

# Soft Starter AC Semiconductor Motor Controller Type RSBS23..A2V.2C24..

CARLO GAVAZZI



- Soft starting of 1-Phase Scroll Compressors
- Enclosed solution
- Integrated current limit
- Rated operational voltage: 230 VACrms, 50/60 Hz
- Rated operational current: up to 32A: AC-53b
- Integral bypassing of semiconductors
- Built-in transient overvoltage protection
- Undervoltage protection after ramp up
- DIN rail or panel mount
- EMC Compliant
- Optional auxiliary alarm relay output
- Relay Protection
- UL, cUL listed
- Optimised algorithm for high pressure starts<sup>4</sup>
- Integrated protection against short-cycling
- Voltage dips and interruptions detection
- Bi-colour LED for indication of delay between starts and/or alarm

## Product Description

This motor controller, intended to be used with single-phase scroll compressors can limit inrush currents to 40AACrms for RSBS2325A2V.2C24.. and 45AACrms for RSBS2332A2V.2C24..<sup>1</sup>. Upon applying the control signal, soft starting is achieved within a 600ms interval<sup>2</sup>. At the end of the soft-start function, the semiconductors are bypassed by electromechanical relays. The device rating is based on a maximum of 12 starts per hr.<sup>3</sup>

Application of supply voltage is indicated by a green LED in the full ON state. Alarm indication is provided through a red LED which signals the type of alarm via a user friendly flashing sequence.

Delay between starts and/or from stop to start is indicated via an orange LED.

Short circuit and Overload protection are not provided with this controller and must be procured separately. Starting and running capacitors are required for controller to operate as intended.

The RSBS can also be supplied with an optional auxiliary alarm relay (Option - V22).

Note: The main and bypass relays may be in an undefined state due to transportation. In case **both** relays are latched in the ON state, there will be a direct on line start of the compressor - even without control signal. To avoid the direct on line start, the user may do a first power up with no load connected for a period of  $\geq 3$ seconds.

## Ordering Code RSB S 23 32 A2 V12 C24 HP

Board level Motor Controller	
Scroll Compressor	
Rated operational voltage	
Rated operational current	
Control voltage	
Options	
Starting Capacitor	
Version	

The RSBS can detect voltage dips and interruptions  $\geq 50$ msec (+20msec/-0msec)\*

\* for 50Hz supply

## Type Selection

Type	Rated operational voltage Ue	Rated operational Current Ie	Control Voltage Uc	Options	Starting Capacitor	Version
RSBS: 1-Phase Soft Starter for Scroll Compressors	23: 230VACrms	25: 25AAC 32: 32AAC	A2: 230VACrms	V12: Enclosed V22: Enclosed & aux. alarm relay	C24: 200 - 240 $\mu$ F	HP: High Pressure Starts

## Selection Guide

Rated operational voltage Ue	Rated operational current Ie		Option
	25A AC-53b	32A AC-53b	
230V ACrms 50/60Hz	RSBS2325A2V12C24	RSBS2332A2V12C24	Enclosed
	RSBS2325A2V22C24	RSBS2332A2V22C24	Enclosed and
		RSBS2332A2V12C24HP	Aux. alarm relay
		RSBS2332A2V22C24HP	

Notes:

1. Applicable to balanced pressure starts in case of RSBS2332A2V.2C24HP
2. For RSBS2332A2V.2C24HP, ramp time is  $< 1$  sec.
3. For RSBS2332A2V.2C24HP, max. starts per hour = 10
4. Applicable to RSBS2332A2V.2C24HP

**ATTENTION:** The RSBS soft starter is NOT to be used as a safety device. The RSBS, on its own, cannot guarantee any safety and therefore other components need to be used to ensure that the system operates safely.

Note: Power up is defined as the moment when L/L1 and N/L2 are applied to the RSBS.

## General Specifications

Ramp up (preset)	
RSBS23..A2V.2C24	< 0.6 sec
RSBS2332A2V.2C24HP	< 1 sec
Operating temperature	-20° to +65°C (-4° to +149°F)
Storage temperature	-30° to +70°C (-22° to +158°F)
Degree of protection	IP20
Pollution Degree	2
Overvoltage category	II
Relative humidity	< 95% non condensing @ 40°C
Altitude*	1000m

\* Above 1000m derate linearly by 1% of unit FLC per 100m to a maximum altitude of 2000m

## Housing Specifications

Dimensions (L x B x H)*	137 x 81.4 x 60.4 mm
Weight	approx 450g
Material	Polyamide
Terminal tightening screws	
Screw Type	
(Max. tightening torque)	
R, Rc, L, N, ON, S	M4 (1.19Nm, 10.5lb-in)
14, 12, 11	M3 (0.5Nm, 4.5lb-in)
Max. cross sectional area of cable (solid)	
R, Rc, L, N, ON, S	0.5 - 16mm <sup>2</sup> , AWG 20-6
14, 12, 11	0.2 - 1.5mm <sup>2</sup> , AWG 28-12
Max. cross sectional area of cable (stranded)	
R, Rc, L, N, ON, S	0.5 - 16mm <sup>2</sup> , AWG 20-6
14, 12, 11	0.2 - 1.5mm <sup>2</sup> , AWG 30-12
Stripping length	
R, Rc, L, N, ON, S	8mm
14, 12, 11	7 - 8mm

\* For RSBS23....V22...., the auxiliary terminal is 10.5mm protruding

## Output Specifications

	RSBS..25A.V.2C24	RSBS..32A.V.2C24..	RSBS2332A2V.2C24HP
Rated operational current	25A AC-53b	32A AC-53b	32A AC-53b
Compressor rating/ UL rating	4.4kW/ 5HP	4.4kW/ 5HP	4.4kW/ 5HP
Max. starting current	40A ACrms	45A ACrms	80A ACrms <sup>1</sup>
Overload profile	25A: AC-53b: 1.6 - 1:60	32A: AC-53b: 1.4 - 1:60	32A: AC-53b: 1.4 - 1:60
No. of starts/hr	12 (evenly distributed)	12 (evenly distributed)	10 (evenly distributed)
I <sup>2</sup> t for fusing t=10ms	1200 A <sup>2</sup> s	1200 A <sup>2</sup> s	1200 A <sup>2</sup> s
Minimum full load current	2.5AACrms	2.5AACrms	2.5AACrms
Minimum time between starts	5 min	5 min	6 min
Minimum time between stop to start	1 min	1 min	3 min

## Supply Specifications

	RSBS23..A2V.2C24..
Rated operational voltage (U <sub>e</sub> )	
L - N	230 VAC ± 15%
Rated AC frequency	50/60Hz ± 5Hz
Rated insulation voltage	250 VACrms
Supply indication	Green LED
Undervoltage alarm*	< 190 VACrms for 1 sec
Overcurrent alarm	> 80 Arms for 1 sec
Alarm indication	Red LED/Aux Relay Output**
Current at no load	15 mA
Pickup voltage (internal power supply)	90VAC
Drop Out voltage (internal power supply)	25VAC

\* Not available during ramping. Refer to voltage dips and interruptions section for mode of operation.

\*\* Only for RSBS23..A2V22C..

## Input Specifications (Control Input)

	RSBS23..A2V.2C24..
Control voltage (U <sub>c</sub> ), ON	230VACrms ±15%
Input Current	3 ... 6mA
Pick up voltage	90 VAC
Drop out voltage	25 VAC
Rated AC frequency	50/60 Hz ± 5Hz
Rated insulation voltage	250 VAC rms
Response time	
Input to output	<200ms

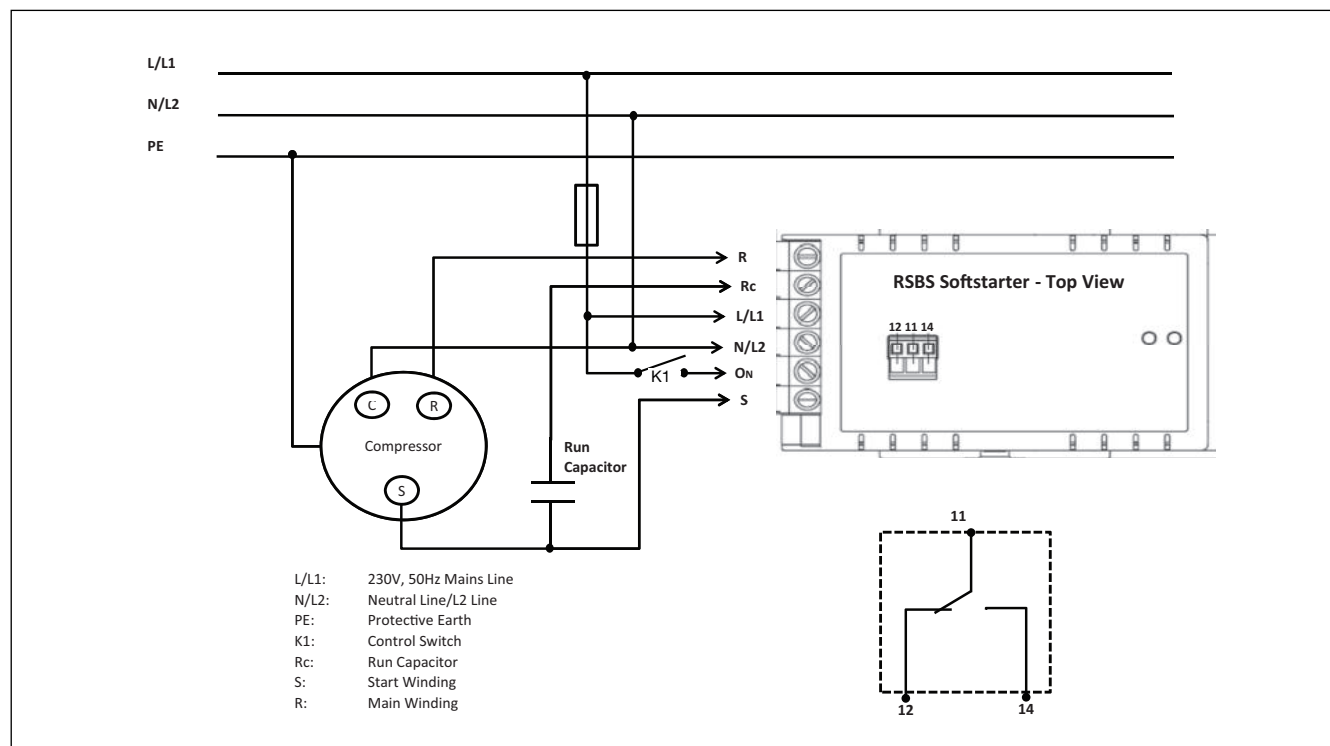
## Auxiliary Alarm Relay\*\*

Alarm	Common, Normally Open, Normally Closed, Changeover
Contact Rating	3A, 250VAC 3A,30VDC

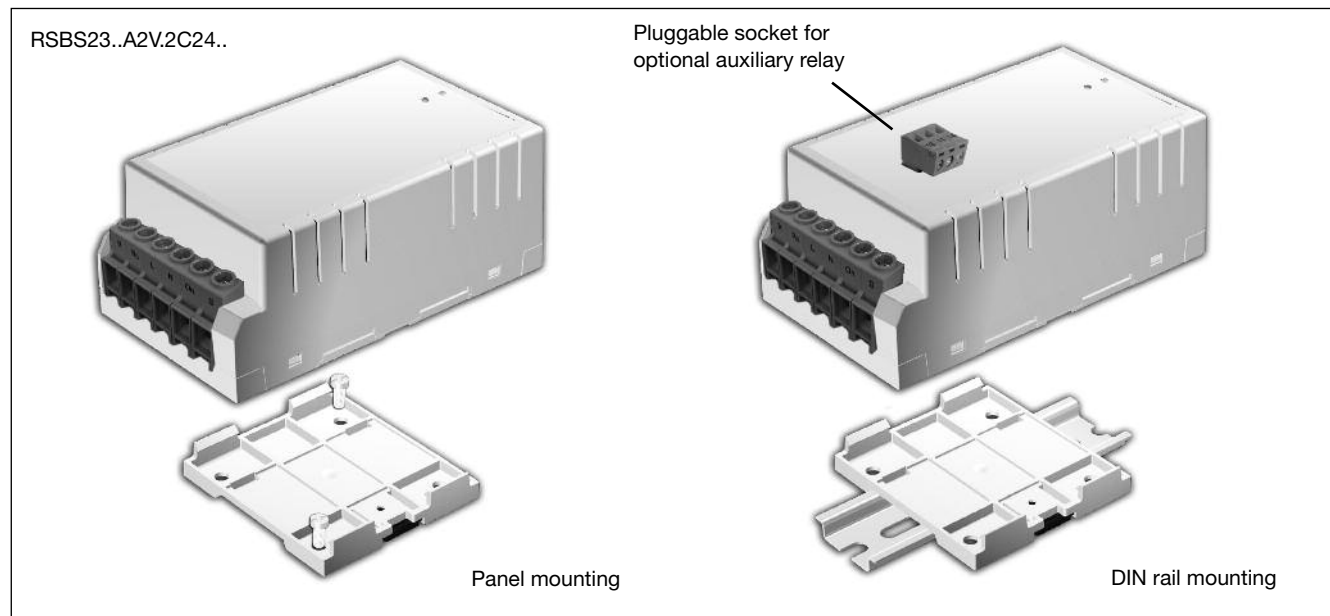
Note:

1. A maximum of 80 Arms current limit may result in case of a locked rotor/ high pressure starting condition.

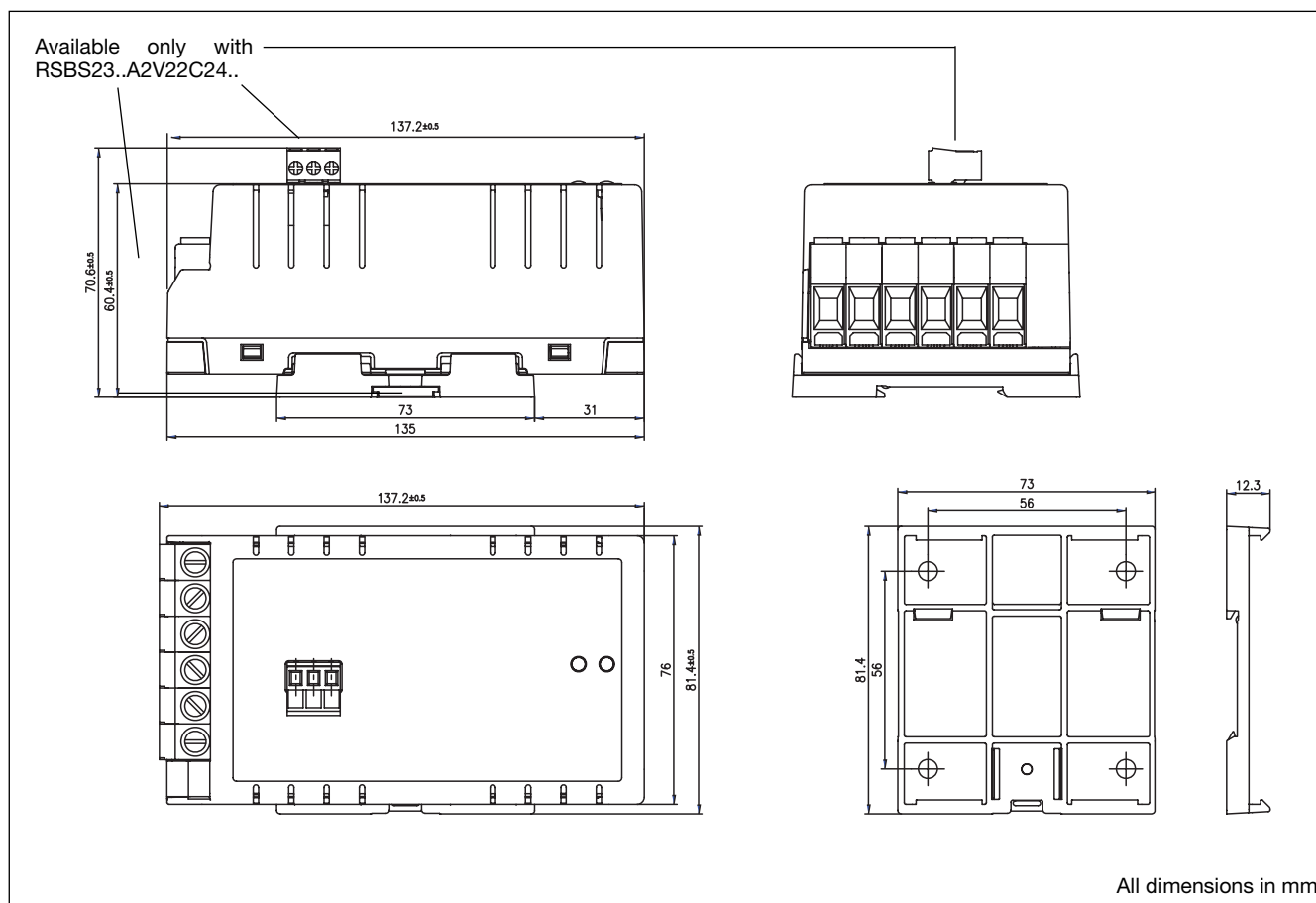
## Connection Diagram



## Mounting



## Dimensions



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

	25 A version	32 A version
Type of co-ordination	1	1
UL Rated short circuit current	<p>“Suitable For Use On A Circuit Capable Of Delivering Not More Than 5,000 A rms Symmetrical Amperes, 240 Volts Max. when Protected by RK5 Fuses.”</p> <ul style="list-style-type: none"> <li>• “Use Fuses Only”.</li> <li>• Maximum allowed ampere rating of the fuse is 45 A.</li> </ul>	<p>“Suitable For Use On A Circuit Capable Of Delivering Not More Than 5,000 A rms Symmetrical Amperes, 240 Volts Max. when Protected by RK5 Fuses.”</p> <ul style="list-style-type: none"> <li>• “Use Fuses Only”.</li> <li>• Maximum allowed ampere rating of the fuse is 45 A.</li> </ul>
Type of co-ordination:	2	2
Rated short circuit current	5 kA when protected by semiconductor fuses	5 kA when protected by semiconductor fuses
Semiconductor fuse	Ferraz Shawmut 40A, class gRC Art. No. 6.9 xxCp gRC 14.51 40 (xx = 00 or 21)	Ferraz Shawmut 40A, class gRC Art. No. 6.9 xxCp gRC 14.51 40 (xx = 00 or 21)

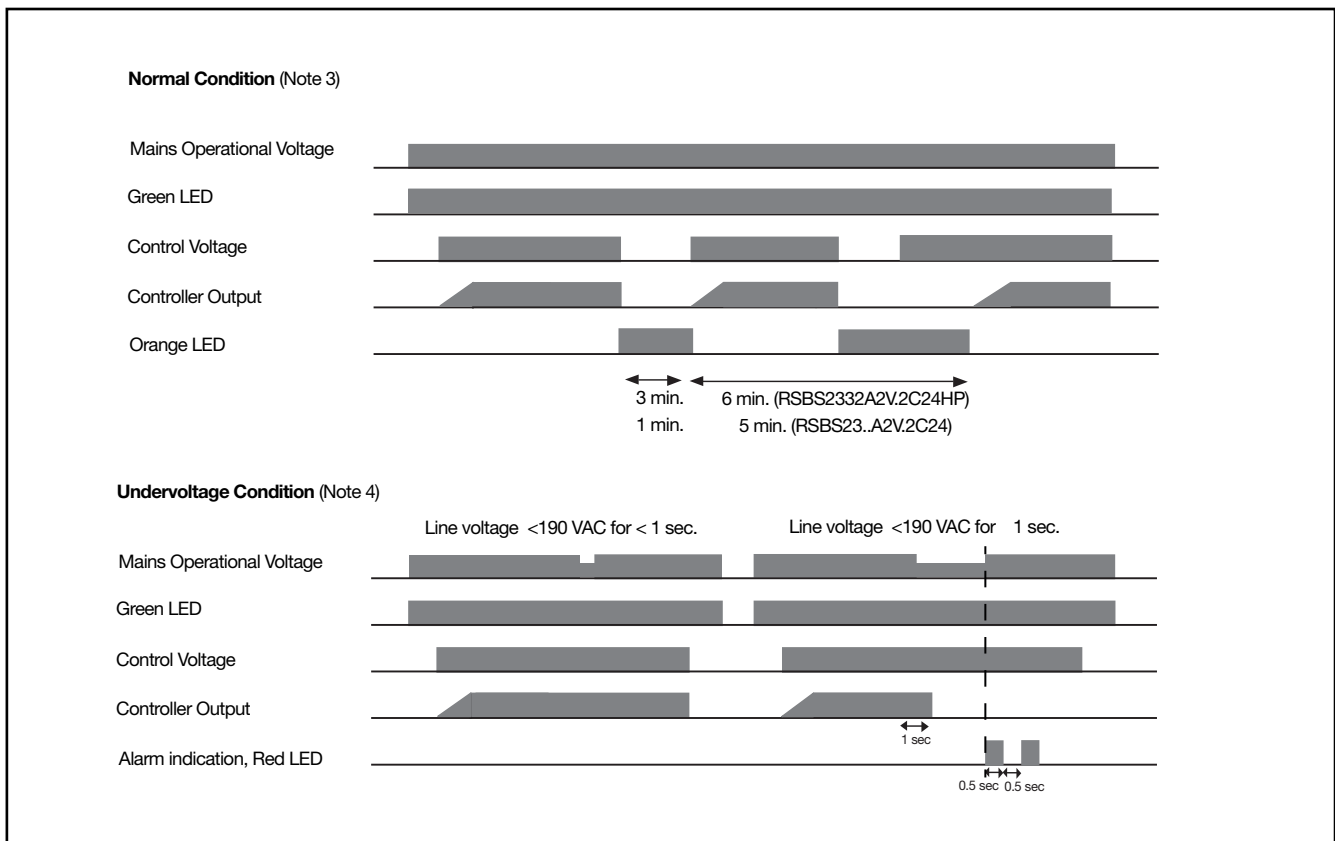
Use 60/75°C copper (CU) conductors.

## Standards

Approvals	UL (E172877), cUL		
CE Marking	LVD	Conducted radio-frequency immunity	IEC/ EN 61000-4-6, PC1 3V/m, 0.15-80MHz
EMC : Immunity	IEC/ EN 60947-4-2/ EN60335-1/ EN 60335-2-40 <sup>2,3</sup>	Voltage dips & interruptions <sup>4</sup>	IEC/ EN 61000-4-11
Emission	IEC/ EN 61000-6-1, EN 55014-2 IEC/ EN 55014-1 IEC/ EN 61000-3-11, IEC/ EN 61000-3-12	Continuous disturbance	IEC/ EN 55014-1 <sup>1</sup>
Electrostatic Discharge ESD Immunity	IEC/ EN 61000-4-2 8kV, PC2 air discharge	Radio interference voltage emissions (conducted)	CISPR 11 IEC/ EN 55011, Class B <sup>1</sup>
Electrical fast transient/ Burst Immunity	4kV, PC2 contact IEC/ EN 61000-4-4	Disturbance power	CISPR 14 IEC/ EN 55014-11
Output	2kV, PC2	Harmonics	IEC/ EN 61000-3-2 <sup>1</sup> IEC/ EN 61000-3-12 <sup>1</sup>
Input	1kV, PC2	Flicker (Load Conditions apply)	IEC/ EN 61000-3-11 <sup>1</sup>
Electrical Surge Immunity	IEC/ EN 61000-4-5, PC2		
Output, line to line	1kV		
Output, line to earth	2kV		
Input, line to line	500V		
Input, line to earth	1kV		
Radiated Radio Frequency	EN 61000-4-3, PC1 3V/m, 80-2700MHz		

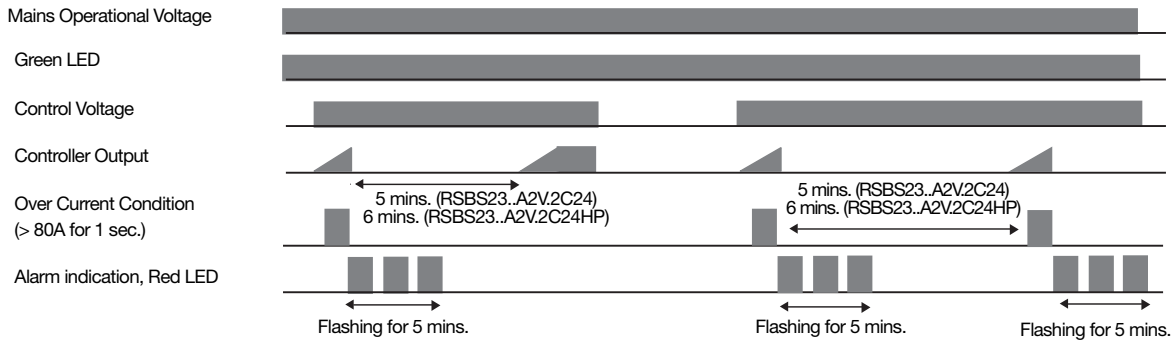
1. Applicable when current limit is 45 AACrms
2. Safety of household and similar electrical appliances. Particular requirements for electrical heatpumps, airconditioners and dehumidifiers.
3. Auxiliary relay terminal (available on RSBS23..A2V2C24) is not suitable to be connected to accessible SELV circuits.
4. Refer to voltage dips and interruptions section for mode of operation.

## Mode of Operation

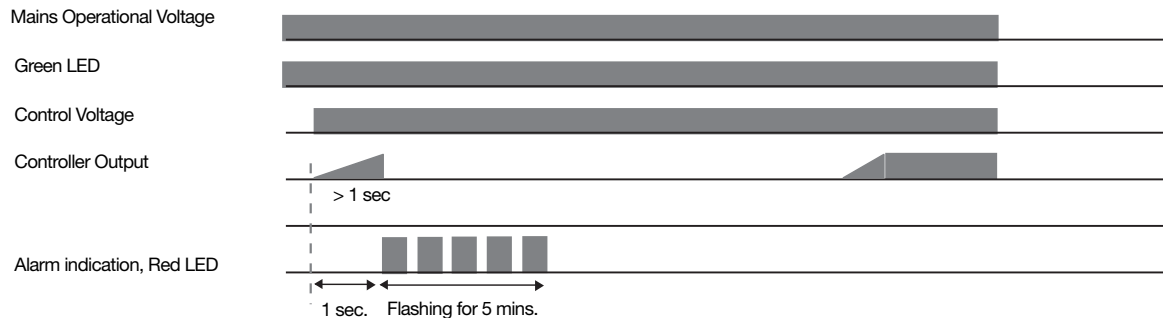


## Mode of Operation (cont.)

### Overcurrent Condition (Note 5)



### Incomplete Ramp Alarm (Note 7)

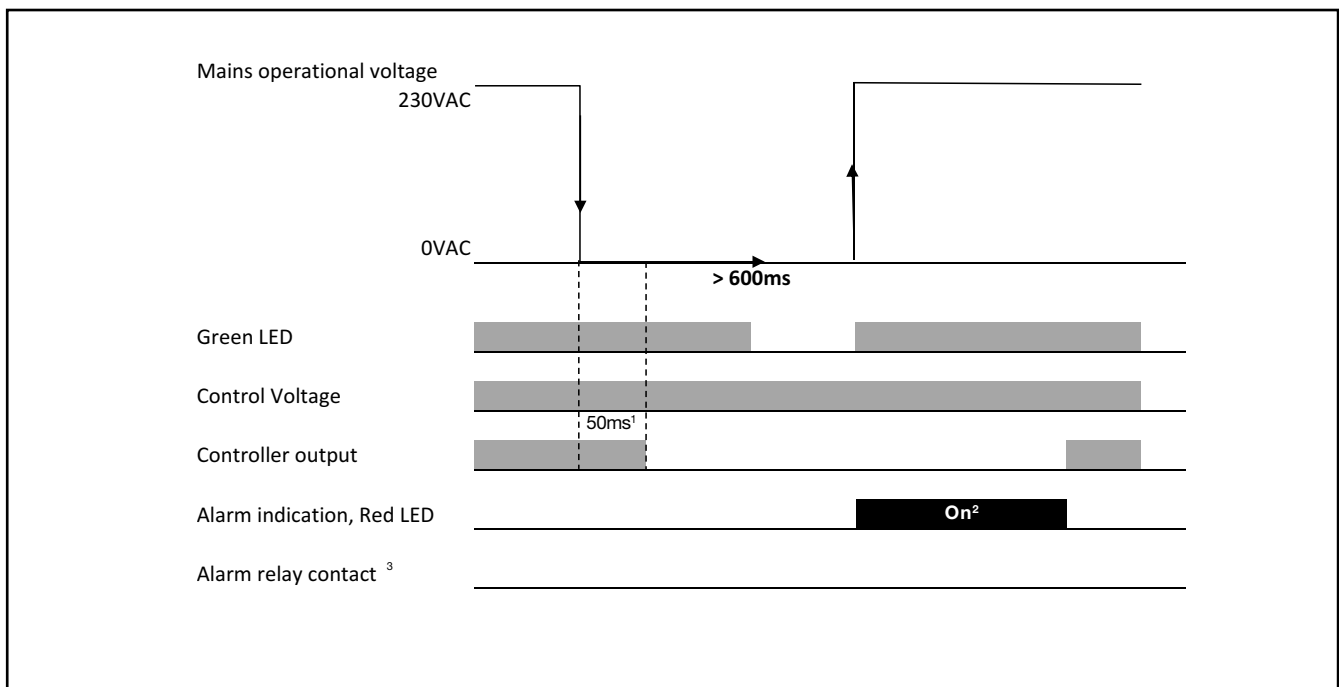
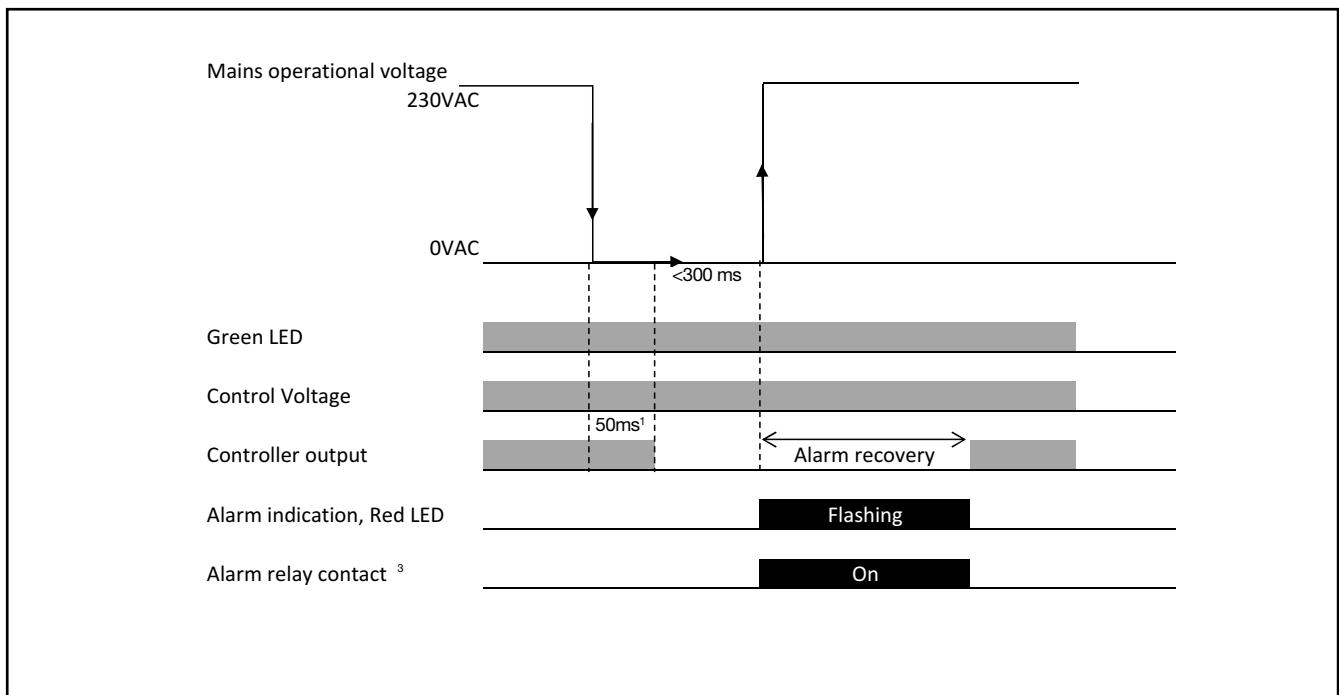


#### Notes:

1. The RSBS has 2 indication LEDs on board. The green LED indicates the status of the on-board power supply, whilst the red LED indicates an alarm condition or in the case of the recovery time between starts, the LED will be orange (Fully ON) .
2. Once the mains voltage is present, the green LED will be fully ON. In case the mains voltage is less than the stated pickup voltage alarm value, the green LED will be flashing. In case mains voltage is higher than the stated pick-up voltage and green LED is flashing, then this may indicate that the on-board power supply is faulty. (Power Supply Alarm)
3. Upon closing K1, the RSBS will start ramping, duration of which is < 1 second, provided that the minimum time from stop to start is respected. When opening K1, the RSBS will stop without any ramp down.
4. In the case of an undervoltage, the RSBS will shut down and the Red LED flashes 2 times as long as the undervoltage is present. Once the mains voltage is restored the red LED will continue flashing for 5 minutes. Following these 5 minutes (6 minutes for HP versions), the RSBS will start ramping function in the case K1 is closed. The device can be reset at any time by removing power on L1 - N connection. When the power is reapplied, the soft starter will start ramping up as soon as K1 is closed, provided that the minimum time between starts and the minimum time from stop to start are respected.
5. If an overcurrent (>80A for 1 sec.) is sensed, the RSBS will shut down and the red LED will flash 3 times indicating an overcurrent situation. This continues for 5 minutes. In the case that the overcurrent is still present at the second attempt, user intervention is required to reset the controller by cycling power for the device to operate again as this implies that there are problems in the system.
6. A detection circuitry provides protection in case of a faulty starting capacitor EMR. In such a situation, the red LED will flash 4 times for 5 minutes. RSBS will check the status of the starting capacitor EMR before attempting a ramping function (in the case K1 is closed). If the starting capacitor EMR is found faulty at the second attempt, user intervention is required to reset the controller by cycling power for the device.
7. In the case of incomplete ramping of the softstarter, the red LED will flash 5 times. This flashing will be indicated by the red LED for 5 minutes. If after the second attempt there is another incomplete ramp alarm, user intervention is required to reset controller.
8. During recovery from Undervoltage, Overcurrent, Incomplete ramp alarms, the red LED will flash at twice the normal flashing frequency, using the same number of flashes. The figure shows the flashing in case of a recovery from an undervoltage alarm.
9. During the recovery time between starts, the RSBS red LED will be continuously ON until the necessary recovery time elapses.<sup>1</sup>
10. If supply on RSBS is removed before the recovery period has elapsed, when supply is restored the delay will continue until the remaining recovery time from the last start/ stop (before supply removal) is over. Following this, another start may be attempted. If supply is removed during alarm recovery (red LED Flashing), upon re-applying supply, the alarm will be reset and the RSBS will only wait for the respective delays between starts and/or stop to start to elapse before attempting another start ( assuming K1 is closed.)

Note 1: Applicable to RSBS23..A2V.2C24HP models only.

## Mode of Operation (Voltage Interruptions)



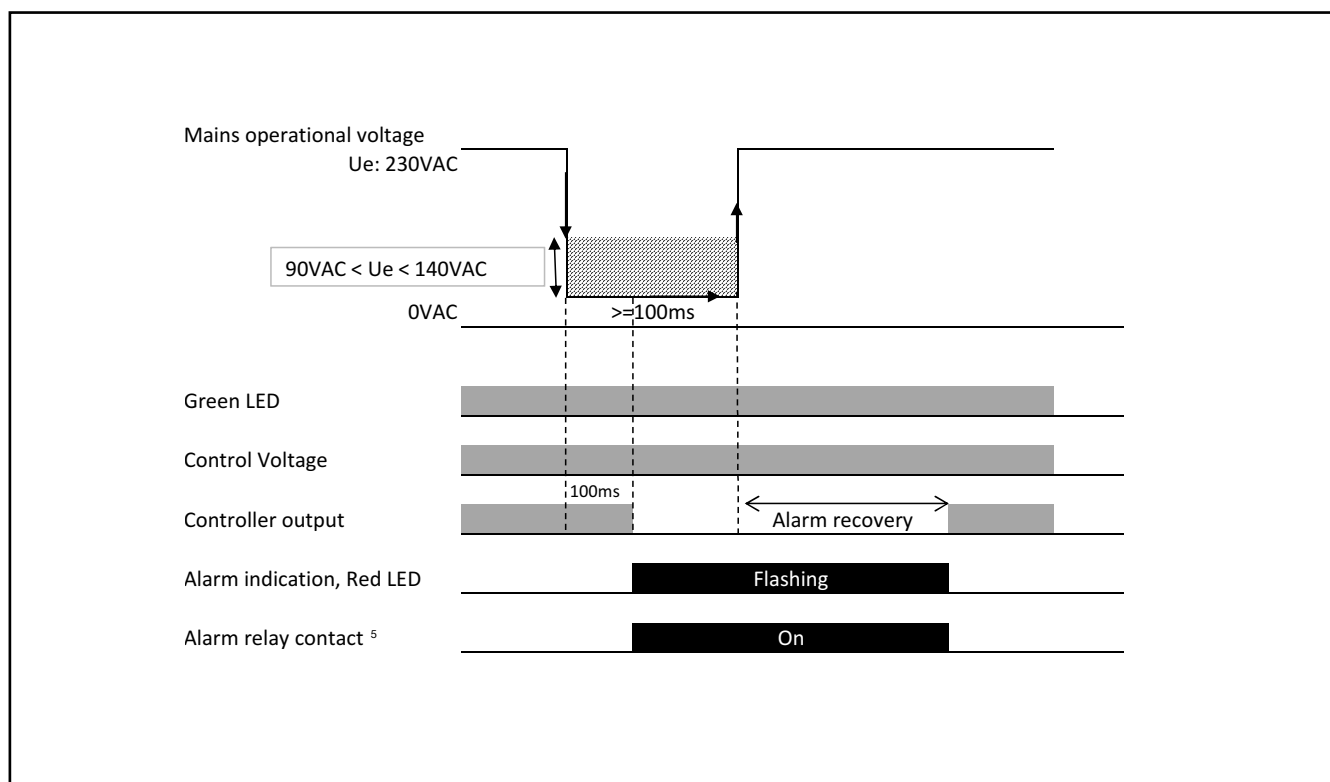
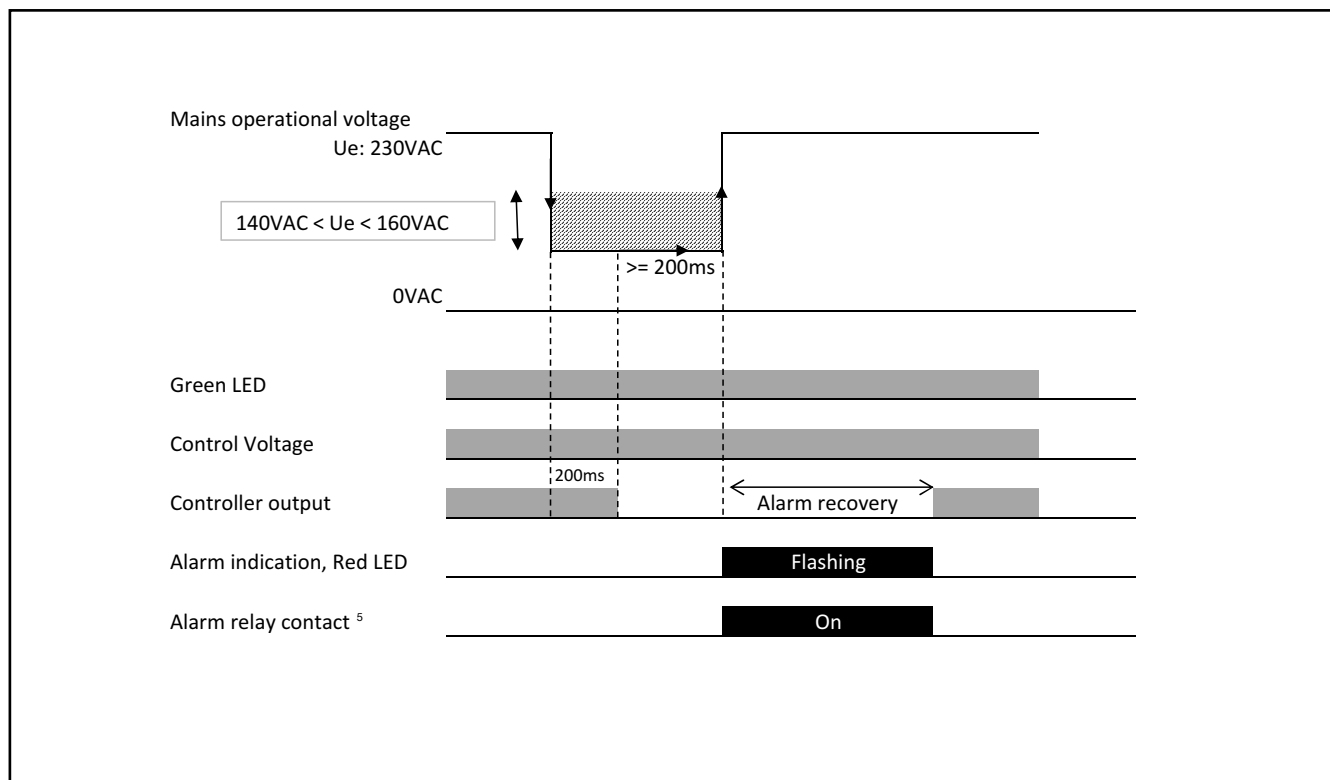
1 For a 50Hz supply, minimum interruption detection is of 50ms (+20ms/-0ms).

2 Red LED will be ON (for HP versions only) if the time between starts and/or time from stop to start has not elapsed.

Following the recovery between starts and/or from stop to start, if control voltage is present, the RSBS shall try to restart the compressor.

3. Applicable to RSBS23..A2V22C24... versions

## Mode of Operation (Voltage Dips)



Note:

1. When a voltage dip and/or interruption is detected the Under voltage alarm will be triggered (2 flashes on red LED).
2. If, during bypass, the current (I<sub>e</sub>) is  $\leq 2.5\text{AACrms}$  for U<sub>e</sub>  $\geq 190\text{VAC}$ , the under-voltage alarm will also be triggered as this might indicate a voltage interruption condition.
3. Voltage dips/interruptions occurring during recovery between starts and/or alarm recovery shall be ignored.
4. Voltage dips/interruptions are not monitored during ramping and idle (control OFF) states.
5. Applicable to RSBS23..A2V22C24... versions



## RSBS...Vx2HP specific mode of operation

The RSBS..V.2C24HP shall try to softstart the compressor at 45AACrms current limit. Depending on the load requirement, the current limit will be gradually increased up to a maximum of 80AACrms after which the RSBS will switch into bypass mode.

If ramping is not achieved after a maximum of 1 second, the Incomplete Ramp Alarm (5 flashes on red LED) will be triggered and the RSBS will enter into a recovery mode for 5 mins. If, at the second consecutive attempt the RSBS raises again the Incomplete Ramp Alarm, then a manual user intervention to reset power on the RSBS shall be required as this might indicate a real locked rotor condition.

For the RSBS2332A2V.2C24HP versions, when control signal (K1) is opened, the red LED will be fully ON until the minimum time between starts and/or the minimum time between stop/start has elapsed.

## LED Status Indication

Orange LED	Relay Contact*	Condition	Action
Fully ON <sup>1</sup>	11/12	Min. recovery time between starts and/or recovery time between stop to start	Auto reset when minimum recovery time elapses.
Red LED	Relay Contact*	Condition	Action
2 flashes	11/14	Undervoltage ( $U_e < 190VAC$ )****	Auto reset with 5 mins recovery **
3 flashes	11/14	Overcurrent ( $>80A$ for 1 sec.)	Auto reset with 5 mins recovery
4 flashes	11/14	Relay protection	Auto reset with 5 mins recovery ***
5 flashes	11/14	Incomplete ramp	Auto reset with 5 mins recovery
N/A	11/12	Supply phase loss	Physical check
N/A	11/12	Idle state	
N/A	11/12	Ramping state	
N/A	11/12	Bypass mode	
Green LED	Relay Contact*	Condition	Action
Flashing	11/12	Power supply alarm	Contact Carlo Gavazzi representative
Fully ON	11/12	Idle state	RSBS waiting for control signal to start

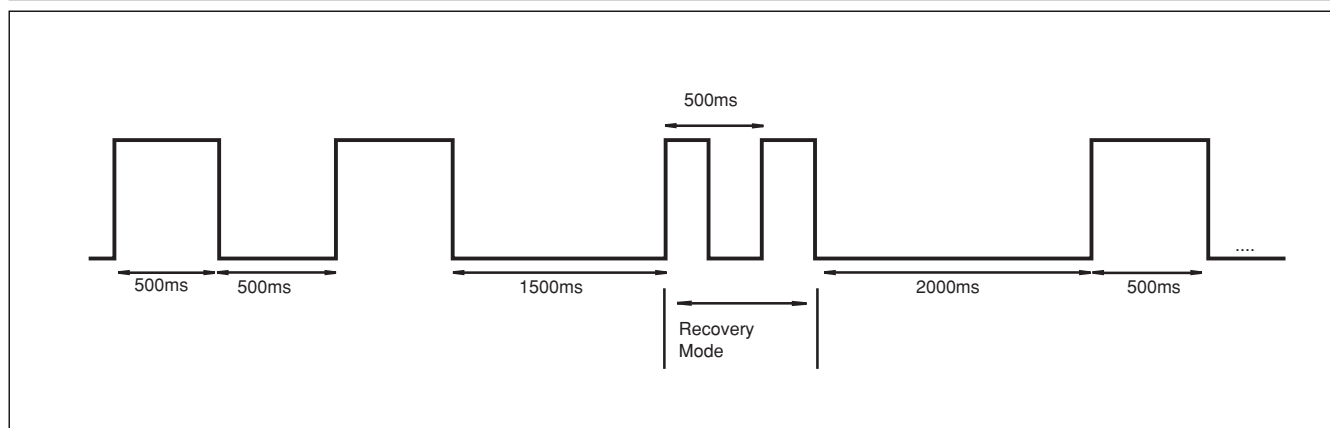
\* Applies only to RSBS23xxA2V22C24.. models

\*\* Monitored during idle and bypass

\*\*\* Refer to note 6 in Mode of operation section

\*\*\*\* Refer to voltage dips and interruptions section for mode of operation

## Flashing Sequence



Note: During recovery from an alarm condition, the red LED will flash at twice the normal flashing frequency between successive flashing cycles as shown above to indicate that the softstarter is in recovery mode which recovery lasts for 5 minutes

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