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

Short circuit and Overload protection are not provided with this controller and

must be procured separately. Starting

and running capacitors are required for

The RSBS can also be supplied with an

optional auxiliary alarm relay (Option -

Note: The main and bypass relays

may be in an undefined state due to

transportation. In case <u>both</u> 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

controller to operate as intended.

V22).

≥ 3seconds.

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#### 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..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.

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

### **Type Selection**

Rated operational Rated operational Control Options Starting Capacitor Version Туре voltage Ue Current le Voltage Uc 23: 230VACrms 25: 25AAC A2: 230VACrms C24:200-240 uF RSBS: 1-Phase V12: Enclosed HP:Hiah Soft Starter for 32: 32AAC V22: Enclosed Pressure Starts Scroll Compressors & aux. alarm relay

### **Selection Guide**

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

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.

#### Specifications are subject to change without notice (12.12.2013)

1

# 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           |  |
| Vorsion                      |  |

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

\* for 50Hz supply

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### **General Specifications**

| Ramp up (preset)<br>RSBS23A2V.2C24<br>RSBS2332A2V.2C24HP | < 0.6 sec<br>< 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                                     | П                              |
| 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<br>Screw Type<br>(Max. tightening torque)<br>R, Rc, L, N, ON, S<br>14, 12, 11 | M4 (1.19Nm, 10.5lb-in)<br>M3 (0.5Nm, 4.5lb-in)   |
| Max. cross sectional area<br>of cable (solid)<br>R, Rc, L, N, ON, S<br>14, 12, 11                        | 0.5 - 16mm², AWG 20-6<br>0.2 - 1.5mm², AWG 28-12 |
| Max. cross sectional area<br>of cable (stranded)<br>R, Rc, L, N, ON, S<br>14, 12, 11                     | 0.5 - 16mm², AWG 20-6<br>0.2 - 1.5mm², AWG 30-12 |
| Stripping length<br>R, Rc, L, N, ON, S<br>14, 12, 11   | 8mm<br>7 - 8mm                                   |
| * For RSBS23V22, the auxiliary term  | inal is 10.5mm protruding                        |

 $^{\ast}$  Above 1000m derate linearly by 1% of unit FLC per 100m to a maximum altitude of 2000m

### **Output Specifications**

|                                    | RSBS25A.V.2C24          | RSBS32A.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) |
| I2t 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**

|                                | RSBS23A2V.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                  |  |

# Input Specifications (Control Input)

|                          | RSBS23A2V.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,<br>Normally Closed, Changeover |  |
|----------------|---|--|
| Contact Rating | 3A, 250VAC  |  |
|                | 3A,30VDC  |  |

\* Not available during ramping. Refer to voltage dips and interruptions sec-

tion for mode of operation.

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

#### Note:

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

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### **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      | <ul> <li>"Suitable For Use On A Circuit Capable<br/>Of Delivering Not More Than 5,000 A rms<br/>Symmetrical Amperes, 240 Volts Max.<br/>when Protected by RK5 Fuses."</li> <li>"Use Fuses Only".</li> <li>Maximum allowed ampere rating of the<br/>fuse is 45 A.</li> </ul> | <ul> <li>"Suitable For Use On A Circuit Capable<br/>Of Delivering Not More Than 5,000 A rms<br/>Symmetrical Amperes, 240 Volts Max.<br/>when Protected by RK5 Fuses."</li> <li>"Use Fuses Only".</li> <li>Maximum allowed ampere rating of the<br/>fuse is 45 A.</li> </ul> |
| Type of co-ordination:              | 2   | 2   |
| Rated short circuit current         | 5 kA when protected by<br>semiconductor fuses   | 5 kA when protected by<br>semiconductor fuses   |
| Semiconductor fuse                  | Ferraz Shawmut  | Ferraz Shawmut  |
|                                     | 40A, class gRC<br>Art. No. 6.9 xxCp gRC<br>14 51 40 (xx = 00 or 21)   | 40A, class gRC<br>Art. No. 6.9 xxCp gRC<br>14 51 40 (xx = 00 or 21)   |
| 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>           |
| EMC : Immu                 | nity | IEC/ EN 61000-6-1, EN 55014-2          |
| Emissio                    | on   | IEC/ EN 55014-1                        |
|                            |      | IEC/ EN 61000-3-11, IEC/ EN 61000-3-12 |
| Electrostatic Discharge E  | SD   |  |
| Immuni                     | ty   | IEC/ EN 61000-4-2                      |
|                            |      | 8kV, PC2 air discharge                 |
| Electrical fast transient/ |      | 4kV, PC2 contact                       |
| Burst Immunity             |      | IEC/ EN 61000-4-4                      |
| Outp                       | ut   | 2kV, PC2                               |
| Inp                        | ut   | 1kV, PC2                               |
| Electrical Surge Immunity  |      | IEC/ EN 61000-4-5, PC2                 |
| Output, line to lir        | ne   | 1kV                                    |
| Output, line to ear        | th   | 2kV                                    |
| Input, line to lir         | ne   | 500V                                   |
| Input, line to ear         | th   | 1kV                                    |
| Radiated Radio Frequenc    | У    | EN 61000-4-3, PC1                      |
|                            |      | 3V/m, 80-2700MHz                       |

| Conducted radio-frequency immunity               | IEC/ EN 61000-4-6, PC1<br>3V/m, 0.15-80MHz      |
|--|---|
| Voltage dips & interruptions <sup>4</sup>        | IEC/ EN 61000-4-11                              |
| Continuous disturbance                           | IEC/ EN 55014-11                                |
| Radio interference voltage emissions (conducted) | CISPR 11<br>IEC/ EN 55011, Class B <sup>1</sup> |
| Disturbance power                                | CISPR 14<br>IEC/ EN 55014-11                    |
| Harmonics  | IEC/ EN 61000-3-21<br>IEC/ EN 61000-3-121       |
| Flicker<br>(Load Conditions apply)               | IEC/ EN 61000-3-111                             |

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..A2V22C24) 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.)



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 reapplying 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:

- 2. If, during bypass, the current (le) is <= 2.5AACrms for Ue>= 190VAC, 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

<sup>1.</sup> When a voltage dip and/or interruption is detected the Under voltage alarm will be triggered (2 flashes on red LED).



### 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 (Ue < 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<br>representative        |
| Fully ON              | 11/12          | Idle state   | RSBS waiting for<br>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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