

# Motor Controller 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

## 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..1. 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.

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).

## 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

## Type Selection

Type	Rated operational voltage U <sub>e</sub>	Rated operational Current I <sub>e</sub>	Control Voltage U <sub>c</sub>	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 µF	HP: High Pressure Starts

## Selection Guide

Rated operational voltage U <sub>e</sub>	Rated operational current I <sub>e</sub>		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

## 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

## 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	2AACrms	2AACrms	2AACrms
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 (Ue)	
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

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

## Input Specifications (Control Input)

	RSBS23..A2V.2C24..
Control voltage (Uc), 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\*

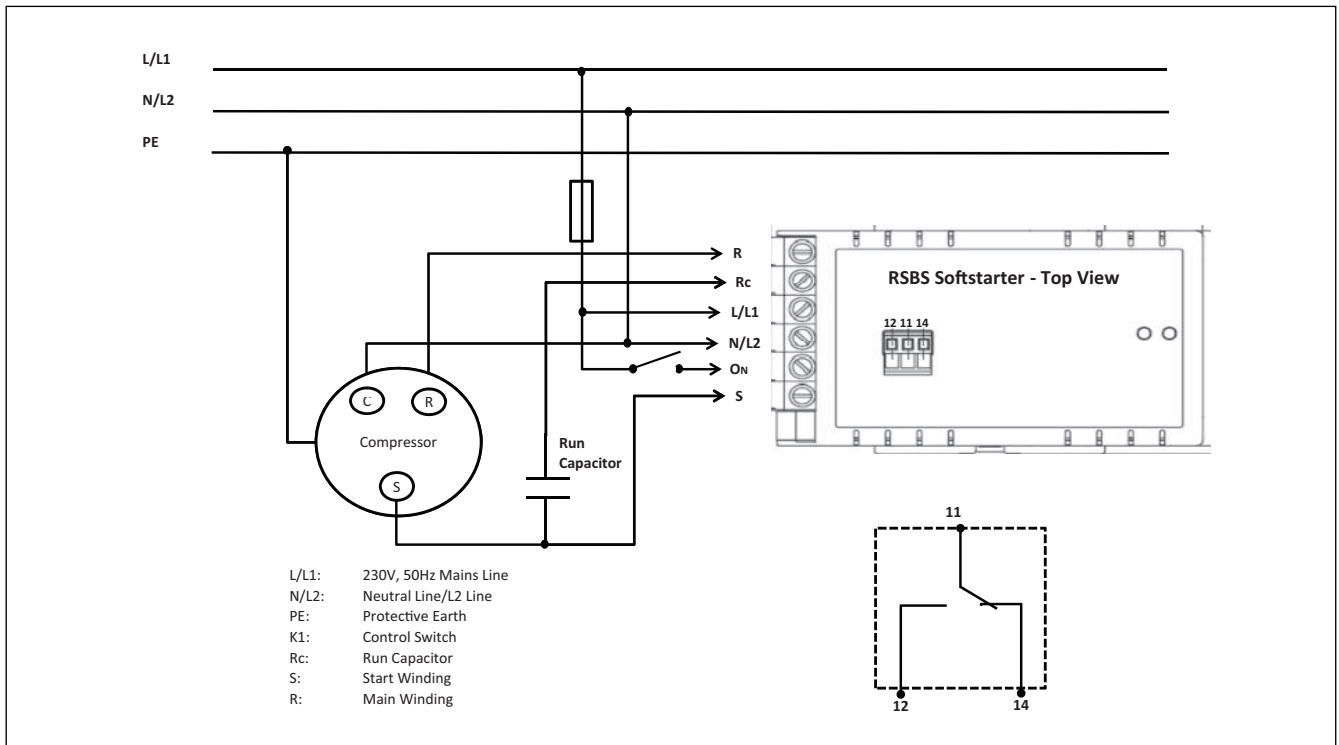
Alarm	Common, Normally Open, Normally Closed, Changeover
Contact Capacity	2A, 250VAC 2A,30VDC

\* Only available for RSBS...A2V22C..

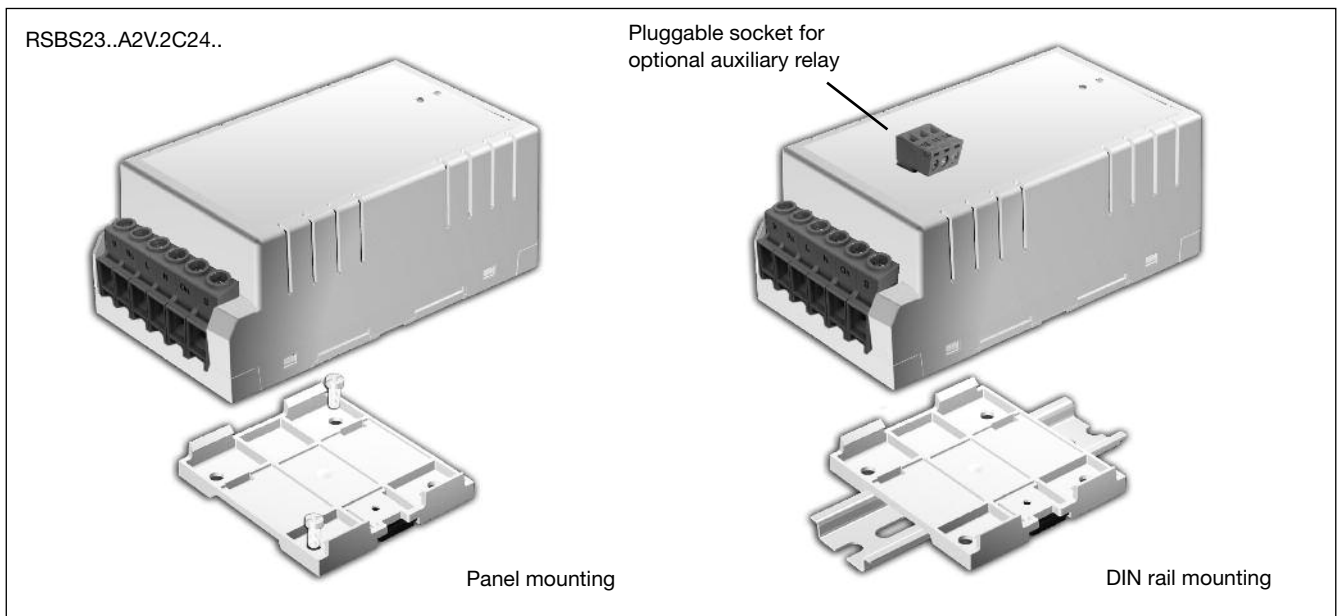
Note:

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

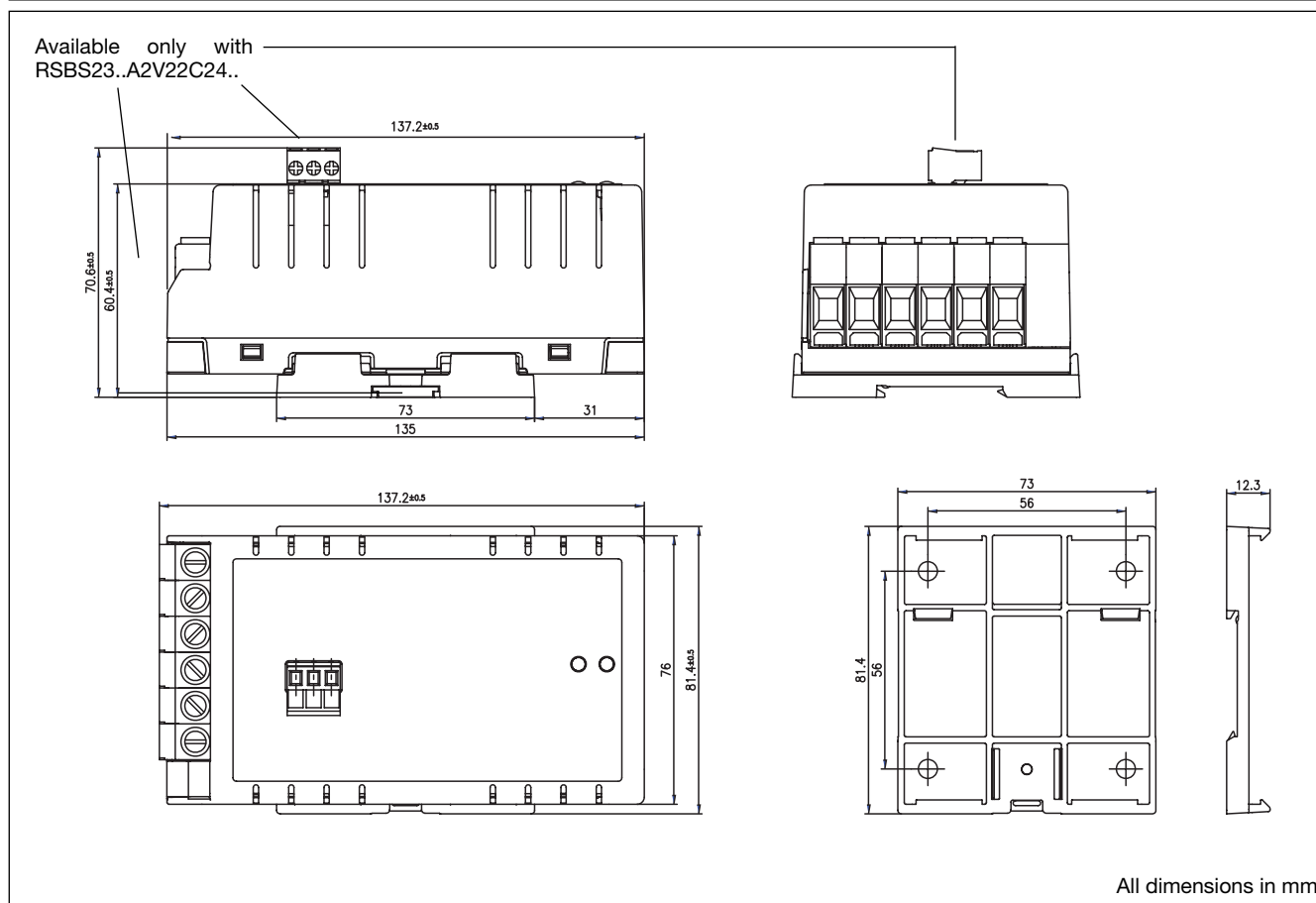
## Connection Diagram



## 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	<p>Ferraz Shawmut</p> <p>40A, class gRC</p> <p>Art. No. 6.9 xxCp gRC</p> <p>14.51 40 (xx = 00 or 21)</p>	<p>Ferraz Shawmut</p> <p>40A, class gRC</p> <p>Art. No. 6.9 xxCp gRC</p> <p>14.51 40 (xx = 00 or 21)</p>

Use 60/75°C copper (CU) conductors.

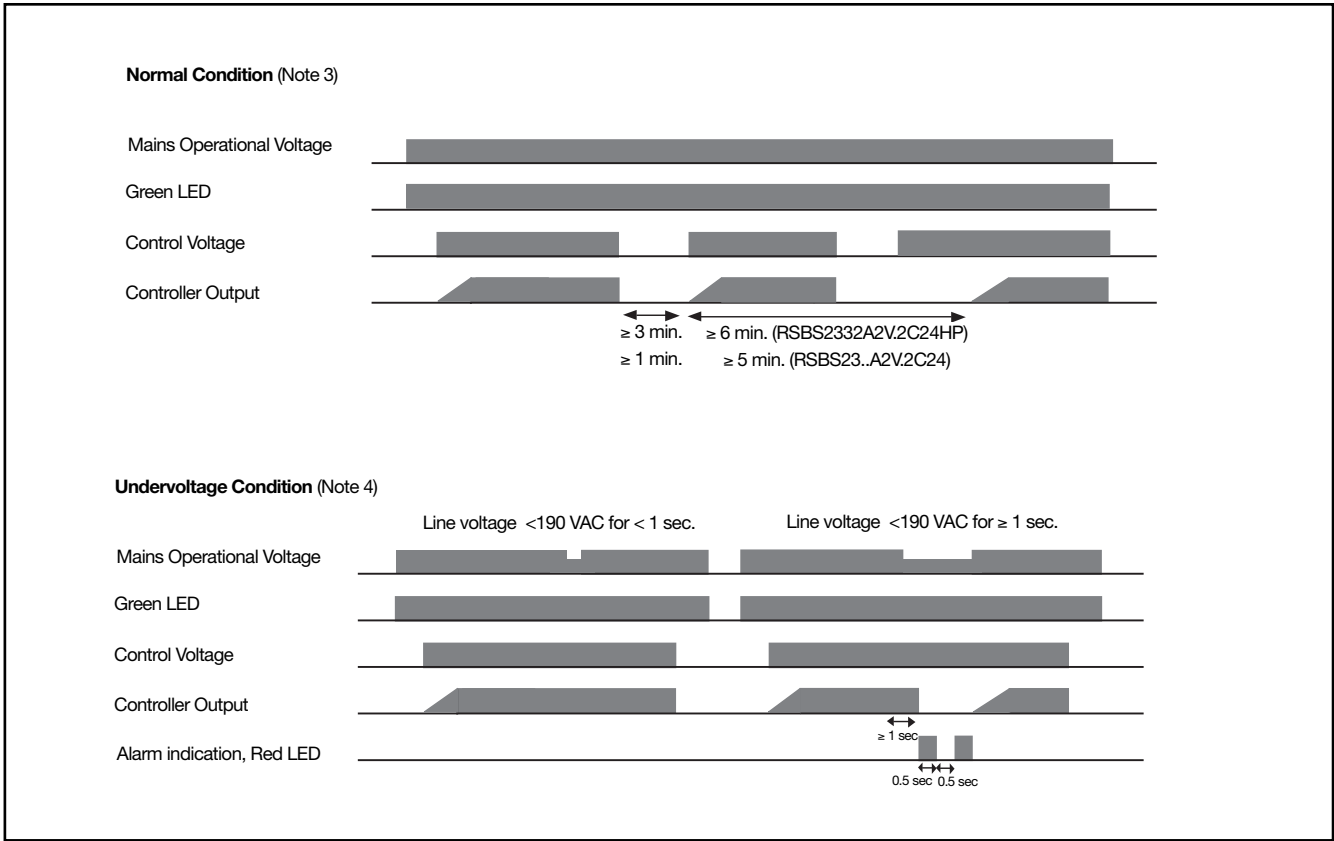


Standards

Approvals	UL (E172877), cUL		
CE Marking	LVD	IEC/ EN 60947-4-2/ EN60335-1/ EN 60335-2-40 <sup>2,3</sup>	Conducted radio-frequency immunity
EMC : Immunity		IEC/ EN 61000-6-1, EN 55014-2	IEC/ EN 61000-4-6, PC1
Emission		IEC/ EN 55014-1	3V/m, 0.15-80MHz
		IEC/ EN 61000-3-11, IEC/ EN 61000-3-12	Voltage dips & interruptions
Electrostatic Discharge ESD Immunity			IEC/ EN 61000-4-11
			100% Ue dip, 20ms, PC2 <sup>1</sup>
			60% Ue dip, 200ms, PC2 <sup>1</sup>
			30% Ue dip, 500ms, PC3 <sup>1</sup>
			100% Ue interruption, 5000ms, PC3
Electrical fast transient/ Burst Immunity			Continuous disturbance
			IEC/ EN 55014-1 <sup>1</sup>
Output		4kV, PC2 contact	Radio interference voltage emissions (conducted)
Input		IEC/ EN 61000-4-4	CISPR 11
		2kV, PC2	IEC/ EN 55011, Class B <sup>1</sup>
		1kV, PC2	Disturbance power
Electrical Surge Immunity			CISPR 14
Output, line to line		IEC/ EN 61000-4-5, PC2	IEC/ EN 55014-1 <sup>1</sup>
Output, line to earth		1kV	Harmonics
Input, line to line		2kV	IEC/ EN 61000-3-2 <sup>1</sup>
Input, line to earth		500V	IEC/ EN 61000-3-12 <sup>1</sup>
		1kV	Flicker
Radiated Radio Frequency			IEC/ EN 61000-3-11 <sup>1</sup>
		EN 61000-4-3, PC1	
		3V/m, 80-2700MHz	(Load Conditions apply)

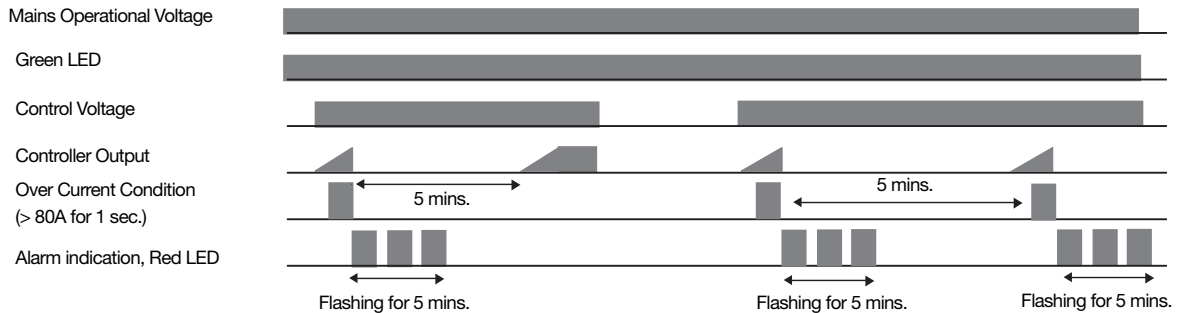
1. Applicable when current limit is  $\leq 45$  AACrms  
2. Safety of household and similar electrical appliances. Particular requirements for electrical heatpumps, airconditioners and dehumidifiers.  
3. Auxiliary relay terminal (available on RSBS23..A2V22C24) is not suitable to be connected to accessible SELV circuits.

Mode of Operation

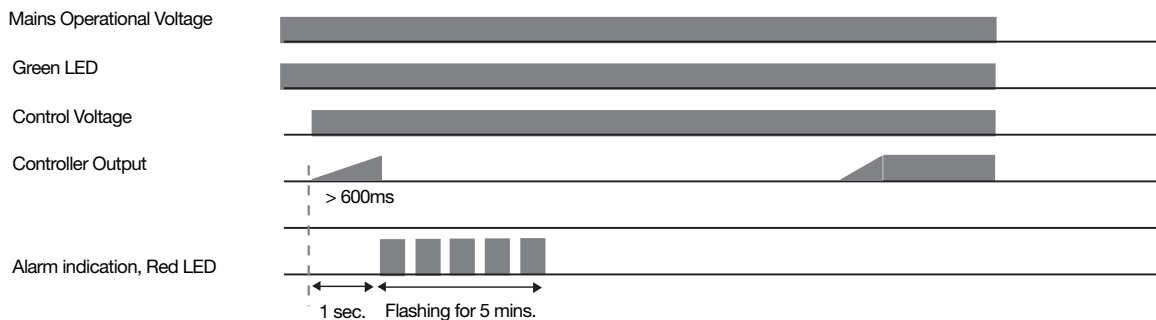


## Mode of Operation (cont.)

### 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 the recovery time between starts.
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 less 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 < 600ms. Provided a minimum time of 3min 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, 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 a minimum period of 6 minutes between starts and a minimum time of 3min 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 before the RSBS tries to ramp up again. 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. Following these 5 minutes (recovery time), the 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 after which the RSBS will start ramping function in the case K1 is closed. If after the second attempt there is another incomplete ramp alarm, user intervention is required to reset controller.
8. As indicated in the figure below, 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 resoted 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.

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

## 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

Red 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.
2 flashes	11/14	Undervoltage ( $U_e < 190VAC$ )	Auto reset with 5 mins recovery **
3 flashes	11/14	Overcurrent ( $>80A$ for $\geq 1$ 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

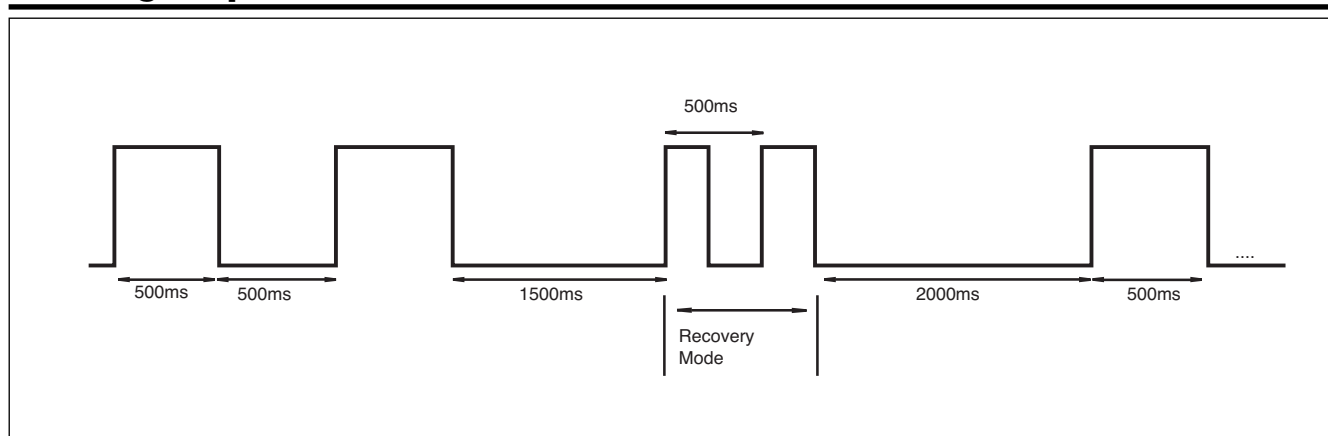
1. Applicable to RSBS2332A2V.2C24HP. For other models, no indication on the red LED is provided.

\* Applies only to RSBS23xxA2V22C24.. models

\*\* Monitored during idle and bypass

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

## 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