# 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<br>48: 230/400VACrms, 50/60Hz<br>277/480VACrms, 50/60Hz<br>60: 346/600VACrms, 50/60Hz | 02: 0.6 - 2 A AC-53b<br>05: 2 - 5 A AC-53b<br>12: 4.5 - 12 A AC-53b<br>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 | |

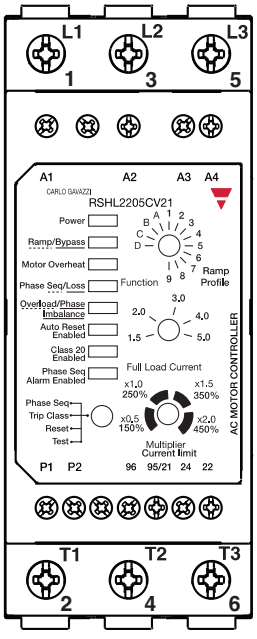
Note: In Current Limit Operation, no soft stop is offered. The motor is left coasting when control is removed.

## 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<br>8kV, PC2 Air discharge<br>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<br>10V/m, 80-1000MHz |
| Conducted radio-frequency immunity | IEC/ EN 61000-4-6, PC1<br>10V/m, 0.15-80MHz |
| Voltage dips & interruptions EN60947-4-2 | IEC/ EN 61000-4-11<br>100% Ue dip, 20ms, PC2<br>60% Ue dip, 200ms, PC2<br>30% Ue dip, 500ms, PC3<br>100% Ue interruption, 5000ms, PC3<br>60% Ue dip, 100ms, PC2<br>60% Ue dip, 1000ms, PC2<br>30% Ue dip, 10ms, PC2<br>100% Ue interruption, 5000ms,PC3 |
| Radio interference field emissions (radiated) | CISPR 11<br>IEC/ EN 55011, Class A |
| Radio interference voltage emissions (conducted) | CISPR 11<br>IEC/ EN 55011, Class A |

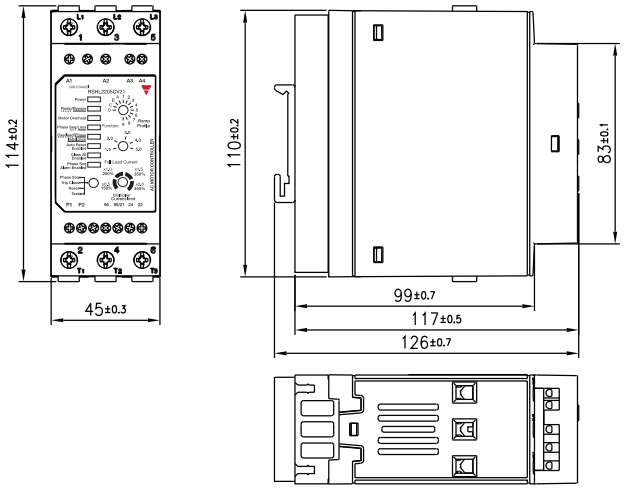
Note: EMC testing was performed with the RSHL connected to representative motor loads of 1.1/ 4.0kW. The EMC performance of the controller would eventually have to be evaluated with the controller connected and fitted as part of the complete system in the end application.

## Terminal Diagram



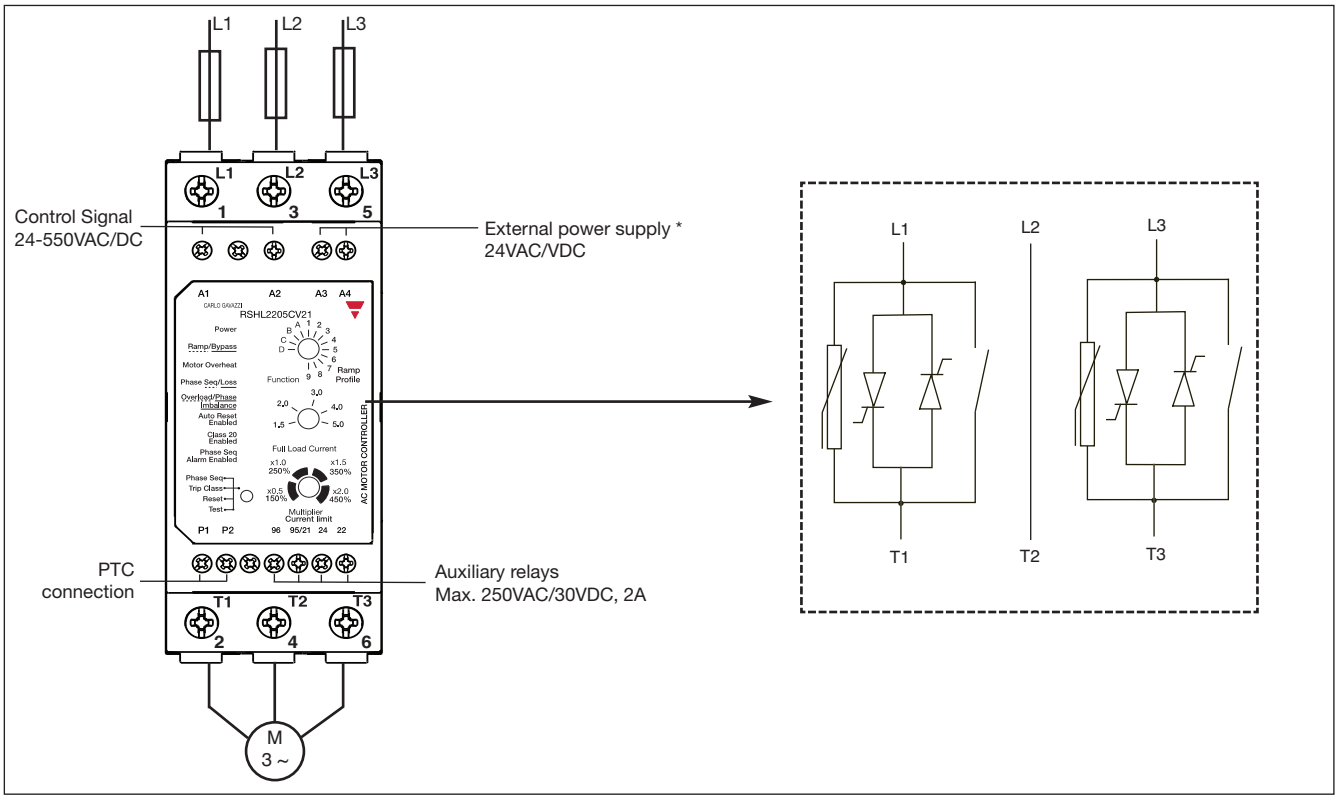

**L1, L2, L3:** Mains supply
**T1, T2, T3:** Motor supply
**A1, A2:** Control input
**A3, A4:** External supply
**P1, P2:** PTC connection from motor
**22:** End of Ramp (Normally Closed)
**24:** End of ramp (Normally Open)
**95/ 21:** Common
**96:** Alarm (Normally closed)

## 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<br>Rated short circuit current | 10kA when protected by RK5 fuses<br>TRS 15R (15A) | 10kA when protected by RK5 fuses<br>TRS 15R (15A) | 10kA when protected by RK5 fuses<br>TRS 40R (40A) | 10kA when protected by RK5 fuses<br>TRS 40R (40A) |
| | | | **RSHL6012CV21** | **RSHL6018CV21** |
| Type of coordination: 1<br>Rated short circuit current | | | 10kA when protected by RK5 fuses<br>TRS 35R (35A) | 10kA when protected by RK5 fuses<br>TRS 35R (35A) |
| | **RSHL..02CV21** | **RSHL..05CV21** | **RSHL..12CV21** | **RSHL..18CV21** |
| Type of coordination: 2<br>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<br>16A, Class URC<br>Art. No. 6.9 CP<br>gRC 14.51.16 | Ferraz Shawmut<br>25A, Class URC<br>Art. No. 6.9 CP<br>gRC 14.51 25 | Ferraz Shawmut<br>50A, Class A70QS<br>Art. No. A70QS50-4 | Ferraz Shawmut<br>60A, Class A70QS<br>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

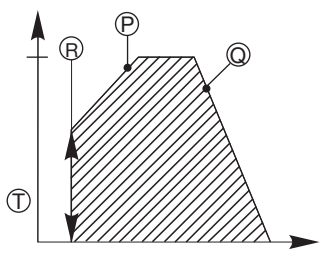
# Alarms

| | |
|---|---|
| Auxiliary Relays<br>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<br>Ramping<br>Idling (when power supply is ON and Control Input is OFF) | Not present<br><br>All three phases must be present for the device to operate.<br>If any phase is missing, alarm is indicated. |
| Bypass Mode | Device will switch off motor, and alarm is indicated |
| Phase Imbalance Alarm<br>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




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

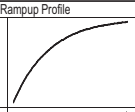
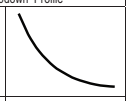
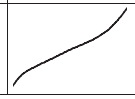
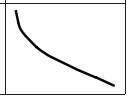
Ⓠ Ramp-down time: time from full load voltage to zero load voltage.

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

Ⓣ Initial Torque

# Operational Diagram

## Ramp Profiles

| Rampup Profile | | Rampdown Profile | |
|---|---|---|---|
| Standard |  | Standard |  |
| Linear Torque |  | 2nd Polynomial |  |

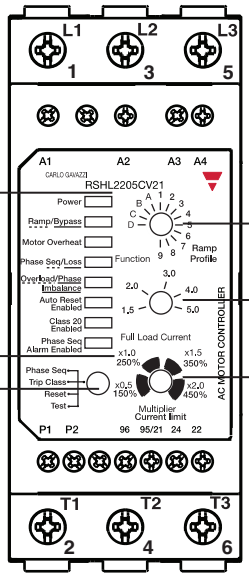
## Parameter Settings

| 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)<br>Default 10 (Hold Button: TEST)<br>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<br><br>(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

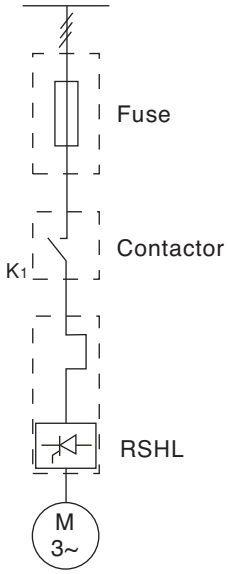



Fig. 1a

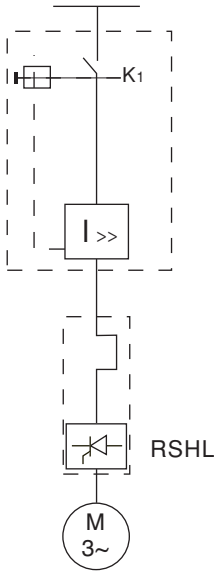



Fig. 2a

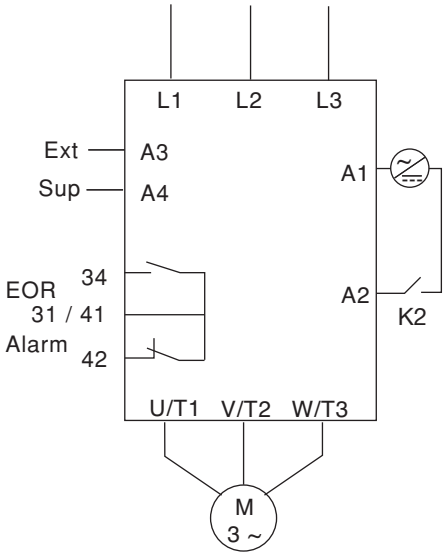



Fig. 3a

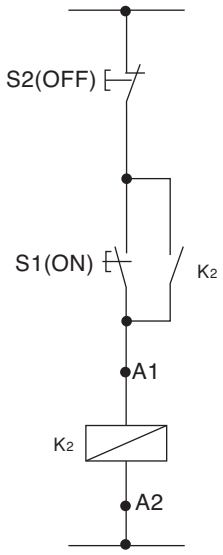



Fig. 4a

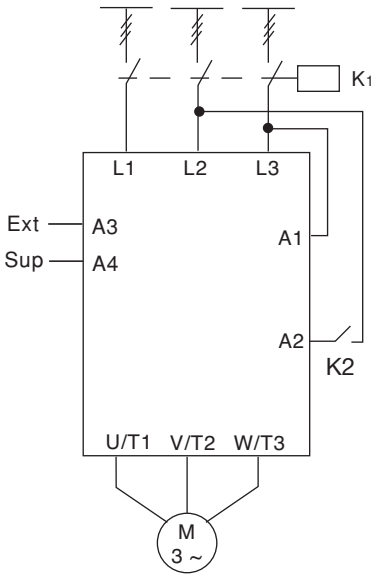



Fig. 5a

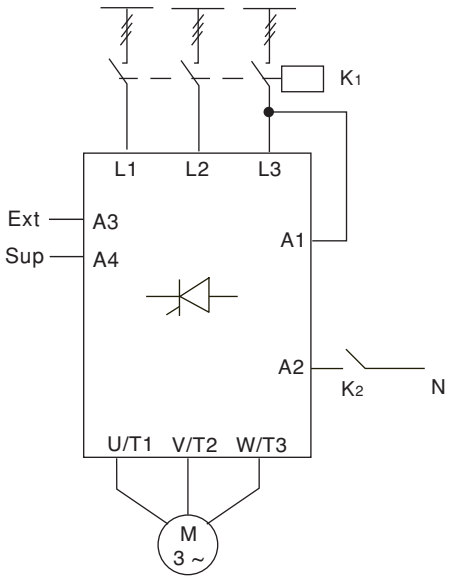



Fig. 6a

**IEC**

## Wiring Diagram (cont.)

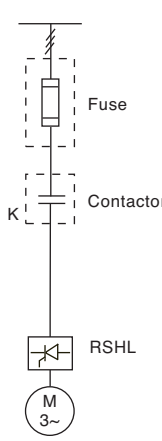



Fig. 1b

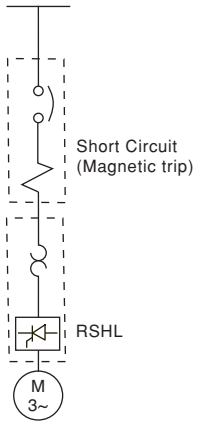



Fig. 2b

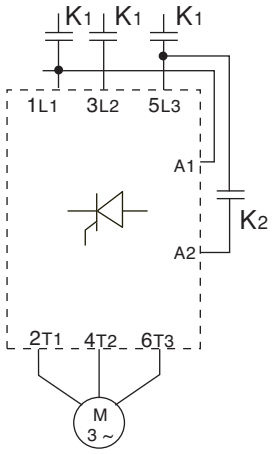



Fig. 5b

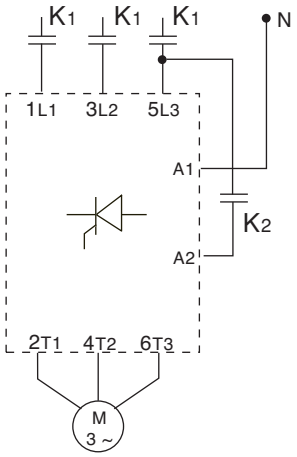



Fig. 6b

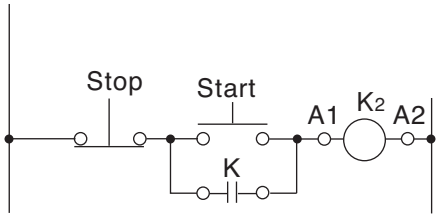



Fig. 4b

**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)**

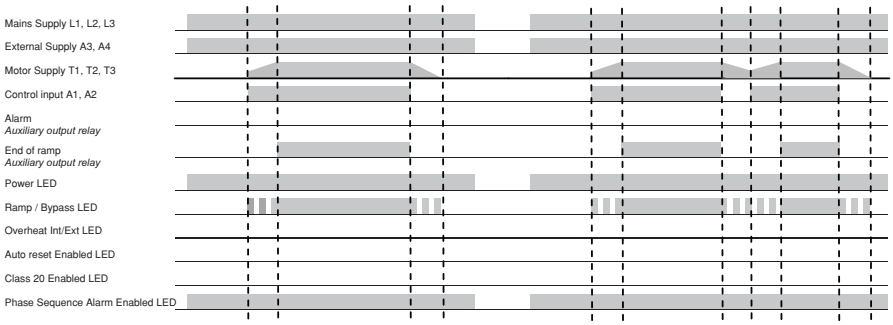



**Diagram 2a: Over-temperature alarm during ramping mode**

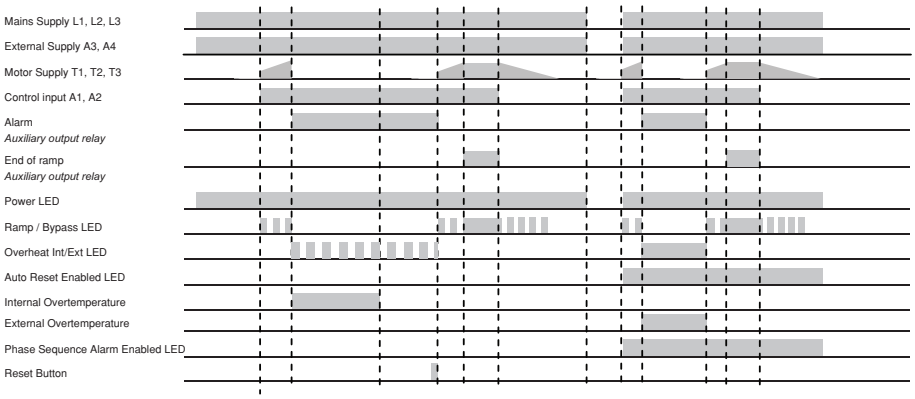
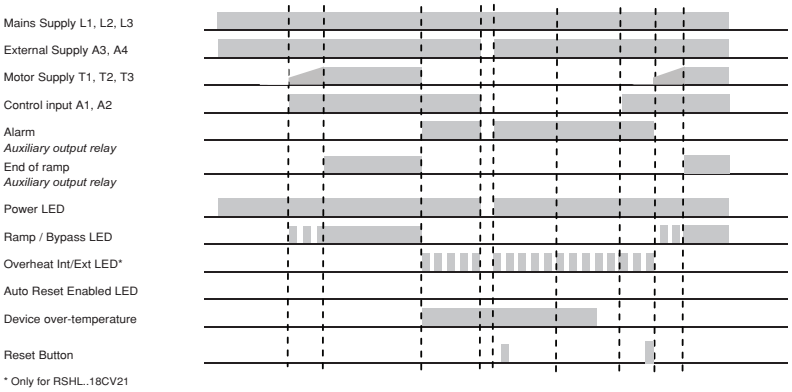
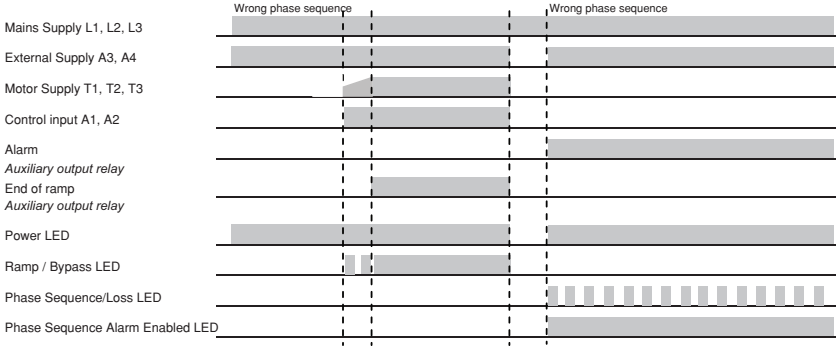



**Diagram 2b: Over-temperature during bypass mode.**




* 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**

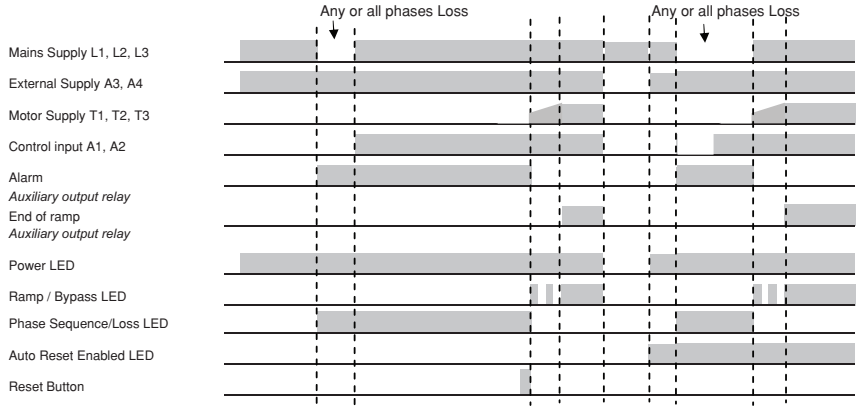



**Diagram 2e: Phase Loss during bypass mode**

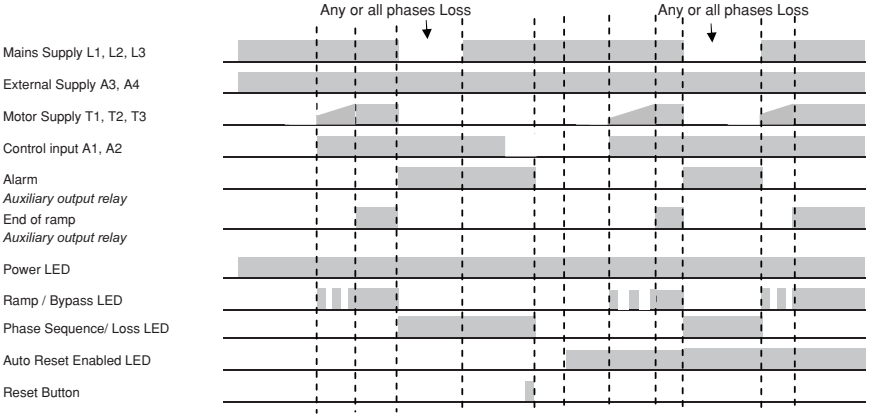
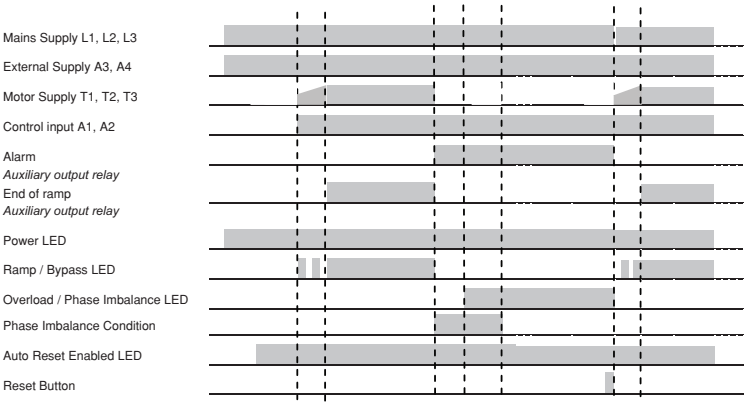


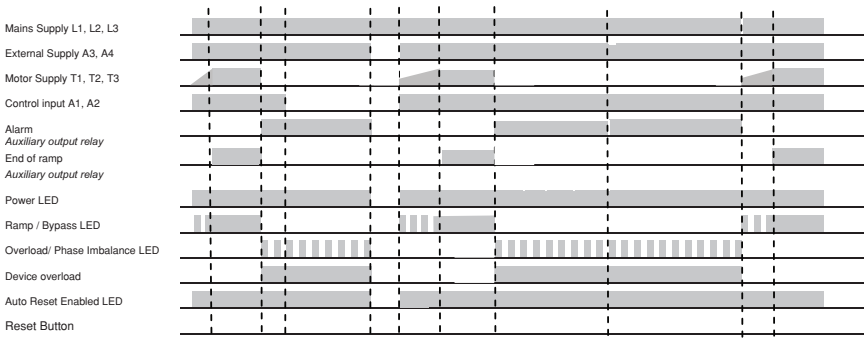

**Diagram 2f: Phase Imbalance while in bypass mode**




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.

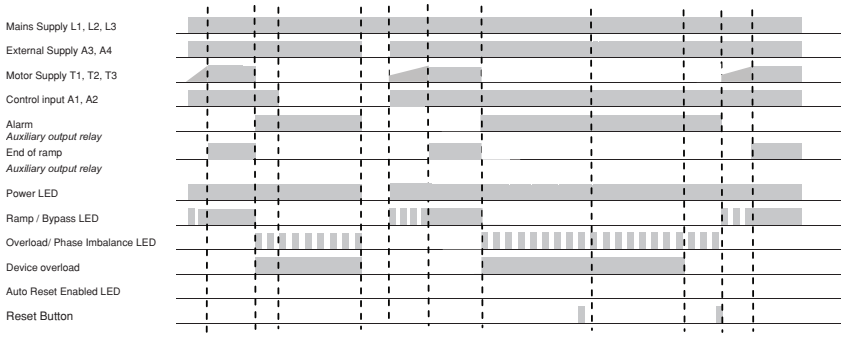
# Timing Diagram (cont.)

**Diagram 2g: Overload alarm (Automatic Reset)**



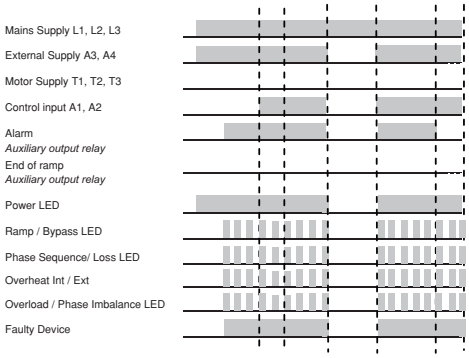

Note:
1. RSHL will only automatically reset Overload and resume normal running when sufficient cooling down time has passed.
2. In case of external supply cycling; user has to make sure that sufficient time for cooling is allowed.
   In case of insufficient cooling time motor and/or device may be damaged.

**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.

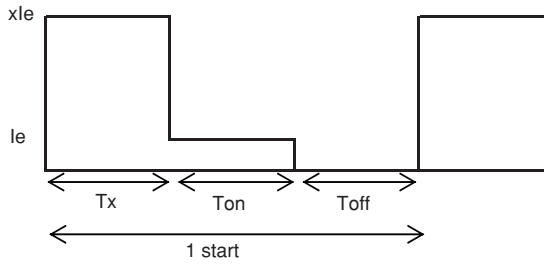
Note 3: Delay time between the moment of pressing the push button until the actual response is 2s.

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

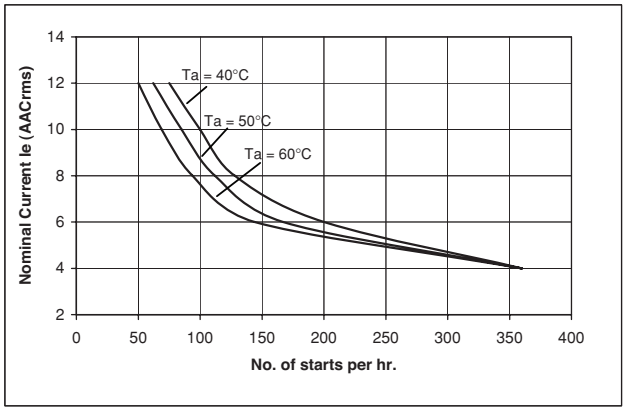



**Table 2: RSHRxxyyCV21,** where xx = 22 or 48, yy = 12 or 18

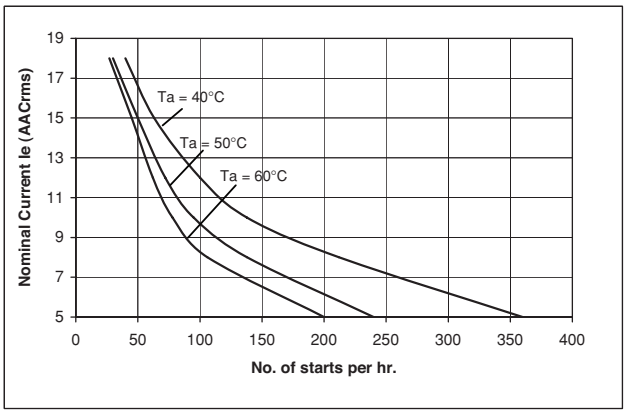
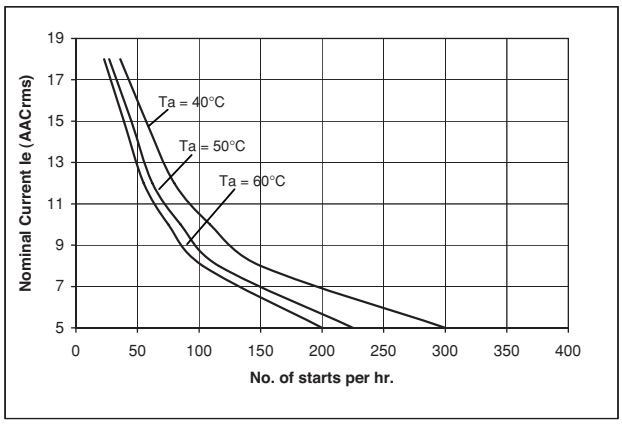



**Table 3: RSHR60yyCV21,** where yy = 02, 05, 12 or 18



# Overload Cycle & Starting Duty (cont.)

**Spacing: 45mm**

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

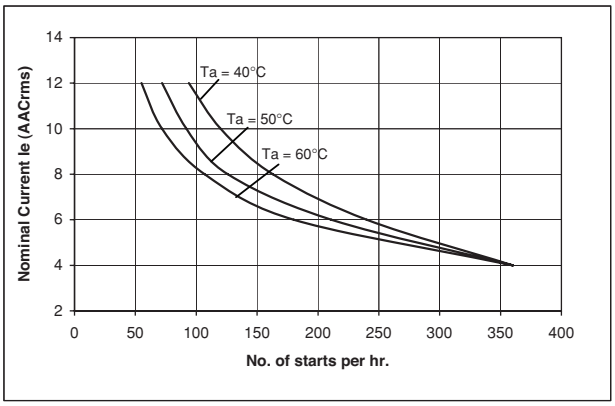



**Table 5: RSHRxxyyCV21,** where xx = 22 or 48, yy = 12 or 18

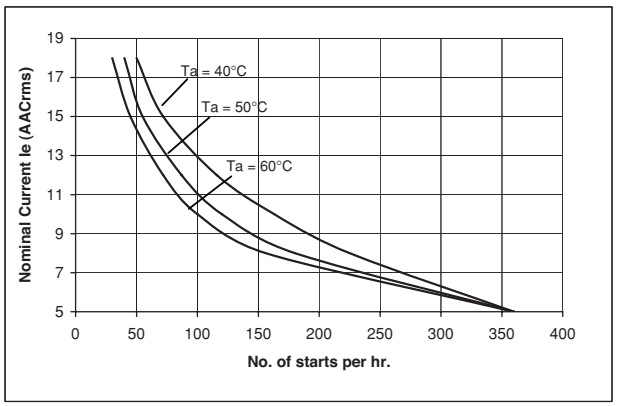
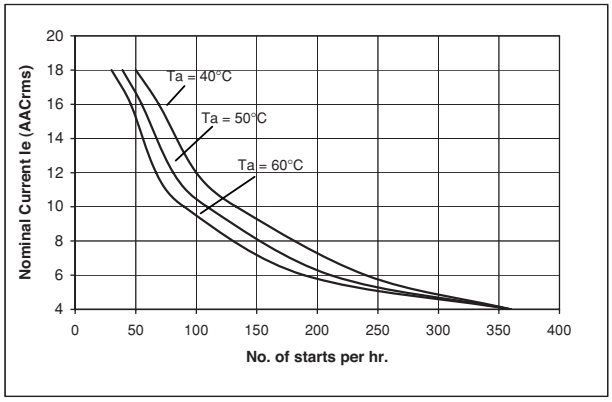



**Table 6: RSHR60yyCV21,** where yy = 02, 05, 12 or 18



## Accessories - External Power Supply 24VDC - SPD 24051

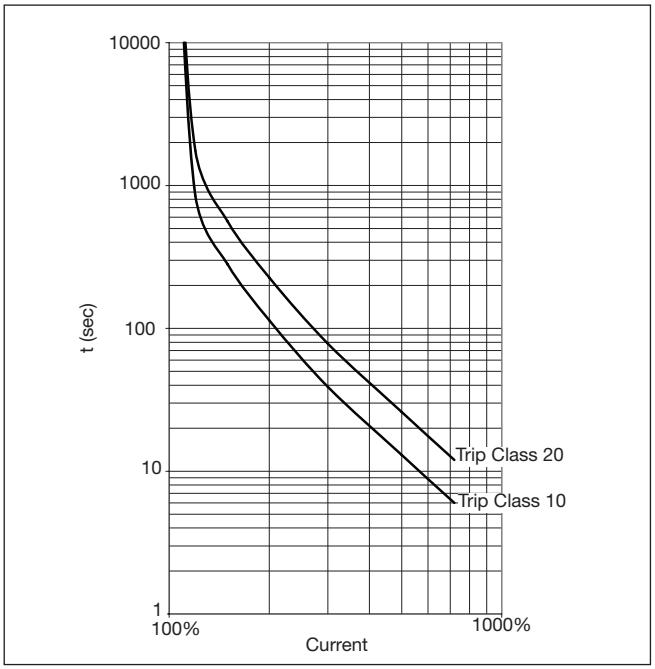
| | | |
|---|---|---|
| Rated input voltage | | 100-240 |
| Voltage range | AC | 90 - 265VAC |
| | DC | 120 - 370VDC |
| Frequency range | | 47 - 63Hz |

| | |
|---|---|
| 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**