

# Motor Controller Three-Phase Scroll Compressor Softstarter Type RSBT....EV..

CARLO GAVAZZI



- Soft starting of 3-phase AC compressors
- Auto adaptive algorithm (patented) for optimum inrush current reduction
- 3-phase controlled with integrated bypass of semiconductors
- Short ramp up time: < 600ms
- Rated operational voltage: 220VACrms, 400VACrms, 50/60 Hz
- Rated operational current: 16, 25, 32A AC-53b
- Built-in transient overvoltage and undervoltage protection
- Phase sequence and under-voltage monitoring
- Overtemperature protection
- Overcurrent protection in bypass mode
- Locked rotor protection
- UL, cUL Listed (for RSBT....V5./ V6. versions only)
- HP version for multi-compressor systems
- VDE approved (Up to 15Arms)

## Product Description

Easy-to-use AC semiconductor compressor softstarter. 3-phase compressors with nominal current up to 32A can be soft-started with this controller. The unit is supplied inside housing, with screw connection, while DIN

Clip adapter is optional on models RSBT....EVx1.

RSBT...EV21 and RSBT...EV61 options include an auxiliary relay module (RFPM) already mounted.

## Ordering Code

**RSB T 40 16 E V10 HP**

Compressor Softstarter \_\_\_\_\_  
 3-Phase Compressor \_\_\_\_\_  
 Rated operational voltage \_\_\_\_\_  
 Rated operational current \_\_\_\_\_  
 Control voltage \_\_\_\_\_  
 Version \_\_\_\_\_  
 Optimised algorithm for multi-compressor systems and high pressure starts \_\_\_\_\_

## Type Selection

Type	Rated operational voltage $U_e$	Rated operational Current $I_e$	Control voltage $U_c$
RSBT: 3-Phase soft starter for scroll compressors	22: 220 VACrms, 50/60 Hz 40: 400 VACrms, 50/60 Hz	16: 16A AC-53b 25: 25A AC-53b 32: 32A AC-53b	E: 110 - 400 VAC $\pm$ 15%, 50/60Hz $\pm$ 10%

### Versions

V10: Standard housing

V11: Standard housing with DIN clip

V20: Standard housing & RFPMV00 module ready mounted

V21: Standard housing with DIN clip & RFPMV00 module ready mounted

V50: Standard housing (UL approved version)

V51: Standard housing with DIN clip (UL approved version)

V61: Standard housing with DIN clip & RFPMV00 module ready mounted (UL approved version)

V..HP: Optimised algorithm for multi-compressor systems & high-pressure starts

## Selection Guide

Rated operational voltage $U_e$	Rated operational current $I_e$		
	16A AC-53b	25A AC-53b	32A AC-53b
220VACrms	RSBT2216EV..	RSBT2225EV..	RSBT2232EV..
400VACrms	RSBT4016EV..	RSBT4025EV..	RSBT4032EV..



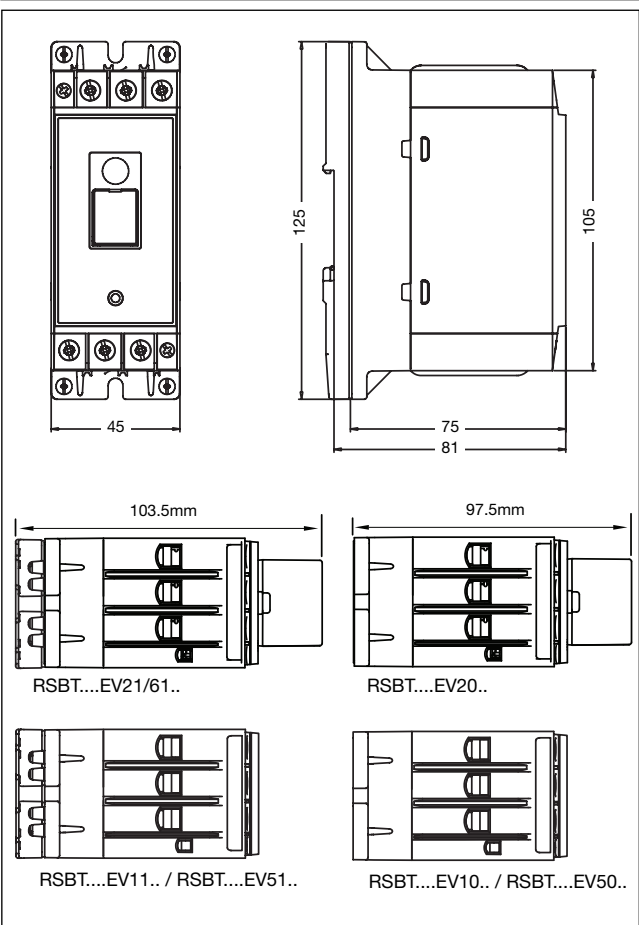
General Specifications

Ramp up time	< 600ms
Ramp down time	0 s
Initial torque	≤ 30%
Integrated current limit	Feedback loop
Undervoltage/ Overvoltage protection	
RSBT22...	190/ 250VAC
RSBT40...	330/ 470VAC
Status indication LEDs	
Power supply ON	LED, Green (continuous)
Recovery mode (1 min. delay)	LED, Green (flashing)
Alarm	LED, Red (flashing sequence)
Protection coordination	Class 10

Input Specifications (Control Input)

Control voltage U <sub>c</sub>	
A1-A2:	110 - 400 VAC ±15%
Rated AC frequency	50/60Hz ±10%
Rated insulation voltage	500 VACrms Overvoltage cat. II (IEC 60664)
Dielectric strength	
Dielectric voltage	2 kVrms
Rated impulse withstand volt.	4 kVrms
Control input current	3 ... 6mA
Input to Output response time	100ms

Dimensions



All dimensions in mm

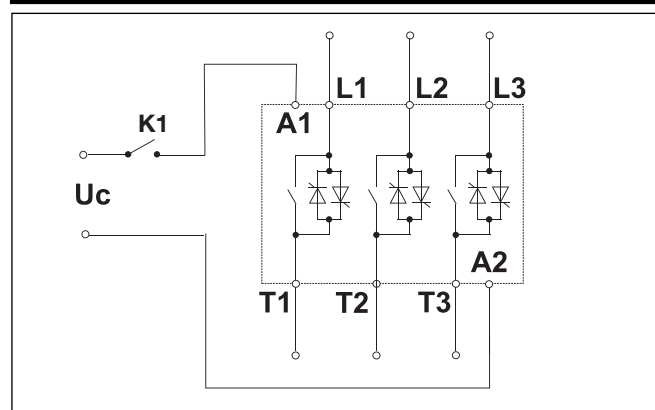
Output Specifications

IEC rated operational current I <sub>e</sub> (AC-53b)		
RSBT..16EV..		16A
RSBT..25EV..		25A
RSBT..32EV..		32A
Overload cycle according to EN/IEC 60947-4-2		
@ 40°C surrounding temp.	RSBT..16EV..	16: AC-53b : 2.5-1 : 60
	RSBT..25EV..	25: AC-53b : 3.6-1 : 60
	RSBT..32EV..	32: AC-53b : 3.4-1 : 60
Number of starts per hour @40°C	RSBT....EV..	12
Minimum full load current	RSBT....EV..	2 AAC rms

## Environmental Specifications

Operating temperature	
RSBT..16EV.. $I_e \leq 16A$	-20°C to +60°C (-4°F to +140°F)
RSBT..25EV.. $I_e \leq 25A$	-20°C to +55°C (-4°F to +131°F)
$I_e \leq 16A$	-20°C to +60°C (-4°F to +140°F)
RSBT..32EV.. $I_e \leq 32A$	-20°C to +50°C (-4°F to +122 °F)
$I_e \leq 25A$	-20°C to +55°C (-4°F to +131°F)
$I_e \leq 16A$	-20°C to +60°C (-4°F to +140°F)
Storage temperature	
-40°C to +80°C (-40°F to +176°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	

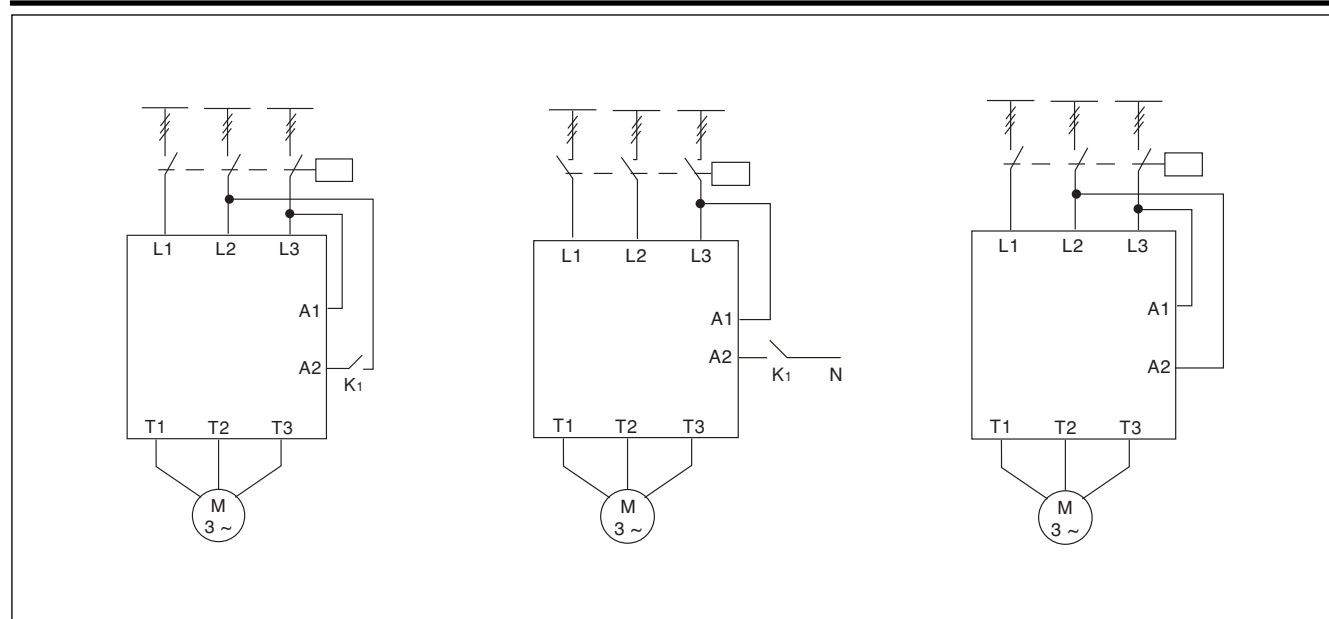
## Connection Diagram



## Conductor Data

<b>Line conductors:</b>	
<b>L1, L2, L3, T1, T2, T3</b>	
according to EN 60947-1	
flexible	2.5 ..... 10mm <sup>2</sup>
	2.5 ..... 2 x 4mm <sup>2</sup>
rigid (solid or stranded)	2.5 ..... 10mm <sup>2</sup>
flexible with ferrule	2.5 ..... 10mm <sup>2</sup>
<b>UL/cUL rated data</b>	
Rigid (stranded)	AWG 6 ... 14
Rigid (solid)	AWG 10 ... 14
Rigid (solid or stranded)	AWG 2 x 10 .... 2 x 14
Terminal screws	6xM4 (cage clamp)
Max. Tightening torque	2.5Nm (22lb.in) with Posidrive bit 2
Stripping length	8.0mm
<b>Secondary conductors:</b>	
<b>A1, A2</b>	
according to EN 60998	
flexible	0.5 ..... 1.5mm <sup>2</sup>
flexible with ferrule	0.5 ..... 1.5mm <sup>2</sup>
rigid (solid)	0.5 ..... 2.5mm <sup>2</sup>
<b>UL/cUL rated data</b>	
Rigid (Solid or Stranded)	AWG 10 ....18
Terminal screws	9xM3 (cage clamp)
Max. Tightening torque	0.6Nm (5.3lb.in) with Posidrive bit 0
Stripping length	6.0mm

## Wiring Diagrams



## Supply Specifications

Rated operational voltage L1 - L3	RSBT22..EV..	127/220VAC $\pm 15\%$
	RSBT40..EV..	230/400VAC $\pm 15\%$
Supply current at standby		25 mA
Blocking voltage	RSBT22..EV..	800 V <sub>p</sub>
	RSBT40..EV..	1200 V <sub>p</sub>
Rated AC frequency		50/60Hz $\pm 10\%$
Rated insulation voltage		630VAC, accord. to EN 60947-1
Dielectric strength		
Dielectric withstand voltage		
Supply to input		2.5 kVrms
Supply to heatsink		2.5 kVrms
Integrated varistor		Across L1 - L3

## Housing Specifications

Dimensions (D x W x H)		
RSBT....EV10/ EV50..		75mm x 45mm x 125mm
RSBT....EV11/ EV51..		81mm x 45mm x 125mm
RSBT....EV20..		97.5mm x 45mm x 125mm
RSBT....EV21/ EV61..		103.5mm x 45mm x 125mm
Weight	RSBT....EV10/ EV50..	400g
	RSBT....EV11/ EV51..	425g
	RSBT....EV20..	435g
	RSBT....EV21/ EV61..	460g
Material		PA66
Material colour		RAL 7035/ RAL 7040
Protection category		IP20
Mounting	RSBT....EV10/ EV50..	Panel
	RSBT....EV11/ EV51..	DIN
	RSBT....EV20..	Panel + Relay module (RFBMV...)
	RSBT....EV21/ EV61..	DIN + Relay module (RFBMV...)

## EMC Standards

Immunity	IEC/ EN 61000-6-2	Radiated Radio Frequency	EN 61000-4-3, PC1
Emission	IEC/ EN 61000-6-3	Immunity	3V/m, 80-1000MHz
Electrostatic Discharge ESD		Conducted Radio Frequency	
Immunity	IEC/ EN 61000-4-2	Immunity	IEC/ EN 61000-4-6, PC1
	8kV, PC2 Air discharge		10V/m, 0.15-80MHz
	4kV, PC2 Contact	Voltage dips & interruptions	IEC/ EN 61000-4-11
Electrical fast transient/ Burst Immunity	IEC/ EN 61000-4-4	Radio interference field	
Output	2kV, PC2	emissions (radiated)	CISPR 11
Input	1kV, PC2		IEC/ EN 55011, Class B
Electrical Surge Immunity	IEC/ EN 61000-4-5, PC2	Radio interference voltage	
Output, line to line	1kV	emissions (conducted)	CISPR 11
Output, line to earth	2kV		IEC/ EN 55011, Class B
Input, line to line	1kV	Harmonics	IEC 61000-3-2
Input, line to earth	2kV	Flicker	IEC/EN 61000-3-3*

\* for RSBT..16EV...only

## Approvals

UL, cUL Listed	E172877*
Restrictions of hazardous substances	RoHs Compliant
CE Marking	
LVD	IEC/ EN 60947-4-2
VDE**	
LVD	EN 60335-1 EN 60335-2-40

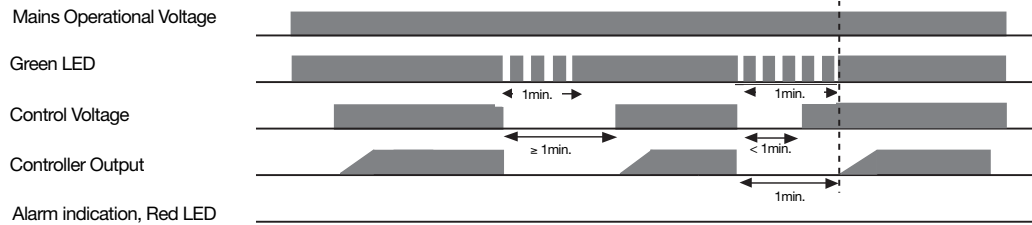
\* for versions RSBT....EV5./ EV6

\*\* Note: VDE approval is applicable up to operational current of 15Arms

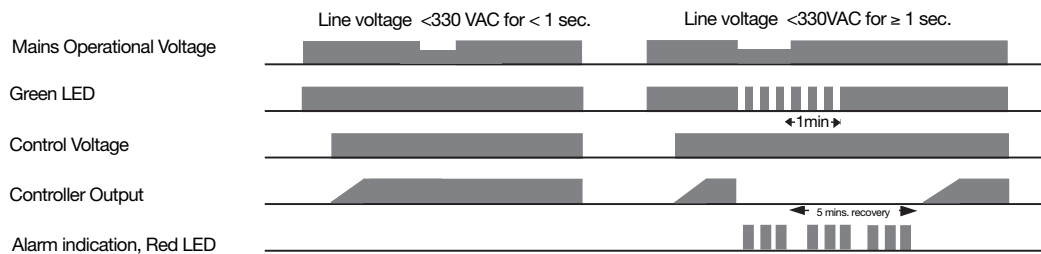


## Mode of Operation

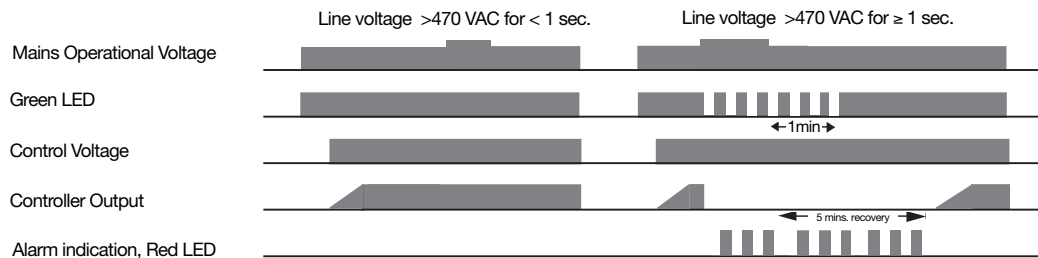
### Normal Condition (note 2)



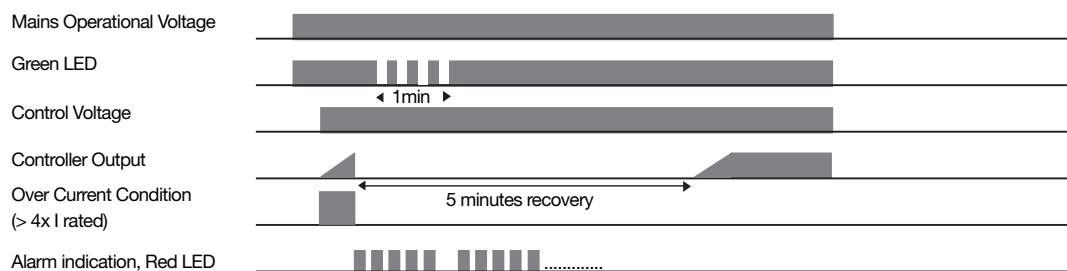
### Undervoltage Condition\* (note 3)



### Overvoltage Condition\* (note 3)



### Locked Rotor Condition during softstart (note 4)

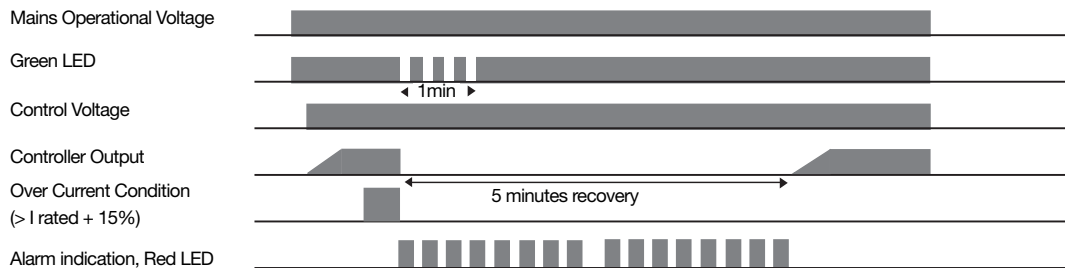


#### Notes:

\* The undervoltage and the overvoltage values quoted above refer to RSBT40..... versions. For RSBT22..... versions, undervoltage limit is 190VAC whereas overvoltage limit is 250VAC.

## Mode of Operation (cont...)

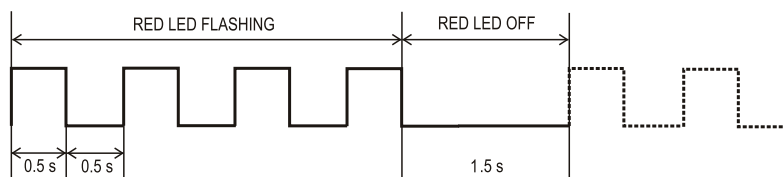
### Overcurrent condition during bypass (note 5)



#### Notes:

1. The RSBT has 2 indication LEDs on board. The green LED indicates the presence of mains voltage and is also used during recovery mode (refer to Note 2). The red LED indicates an alarm condition through a flashing sequence.
2. Once the mains voltage is present, the green LED will be fully ON. Upon closing K1, the RSBT will start ramping, duration of which is < 600ms. When K1 is opened, the RSBT will stop the compressor without any ramp down. The green LED will start flashing to indicate a 1 minute delay at the end of which another start will be possible.
3. In case of an undervoltage/overvoltage condition > 1sec, the RSBT will shut down and the red LED will flash accordingly as long as the undervoltage/overvoltage condition is present. Once the mains voltage is restored, the RSBT will start ramping in case K1 is closed, following a 5 minute recovery.
4. If during ramping an overcurrent (> 4 $\times$ Ie for  $\geq$  1sec) is sensed, the RSBT will shut down and the red LED will start flashing accordingly. After a 5 minutes recovery, if K1 is closed, the RSBT will attempt another start. If after 2 consecutive attempts the RSBT senses an overcurrent, user intervention is required to reset the controller. Reset of the RSBT can be performed by removing power on L1,L2,L3 connection. As soon as mains voltage is reapplied, the RSBT will start ramping as soon as K1 is closed.
5. In bypass mode, if there is an overcurrent (> Ie +15% for  $\geq$  1sec), the RSBT will shut down and the red LED will start flashing accordingly. After a 5 minutes recovery, if K1 is closed, the RSBT will attempt another start.
6. If after 1sec, ramp up is not achieved, the RSBT will shut down and the red LED will start flashing accordingly. After a 5 minutes recovery, if K1 is closed, the RSBT will attempt another start. If at the second attempt, ramp up is not performed within the specified time, the RSBT will shut down and user intervention will be required to reset the controller.
7. The RSBT has a built-in internal temperature sensing function to protect the controller against overheating during ramping. When an internal overtemperature condition is sensed, the RSBT will shut down and the red LED will start flashing accordingly. After a 5 minutes recovery, if K1 is closed, the RSBT will start another ramping function as soon as the internal temperature settles within the specified range.
8. In case that the mains frequency is out of range ( $f < 45\text{Hz}$  or  $f > 65\text{Hz}$ ) the RSBT will shut down with a flashing red LED as long as the frequency is out of range. Once the mains frequency is within range, the RSBT will start ramping function after a 5 minute recovery, in the case K1 is closed.
9. In case that there is  $\geq 10\%$  unbalance between (L1, L2, L3), RSBT will shut down with a flashing red LED as long as the supply voltage is unbalanced. After a 5 minute recovery, if K1 is closed and all phases (L1, L2, L3) are connected, RSBT will attempt another start

## Flashing Sequence



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

Type of coordination: 1 Rated short circuit current	RSBT..16EV5. RSBT..16EV6.	RSBT..25EV5. RSBT..25EV6.	RSBT..32EV5. RSBT..32EV6.
	RK5 fuses up to 40A	RK5 fuses up to 40A	RK5 fuses up to 40A
Type of coordination: 2 Rated short circuit current	RSBT..16EV..	RSBT..25EV..	RSBT..32EV..
	5kA when protected by semiconductor fuses Semiconductor fuse 50A, Class gRC Art. No. 6.9xx CP gRC 14.51 50 (xx = 00 or 21)	5kA when protected by semiconductor fuses Semiconductor fuse 50A, Class gRC Art. No. 6.9xx CP gRC 14.51 50 (xx = 00 or 21)	5kA when protected by semiconductor fuses Semiconductor fuse 50A, Class gRC Art. No. 6.9xx CP gRC 14.51 50 (xx = 00 or 21)

## Current/Power rating

I <sub>e</sub> (AC-53b)	Assigned compressor rating @ 220V	Assigned compressor rating @ 400V	Max. Current limit level I <sub>rms</sub>
16A	4.0kW (5Hp)	7.5kW (7.5Hp)	40A*
25A	5.5kW (7.5Hp)	11.0kW (10Hp)	90A*
32A	9.0kW (10Hp)	15.0kW (15Hp)	110A*

### \* Auto Adaptive Algorithm (Patented)

RSBT series of softstarters includes an innovative auto-adaptive algorithm (Patented) such that an optimum starting current performance is achieved at every compressor start.

This feature is active at every compressor start. Appropriate parameters are automatically set by the softstarter in order to achieve an optimum inrush current reduction whilst

maintaining a ramp-up time < 600ms.

In case of Locked Rotor/ Ramp Up Time alarm, default parameter settings are restored automatically. During

the subsequent compressor starts, the auto adaptive function will start optimising such parameters automatically once again.

## RSBT...V..HP specific mode of operation

The RSBT...V..HP shall try to soft start the compressor at the set current limit. Depending on the load requirement, the current limit will be gradually increased up to a maximum of:

40AAC - RSBT..16EV..HP

90AAC - RSBT..25EV..HP

110AAC - RSBT..32EV..HP after which the RSBT HP 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 RSBT HP will enter into a recovery mode for 5 mins. If, at the second consecutive attempt the RSBT HP raises again the Incomplete Ramp Alarm, then a manual user intervention to reset power on the RSBT HP shall be required as this might indicate a real locked rotor condition.

## LED Status Indication

No. of flashes Red LED	Relay Contact*		Condition	Action
	RSBT....V..	RSBT.....HP		
2	11/12	11/12	Wrong Phase sequence	Physical change
3	11/12	11/12	Line Voltage Out of Range	Auto reset with 5 mins recovery
4	11/12	11/12	Frequency Out of Range	Auto reset with 5 mins recovery
5	11/12	11/12	Locked Rotor Condition (during Ramping)	Auto reset with 5 mins recovery
6	11/12	11/12	Ramp Up Time > 1 sec	Auto reset with 5 mins recovery
7	11/12	11/12	Over Temperature	Auto reset with 5 mins recovery
8	11/12	11/12	Over Current (during Bypass)	Auto reset with 5 mins recovery
9	11/12	11/12	Supply Voltage Unbalance	Auto reset with 5 mins recovery assuming all phases (L1,L2, L3) are connected
Green LED	Relay Contact*		Condition	Action
Flashing	11/14	11/14	1 min recovery time between starts	N/A
Fully ON	11/14	11/14	Idle state	N/A
Fully ON	11/12	11/14	Ramping	N/A

\* available for RFPM / RSPMV120 / RSBT....EV1... / RSBT....EV6...



## Accessories

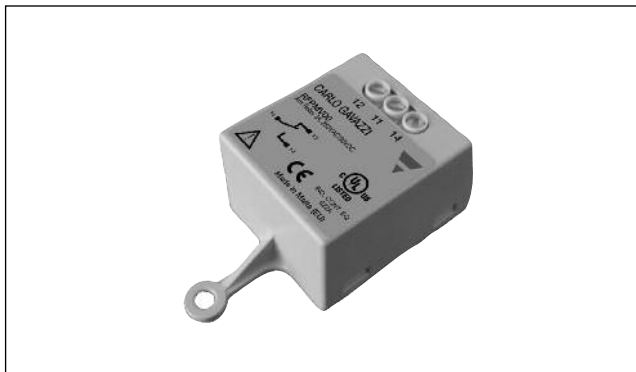
### Auxiliary Output Module



- 17.5mm DIN rail housing
- LED indication for supply ON
- Plug'n'play design
- Output (1): 100mA, Open collector, Normally Open (NO)
- Output (2): 3A SPDT relay \*
- RoHs compliant
- Ordering code: RSPMV110 (1-output) / RSPMV120 (2-output)
- CE, cULus (Accessory of listed RSBT)

\* Only applicable to RSPMV120

### Auxiliary Relay Alarm Output



- Normally open (NO) or Normally Closed (NC) configuration
- Contact rating: 3A, 250 VAC / 3A, 30VDC
- 1-Relay Output for alarms generated by softstarter
- Ordering code: RFPMV00
- UL, cUL Listed (Accessory of Listed RSBT)

### EMC/ RFI Filter



- Insertion loss 5dB
- Lightweight and compact design
- Operational current: Max. 32A @ 60°C
- Rated operational voltage: 220/ 440 VAC  $\pm$  15%
- Ordering code: RFILT4032V00
- UL, cUL Listed (Accessory of Listed RSBT)

### DIN Rail Mounting



- Only available with RSBT...EV.1.. models