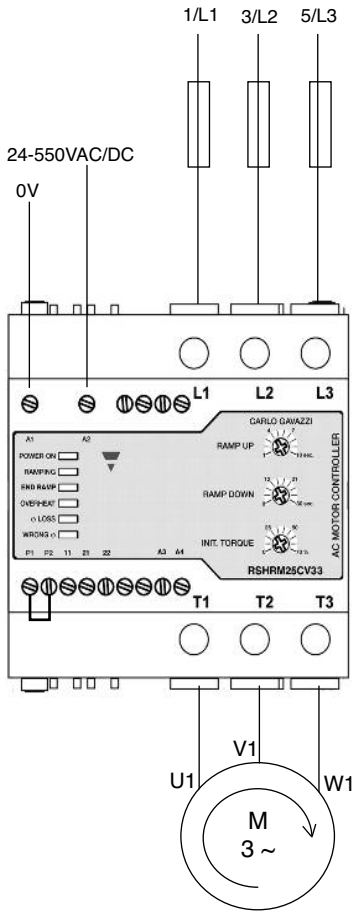


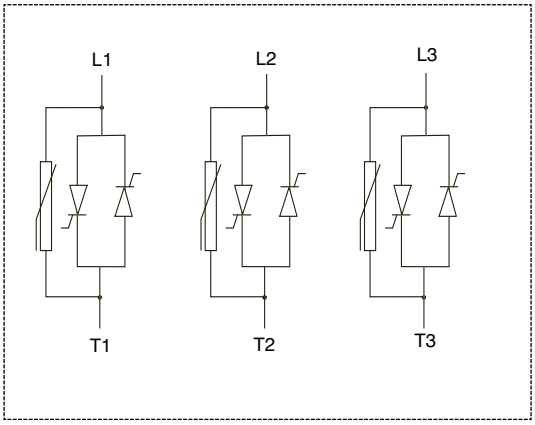


NOTES:

1. A3, A4 24VAC/DC used only for RSHRM models
2. A1, A2 24-660VAC/DC for RSHR60..DV33 models
3. In order to have the motor rotating in an another direction it is necessary to swap 2 motor windings as indicated.

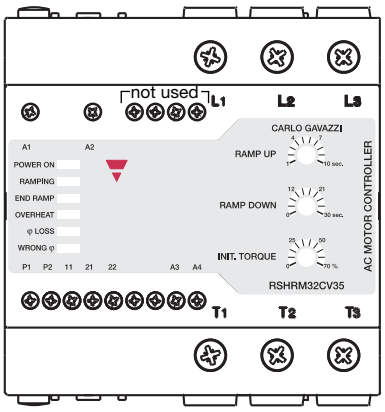
Connection Diagram - In Line





NOTES:
1. A3, A4 24VAC/DC used only for RSHRM models
2. A1, A2 24-660VAC/DC for RSHR60..DV32 models

Terminal Diagram



A1, A2:Control input

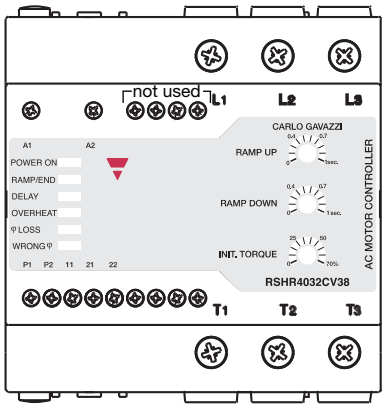
A3, A4: External supply

P1, P2:PTC input

11, 22: Alarms (NC)

21, 22: End Ramp relay activation (NO)

Note: A3, A4 are only used for the RSHRM... versions



A1, A2:Control input

A3, A4: External supply

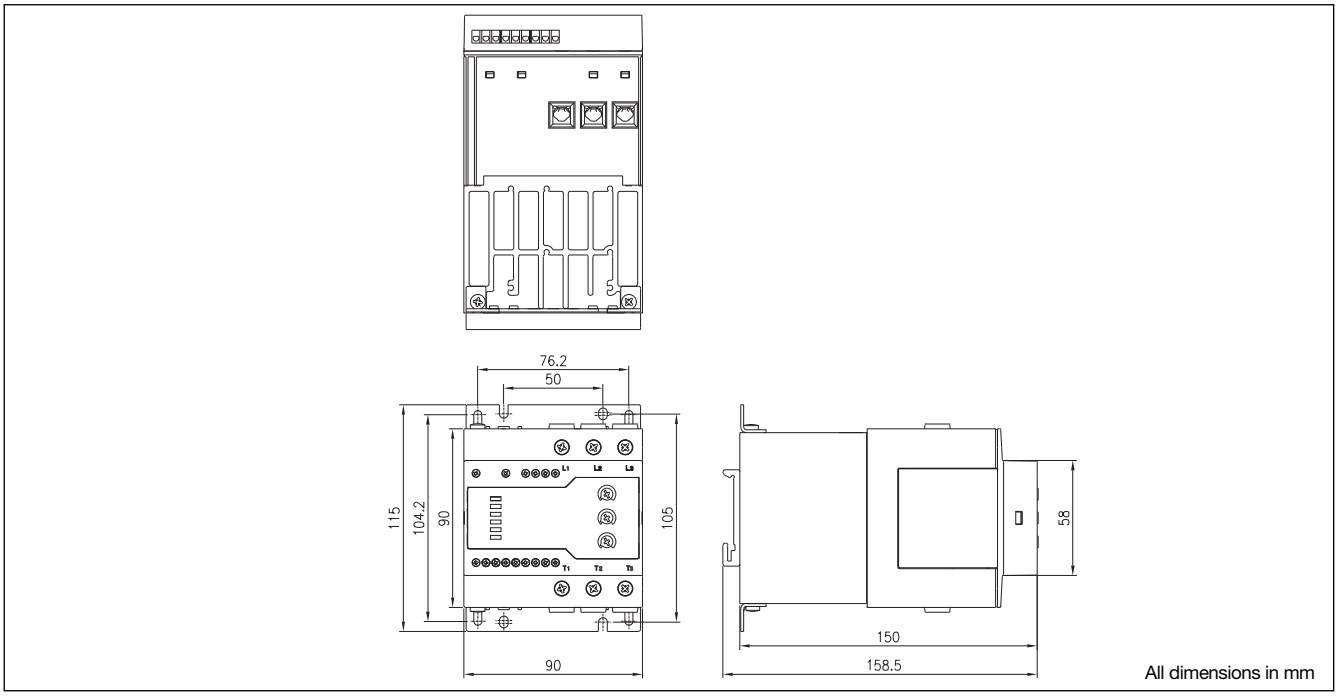
P1, P2:PTC input

11, 22: Alarms (NC)

21, 22: End Ramp relay activation (NO)

Note: Applies only to RSH...V38 versions

Dimensions



NOTE: Panel mounting bracket is an accessory that has to be ordered separately

Short Circuit Protection

	RSHR..25.V3.	RSHR..32.V3.
Type of coordination: 1		
UL rated short circuit current	10kA when protected by fast acting Class J fuses*	10kA when protected by fast acting Class J fuses*
Class J (Fast Acting) fuse rating		
RSHR22...V32/4/8	80A	110A
RSHR40...V32/4/8	70A	125A
RSHR48...V32/4/8	80A	125A
RSHR60...V32/4/8	80A	125A
RSHR22...V33/5	150A	200A
RSHR40...V33/5	125A	200A
RSHR48...V33/5	150A	200A
RSHR60...V33/5	150A	200A
Type of coordination: 2		
Rated short circuit current	10kA when protected by semiconductor fuses	10kA when protected by semiconductor fuses
Semiconductor fuse	Ferraz Shawmut model, A70 QS60-4	Ferraz Shawmut model, A70 QS100-4

* such as series JLS from Littlefuse

Wiring Diagram

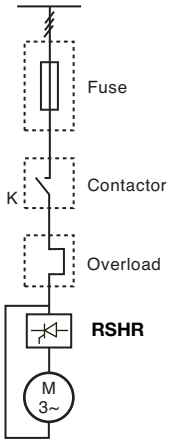


Fig. 1a

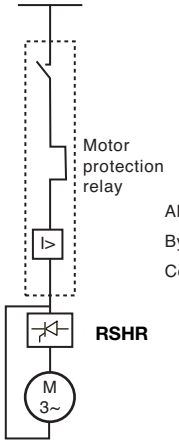


Fig. 2a

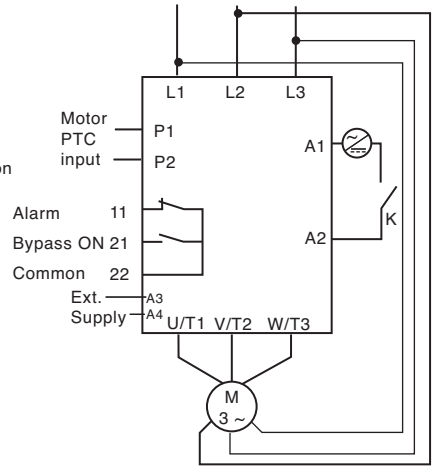


Fig. 3a

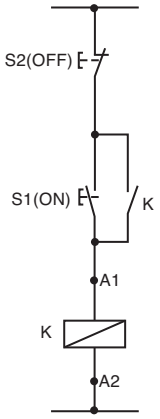


Fig. 4a

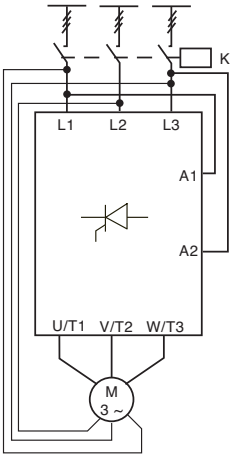


Fig. 5a

IEC

The RSHR 3-Phase does not include internal bypass relays. As such semiconductors can be damaged by short-circuit currents during Ramp up, Ramp Down and Running. Please note that the motor controller does not isolate the motor from the mains.

Figure 1: Protection of the device when using fuses.
Protection with semiconductor fuses is intended to protect the motor feeder and motor controller from damage due to short-circuit.

Figure 2: Protection using a thermal-magnetic motor protection relay.
The motor feeder is protected but damage to the motor controller is possible. When motor failure occurs, if part of the motor winding limits the fault current and the motor feeder is protected, this type of protection can be considered acceptable.

Figure 3: Secondary conductors.
3.1: Control using a 2-position switch
When K is closed, the control input is supplied to A1, A2 and soft starting of the motor is performed. When K is opened, soft stopping is performed.

3.2: Motor PTC input
When the motor PTC sensor is connected to P1, P2 the motor controller detects overheating of the motor windings.

3.3: Auxiliary Relays
The Alarm relay 11, 22 (NC) can be connected in series with the supply to the coil of a mains contactor. The End of Ramp relay 21, 22 (NO) can be used in series with the supply to the coil of an external bypass contactor.

Figure 4: Control using ON and OFF push buttons
Pushing S1 soft starts the RSHR. Pushing S2 soft stops the RSHR. K is an auxiliary contact of the mains contactor.

Figure 5: Control using 2 phases
Connecting input A1, A2 to two of the incomming lines will soft start the motor when K is operated. When K is switched off, the motor will stop (no soft stop).

Note: In the indicated wiring diagram the RSHR is configured In Delta. Models RSHR...V32/V34/V38 should be configured In Line as shown in the Connection diagram

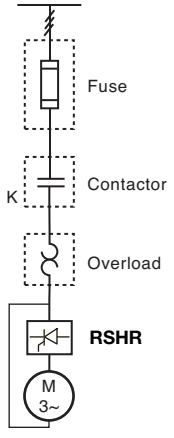


Fig. 1b

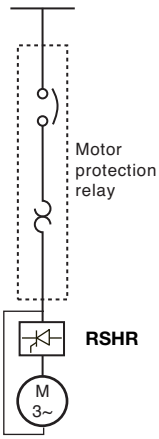


Fig. 2b

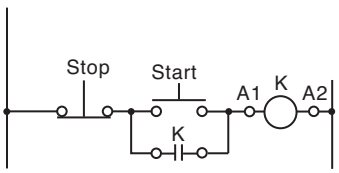


Fig. 4b

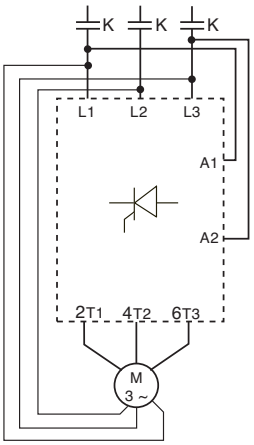


Fig. 5b

NEMA

Operations diagram for RSHR 3-Phase

Diagram 1a: Normal Operation

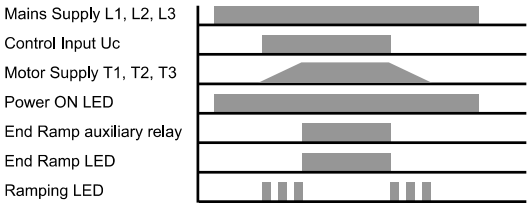


Diagram 1b: Normal Operation for RSHRM models

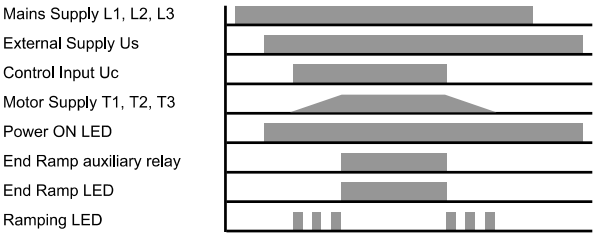


Diagram 2a: Device over-temperature alarm

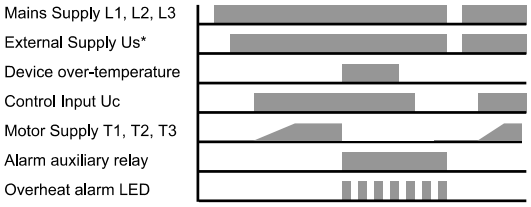


Diagram 2b: Motor PTC alarm

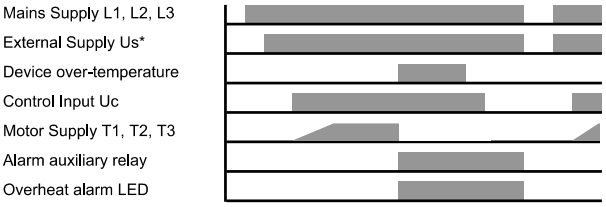


Diagram 2c: Phase sequence

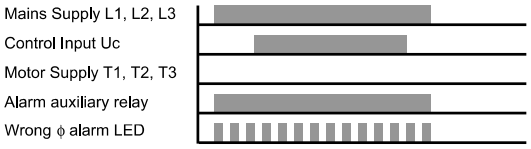


Diagram 2d: Phase sequence for RSHM models

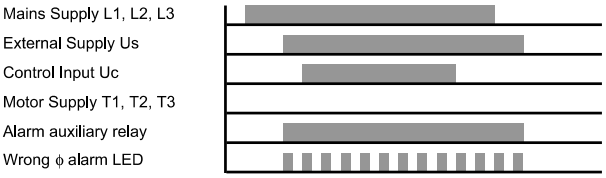


Diagram 2e: Phase loss on POWER UP

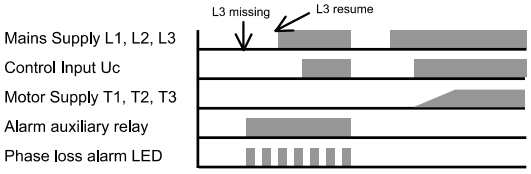


Diagram 2f: Phase loss on POWER UP for RSHRM models

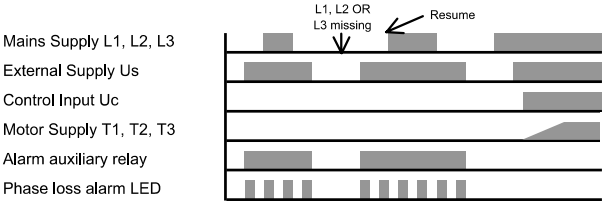


Diagram 2g: Phase loss during OPERATION

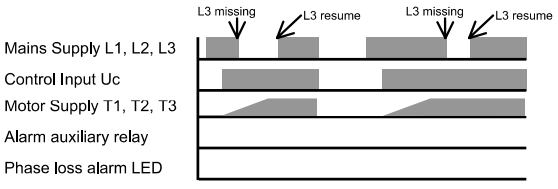


Diagram 2h: Phase loss during OPERATION for RSHM models

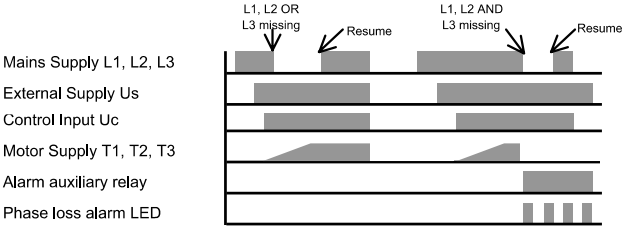


Diagram 3a: Normal Operation for RSHR..V38 models

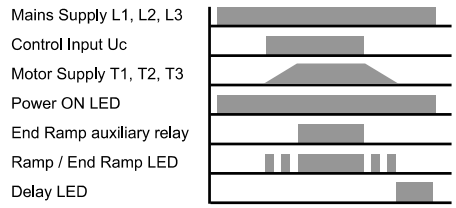
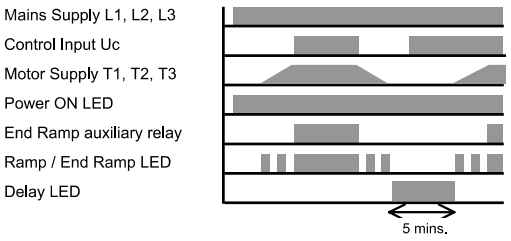


Diagram 3b: Delay ON



* External supply applies to RSHRM models only

Operations diagram for RSHR 3-Phase (cont.)

Notes:

Note 1: In the RSHRM models, the POWER ON Led does not give any indication to the presence of the mains voltage at L1, L2 and L3, since it goes ON only once the external supply is applied.

Note 2: The number of starts per hr. and overload cycle values should always be taken in consideration when the control input is cycled.

Note 3: Over-temperature is checked before Phase loss and Phase sequence alarms. The alarms will be activated as soon as the supply is applied.

Note 4: Apart from the RSHRM models, a Phase loss on L1 or L2 will cause the device to reset.

Note 5: When a motor PTC is connected, electromagnetic noise may be conducted into the unit. Thus if abnormal function is observed, the use of of ferrite beads on the PTC wire (at the unit end) is recommended.

Note 6: Phase loss and Phase sequence are only checked on start up. In the case of the RSHRM, a phase loss of ALL 3 phases is detected during operation (ramping and running).

Note 7: Following Ramp Down, the Delay LED remains ON for 5 mins. or until the mains supply is present, whichever is the shortest. The compressor will not start in case of an attempt to start during the Delay period. Once the 5 mins. have elapsed the compressor will start as long as the control signal remains present.

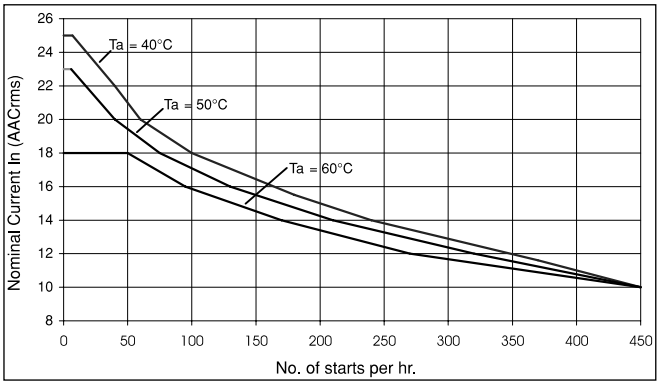
Overload Cycle & Starting Duty

Overload profile

In: AC-53a: x- Tx : F-S
where: In = nominal current through RSHR
x = overload current as a multiple of In
Tx = duration time for the controlled overload currents during starting
F = duty cycle (expressed as a percentage)
S = no of starts/hr.

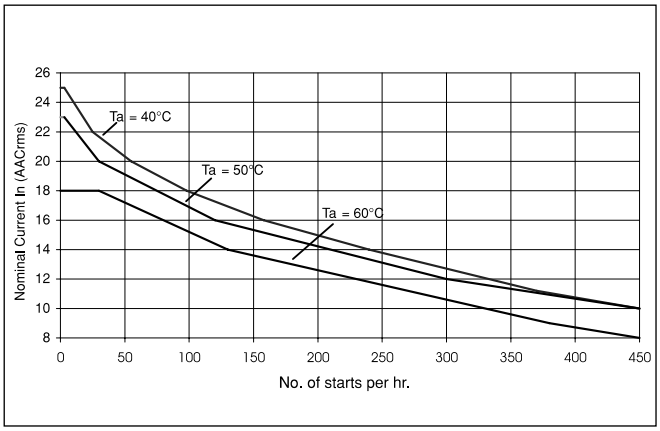
The following tables indicate the allowable no. of starts as per Overload profile: In: AC-53a: 4-4: 50-S

Table 1: RSHRxx25CV3., where xx = 22 or 40



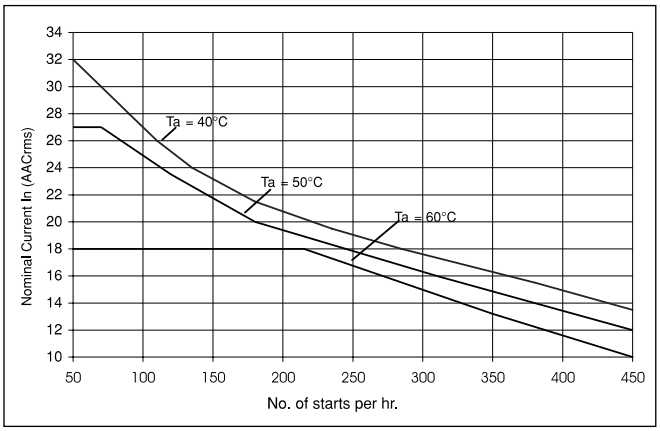
Multiple devices can be used with 0mm spacing

Table 2: RSHRxx25yV3., where xx = 48, 60 or M and y = C or D



The indicated current ratings apply only when a clearance of 30mm is applied on each side of the device. When multiple devices are used with 0mm spacing, a 15% derating factor on current rating is required for surrounding ambients up to 50°C

Table 3: RSHRxx32yV3., where xx = 22, 40, 48, 60 or M and y = C or D



The indicated current ratings apply only when a clearance of 50mm is applied on each side of the device. When multiple devices are used with 0mm spacing, a 15% derating factor on current rating is required for surrounding ambients up to 50°C

Motor Controllers
AC Semiconductor Motor Controller
Type RSHR MIDI

- **Soft starting and stopping of 3-phase induction squirrel cage motors**
- **2-phase control with integral bypassing of semiconductors**
- **Low inrush and reduced vibration during starting**
- **Rated operational voltage: up to 600 VAC, 50/60Hz**
- **Rated operational current: up to 18A AC-53b**
- **Multivoltage option with a range of 190 - 530 VAC***
- **LED status indicators**
- **Optional device over-temperature protection**
- **Optional auxiliary relay for end of ramp**
- **DIN rail mounting**

* requires external supply

Product Description

The RSHR Midi is a compact easy-to-use AC semiconductor motor controller. With this controller 3-phase motors with nominal currents up to 18A can be soft started and/or soft stopped. The RSHR Midi controls 2 phases only, one phase is continously connected to the load. Soft starting and soft stopping is achieved by controlling the motor voltage. During running operation the semiconductors are bypassed by internal electromechanical relays. Starting and stopping time as well as initial torque can be independently adjusted by built-in potentiometers.
LEDs indicate the status of the controller including an alarm status in case of overtemperature in the RSHR...V21 models. The RSHR Midi comes with an integrated heatsink and is ready to mount on DIN rail.

Ordering Key

RSH R 48 18 B V21

- **H-line Motor Controller**
- **Rotary Ramp profile setting**
- **Rated operational voltage**
- **Rated operational current**
- **Control voltage**
- **Options**

Type Selection

Type	Rated Operational Voltage Ue	Rated Operational Current Ie	Control Voltage Uc	Options
RSHR: H-line motor controller with rotary settings	22: 127/220VACrms, 50/60Hz 40: 230/400VACrms, 50/60Hz 48: 277/480VACrms, 50/60Hz 60: 346/600VACrms, 50/60Hz M: 190-530VACrms, 50/60Hz	06: 6A AC-53b 12: 12A AC-53b 18: 18A AC-53b	B: 24 to 110VAC/DC & 110 to 480VAC	V20: Basic V21: End of Ramp Relay & Over-Temperature Protection

Selection Guide

Rated operational voltage U_e	Rated operational current I_e 6A AC-53b	12A AC-53b	18A AC-53b
220VACrms	**RSHR2206BV20**	**RSHR2212BV20**	**RSHR2218BV20**
400VACrms	**RSHR4006BV20**	**RSHR4012BV20**	**RSHR4018BV20**
480VACrms	**RSHR4806BV20**	**RSHR4812BV20**	**RSHR4818BV20**
600VACrms	**RSHR6006BV20**	**RSHR6012BV20**	**RSHR6018BV20**
190-530VACrms	**RSHRM06BV20**	**RSHRM12BV20**	**RSHRM18BV20**

Load Ratings

		RSHR22..BV.. RSHR40..BV.. RSHR48..BV.. RSHRM..BV..	RSHR2218BV.. RSHR4018BV.. RSHR4818BV.. RSHRM18BV..	RSHR60..BV..
IEC rated operational current Ie (AC-53b)	RSHR..06....	6A		6A
	RSHR..12...	12A		12A
	RSHR..18...		18A	18A
Overload cycle according to EN/IEC 60947-4-2				
@ 40˚C surrounding temp.	RSHR..06...	6A: AC-53b:4-5:4		6A: AC-53b: 4-5:3
	RSHR..12...	12A: AC-53b:4-5:50		12A: AC-53b:4-5:14
	RSHR..18..		18A: AC-53b:4-5:50	18A: AC-53b:4-5:50
Overload cycle according to EN/IEC 60947-4-2				
@ 50˚C surrounding temp.	RSHR..06...	6A: AC-53b:4-5:26		6A: AC-53b: 4-5:8
	RSHR..12...	12A: AC-53b:4-5:62		12A: AC-53b:4-5:26
	RSHR..18..		18A: AC-53b:4-5:62	18A: AC-53b:4-5:62
Overload cycle according to EN/IEC 60947-4-2				
@ 60˚C surrounding temp.	RSHR..06...	6A: AC-53b:4-5:62		6A: AC-53b: 4-5:26
	RSHR..12...	12A: AC-53b:4-5:80		12A: AC-53b:4-5:50
	RSHR..18...		18A: AC-53b:4-5:110	18A: AC-53b:4-5:110
Number of starts per hour @40/50/60˚C	RSHR..06...	250/ 100/ 50		275/ 200/ 100
	RSHR..12...	60/50/40		150/ 100/ 60
	RSHR..18...		60/ 50/ 30	60/ 50/ 30
Minimum load rating		0.25kW	0.25kW	0.25kW

Motor Ratings

IEC rated operational current Ie (AC-53b)		6A	12A	18A
Assigned motor rating @60˚C/UL rating @60˚C	220VACrms	1.1kW/ 1.5HP	3kW/ 3HP	4kW/ 5HP
	400VACrms	2.2kW/ 3HP	5.5kW/ 7.5HP	7.5kW/ 10 HP
	480VACrms	2.2kW/ 5HP	5.5kW/ 7.5HP	7.5kW/ 10HP
	600VACrms	3kW/ 5HP	7.5kW/ 10HP	11kW/ 15HP

General Specifications

Ramp up time	0.5…10s
	+/- 1.5s on max.
Ramp down time	0.5…20s
	+/- 4s on max.
Initial torque	0…85%
Status indicator LEDs	
Power supply ON	LED, green
Ramping	LED, yellow
Bypass relay ON	LED, yellow
Over-temperature alarm*	LED, red
Auxiliary relay*	Normally open (11, 12)
Auxiliary relay contact capacity*	3A, 250VAC
	3A, 30VDC
Form designation	1
Weight	800g (approx.)
Mounting	DIN Rail 35mm
Housing material	Polyamide

Input Specifications

Rated control input voltage Uc		
	A1:A2	24 - 110VDC/AC
	A1:A3	110 - 480VAC
Rated AC frequency		50/60Hz +/-10%
Max. control input current	A1:A2	5mA
	A1:A3	5mA
Min. control input current	A1:A2	1mA
	A1:A3	1mA
Dielectric strength		
Dielectric withstand voltage		
Input to heatsink		3.5 kVrms
Rated impulse withstand voltage		6 kV (1.2/50us)

Environmental Specifications

Operating temperature	-20°C to +60°C (-4°F to +140°F)
Storage temperature	-50°C to +85°C (-58°F to +185°F)
Relative humidity	<95% non-condensing @40°C
Pollution Degree	3
Degree of Protection	IP20 (EN/IEC 60529)
Installation category	III
Installation Altitude	Above 1000m derate linearly by 1% of unit FLC per 100m to a maximum altitude of 2000m
Vibration Sinosodial (IEC 60068-2-6)	13 to 25Hz: 2.0mm peak 25 to 150Hz: 20m/s^2

Supply Specification

Rated operational voltage Ue through L1, L2 L3	RSHR22..	127/220VAC -15% / +10%
	RSHR40..	230/400VAC -15% / +10%
	RSHR48..	277/480VAC -15% / +10%
	RSHR60..	346/600VAC -15% / +10%
	RSHRM	190-530VAC
Rated AC frequency		50/60Hz +/-10%
Rated insulation voltage		630V, accord. to EN 60947-1
Dielectric strength		
Dielectric withstand voltage		
Supply to input		4 kVrms
Supply to heatsink		4 kVrms
Supply to external supply		2.5 kVrms
Rated impulse withstand voltage		6 kV (1.2/50us)

External Supply Specifications

External supply voltage Us, A4:A5*	24VDC/AC -15% / +10%
Rated AC frequency	50/60Hz +/-10%
Maximum supply current	265mAAC, 140mADC
Minimum supply current	195mAAC, 100mADC
Dielectric strength	
Dielectric withstand voltage	
Supply to input	2.5 kVrms
Supply to heatsink	2.5 kVrms

* Applicable to RSHRM models only

Conductor Data

Line conductors: L1, L2, L3, T1, T2, T3 according to EN 60947-1	
flexible	2.5 ..... 10mm^2 2.5 ..... 2 x 4mm^2
rigid (solid or stranded)	2.5 ..... 10mm^2
flexible with ferrule	2.5 ..... 10mm^2
UL/CSA rated data	
flexible	AWG14…8 AWG14…2 x 10
rigid (solid or stranded)	AWG14…8
Terminal screws	6xM4 (cage clamp)
Tightening torque	2.0Nm (17.7lb.in) with Posidrive bit 2
Stripping length	8.0mm

Secondary conductors: A1, A2, A3, A4, A5, 11, 12 according to EN 60998	
flexible	0.5 ..... 1.5mm^2
flexible with ferrule	0.5 ..... 1.5mm^2
rigid (solid)	0.5 ..... 2.5mm^2
UL/CSA rated data	AWG22…12
Terminal screws	7xM3 (cage clamp)
Tightening torque	0.5Nm (4.5lb.in) with Philips bit 0
Stripping length	6.0mm

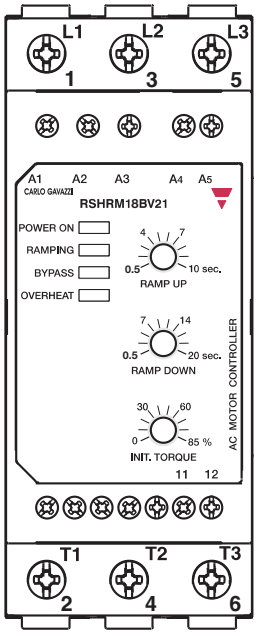
Standards

Approvals	UL, cUL listed (E172877) CSA (204075)
Markings	CE
EMC (Electromagnetic compatability) accord. to EN/IEC 60947-4-2	
Wire conducted emission	Class A
Radiated emission	Class A
ESD Immunity (EN 61000-4-2)	4kV contact, PC2 8kV air discharge, PC1
Radiated RF immunity (EN 61000-4-3)	10V/m, PC1 (80-1000MHz)
Voltage dips and interruptions (EN 61000-4-11)	0% Ue & Uc, 20ms, PC2 40% Ue & Uc, 200ms, PC2 70% Ue & Uc, 5000ms, PC2

Fast transient immunity (EN 61000-4-4)	Output	2kV, PC1 (4kV, PC2)
	Input	2kV, PC1
Surge immunity (EN 61000-4-5)		
Output: line to line		1kV, PC1
line to ground		2kV, PC1
Input: line to line		1kV, PC2 (500V, PC1)
line to ground		2kV, PC2 (500V, PC1)
Conducted RF immunity (EN 61000-4-6)		140dBuV, PC1 (0.15-80MHz)

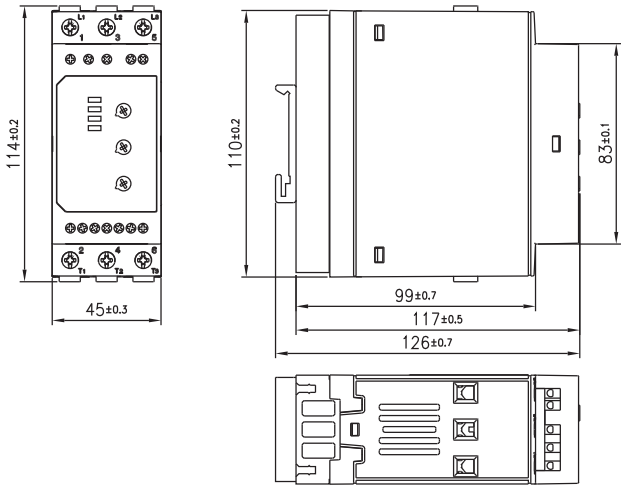
Note: EMC testing was performed with the RSHR connected to representative motor loads of 1.1/ 4.0kW. The EMC performance of the controller would eventually have to be evaluated with the controller connected and fitted as part of the complete system in the end application.

Terminal Diagram



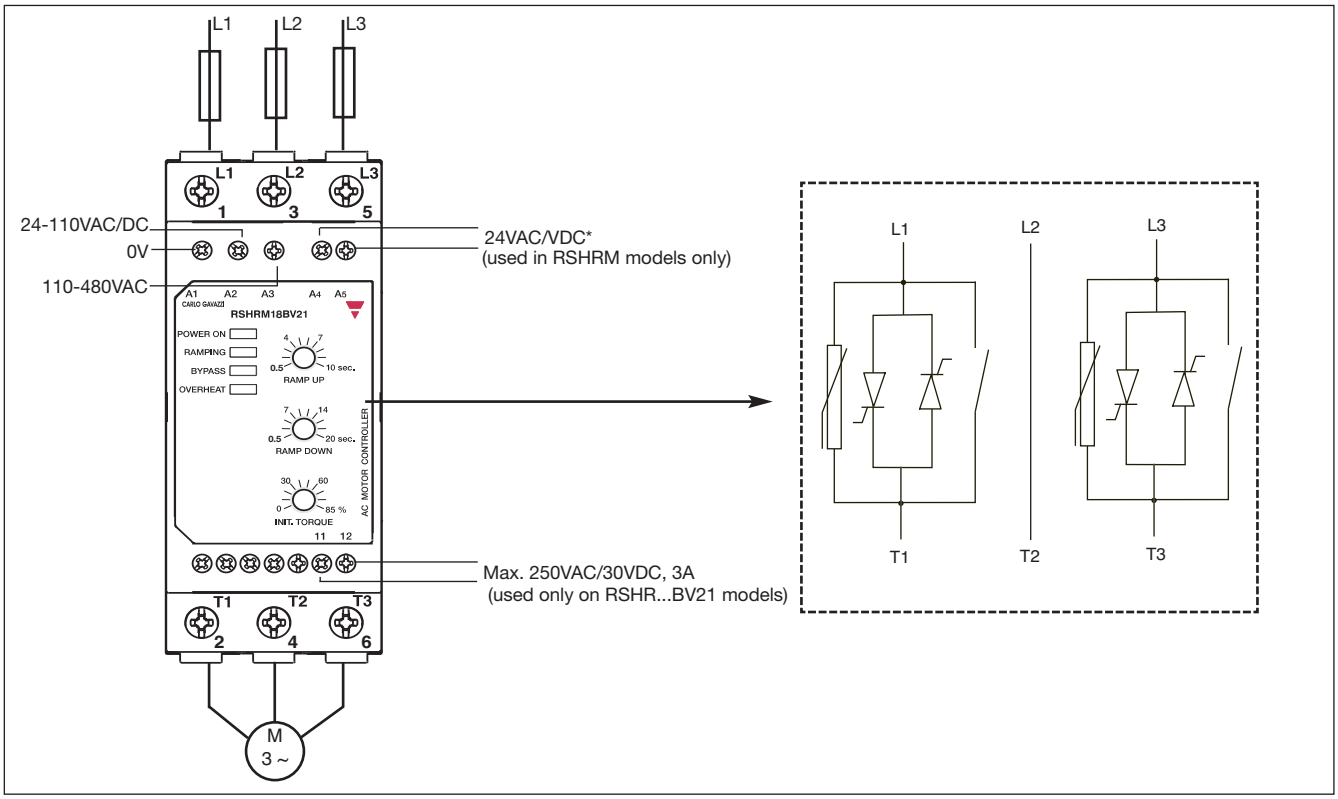
L1, L2, L3: Mains supply
T1, T2, T3: Motor supply
A1, A2, A3: Control input
A4, A5: External supply for RSHRM ... models
11, 12: End of ramp (NO) for RSHR...V21 models

Dimensions



All dimensions in mm

Connection Diagram



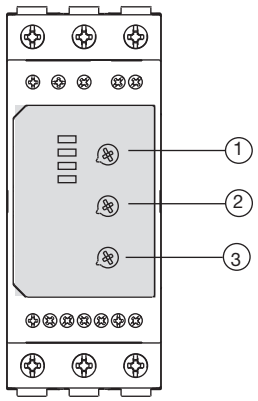
* For the 24VDC external supply, CG power supply model SPD24051 can be used

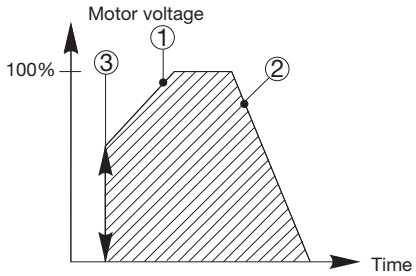
Short circuit Protection (according to EN/IEC 60947-4-2 and UL 508)

	RSHR..06BV21	RSHR..12BV21	RSHR..18BV21
Type of coordination: 1			
UL rated short circuit current	5kA when protected by RK5 fuses*	10kA when protected by RK5 fuses*	10kA when protected by RK5 fuses
RK5 fuse			
220VACrms	TRS12R 12A	TRS20R 20A	TRS30R 30A
400VACrms	TRS12R 12A	TRS30R 30A	TRS35R 35A
480VACrms	TRS12R 12A	TRS20R 20A	TRS30R 30A
600VACrms	TRS12R 12A	TRS20R 20A	TRS35R 35A
Type of coordination: 2			
Rated short circuit current	10kA when protected by semiconductor fuses	10kA when protected by semiconductor fuses	10kA when protected by semiconductor fuses
Semiconductor fuse	Ferraz Shawmut 25A, Class URC Art. No. 6.9 CP gRC 14.51 25	Ferraz Shawmut 40A, Class URC Art. No. 6.9 CP gRC 14.51 40	Ferraz Shawmut 40A, Class URC Art. No. 6.9 CP gRC 14.51 40

* 10kA for RSHR60 models

Operation Diagram





(1) Ramp-up time 0.5 to 10 s. Time from zero load voltage to full load voltage.

(2) Ramp-down time 0.5 to 20 s. Time from full load voltage to zero load voltage.

(3) Initial torque 0 to 85% voltage at the start of the ramp-up function.

Operation Diagrams for RSHR MIDI

Diagram 1: Normal Operation

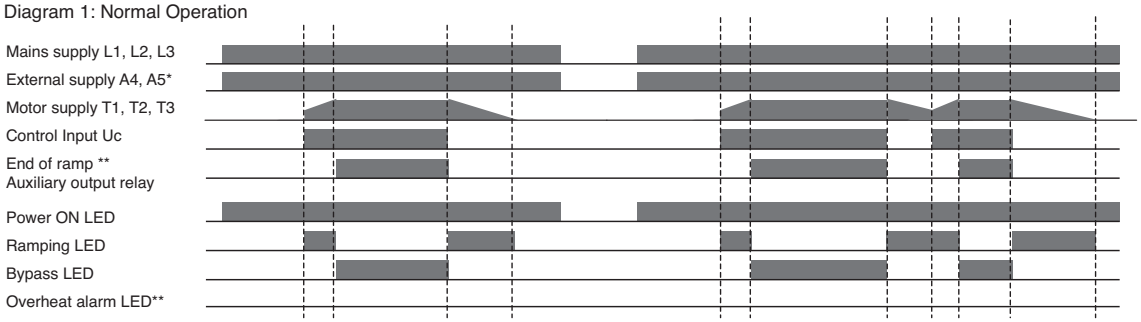


Diagram 2: Over-temperature alarm during ramping mode **

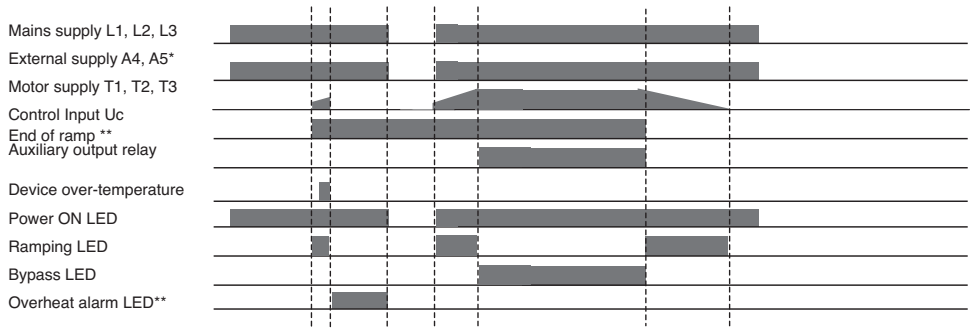
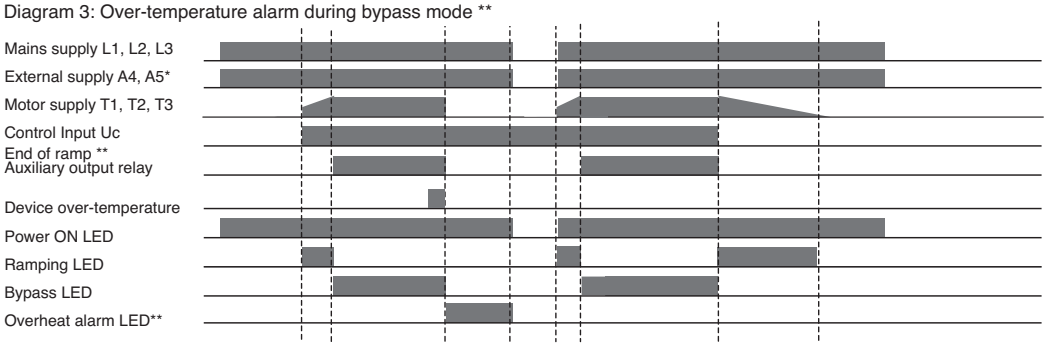


Diagram 3: Over-temperature alarm during bypass mode **



* Applicable to RSHRM models only
** Applicable to RSHR ...BV21 models only

Note: for proper operation of RSHRM models always remove mains supply voltage before switching off external power supply.

Wiring Diagram

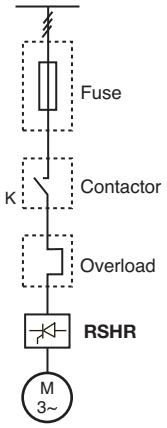


Fig. 1a

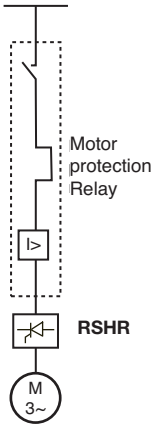


Fig. 2a

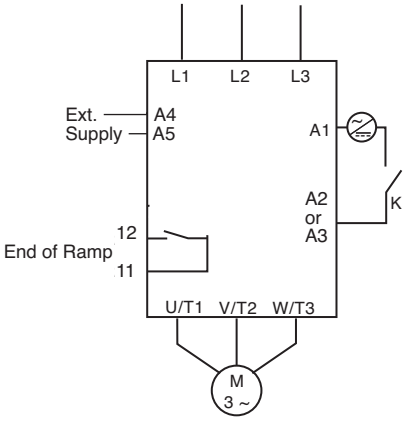


Fig. 3a

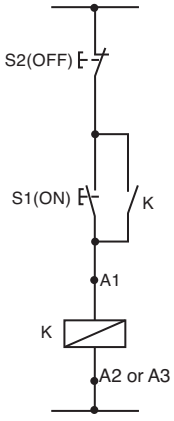


Fig. 4a

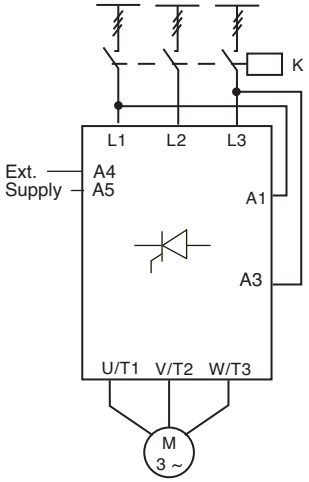


Fig. 5a

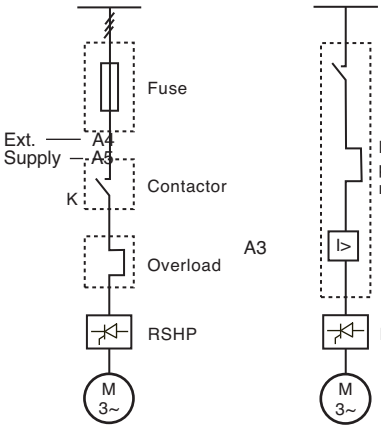


Fig. 6a

IEC

Wiring Diagram (cont.)

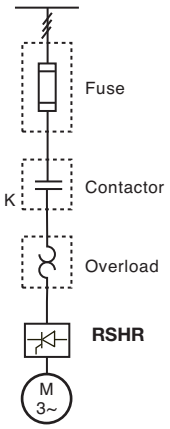


Fig. 1b

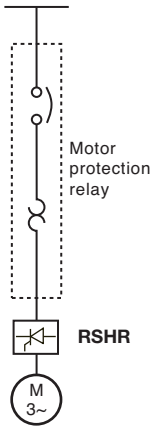


Fig. 2b

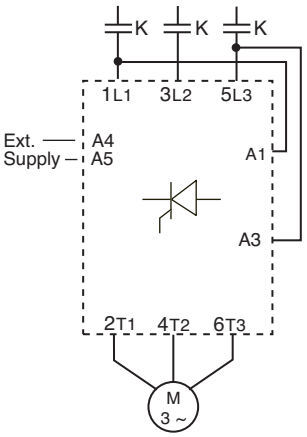


Fig. 5b

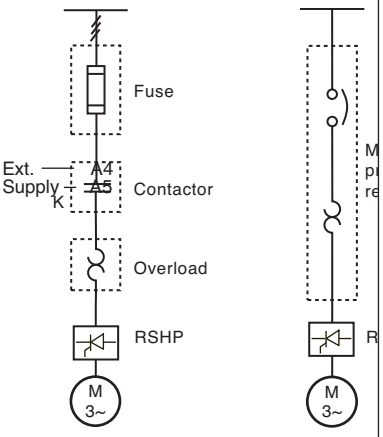


Fig. 6b

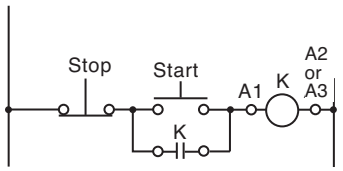


Fig. 4b

NEMA

The motor controller provides by-passing of the semiconductors during running operation. Therefore the semiconductors can only be damaged by short-circuit currents during ramp-up and ramp-down. Please note that the motor controller does not isolate the motor from the mains.

Figure 1: Protection of the device when using fuses.
Protection with semiconductor fuses is intended to protect the motor feeder and motor controller from damage due to short-circuit.

Figure 2: Protection using a thermal-magnetic motor protection relay.
The motor feeder is protected but damage to the motor controller is possible. When motor failure occurs, if part of the motor winding limits the fault current and the motor feeder is protected, this type of protection can be considered acceptable.

Figure 3: Secondary conductors.
3.1: Control using a 2-position switch.
When K is closed, the control input is supplied to A1, A2 or A3 and soft starting of the motor is performed. When K is opened, soft stopping is performed.

3.2: Auxiliary Relay
(For RSHR...BV21 models)
The End of Ramp relay 11, 12 (NO) can be used in series with the supply to the coil of an external bypass contactor.

Figure 4: Control using ON and OFF push buttons
Pushing S1 soft starts the RSHR. Pushing S2 soft stops the RSHR. K is an auxiliary contact of the mains contactor.

Figure 5: Control using 2 phases
Connecting input A1, A3 to two of the incomming lines will soft start the motor when K is operated. When K is switched off, the motor will stop (no soft stop). This configuration does not apply to the RSHR60.... versions.

Figure 6: Control when using operational voltage greater than 480V
Connecting A1 to Neutral and A3 to one of the incoming phases (or vice-versa) will soft start the motor when K is closed. When K is opened, the motor will stop (no soft stop).

Accessories - External Power Supply 24VDC - SPD 24051

Rated input voltage		100-240
Voltage range	AC	90 - 265VAC
	DC	120 - 370VDC
Frequency range		47 - 63Hz

Voltage trim range	21.6 - 28.8VDC
Output voltage accuracy	± 1%
Output current	0.21A

For further details refer to Carlo Gavazzi SPD series datasheet

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