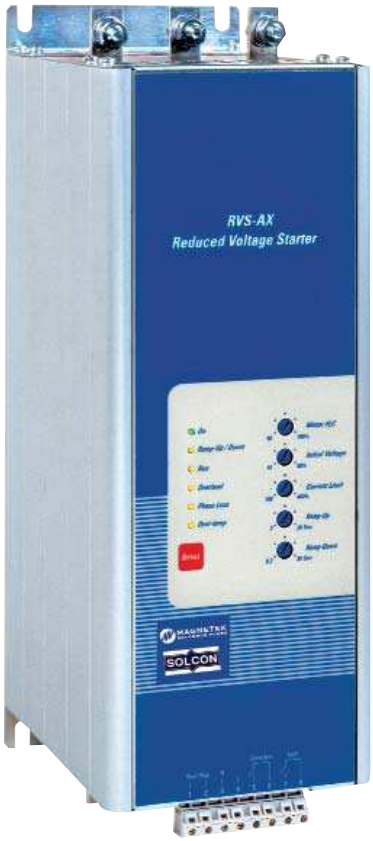

RVS-AX Analog Soft Starter Instruction Manual

MAGNETEK
UNCOMMON POWER

Power Control Systems

April 1, 2004
Part Number: 188-10037

Contents

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DANGER, WARNING, CAUTION and *NOTE* Statements

DANGER, WARNING, CAUTION, and *Note* statements are used throughout this manual to emphasize important and critical information. You must read these statements to help ensure safety and to prevent product damage. The statements are defined below.

DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.

WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTE: A NOTE statement is used to notify people of installation, operation, programming, or maintenance information that is important, but not hazard-related.

Disclaimer of Warranty

Magnetek, hereafter referred to as Company, assumes no responsibility for improper programming of a soft starter by untrained personnel. A soft starter should only be installed by a trained technician who has read and understands the contents of this manual. Improper installation of a soft starter can lead to unexpected, undesirable, or unsafe operation or performance. This may result in damage to equipment or personal injury. Company shall not be liable for economic loss, property damage, or other consequential damages or physical injury sustained by the purchaser or by any third party as a result of such programming. Company neither assumes nor authorizes any other person to assume for Company any other liability in connection with the sale or use of this product.

WARNING

Improper installation of a soft starter can lead to unexpected, undesirable, or unsafe operation or performance.

IMPORTANT

1. Read this manual carefully and follow its instructions before operating equipment.
2. Installation, operation, and maintenance should be in strict accordance with this manual, national codes and good practice. Installation or operation not performed in strict accordance with these instructions will void manufacturer's warranty.
3. Disconnect all power inputs before wiring or servicing the equipment.
4. After installation, verify that no hardware (bolts, washers, etc.) have fallen into the power section.

WARNING

1. Internal components and printed circuit boards are at main potential when the RVS-AX is connected to main power. This voltage is extremely dangerous, and may cause death or severe injury if contacted.
2. The control PCB employs CMOS ICs that are easily damaged by static electricity. Use proper electrostatic discharge (ESD) procedures when handling the control PCB.
3. When the RVS-AX is connected to main power, even if control power is not connected and the motor is stopped, full voltage may appear on the RVS-AX's output terminals.
4. RVS-AX must be grounded to ensure correct operation, safety, and to prevent damage.
5. Power factor capacitors must NOT be connected to the output side of the RVS-AX.

ATTENTION

1. This product was designed for compliance with IEC 947-4-2 for class A equipment.
2. RVS-AX are listed under UL508C.

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c h a p t e r **1**

Introduction

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Overview

The RVS-AX electronic soft starter incorporates six SCR's to start a three phase squirrel cage induction motor by supplying a slowly increasing voltage, providing soft start and smooth stepless acceleration, while drawing the minimum current necessary to start the motor.

Using the soft stop, the RVS-AX slowly reduces the motor voltage, thus softly stopping a high friction load. In applications where the inertia of a load would cause the motor to "free wheel"; the soft stop will not stop the motor any faster than the coast to stop.

Starter Selection

Select the RVS-AX soft starter according to the motor's Full Load Amps. Also consider the following information:

Ambient Temp.	I start	Acc Time
	300% In	30 Sec.
40°C	350% In	20 Sec.
	400% In	5 Sec.

Maximum starts per hour: 4 starts per hour at maximum ratings up to 10 starts/hour for lightly loaded applications.

NOTE: For very frequent starts (inching applications) the inching current should be considered the FLA.

Supply Voltage (Line to Line): +10%–15%

Standard Supply Voltage: 220–240 volts
460–500 volts
575–600 volts

Special Order Voltage: 380–440 volts

(No control voltage required)

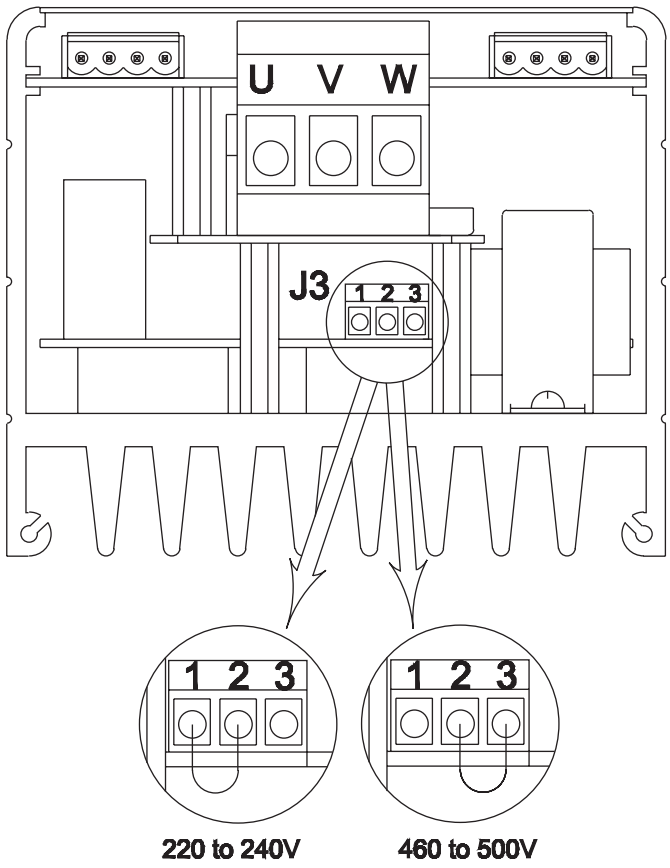
		Model Number	
Max. FLA	**Frame Size**	**230/460 Volts***	**575 Volt**
8	A1	RVS-AX-8-D	RVS-AX-8-E
17		RVS-AX-17-D	RVS-AX-17-E
31		RVS-AX-31-D	RVS-AX-31-E
44		RVS-AX-44-D	RVS-AX-44-E
58	A2	RVS-AX-58-D	RVS-AX-58-E
72		RVS-AX-72-D	RVS-AX-72-E
85	A3	RVS-AX-85-D	RVS-AX-85-E
105		RVS-AX-105-D	RVS-AX-105-E
145	A4	RVS-AX-145-D	RVS-AX-145-E
170		RVS-AX-170-D	RVS-AX-170-E

*Dual rated Soft Starters come pre-set for 460 volts. To set for 230 volts, see "230 volt setup" on the following page.

230 Volt Setup

Dual rated (230/460 volt) RVS-AX soft starters come from the factory set up for 460 volt operation.

For units rated 8 to 44 Amps:
To set the RVS-AX to 230 volt, remove the internal Jumper J3 from terminals 2 and 3, position it across terminals 1 and 2 (as shown below).



For units rated 58 to 170 Amps:
To set the RVS-AX to 230 volt operation, remove jumper J3 from terminals 3 and 4, position it across terminals 4 and 5.

Jumper J3 is located on the control board for RVS-AX units rated 85 to 170 Amps.

c h a p t e r **2**

Installation

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Physical Installation

Location of the RVS-AX is important to achieve proper performance and normal operating life. The unit should be installed in an area where it will be protected from:

- Direct Sunlight, rain or moisture
- Corrosive gases or liquids
- Vibration, airborne dustor metallic particles

When preparing to mount the RVS-AX, lift it by its base, never by the front cover. For effective cooling as well as proper maintenance, the RVS-AX must be installed on a flat, non-flammable vertical surface (wall or panel) using four mounting screws. There must be a minimum of 4.7 in. clearance above and below the RVS-AX for sufficient airflow. A minimum of 1.2 in. clearance is required on each side of the RVS-AX.

The protected chassis is rated to operate over a temperature range of -14°F (-10°C) to +122°F (40°C). Relative non-condensing humidity should not exceed 93%.

Enclosures

If the RVS-AX is to be mounted in a customer supplied enclosure, the heat dissipation should be considered when sizing an enclosure. Since the RVS-AX does have built in bypass after acceleration the watts loss is minimized. The RVS-AX watts loss is approximately 0.4 x the FLA in watts. (example: for a motor of 100A, expect watts loss of the starter for be 40 watts.) Internal enclosure heating can be reduced by using additional ventilation.

Enclosures must be selected to allow surrounding air temperature not to exceed 40°C. Recommended enclosure sizing is given in the table below.

RVS-AX Model	Frame	Enclosure Size
RVS-AX-8	A1	12" x 12" x 6"
RVS-AX-17		12" x 12" x 6"
RVS-AX-31		12" x 12" x 6"
RVS-AX-44		12" x 12" x 6"
RVS-AX-58	A2	20" x 16" x 10"
RVS-AX-72		20" x 16" x 10"
RVS-AX-85	A3	20" x 16" x 10"
RVS-AX-105		20" x 16" x 10"
RVS-AX-145	A4	20" x 16" x 10"
RVS-AX-170		20" x 16" x 10"

CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It may also be used to alert against unsafe practices.

Additional Protection

The RVS-AX should be protected by circuit breaker or fast acting fuses. The 1^2T values of the RVS-AX's SCR's are given in the table below, as well as the recommended circuit breaker sizes.

RVS-AX Amp Rating	RVS-AX I^2T Rating	Circuit Breaker Amp Rating
8	400	15
17	2,000	30
31	3,000	50
44	6,000	75
58	12,000	100
72	18,000	100
85	40,000	150
105	60,000	150
145	100,000	250
170	140,000	250

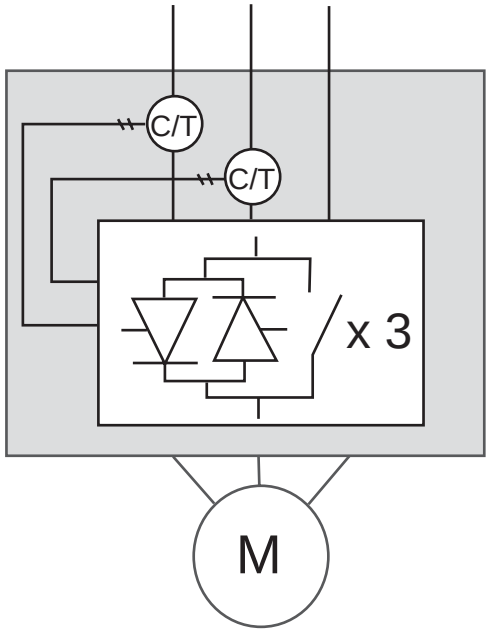
NOTE: When sizing fast-acting fuses, the amp rating of the fuse should be approximately 200% of the RVS-AX FLA.

NOTE: Power factor correction must NOT be installed on the RVS-AX's load side. When required, install the capacitors on the line side.

Built in Bypass After Acceleration

The bypass after acceleration allows the RVS-AX to control the motor during starting and stopping for smooth, step-less acceleration and deceleration. However, once up to full voltage the RVS-AX is bypassed to reduce the watt loss.

The RVS-AX incorporates internal bypass relays allowing current flow through the SCR's only during the soft start process. At the end of the soft start, the built-in relays bypass the SCR's and carry current to the motor. Upon stop signal, or in case of fault, all three bypass relays will open and stop the motor. When the ramp-down potentiometer is set to allow soft stopping, upon stop command, the bypass relays will open immediately and the current will flow through the SCR's. The voltage will then be reduced slowly and smoothly to zero.



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c h a p t e r **3**

RVS-AX Layout and Wiring

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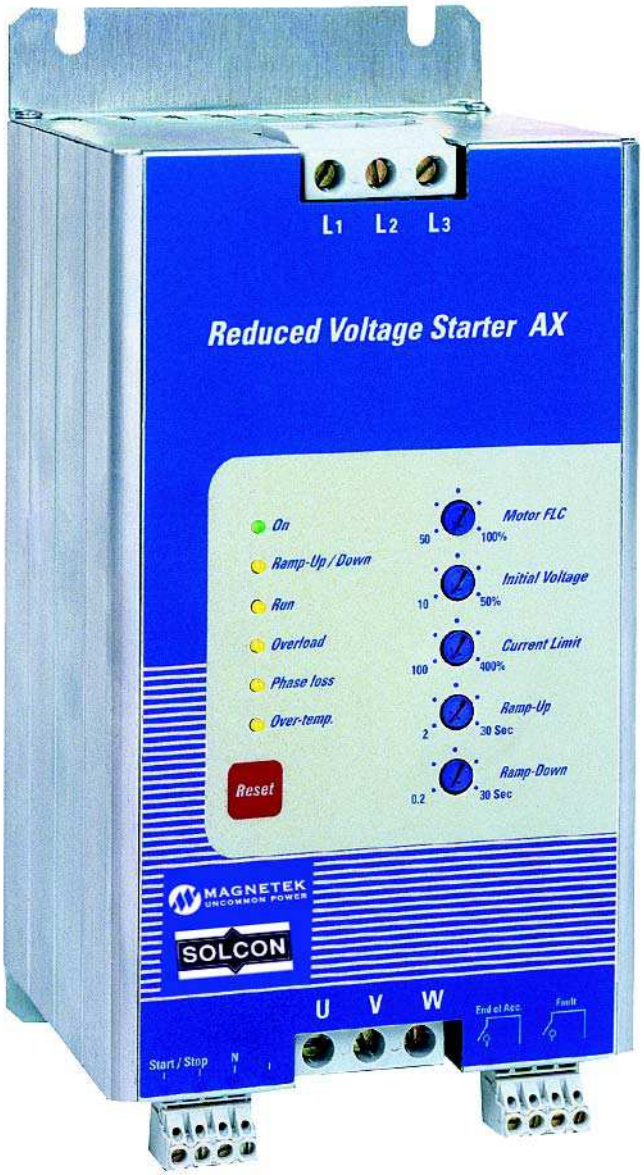
Front Panel Layout

The front panel of the RVS-AX soft starter consists of five potentiometers, six LED's, eight control terminals and a reset button. The front panel is illustrated below.



Control Terminals

Terminal	Function	Description
1 2	Start/Stop	Dry contact. Close terminals 1-2 for start command and open for stop. *(Note 1)* *(DO NOT APPLY VOLTAGE)*
3	Neutral	Neutral wire (when available). Neutral connection is required for Phase Loss protection. *(Note 2)*
4	Open	Do not connect to terminal 4.
5 6	End of Acceleration contact *(Note 3)*	Contact closes after the ramp up time (on "Ramp Up" potentiometer). Contact returns to open position on stop signal, fault, beginning of soft stop and upon voltage outage.
7 8	Fault Contact *(Note 3)*	Contact closes upon any fault and returns to open position (after the fault has been removed) upon reset, or disconnection of main supply voltage.

1. The RVS-AX will soft stop when terminals 1-2 are opened and the "Ramp Down" potentiometer is set.

2. The RVS-AX incorporates an internal control transformer connected to phase L1 and L3, in case of phase loss of L1 or L3 the RVS-AX will stop the motor. In case of phase loss of L2 phase the RVS-AX will trip (if neutral is connected on terminal 3).

3.End of Acceleration and Fault contacts are voltage free, NO, 8A/250VAC, 2000 VA max.

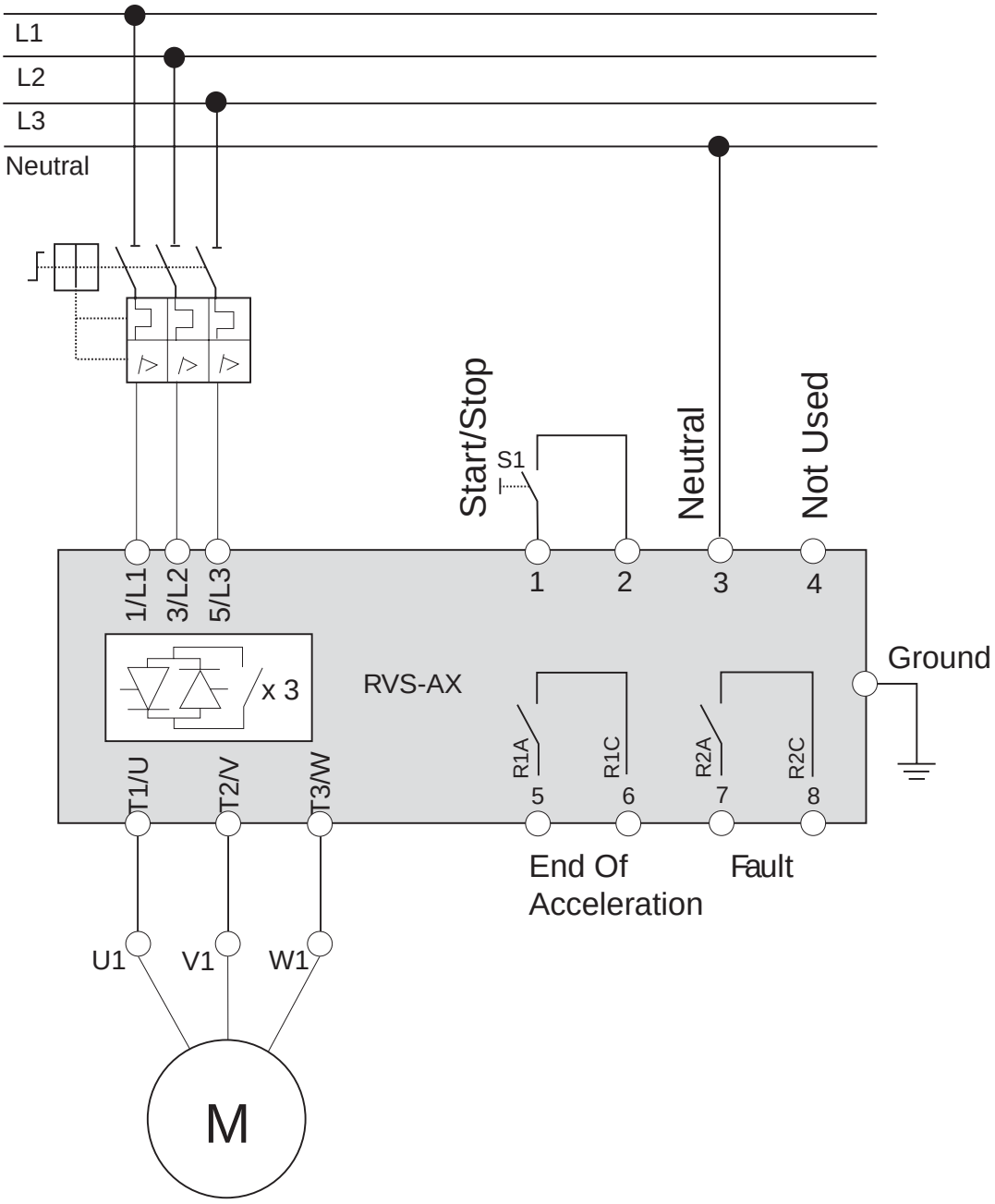
WARNING

Do not use the fault contact to trip an upstream contactor. When the fault contact trips the upstream contactor, main voltage will be disconnected thus resetting the soft starter and the motor will restart immediately upon power being restored.

WARNING

Start/stop with maintained contact. When the line contractor is operated by a maintained contact, if main supply voltage is lost, the motor will automatically restart upon voltage restoration. When resetting after a fault, the motor will restart upon the fault being reset.

Typical Wiring Diagram



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chapter **4**

Features

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Start and Stop Features

The RVS-AX incorporates many features that assist in starting and/or stopping for various applications. These features are described within this section.

Motor Full Load Current

The motor full load current is programmed in as a percentage of the RVS-AX rated current. This adjusts the following features: overload and current limit to match the motor.

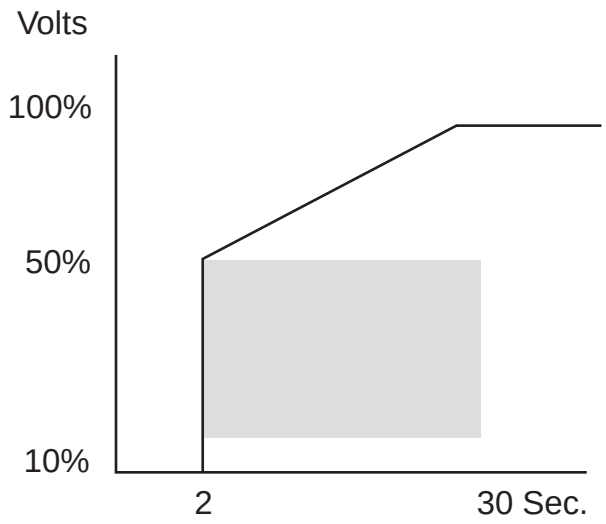
The setting is adjustable from 50 to 100% of the RVS-AX rated current. The Motor Full Load Current (%) potentiometer should be set using the following equation.

$$\text{FLC (\%)} = \frac{\text{Motor rated FLA (x 100)}}{\text{RVS-AX rated FLA}}$$

Initial Voltage

The initial voltage determines the motor's initial torque setting (the torque is directly proportional to the square of the voltage). The initial voltage setting may be set from 10 to 50%. The initial voltage also affects the inrush current and mechanical shock. An initial voltage setting that is too high may cause mechanical shock and high inrush current (Initial voltage setting over-rides the Current Limit setting). An initial voltage setting that is too low may result in a prolonged period of time before the motor begins to turn.

Generally, this setting should cause the motor to begin turning immediately after the start signal, while minimizing mechanical shock and inrush current.

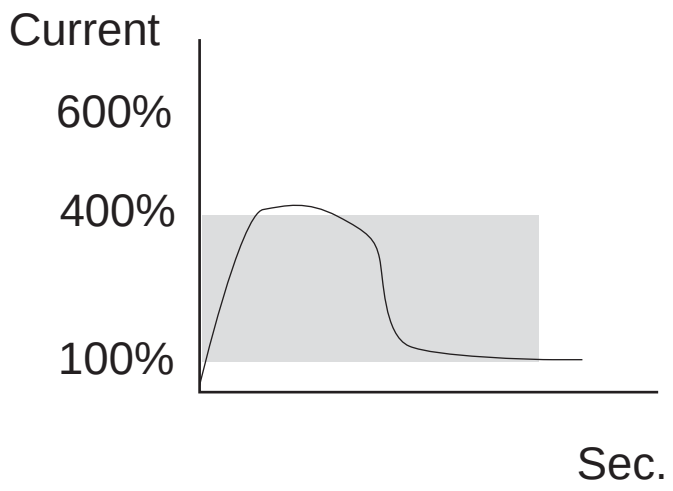


Current Limit

The current limit feature sets the highest current level that will reach the motor during the starting process. The current limit may be set from 100 to 400%. Once the preset current limit value is reached the voltage will level off, and only continue ramping up once the current is below the limit.

If the current limit is set too high, there will be a greater current draw from the main power and a faster acceleration. If the current limit is set too low, the motor may be unable to reach full speed.

Generally this setting should be high enough to start the motor without stalling.



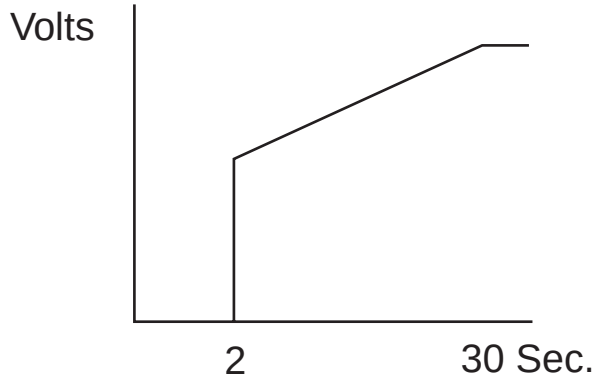
Ramp-Up Time

The ramp-up time determines the motor's voltage ramp up time from initial to full voltage. The ramp-up time can be set from 2 to 30 seconds.

The time it takes the motor to reach full speed may not necessarily be the same as the ramp-up time. The following situations may override the ramp-up time setting.

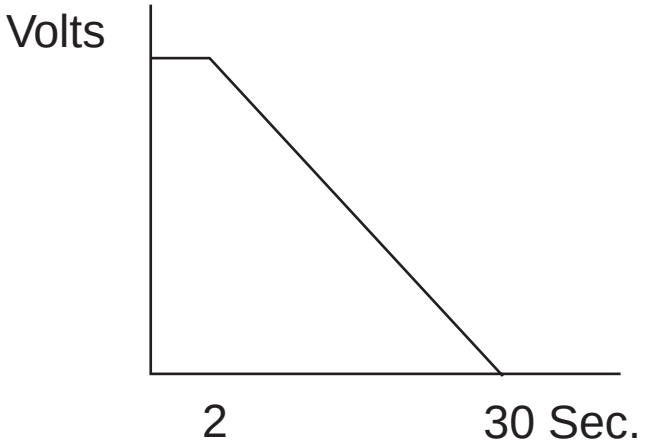
1. Since current limit overrides ramp-up time, setting the current limit low will extend the ramp-up time.
2. When the motor reaches full speed prior to reaching full voltage, ramp-up time is overridden and voltage quickly ramps up to nominal. (This situation is common with lightly loaded motors).

Generally, this setting should be the minimum acceptable time (Approx. 5 seconds).



Ramp-Down Time

The ramp-down time is used for controlled deceleration of high friction loads. When the soft stop is initiated the RVS-AX's output voltage is gradually ramped down. The ramp-down time is adjustable from 0.2 to 30 seconds.



Motor Protection Features

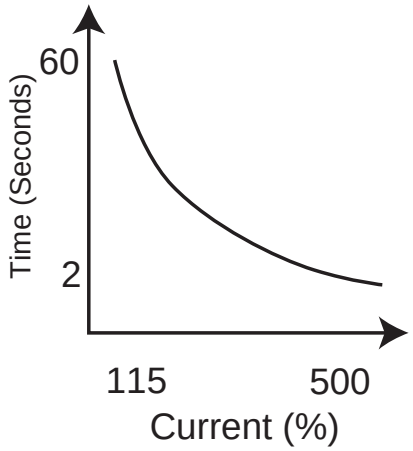
The RVS-AX incorporates motor protection features, which are described in detail below.

Electronic Overload

The inverse time electronic overload becomes operational after the end of acceleration.

The trip current is factory set to 115% of the motor's full load current (as set on the Motor FLC potentiometer.) For example, to increase the O/L trip point, increase the Motor FLC setting above the calculated level.

Tripping time varies from 60 seconds at 150% of nominal current to 2 seconds at 600% of nominal current.



Phase Loss

This protection feature is operational when the starter is energized. It is designed to protect the motor from single phasing. The starter will trip when 1 or 2 phases are missing for more than one second.

NOTE: Phase loss protection is available only when terminal 3 (Neutral) is connected.

Heatsink Over Temperature

The RVS-AX has thermal sensors mounted on the heatsink tripping the starter when the heatsink temperature rises above 85°C.

WARNING

The over temperature protection is designed to operate under normal conditions. The SCR's could overheat and fail before the heatsink reaches 85°C in the following situations: if the starter is run at extended low overload, with insufficient ventilation, sized improperly, started too frequently or started frequently beyond maximum conditions.

Fault Logic, Alarm and Reset Circuits

When any of the above protections cause the starter to trip, it locks in a fault condition and disables the SCR firing. The proper fault indication LED illuminates and the fault contact closes (on terminals 7 and 8).

The fault may be reset once the fault condition has cleared:
- by pressing the 'Reset' button on the front panel
- by cycling power to the RVS-AX.

CAUTION

When the motor is operated by a maintained contact, resetting the fault will start the motor immediately.

WARNING

Do not use a fault contact to trip an up stream contactor. When the fault contact closes upon fault and trips the up stream contactor, main power will be disconnected, thus resetting the RVS-AX and the motor will restart immediately.

Short Circuit Protection

The RVS-AX should be protected against a short circuit by fast acting (semi-conductor) fuses. See recommended 1^2T ratings on page 2-3.

Transient Protection

Line transient voltages can cause malfunction of the RVS-AX and damage to the SCR's. When transients are expected, additional external protection should be used (MOV's–Metal Oxide Varistors).

WARNING

When main voltage is connected to the RVS-AX, even if start signal is not given, full voltage may appear on the RVS-AX load terminals. Therefore, for isolation purposes it is recommended to connect an isolation device (circuit breaker, disconnect switch, input contactor, etc.) in series with RVS-AX.

NOTE: When power factor correction capacitors are used, they must be installed on the soft starter line side.

c h a p t e r **5**

Start-Up Procedure

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Start-up Procedure

1. Set Motor Full Load Current (%) according to the following calculation:

$$FLC = \frac{\text{Motor Rated Current (x100)}}{\text{RVS-AX Rated Current}}$$

2. Set the front potentiometers as follows:
   Current Limit = 350%
   Initial Voltage = 40%
   Ramp-up Time = 5 Sec.
3. Connect main voltage to RVS-AX line terminals and motor leads to RVS-AX load terminals. (Also, connect the neutral to terminal 3, if available.)
4. Connect start/stop circuitry per drawing on page 3-5 for typical wiring. DO NOT connect power to terminals 1 and 2. The RVS-AX start/stop control requires a dry contact.
5. Give a start command. If motor starts to turn shortly after the start signal proceed to #6. If the motor does not begin turning, increase the “Initial Voltage” and press start again. When starting if initial inrush and mechanical shock are too high, decrease “Initial Voltage” setting and proceed to #6.
6. Motor has begun to turn. If the motor accelerates smoothly to full speed, proceed to #7. If the motor does not accelerate to full speed, increase the current limit setting. If current during accelerations is too high, slightly decrease the current limit setting.
7. Give a stop command (open terminals 1 and 2) and wait until the motor stops.
8. Slightly increase the “Initial Voltage” and “Current Limit” settings to allow for load changes.
9. Start the motor again, to verify that the motor acceleration process to full speed is as required.
10. If acceleration time is too short, increase “Ramp-up Time” setting as required.

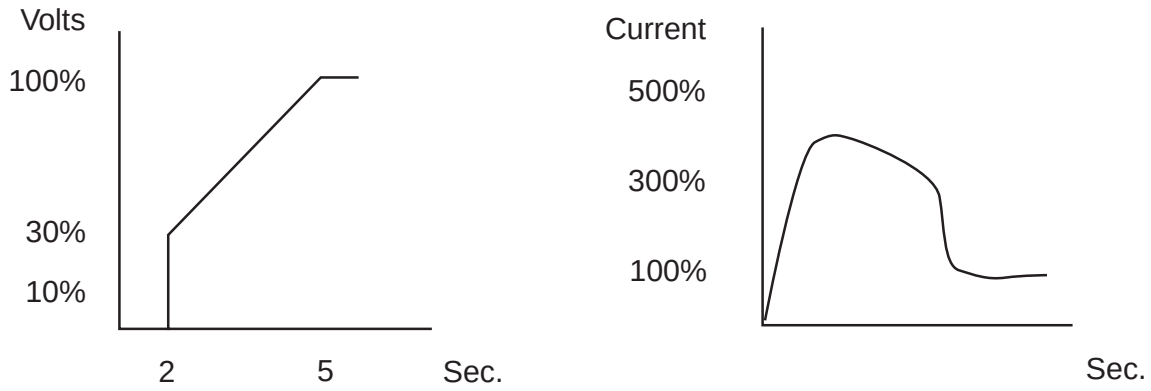
When soft stop is required, set the Ramp-down potentiometer to the required time (minimum allowable deceleration time is recommended) and check that soft stopping process is as required.

NOTE: If ramp down potentiometer is not at the minimum setting. Emergency stop may be performed by disconnecting main power.

Examples of Starting Curves:

Variable torque load (Fan, Pump, etc.)

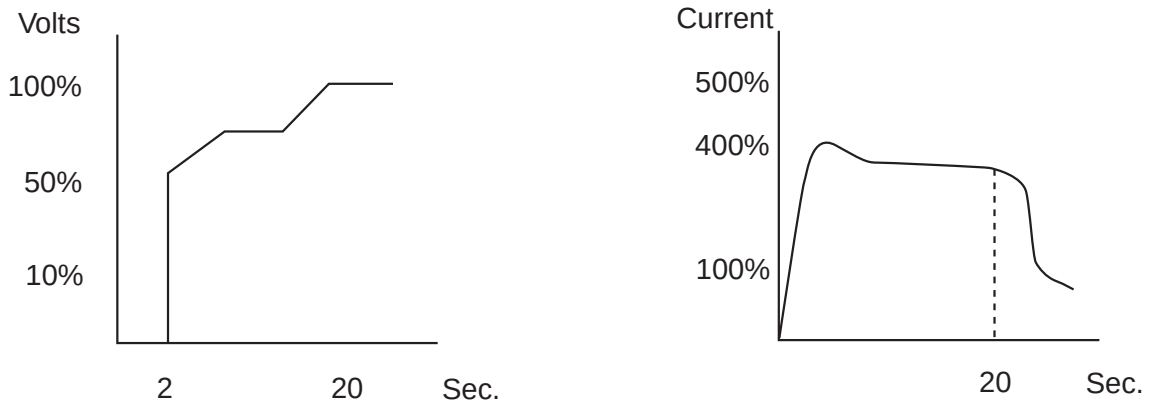
Current Limit = 300%
Initial Voltage = 30%
Ramp-Up Time = 5 Seconds



Voltage quickly increases to initial voltage setting (30% main power) and then gradually ramps up to nominal. The current will simultaneously increase to peak current value, which can be the current limit setting or less, before smoothly decreasing to the operating current. The motor will quickly and smoothly accelerate to full speed.

High Inertia Load (Compressors, Crushers, Centrifuges, etc.)

Current Limit = 400%
Initial Voltage = 50%
Ramp-Up Time = 10 Seconds



Voltage quickly increases to the initial voltage setting (50% main power), and then voltage and current increase until current gradually reaches current limit value. Voltage is held at this value until the motor approaches full speed, where current starts to decrease, after which voltage continues to ramp-up to nominal. The motor has smoothly accelerated to full speed.

chapter **A**

Technical Specifications/ Dimensional Drawings

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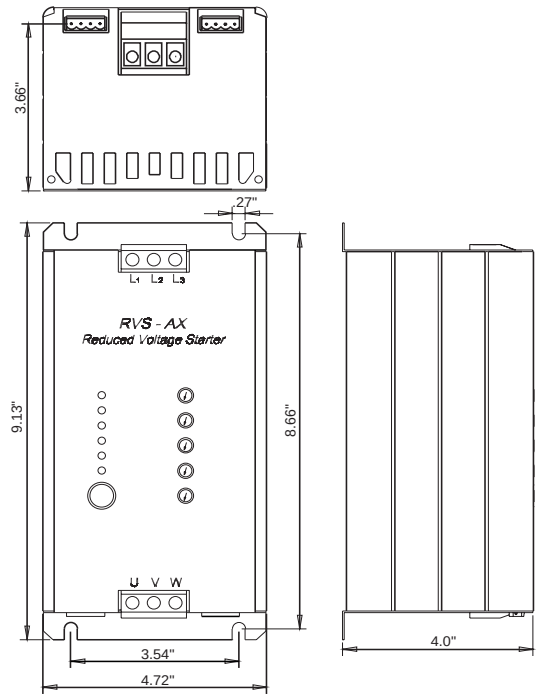
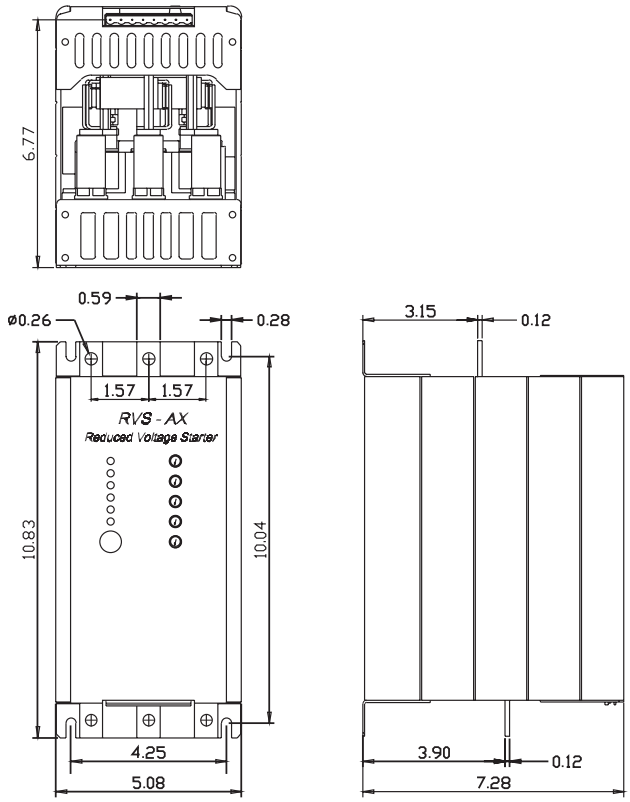
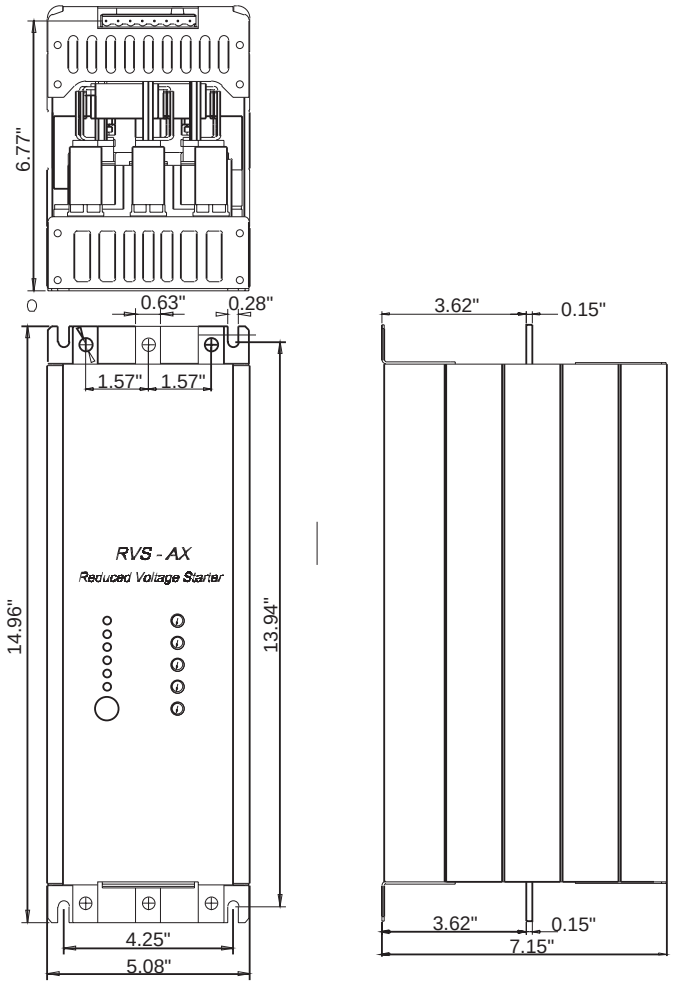


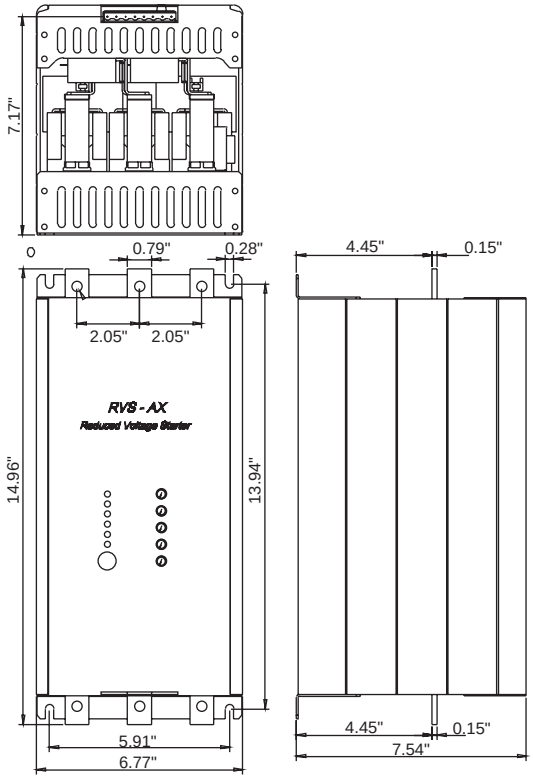
RVS-AX 8-44 Amp



RVS-AX 58-72 Amp



RVS-AX 85-105 Amp



RVS-AX 145-170 Amp

RVS-AX Frame Size	Width (in.)	Height (in.)	Depth (in.)	Weight (lb.)
A1 (8-44 Amps)	4.72	9.13	4.02	5.7
A2 (58-72 Amps)	5.08	10.83	7.28	11
A3 (85-105 Amps)	5.08	14.96	7.15	18
A4 (145-170 Amps)	6.77	14.96	7.54	26

Technical Specifications

Environment		
Supply Voltage	Three phase, line to line, 460–575 Vac +10% -15%* 575–600 Vac +10% -15%	* 460 Vac is applicable for 230 Vac by changing the position of the internal jumper–J3 as shown on page 1-4.
Frequency	50/60 Hz	
Load	Three-Phase, Three-Wire, Squirrel Cage Induction Motor	
Degree of protection	IP20	
Altitude	1000 m above sea level	Consult factory for de-rating
Adjustments		
FLC (Full Load Current)	50%-100%	
Starting Torque (Initial Voltage)	10%-50% of full voltage	
Current Limit	100%-400% of nominal current	
Ramp Up Time (soft start)	2-30 sec.	
Ramp Down Time (soft stop)	0.2-30 sec.	
Protection		
Electronic Overload	Inverse time (I^2t), factory preset at 115% of FLC, active only during Run.	
Phase Loss	Trips when one phase is missing (when neutral is connected).	
Heatsink Over Temperature	Trips when the heatsink temperature exceeds 85°C.	
Reset Buttons	To reset the starter, after the fault has been removed.	
Indications		
Indication Lights (LEDs)	ON–Green	Lights when three phases are connected to the RVS-AX.
	Ramp Up/Ramp Down–Yellow	Lights upon start signal or during soft stopping.
	RUN–GREEN	Lights upon end of starting; when the internal bypass relays close.
	Overload–Red	Inverse time electronic overload becomes operational after the End of Acceleration process.
	Phase Loss–Red	Lights when one or two phases are missing for more than 1 sec.
	Over temperature–Red	Lights on and trips the starter when the heatsink temperature rises above 85°C.
Temperatures		
Operating	-10° to 40°C	
Storage	-20° to 70°C	
Relative humidity	93%–non condensed	
EMC		
Immunity to radio electric interference	EN 1000-4-3 level 3	Conforming to EN 60947-4-2
Electrostatic discharge	EN 1000-4-2 level 3	Conforming to EN 60947-4-2
Immunity to electrical transients	EN 1000-4-4 level 4	Conforming to EN 60947-4-2
Shock waves of voltage/current	EN 1000-4-5 level 3	Conforming to EN 60947-4-2
Radiated and conducted emissions	EN 1000-4-6 level 3	
Radio frequency emissions	According to EN 55011 Class A	Conforming to EN 60947-4-2
Mechanical		
Shock resistance	8 gn	Conforming to EN 60947-4-2
Vibration resistance	2 gn	Conforming to EN 60947-4-2
Output relay		

Environment	
End of Acceleration	N.O.
Rated Operating Current	5 A, 250V–Size A1 8 A, 250V–Size A2

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