Cutler-Hammer Intelligent Technology (IT.) S801 Soft Starter

User Manual

The Cutler-Hammer Intelligent Technology Soft Starter

EATON | Cutler-Hammer
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Catalog No. S801USERMAN
Rev. K

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Safety

Cutler-Hammer has made every effort to provide you with the safest motor starters on the market. However, we wish to point out how to safely operate and troubleshoot your starter.

The Meaning of Safety Statements

You will find various types of safety information on the following pages and on the labels attached to the equipment. This section explains their meaning.

The Safety Alert Symbol means ATTENTION!
BECOME ALERT! YOUR SAFETY IS INVOLVED!

Le symbole d'alerte signifie ATTENTION!
SOYEZ VIGILANT! VOTRE SECURITE EST EN JEU!

⚠ Danger	⚠ Danger
Danger means that failure to follow the safety statement ***will*** result in serious personal injury, death, or substantial property damage.	**Danger** signifie que l'inobservation de l'énoncé relatif à la sécurité ***entrainera*** des blessures corporelles graves ou mortelles.

⚠ Warning	⚠ Avertissement
Warning means that failure to follow the safety statement ***could*** result in serious personal injury, death, or substantial property damage.	**Avertissement** signifie que l'inobservation de l'énoncé relatif à la sécurité ***pourrait*** entraîner des blessures corporelles graves ou mortelles, ou des dommages matériels importants.

⚠ Caution	⚠ Attention
Caution means that failure to follow the safety statement ***may*** result in minor or moderate personal injury or property damage.	**Attention** signifie que l'inobservation de l'énoncé relatif à la sécurité ***peut*** entraîner des blessures corporelles mineures ou moderees ou des dommages matériels.

Notice	Avis
Notice means that failure to follow these instructions ***could*** cause damage to the equipment or cause it to operate improperly.	**Avis** signife que l'inobservation des presentes directives ***pourrait*** causer des dommages a l'equipement ou en provoquer le mauvais fonctionnement.

IT. Soft Starter Safety Statements

The following safety statements relate to the installation, operation, and troubleshooting of Cutler-Hammer Motor Starters.

Notice	Avis
Make sure you read and understand the installation procedures in this manual **before** you attempt to operate or troubleshoot the equipment.	Lire et bien comprendre les methodes de montage de ce manuel avant de faire fonctionner cet equipement ou de proceder au depannage.

⚠ Warning	⚠ Avertissement
The instruction manual should be used for proper installation, operation, and maintenance of the equipment. Improperly installing and maintaining these products can result in serious personal injury or property damage. Before attempting installation or maintenance, read and understand this entire manual.	Consulter la notice pour l'installation, le fonctionnement et l'entretien de l'equipement. Use mauvaise installation et un entretien inadequat peuvent causer des blessures graves et des dommages materials. Avant de proceder a l'installation et a l'entretien, bien lire et comprendre cette notice.

⚠ Danger High Voltage	⚠ Danger (Haute tension)
There can be line voltage potential at the motor load terminals even with the starter in the off state. This is due to the possible leakage across SCRs. Always disconnect input power before servicing starter or motor.	Il peut exister une tension de ligne aux bornes du côté charge du moteur bien que le moteur soit arrêté. Cela s'explique du fait de fuites possibles à travers les redresseurs au silicium. Toujours débrancher l'alimentation avant d'effectuer des travaux sur le démarreur ou le moteur.

Notice	Avis
Power factor capacitors: Do not connect power factor correcting capacitors to the load side of the starter. They will cause the starter to fail. If capacitors are used, they must be connected to the line side of the starter, as far upstream as possible.	Condensateurs de compensation: ne pas raccorder ces appareils du côté charge du démarreur. Cela entraînera la défaillance du démarreur. Raccorder tout condensateur du côté ligne du démarreur, aussi loin amont que possible.

Introduction

The Intelligent Technologies *IT.* Soft Starter is an electronic, self-contained, panel- or enclosure-mounted motor soft-starting device. It is intended to provide 3-phase induction motors with a smooth start, both mechanically and electrically. The *IT.* line of soft starters utilizes six thyristors connected in a full wave power bridge. Varying the thyristor conduction period controls the voltage applied to the motor. This in turn controls the torque developed by the motor. After the motor reaches speed, contacts are closed to bypass the thyristors.

The Intelligent Technologies *IT.* Soft Starter is designed to fulfill the industrial service requirements for applications such as Chillers, Pumps, and Machine Tools that require less than 85% if the motor's rated starting torque for worst case starting condition.

The Intelligent Technologies *IT.* Soft Starter meets all relevant specifications set forth by NEMA ICS 1, ICS 2 and ICS 5, UL 508, IEC 60947-4-2, CE, and CSA.

This user manual covers everything you need to know in order to install, set up, operate, troubleshoot and maintain the *IT.* Soft Starter.

However, no publication can take into account every possible situation. If you require further assistance with any aspect of this product, or a particular application, feel free to contact us. You will find our address, phone number, and other contact information on the back cover of this manual.

General Appearance Notes

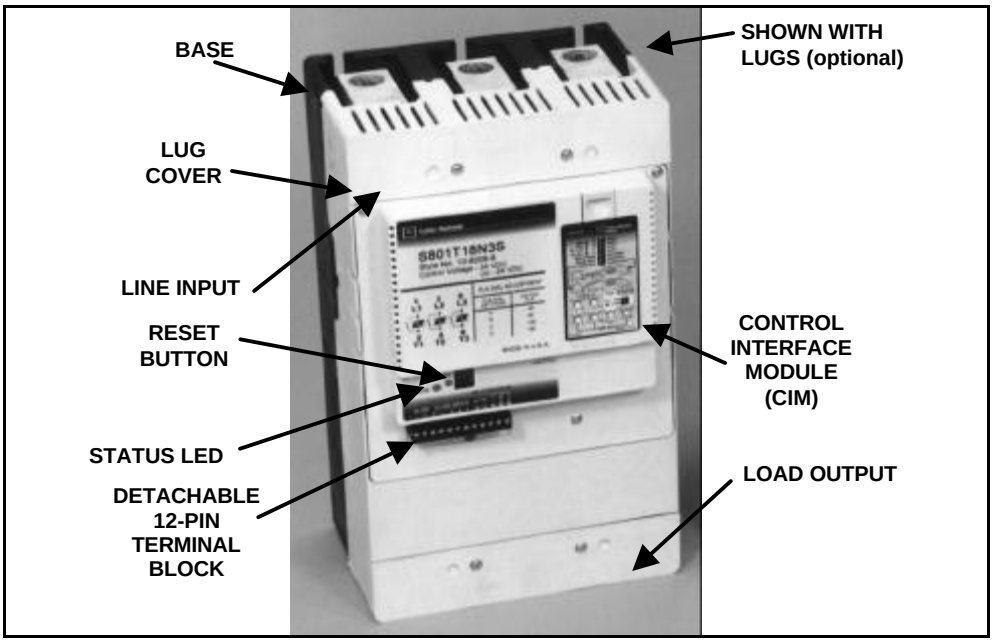


Figure 1: The Cutler-Hammer Intelligent Technologies (IT) Soft Starter

- The Control Interface Module (CIM) is mounted on the face of the unit.
- The base supports the soft starter and all internal and external components.
- The lug cover (T and V frames only) reduces the chance of accidental contact with live cabling.
- The 12-pin terminal block is detachable for easy wiring.

Inspection

General

Upon receipt of the unit, verify that the catalog number and unit options stated on the shipping container match those stated on the order/purchase form.

Inspect the equipment upon delivery. Report any crate or carton damage to the carrier prior to accepting the delivery. Have this information noted on the freight bill. Cutler-Hammer is not responsible for damage incurred in shipping.

Unpacking

Remove all packing material from the unit. Be sure to remove all packing material from lug locations. Also, make sure no packing material blocks the airflow near the fans. For V frame units, verify mounting hardware has been included with shipment.

Check the unit for any signs of shipping damage. If damage is found after unpacking, report it to the freight company. Retain the packaging materials for carrier to review.

Verify that the unit's catalog number and options match those stated on the order/purchase form.

Storage

It is recommended that the unit be stored in its original shipping box/crate until it is to be installed.

The unit should be stored in a location where:

- The ambient temperature is between -50°C and 70°C (-58°F and 158°F)
- The relative humidity is between 0% and 95%, non-condensing
- The environment is dry, clean, and non-corrosive
- The unit will not be subjected to high shock or vibration conditions

Mounting

Size

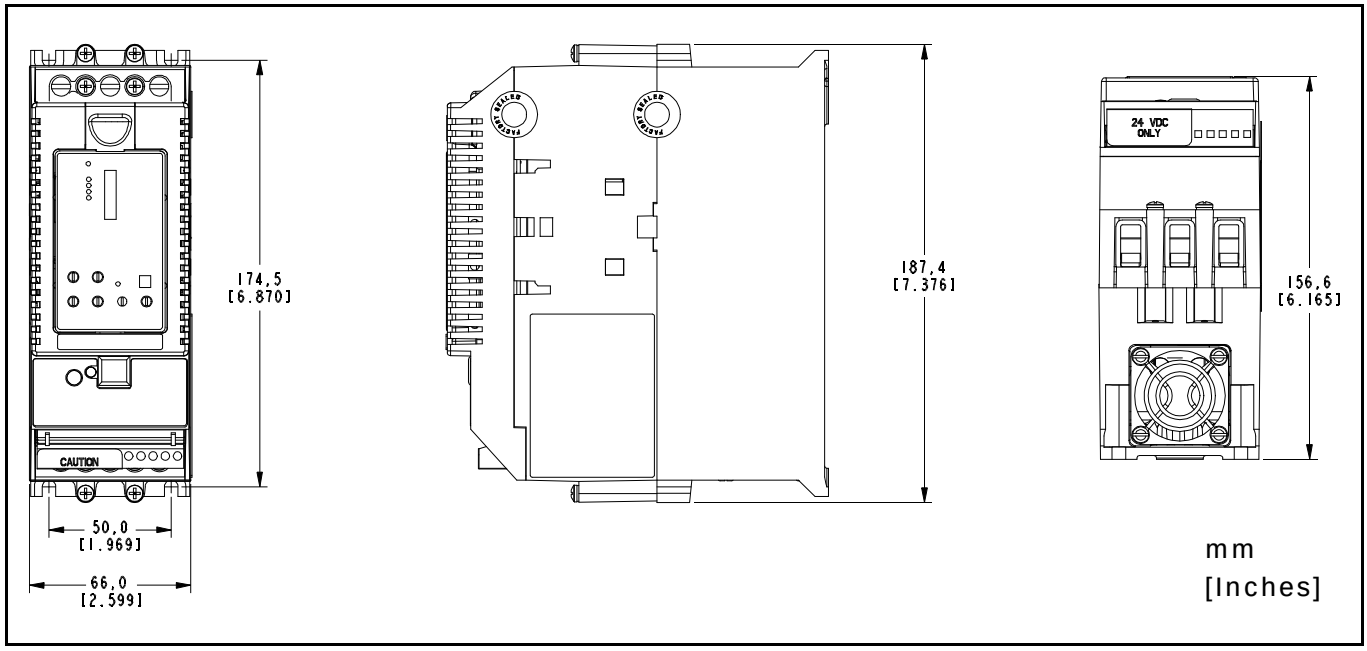


Figure 2: N Frame

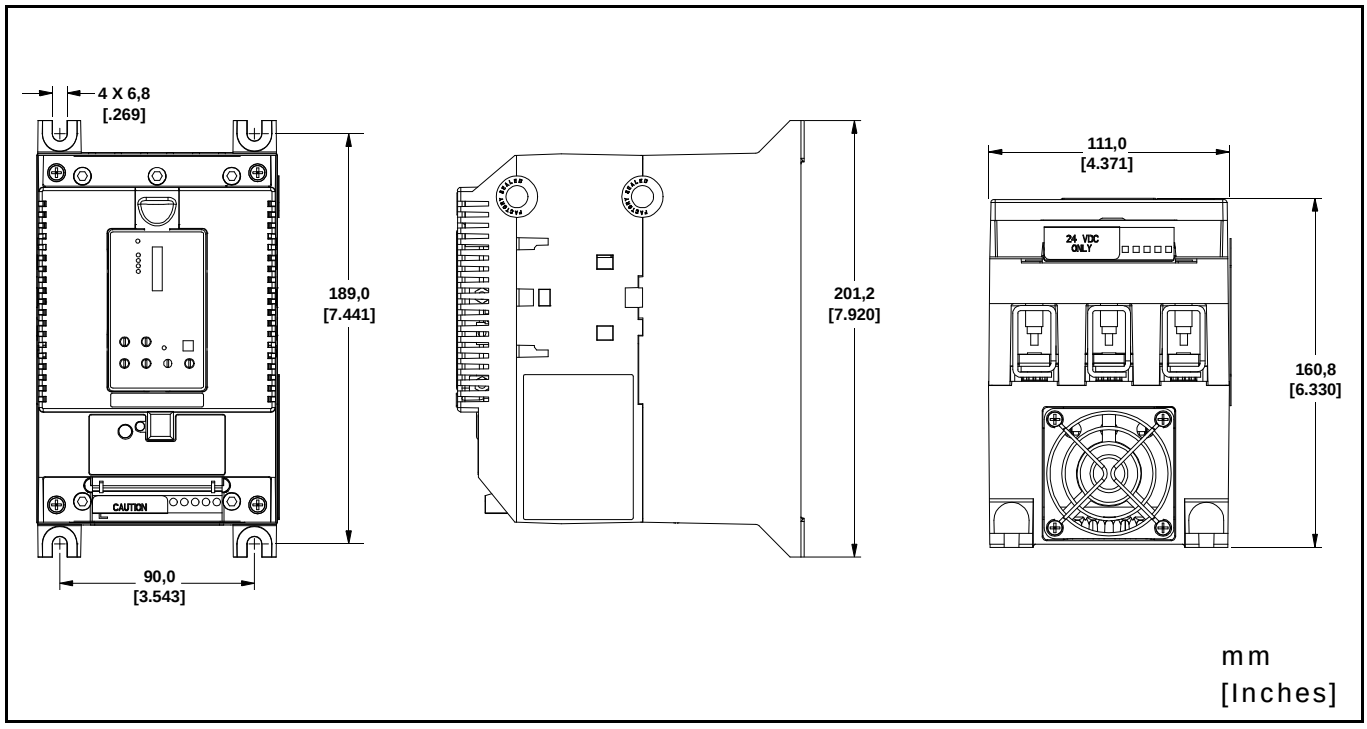


Figure 3: R Frame

Size (continued)

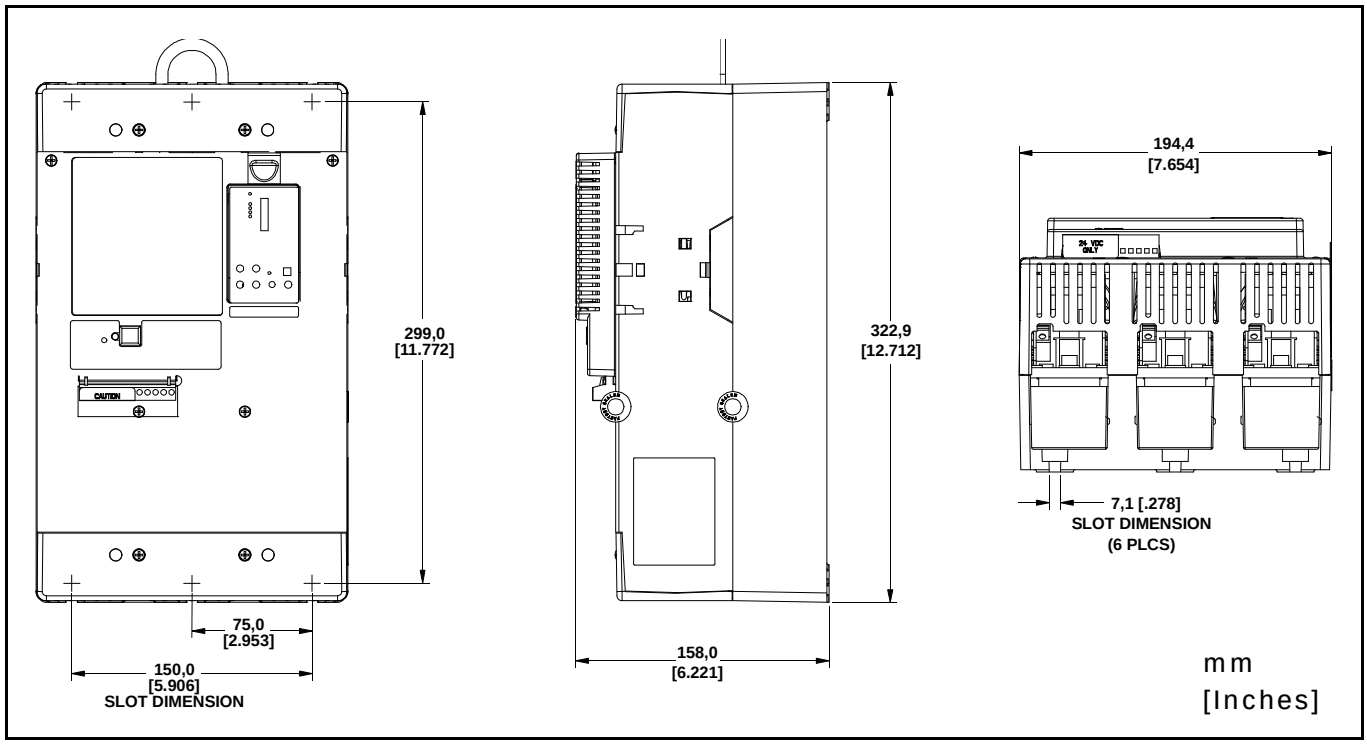


Figure 4: T Frame

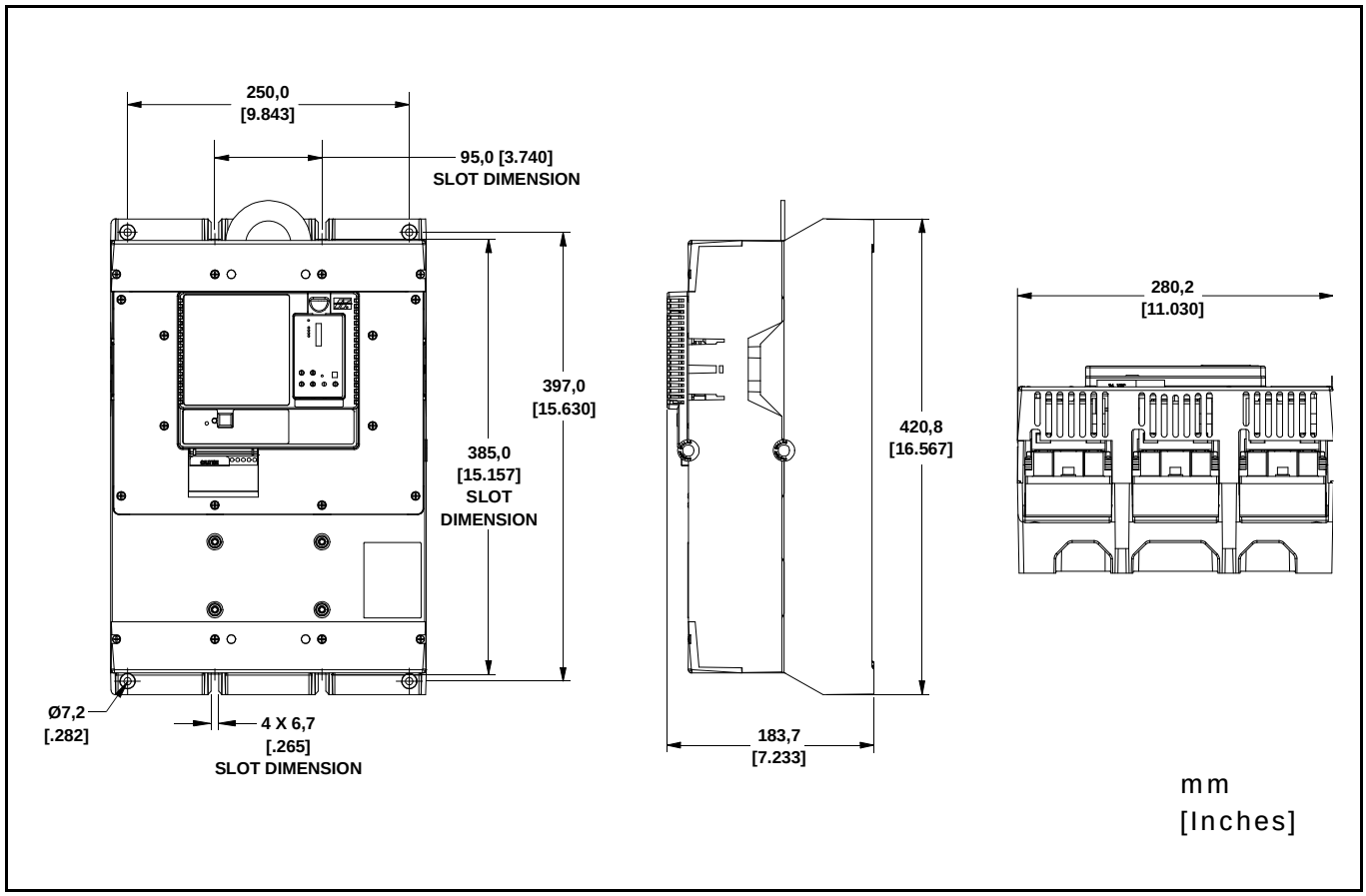


Figure 5: V Frame

Required Mounting Hardware

Frame Size	Screw Size	Washer Size	Quantity Required	Torque Required
N	#10 – 32 x 0.5	Standard #10 Lockwasher and Flat Washer	4	1.7 N-m (15 LB-IN)
R	1/4 – 20 x 0.625	Standard 1/4 Lockwasher and Flat Washer	4	2.8 N-m (25 LB-IN)
T	1/4 – 20 x 0.625	Standard 1/4 Lockwasher and Flat Washer	6	3.4 N-m (30 LB-IN)
V	1/4 – 20 x 1.5 Grade 8 Allen head hex cap screws	Quantity: 4 ID: 0.270 OD: 0.495-0.505 Max. 0.055 Thick	8	5.6 N-m (50 LB-IN)
		Quantity: 4 Special Washer		
	Included with V frame units			

Weight Support Requirements

Frame Size	Weight of Unit
N	2.6 Kg (5.8 pounds)
R	4.8 Kg (10.5 pounds)
T	21.8 Kg (48 pounds) with lugs
	18.6 Kg (41 pounds) without lugs
V	46.8 Kg (103 pounds) with lugs
	41.4 Kg (91 pounds) without lugs

Environmental Requirements

Operating Temperature Range	-40°C to 50°C (-40°F to 122°F)
Storage Temperature Range	-50°C to 70°C (-58°F to 158°F)
Elevation	Up to 2000 meters (6600 feet). Above 2000 meters, derate 0.5% per 100 meters (330 feet)
Humidity	Functional to 95% non-condensing
Operating Orientation	Any
Pollution ºree IEC 60947-1	3
Shock Resistance	15g in any direction
Vibration Resistance	3g in any direction

Mounting Instructions for Models S801N, S801R and S801T

The IT Soft Starter is easy to mount. It does not require any special tools.

To aid you with panel layout, refer to the dimension drawings on pages 9 and 10 of this manual. Drill and tap holes per mounting hole location as shown.

To mount the unit, use all the hardware specified in the chart on page 11. Tighten to the torque specified.

The T frame Soft Starter is supplied with a lifting eye mounted on the center phase of the line end of the device. This will aid in mounting the unit.

⚠ Warning	⚠Avertissement
After mounting the T frame unit, remove and discard the lifting eye and packaging bolts before continuing with the installation process.	Enlever et jeter les oeillets de levage et les boulons de l'emballage avant de poursuivre l'installation.

Mounting Instructions for Model S801V

⚠ Caution	⚠ Attention
The S801V soft starter weighs approximately 45 kg (100 pounds). To prevent personal injury or equipment damage, use proper lifting equipment (such as a floor crane) to safely lift and install the soft starter. A lifting eye is provided at the line end of the soft starter.	Le démarreur S801V pèse environ 45 kg (100 livres). Pour éviter les blessures personnelles et les dommages matériels, utiliser un matériel de levage approprié (comme un grue roulante d'atelier) pour soulever et installer le démarreur de façon sécuritaire. Un oeillet de levage est prévu du côté ligne du démarreur.
Notice	**Avis**
The soft starter includes mounting hardware (8 1/4-20 x 1.5" Allen hex head cap screws and special washers). Do not substitute for this hardware. See Figure 5 on page 10 for panel hole locations. Applicable codes or standards must be considered before locating and mounting the soft starter. The four special rectangular/ rounded washers must be used on the two innermost mounting holes on both the line and load side of the soft starter.	Le démarreur à tension réduite inclut des ferrures de montage (vis à tête hexagonale 8-1/4-20 x 1,5 po et des rondelles spéciales). Ne pas utiliser d'autres ferrures. Consulter la Figure 5 de la page 10 pour la position des trous dans le panneau. Tenir compte des normes et des codes existants avant de localiser et de monter le démarreur à tension réduite. Fixer les 4 rondelles rectangulaires/ arrondies spéciales aux 2 trous de montage les plus à l'intérieur, des côtés ligne et charge du démarreur à tension réduite.

continued on next page…

Mounting Instructions for Model S801V (continued)

Drill and tap the eight mounting holes. Thread the two lower middle screws (with special flat washer and lock washer) into the panel before lifting the soft starter. These two screws will assist in mounting. Special mounting hardware is included with the soft starter. Hardware supplied must be used.

Hook lifting equipment to the soft starter lifting eye. If you are using a hydraulic crane, minimize the chain length between the boom and the soft starter. Make sure that the back of the soft starter is oriented to the panel-mounting surface. Make sure that the lifting equipment hook is fully engaged with the soft starter lifting eye before lifting.

Slowly lift the soft starter to about 5 cm (2 inches) above the mounting location. Then move it back against the mounting panel. Carefully lower the soft starter onto the two mounting screws. Make sure the screws align with the slots on the load end of the soft starter, and that the two washers are between the soft starter base and the screw head.

Install and tighten the remaining six mounting screws, washers and lockwashers. Then tighten the two lower middle screws. Tighten all eight screws to 5.6 N-m (50 LB-IN).

Disengage and remove the lifting equipment.

⚠ Warning	⚠Avertissement
After mounting the unit, remove and discard the lifting eye and packaging bolts before continuing with the installation process.	Enlever et jeter les oeillets de levage et les boulons de l'emballage avant de poursuivre l'installation.

Figure 6

Power Wiring

Safety Notices

	**⚠ Danger** Hazard of Burn or Electrical Shock	**⚠ Danger** Risque de Brulure ou Electriques de Choc

	**⚠ Danger** To avoid shock hazard, disconnect all power to the controller, motor, or other control devices before any work is performed on this equipment. Failure to do so will result in personal injury, death, or substantial property damage.	**⚠ Danger** Pour éviter les chocs électriques, couper l'alimentation électrique du contrôleur, du moteur ou autres dispositifs de commande avant d'y effectuer quelque travail. L'inobservation de cette mesure entraînera des blessures corporelles, la mort ou des dommages matériels.
	Do not apply a disconnect device on the output of the ***IT.*** Soft Starter unless a means to turn off the soft starter when disconnect switch is open is utilized. Opening disconnect while the ***IT.*** Soft Starter is operating may cause a malfunction. Closing disconnect switch while the ***IT.*** Soft Starter is operating will result in a soft starter failure and potential equipment damage and personnel hazard.	

The *IT.* Soft Starter is to be wired into the three phase line feeding the three main motor input leads as would be done for normal across-the-line starting. ***It must <u>not</u> be wired internally between motor windings.*** Refer to the motor nameplate for correct wiring information for normal across-the-line operation. Contact Cutler-Hammer if a special motor wiring requirement exists before wiring your starter.

The *IT.* Soft Starter is to be connected with an ABC phase rotation on the incoming power wiring. If the motor turns in the incorrect direction upon energization, exchange two phases at the motor terminal box or at the output terminals of the soft starter. Do not change the input wiring. Otherwise, a phase reverse trip will occur.

If the input phase rotation to the soft starter is not ABC, correct this first. Then rewire the motor phases, if needed, for correct rotation.

Safety Notices (continued)

If the application requires a reversing contactor, it should be connected on the output side of the soft starter. The contactor must be closed before starting the soft starter. The soft starter must be off before switching the direction of the reversing contactor. The reversing contactor must never be switched while the soft starter is operating.

Note that in some situations it may be desired to place the reversing contactor ahead of the *IT.* Soft Starter. In one of the directions, the phase rotation will not be ABC and a Phase Reverse trip will occur. To prevent the trip, the Phase Reverse trip will need to be disabled. See page 31.

See the **Motor/Application Considerations** section of this manual for information on typical motor winding configurations.

Line and Load power wiring data is shown in the following table.

Frame Size	Lug Kit Options	Number of Con-ductors	Lug Type	Wire Sizes Cu 75°C Only	Torque Requirements	Number of Kits Required
N	Supplied Standard with Box Lugs	1	Box Lug	2 AWG	5.6 N-m (50 LB-IN)	N/A
				4 – 6 AWG	5.0 N-m (45 LB-IN)	
				8 AWG	4.5 N-m (40 LB-IN)	
				10 –14 AWG	4.0 N-m (35 LB-IN)	
R	Supplied Standard with Box Lugs	1	Box Lug	2.5 – 10 mm^2 (14 – 8 AWG)	10.1 - 11.3 N-m (90 – 100 LB-IN)	N/A
				16 – 25 mm^2 (6 – 4 AWG)		
				27 – 95 mm^2 (3 – 3/0 AWG)		
T	EML22	2		21.2 – 53.5 mm^2 (4 – 1/0 MCM)	28.3 N-m (250 LB-IN)	2
	EML23	1		107 – 240 mm^2 (4/0 – 500 MCM)	28.3 N-m (250 LB-IN)	
	EML24	2 +		107 – 150 mm^2 (4/0 – 500 MCM)	28.3 N-m (250 LB-IN)	
	EML25	1		70 – 150 mm^2 (2/0 – 300 MCM)	25.5 N-m (225 LB-IN)	
	EML26	2		70 – 150 mm^2 (2/0 – 300 MCM)	25.5 N-m (225 LB-IN)	
V	EML28	2+		107 – 240 mm^2 (4/0 – 500 MCM)	28.3 N-m (250 LB-IN)	2
	EML30	4+		107 – 240 mm^2 (4/0 – 500 MCM)	28.3 N-m (250 LB-IN)	
	EML32	6*+		107 – 240 mm^2 (4/0 – 500 MCM)	28.3 N-m (250 LB-IN)	
	EML33	4		70 – 150 mm^2 (2/0 – 300 MCM)	25.5 N-m (225 LB-IN)	

* Requires special lug cover. Check with Cutler-Hammer for availability.
\+ CSA approved 350MCM – 500MCM

Lugs for T and V Frame

T and V frame units are supplied standard without lugs. If lugs are needed, they can be ordered through your local Cutler-Hammer distributor. Each lug kit contains three lugs, mounting hardware, and instructions for use on either line or load side of the IT Soft Starter. Catalog numbers and wire ranges for lug kits are listed in the table above.

Lug Installation

	⚠ Danger Hazard of Burn or Electrical Shock	⚠ Danger Risque de Brulure ou Elecriques de Choc
	Make sure all power is off before wiring.	S'assurer de couper le courant avant de cabler.

Note: For additional motor and system protection, a Metal Oxide Varistor (MOV) may be installed on the line side of the unit. An MOV can also be installed on the load side of the Soft Starter if additional protection is desired. Generally, it is more common to use a MOV on the line side. Refer to the instructions provided with the MOV kit.

1. For T and V Frame Soft Starters, remove line and load terminal covers by removing the screws that hold each cover (and the MOV, if installed) onto the unit.

Note: For N and R Frame Soft Starters, it is not necessary to remove the covers in order to wire the device. Proceed to step 3.

2. After screws are removed, slide covers off of unit. Set the covers and screws aside.
3. Position lugs and install lug mounting screws according to instructions provided with the kit. Tighten lug mounting screws provided with the kit to 13.6 N-m (120 LB-IN).
4. Wire the appropriate line and load conductors to the IT Soft Starter (as required by NEC and local codes based on the device rating).
5. Torque bolts as directed by the table on page 15 of this manual.

Figure 7: V frame shown with terminal cover removed and EML30 lug kit installed on load side

6. Slide the line and load covers back into place on the soft starter.
7. Reinstall the cover screws through the cover and the MOV, if installed.
8. Insert two outer cover screws through cover.
9. Align cover and torque all cover screws to 0.6 N-m (5 LB-IN). **Do not** overtighten screws.

Control Wiring

The table below provides the 12-pin terminal block wiring capacity and torque requirements for the control wiring.

Wire Size	Number of Conductors	Torque
0.33 – 2.5 mm^2 (#22 – #14 AWG)	2	0.4 N-m (3.5 LB-IN)
4.0 mm^2 (#12 AWG)	1	0.4 N-m (3.5 LB-IN)

Motor/Application Considerations

Using MOVs

Most utility power systems experience periodic transient voltages. Line or power factor correction capacitor switching, nearby lightning strikes, utility supply faults, or a user starting or shutting down a large load such as a motor can cause these voltages. The *IT.* starter has been designed to handle transient voltages of up to 4 kV lasting up to 20 µsecs. If transient voltages of greater magnitude or longer duration than the standard withstand capability are expected, a protective module must be installed. The protective module contains metal oxide varistors (MOVs). MOVs are devices that remain in a passive state until a transient voltage occurs. Under the transient condition, the MOV turns on and holds the peak line voltage down to a level less than the IT transient voltage rating. When the transient clears, the MOV returns to a passive state.
Cutler-Hammer offers two MOV option kits:

EMS38	600 V (max) MOV for S801N and S801R Soft Start (side mounted)
EMS39	600 V (max) MOV for S801T and S801V Soft Start
EMS41	690 V (max) MOV for S801T….V35 and S801V….V35

The EMS38 is panel mounted, while the EMS39 and EMS41 are mounted directly on the IT Soft Starter.
The EMS39 and EMS41 is mounted directly on the IT Soft Starter.
In situations where an MOV must be used, the installer may choose to apply a different transient absorption device, but it must be equivalent to the EMS38, EMS39 or EMS41.
These MOVs may also be used on the load side of the soft starter where long cables connect the motor to the Soft Starter or where the cables are located outdoors.

Squirrel Cage Motor

This is the most common application.
The motor is configured with three motor leads available.
In this case, wire the motor to the Soft Starter with one lead per phase, observing proper phase rotation. An in-sight disconnect means should be installed, per code requirements.

Wye-Delta Motor

The wye-delta motor is a traditional way of achieving a reduced voltage start using regular contactors and starters. In this method, the motor is constructed with all six leads brought out to connect the unit in a wye configuration. This allows about 58% of the current (33% starting torque) to be applied during start-up. A timer is used to control the circuit and switch to the delta configuration as the unit approaches full speed.

In this case, wire the six-lead motor in a standard delta configuration. The Soft Starter is then used to control the voltage and motor torque without the need for additional circuitry. An in-sight disconnect means should be installed, per local code. The *IT.* Soft Starter must be wired into the three phase line feeding the three main motor input leads as would be done for normal across-the-line starting. ***It must <u>not</u> be wired internally between motor windings in an inside-the-delta configuration. If an inside-the-delta starting configuration is desired, please contact Cutler-Hammer for details about our inside-the-delta soft starters, designated S801----------D.***

Part Winding Motor

The part winding motor is another design created to help achieve a soft start to the load. A part winding motor is constructed of two separate (but parallel) windings. When using a traditional starter, the first winding would receive full voltage. This winding supplies as much as 400% of the motor's FLA; about 45% starting torque in a delta configuration for motor startup. After a timed delay, full voltage is applied to the second winding. The second winding acts in parallel with the first to provide for normal running current. Part winding motors are available in both a wye and delta configuration, dependant upon the manufacturer. Refer to the motor nameplate for the correct wiring information. In this case, wire the two windings in parallel. The soft starter is then used to control the current applied to the motor. An in-sight disconnect means should be installed, per code requirements. In this case, wire the two windings in parallel. The soft starter is then used to control the current applied to the motor. An in-sight disconnect means should be installed, per code requirements.

Motor/Application Considerations
(continued)

Dual Voltage Motor

A dual voltage motor should be wired into the appropriate configuration for the line voltage it is being applied to. Refer to the motor nameplate for the correct wiring information. The Soft Starter must be selected for the appropriate line voltage.

Multi-Speed Motor

Some motors have multiple windings to allow operation at different base speeds. The multiple speeds are sometimes utilized for soft starting and other times for a process requirement of the machine to which it is attached. If only one speed is required, the motor should be wired for that speed. If multiple speeds are required, the appropriate contactors will need to be connected to the output of the Soft Starter. The contactors must be in the selected speed position before the Soft Starter is started. The motor must be stopped and the Soft Starter turned off before the speed selection contactors are changed.

Other Winding Configurations

Motors with other winding configurations, designed for specific characteristics, should be wired in a fashion consistent with their intended use. The motor nameplate contains information on the available configurations. The motor winding configuration chosen must be appropriate for the available line voltage. The Soft Starter must also be selected on the basis of the configuration chosen.

Power Factor Correction Capacitors

Power factor correction capacitors must never be connected on the load side of the *IT.* Soft Starter or at the motor terminal box. To do so will result in soft starter failure. If you choose to use individual motor capacitors, they must be wired on the line input side of the IT Soft Starter as far upstream as possible.

	⚠ Caution	⚠ Attention
	Never megger a motor while it is connected to the IT. Soft Starter. Disconnect the leads at the IT. Soft Starter before meggering the motor.	

Control Wiring Inputs

The *IT.* Soft Starter has the following control inputs:

⚠ Caution	⚠ Attention
Only apply 24V DC to the control terminal block unless specified otherwise in this manual. All control wiring is #22 - #12 AWG. Failure to follow this caution could result in severe damage to the controller.	Appliquer seulement une tension de 24 V c.c. aux bornier sauf avis contraire dans ce manuel. Toute la filerie de commande est de calibre 22 à 12 AWG. L'inobservation de cette mesure pourrait causer des dommages importants au contrôleur.

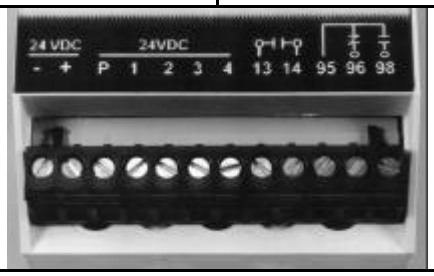


Figure 8: Terminal Block

Terminal Block Designation	Default	Input
-	-	Negative
+	-	24V DC nominal (see Page 25 for sizing)
P (24VDC only)	Hardwired Stop	24V DC only (maintained input)
1 (24VDC only)	Start	24V DC only (momentary input)
2 (24VDC only)	Jog	24V DC only (momentary input)
3 (24VDC only)	Overload Disable	24V DC only (momentary input)
4 (24VDC only)	Fault Reset	24V DC only (momentary input)
13	-	Relay close connects to 14
14	-	3 Amps, @ 120 VAC/24V DC, 10 Amps, Max (Resistive) Switching
95	-	Form C Common for 96 and 98
96	-	3 Amps, @ 120 VAC/24V DC, 10 Amps, Max (Resistive) Switching
98	-	3 Amps, @ 120 VAC/24V DC, 10 Amps, Max (Resistive) Switching

13 and 14 Closed when in bypass. Contact is normally open.
95 and 96 Closed – System OK, Opened - Fault.
95 and 98 Opened – System OK, Closed – Fault

See “Using an Auxiliary Relay” section.

Pins 95, 96, and 98 are a Form C contact. 95 acts as common. 96 is a normally closed contact, and 98 is a normally open contact. On any fault that trips the unit or causes it not to start, 96 opens and 98 closes.

The control wiring is connected to the soft starter by a 12-pin removable terminal block located on the front of the unit. Each terminal is capable of holding one or two 0.33 – 2.5 mm^2 (#22 - #14 AWG) wires, or one $4mm^2$ (#12 AWG) wire. The terminals should be tightened to 0.4 N-m (3.5 LB-IN).

Control Wiring Inputs (continued)

Each diagram illustrates a typical wiring scheme for the options described. The terminal block represents the soft starter. The additional items shown on the diagrams are not included, but they may be purchased from Cutler-Hammer.

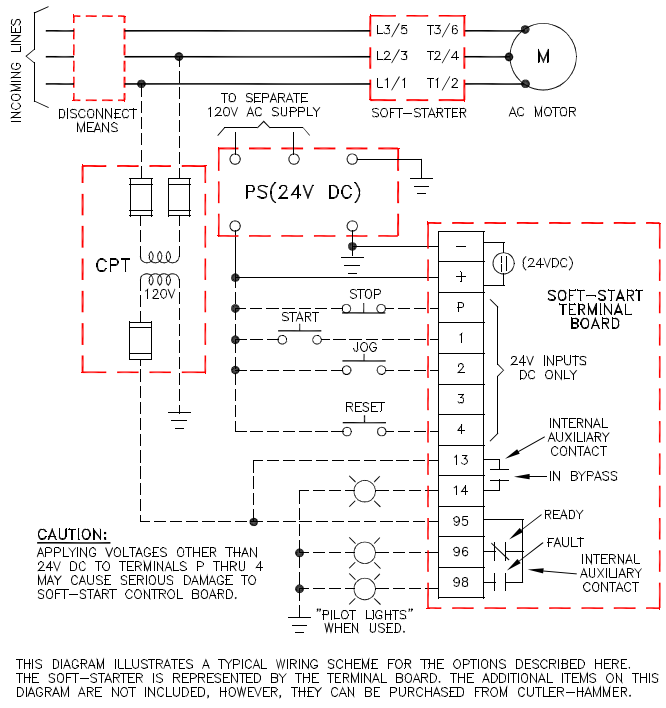


Figure 9.
Elementary Diagram For Soft Starter
with START/STOP/RESET/JOG
with 120 VAC Alarm and Run Indication

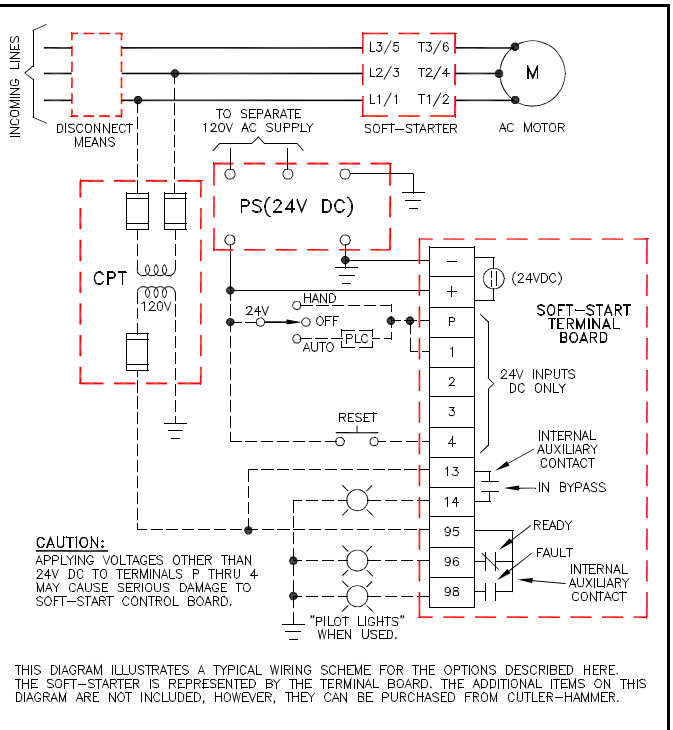


Figure 10.
Elementary Diagram For Soft Starter
with HAND/OFF/AUTO/RESET
with PLC Shown with 120 VAC Alarm and Run Indication

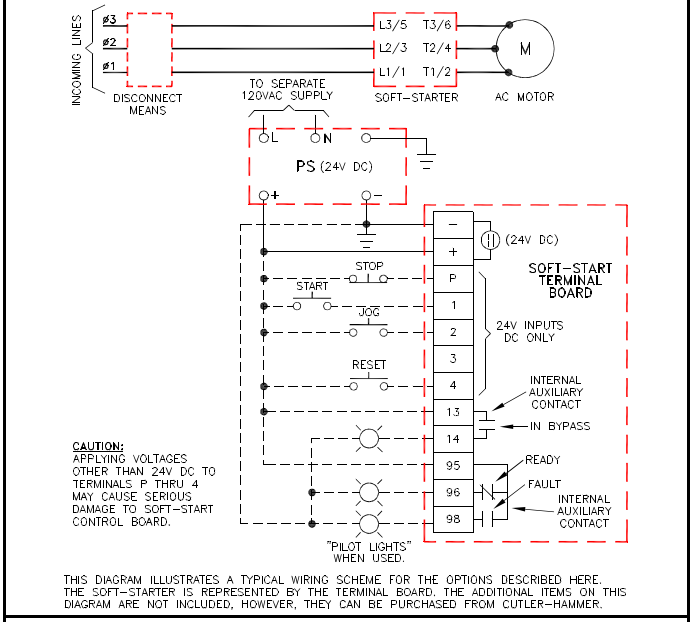


Figure 11.
Elementary Diagram For Soft Starter
with START/STOP/RESET/JOG
with 24V DC Alarm and Run Indication

Notes:

1. A minimum of wire of 2.5mm^2 (#14 AWG) should be used between the power supply and the 24V DC + and – terminals.
2. See "Using an Auxiliary Relay" section if it is desired to use a relay instead of an indicating lamp for terminals 13, 14, 95, 96, and 98.

Using an Auxiliary Relay

The *IT.* Soft starter contains one Form A and one Form C set of auxiliary contacts to indicate its status. A contact between terminals 13 and 14 indicates when the *IT.* is in bypass. The contacts between terminals 95 and 96 and 95 and 95 indicate the *IT.* is in a normal or tripped state. Often these contacts are used as shown in Figure 9, 10, and 11 with indicating lamps. In some installations the user may wish to use an electromagnetic relay for indication of the status at a remote location for use by a programmable controller (PLC), or in a 120V AC or 24V DC control circuit.

If the *IT.* Soft Starter is subject to mechanical shock during operation, it is possible that these contacts may momentarily open, causing nuisance fault tripping of down stream devices. When used with an indicating lamp, a momentary contact opening would not be observed. In order to assure proper application, it is suggested that the following recommendations be followed:

PLC Interface – It is suggested that a 20ms delay be programmed to assure the contact status before a change of status is indicated. The application and the environmental issues will determine the exact requirements.

24V DC Control Figure 1: – When a relay is used in conjunction with an electronic control, it is highly recommended that a noise suppression/snubber diode be placed anti-parallel to the relay coil as shown below. This diode offers two benefits. The first, is the suppression of any electrical noise generated when the relay coil is de-energized. The second, is that the diode delays the opening of the relay slightly as it dissipates the energy stored in the relay coil. This delay is often long enough to compensate for the potential effects of a mechanical shock opening the control contact. A typical suppression diode is a 1N40001.

120V AC Control Figure 2: – When a relay is used in conjunction with an electronic control, it is highly recommended that a noise suppressor be used across the relay coil. In the case of an AC coil, the noise suppressor is made up of a series connected resistor and capacitor as shown below. Usually the delay in the relay opening is very small, so if the system is subject to shock, a delay should be added in the external control before the contact change of state is recognized. The resistor is rated 100 ohms at 0.5 watts. The capacitor is 0.25 μF at 250V AC.

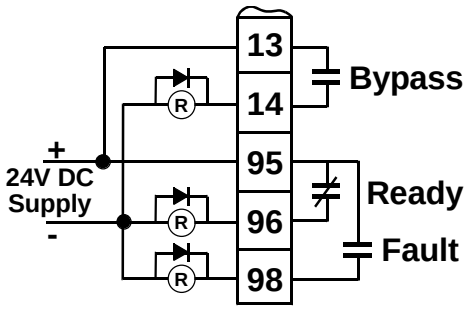


Figure 1

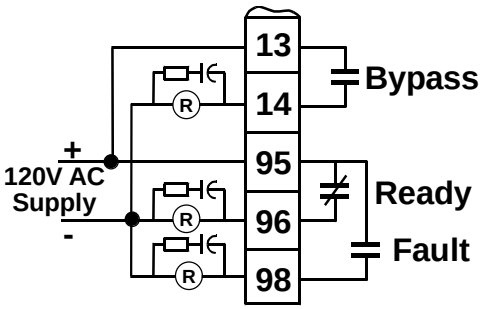


Figure 2:

Edge & Level Sensing Control

Edge Sensing -

Edge sensing is denoted with an “S” in the last character of the catalog number.
Example: **S801T30N3S**

Edge sensing requires +24VDC power be momentarily applied to pin 1 (with terminal “P” at +24V DC) to initiate a start under all conditions. After a stop or fault occurs, the +24VDC must be removed, then reapplied to pin 1 before another start can occur. This control configuration should be used when restarting of the motor after a fault or stop must be supervised manually or as a part of a control scheme. The cycling of +24VDC power to terminal 1 before starting is required regardless of the position of the auto reset switch on the CIM.

Level Sensing –

Level sensing is denoted with an “B” in the last character of the catalog number.
Example: **S801T30N3B**

Level sensing will enable a motor to restart after a fault is cleared without cycling +24VDC power to terminal 1 as long as:

- Terminal P is supplied with +24VDC
- The Auto reset switch on the CIM is set to enabled
- All faults have been reset.

This control configuration should be used where it is desirable to restart a motor after a fault without additional manual or automatic control. An example of this condition would be on a remote pumping station where it is desirable to automatically restart a pump after a power outage without operator intervention.

If the auto-reset feature is used, CAUTION must be exercised to assure that any restart occurs in a safe manner.

Using a Supplemental Line Contactor

In some installations, the customer may dictate the use of an electromagnetic contactor in series with the soft starter.

If an electromagnetic contactor is used, it is recommended that the contactor be placed on the load side of the Soft Starter. The contactor must be closed prior to starting the Soft Starter and remain closed until the Soft Starter has been stopped.

If an electromagnetic contactor is used on the line side of the soft starter, additional control circuitry must be supplied by the user when using edge level control to ensure the line power is supplied to the Soft Starter before control power (24V DC) is applied. If this sequence is not followed, the Soft Starter will fault on either a phase loss or zero voltage-crossing fault. This control scheme is illustrated in the following figure:

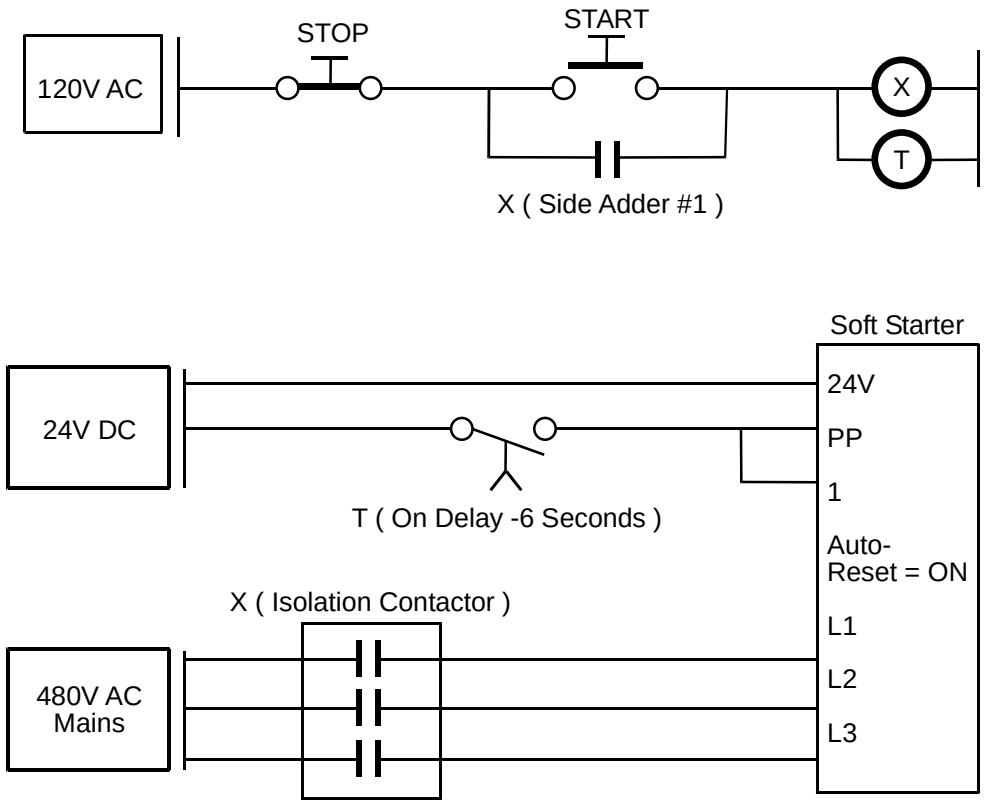


Figure 12

If it is desired to place an electromagnetic contactor on the line side of the soft starter, when using level control, no additional control circuitry is required. A start can be completed when the line power is supplied to the unit after the control power (24V DC) providing the auto-reset feature is enabled and the unit has a green light status with +24V DC on pin 1. The Soft Starter will not fault on either a phase loss or zero voltage-crossing faults. **If the auto-reset feature is used, CAUTION must be exercised to assure that any restart occurs in the safe manner.**

Providing Control Power

⚠ Caution	⚠ Attention
Only apply 24V DC to the terminal block unless specified otherwise in this manual. All control wiring is 0.33 – 2.5mm^2 (#22 to #12 AWG). Failure to follow this caution could result in severe damage to the controller.	Appliquer une tension de 24 V c.c. aux bornes sauf avis contraire dans ce manuel. Toute la filerie de commande est de calibre 0.33 – 2.5mm^2 (22 à 12 AWG). L'inobservation de cette mesure pourrait causer des dommages importants au contrôleur.

1. Connect DC common (negative) to terminal –, using a minimum wire of 2.5mm^2 (#14 AWG).
2. Connect +24 V DC positive to terminal +, using a minimum wire of 2.5mm^2 (#14 AWG).
3. Terminal P (permissive circuit) - Must be energized at +24V DC to enable operation of all S801 softstarters. For all units, if power is removed from the permissive circuit at any time, the unit will initiate a stop sequence, including a soft-stop if enabled.

   NOTE: With level sensing control, if +24VDC is removed from the permissive circuit at any time, the unit will initiate a stop and restart when +24VDC is reapplied to terminal P if :

   a) +24VDC is still available on pin 1,
   b) the device shows a green status light(not faulted), and
   c) auto reset is enabled on Control Interface Module (CIM).

   See the Edge and Level Sensing section of this manual for more details. **If the auto-reset feature is used, CAUTION must be exercised to assure that any restart occurs in a safe manner.**
4. Terminal 1 (Start mode) - If terminal P is at +24VDC, momentary application of +24VDC to terminal 1 will initiate a start sequence for all S801 softstarters.

   NOTE: With level sensing control, if +24VDC is maintained on terminal 1(Start) and removed from the permissive circuit at any time, the unit will initiate a stop. The unit will restart on application of +24VDC to terminal P if :

   a) +24VDC is still available on pin 1,
   b) the device shows a green status light(not faulted), and
   c) auto reset is enabled on Control Interface Module (CIM).

   See the Edge and Level Sensing section of this manual for more details. **If the auto-reset feature is used, CAUTION must be exercised to assure that any restart occurs in a safe manner.**
5. Terminal 2 (Jog mode) - If +24V DC power is applied to this terminal while terminal P is at +24V DC, the soft starter will operate in the jog mode as long as +24VDC is on terminal 2 and no faults occur. In jog mode, the softstarter will operate only on the thyristors and the bypass contactors will not close.
6. Terminal 3(Overload disable) - Momentary application of +24VDC to terminal 3 prior to a start raises the overload fault trip point to 125% of the maximum rating of the frame size for the next start only.

7. Terminal 4 (Reset) – Application of +24V DC power will reset the soft starter after all fault conditions are cleared. If the auto reset feature is used with level control CAUTION must be exercised to assure that any restart occurs in a safe manner. See Edge and Level sensing. **If the auto-reset feature is used, CAUTION must be exercised to assure that any restart occurs in a safe manner.**

8. Terminals 13 and 14 (Bypass Contactor Relay Contacts, NO) - Relay contacts for use up to 120VAC or 24VDC provide bypass contactor status. The contact closes upon bypass and will remain closed until a stop is initiated or a fault occurs. The motor and load may continue to rotate after a stop is initiated if soft stop is being used or if the load inertia is high. See "Using an Auxiliary Relay" section for additional contact interface information.

9. Terminals 95, 96, and 98(Fault Relay Contacts Form C) - Relay contacts for use up to 120VAC or 24VDC provide fault or ready status indication. See page 20 for a description of their operation.

Note: When 24V DC is first applied to terminals + and -, all of the LED's on the Control Interface Module (CIM) will be briefly illuminated. This is a normal startup test that verifies communication to the CIM. Pressing the "Fault Reset" button (located below the CIM) will also momentarily lights all of the LED's. This verifies the CIM board is functional, and tests all LED's for functionality.

24VDC Power Requirements

When selecting a 24V DC power supply for your *IT*. Soft Starter, it must meet the following steady state and inrush characteristics.

Steady State Minimum = 25 watts

Inrush minimum = 240 watts for 150 mSecs.

Voltage on the *IT*.'s + and – terminals must not exceed 30V DC to prevent hardware damage. The soft starter will shut down at approximately 19V DC.

It is recommended that Cutler-Hammer power supplies be used, as other power supplies may not be able to meet the inrush current requirements.

The following Cutler-Hammer power supplies are available:

Catalog Number	Steady State Wattage	Inrush Wattage	Input Voltage
PSS55A	55W	250W	115VAC
PSS55B	55W	250W	230VAC
PSS55C	55W	250W	360 – 480VAC

Note: A minimum wire size of #14 AWG should be used between the power supply and the 24V DC + and – terminals.

Set Up / Software

General

The software contained in the *IT.* Soft Starter is the heart of the product. This software allows you to control nearly every aspect of the IT Soft Starter's functionality. In this section, various features are described.

Starting Options

The following starting choices are available in the *IT.* Soft Starter:
Note that the motor current observable with a standard RMS indicating meter may not be correct because of its non-sinusoidal nature during starting. It is suggested that the starting current be estimated from the T_1 or T_2 setting and the tabulation in Table M on Page 36.

1. Soft Start with Selectable Kick Start

This mode of operation works in both the Ramp Start and Current Limit Start modes. A kick-start (or boost) allows the motor to draw greater current to develop additional torque to breakaway a high friction load.

The kick start torque is programmable from 5% to 85% of motor's across-the-line locked rotor torque, corresponding to 23% to 92% of the motor's across-the-line locked rotor current. The factory default is 5%. The kick start time is programmable from 0.0 seconds to 2.0 seconds.

If no kick-start is desired, set the kick start torque (T_1) and kick start time (t_k) to zero.

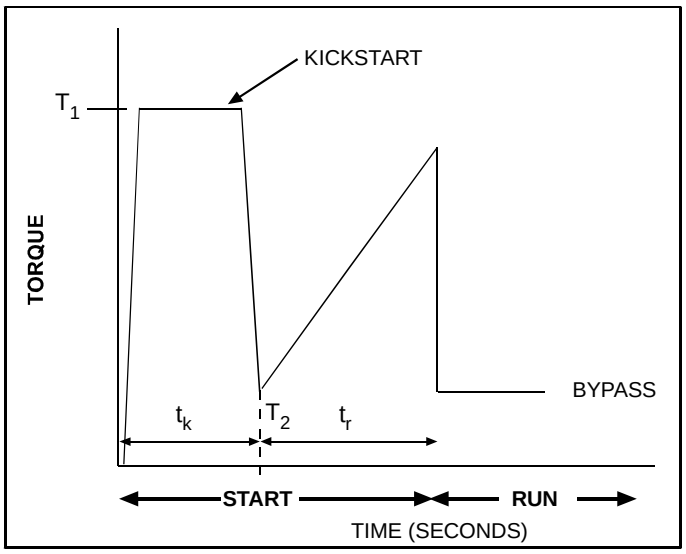


Figure 13: Selectable Kick-Start

Continued on next page…

2. Ramp Start

This mode of operation is the most commonly used form of soft start.

The motor is accelerated using an initial torque (T_2) value of 5% to 85% of across-the-line locked rotor torque, corresponding to 23% to 92% of the motor's across-the-line locked rotor current. The factory default is 35%. The torque is then increased over the range of the programmed acceleration ramp start time (t_r) by increasing the motor voltage. This can be programmed from 0.5 to 180 seconds. The factory default is 9 seconds. The first half of the control adjusts from 0.5 to 20 seconds, the next quarter from 20 to 60 seconds, and the last quarter from 60 to 180 seconds. The unit will limit current to the specified torque. When the motor is up to speed, it will go into bypass.

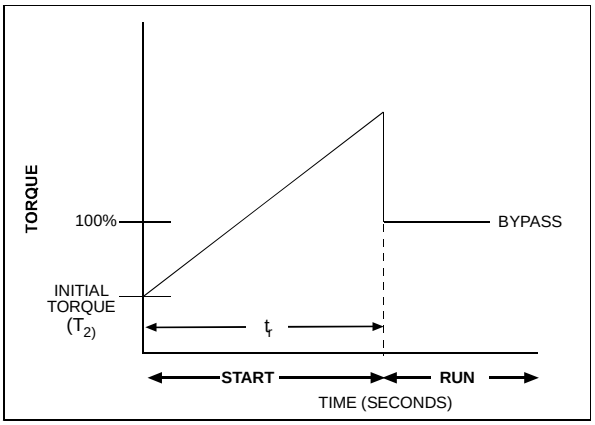


Figure 14: Ramp Start

3. Current Limit Start

This mode is typically used when it is necessary to limit the maximum current during start-up.

Starting torque (T_2) can be programmed from 5% to 85% of the motor's across-the-line locked rotor torque, corresponding to 23% to 92% of the motor's across-the-line locked rotor current. The T_2 default is 35%. The ramp time is programmable from 0.5 to 180 seconds. The factory default is 9 seconds. The control is not linear to allow finer setting of short ramp times. The first half of the control adjusts from 0.5 to 20 seconds, the next quarter from 20 to 60 seconds, and the last quarter from 60 to 180 seconds. The unit will limit current to the specified torque. When the motor is up to speed, it will go into bypass.

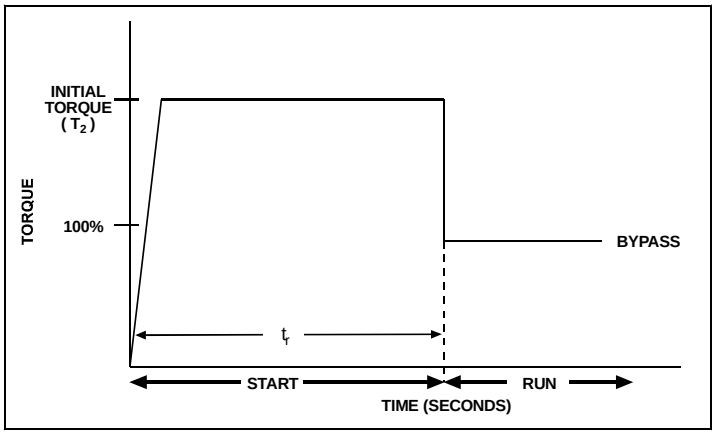


Figure 15: Current Limit Start

4. Pump Start

The pump control option is addressed in the Special Function Options section, Page 57.

Soft Stop

1. Soft Stop - Standard

This feature is used for applications that require a controlled extended stop. It is designed for high frictional loads that tend to stop suddenly when voltage is removed from the motor.

The ramp down time is programmable from 0 to 60 seconds. The factory default is 0 seconds. The voltage is gradually reduced over the ramp down time t_s, slowing the motor and its load.

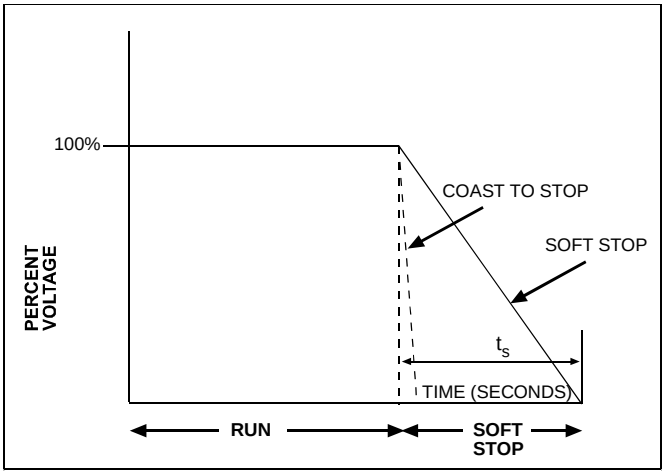


Figure 16: Soft Stop

Note: This is not an electronic brake function, and cannot make the load stop faster than its normal coast-to-stop time. This feature can only extend the stop time. In some applications the motor will come to a stop in less than the selected t_s time, if t_s is set too long.

2. Soft Pump Stop

The pump control option is addressed in the Special Function Options section, Page 57.

⚠ Caution	⚠ Attention
Soft Stop is not an emergency stop, and cannot make the load stop faster than its normal coast-to-stop time. If removal of control is desired, additional control is required to open up the 24V DC to terminal +. Using terminal P to initiate power removal is not recommended.	

Protective Features

Thermal Overload

The *IT.* Soft Starter features an electronic motor overload protection feature. This is intended to protect the motor and power wiring against overheating caused by excessive current for extended periods of time.

NOTE: Short circuit protection must be applied on the line side of the soft starter.

Entering the motor full load current rating, using the "FLA current adjust" dial programs trip current. It is programmable from 32% to 100% of the unit's rated current.

Frame Size	Catalog Number	Current Range	Value of Adjustment Settings (Amps)									
			A	I	I	B	I	I	C	I	I	D
N	S801N37N3S	11 – 37	11	14	16	19	22	24	27	30	34	37
	S801N66N3S	20 - 66	20	25	30	35	40	45	50	55	61	66
R	S801R10N3S	32 – 105	32	40	48	56	64	72	80	88	97	105
	S801R13N3S	42 - 135	42	52	63	73	83	94	104	114	125	135
T	S801T18N3S	56 - 180	56	70	83	97	111	124	138	152	166	180
	S801T18V3S											
	S801T24N3S	75 – 240	75	93	112	130	148	167	185	203	222	240
	S801T24V3S											
	S801T30N3S	95 – 304	95	118	141	164	187	210	233	257	280	304
	S801T30V3S											
V	S801V36N3S	112 - 360	112	139	167	194	221	249	276	304	332	360
	S801V36V3S											
	S801V42N3S	131 - 420	131	163	195	227	259	291	323	355	388	420
	S801V42V3S											
	S801V50N3S	156 - 500	156	194	232	270	308	346	384	423	461	500
	S801V50V3S											
	S801V65N3S	203 – 650	203	253	302	352	402	451	501	551	600	650
	S801V65V3S											
	S801V72N3S	225 – 720	225	270	335	390	445	500	555	610	665	720
	S801V72V3S											
	S801V85N3S	265 - 850	265	330	395	460	525	590	655	720	785	850
	S801V85V3S											
	*S801V10N3S	320 – 1000	320	396	471	547	622	698	773	849	924	1000

Note: The current adjust dial is settable to any point within its range.

*See application note Page 59.

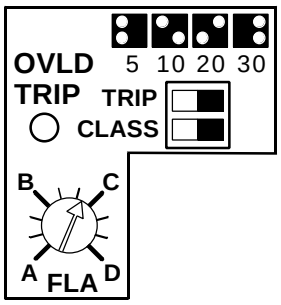


Figure 17:
Setting Trip Class
and FLA on the CIM

Thermal memory is incorporated to accurately monitor motor operating temperature. Ambient temperature does not affect soft starter function, within its operating limits.

The overload trip class can be set to class 5, 10, 20, or 30. The setting determines the time to trip, based on the severity of the overload condition.

Thermal Overload (continued)

The normal overload trip setting may be disabled for the next start by placing the overload ON/DISABLE switch in the DISABLE position. This raises the overload fault trip point to 125% of the maximum current rating of the frame size. The overload trip resets to its normal set value for all subsequent starts. To affect another start, the ON/DISABLE switch would need to be moved to the ON position and then back into the DISABLE position. This same action is possible by momentarily connecting terminal 3 to the 24V DC + terminal prior to the start. This only affects the next start and not any subsequent starts unless terminal 3 is again momentarily connected to the +24V DC prior to the start.

Jam Detection

This feature is selectable: ON/DISABLE.

A current value of greater than 3 x FLA setting will stop the motor on a jam fault. If a jam is detected, the soft starter shuts down, and the "Jam" light illuminates.

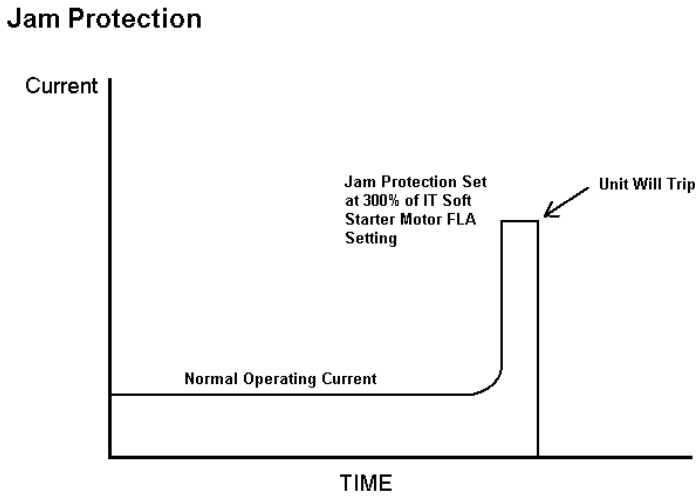


Figure 18

Note: Jam detection is active only after the motor has reached full speed and is in bypass mode. If jam is disabled and the unit is in bypass and a jam occurs, the soft starter will trip on contactor overcurrent if the motor current exceeds 4x the starter maximum ampere rating.

Stall Detection

This feature is selectable: ON/DISABLE.

If the soft starter detects a stall condition greater than 2x FLA setting at end of ramp, the soft starter shuts down and the “Stall” light illuminates.

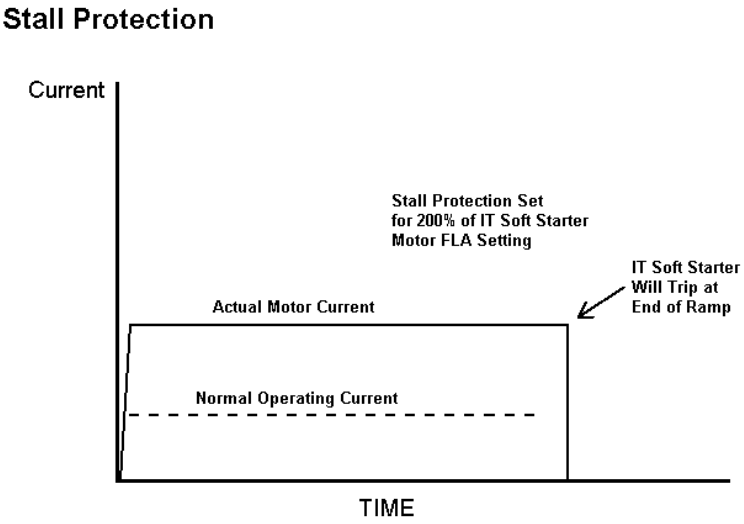


Figure 19

Note: If stall detection is off and a stall occurs during start, the soft starter will trip on SCR over current if the motor current exceeds 3x the FLA setting at the end of ramp.

Phase Loss/Current Unbalance Detection & Load Disconnect

This feature is selectable: ON/DISABLE.

The phase loss and unbalance current protection features monitor the line voltage and current respectively. If a phase voltage is lost or the line current is unbalanced more than 40% from the average of all 3 phases, the soft starter shuts down, and the “Phase Loss” light is illuminated. See the CIM flash code table on Page 45 for indication of the possible cause.

Load disconnect protection feature monitors the line current. If the phase rotation is not ABC, the soft starter shuts down and the “SS TRIP” light is illuminated. See the CIM flash code table on Page 45 for indication of the possible cause.

Phase Reversal Detection

This feature is selectable: ON/DISABLE.

The phase reversal protection feature monitors the phase rotation of the incoming power line. If the phase rotation is not ABC, the soft starter shuts down and the “Phase Reverse” light is illuminated.

Protective Features Review

Thermal Motor Overload

The thermal overload is designed to protect the motor from heating caused by drawing too much current. If the motor is overloaded, the current drawn rises and heats the motor. The FLA sets the trip threshold and the trip class (5, 10, 20, or 30) is set on the CIM.

If the device trips on a thermal overload, an internal timer is started which inhibits a reset for three minutes. After this timer expires, the device may be reset and the thermal fault is cleared. At this point another internal timer is started, this timer is 26 x 3 or 48 minutes. If another trip occurs before this timer expires, the reset inhibit time is increased to 6 minutes.

Once the trip level reaches 3, it will take 144 minutes to go back to level 2, then 96 minutes to get back to level 1. To get from level 3 to a reset thermal overload at level 1, it takes 288 minutes without a trip. A reset thermal overload at level 1 means the next thermal overload trip will have a 3-minute reset inhibit as shown below.

Trip	Reset Inhibit Time	Reset Time to Previous Trip Level
1	3 minutes	48 minutes
2	6 minutes	96 minutes
>3	9 minutes	144 minutes

Cycling power on the device will typically NOT clear the thermal trip. The thermal pile and the reset inhibit time are saved to the non-volatile memory. These values are reloaded when the device boots and the timer is restarted at the full reset time. This means if the 3 minute inhibit timer has been running two minutes, cycling power will require the user to wait the full three minutes before a reset can clear the overload fault.

If the device is shut down when the overload fault is tripped, the temperature is also saved to the non-volatile memory. If the device is left to cool and then powered, the temperature read from the sensor is compared to the saved temperature. If the current temperature is 87% or less of the saved temperature, a full thermal pile rest is initiated.

The unit monitors the following condition for overload:

- Thermal (current) Overload – monitors RMS current with a 5, 10, 20 or 30 second delay time based on Trip Class setting

Protective Features	Settings	Factory Default
Overload (FLA Dial Range)	32% - 100% of rated current	32%
Trip Class	5, 10, 20, 30	5
Fault Reset	Auto, Manual	Manual
Jam	On, Disable	On
Stall	On, Disable	On
Phase Loss & Load Disconnect	On, Disable	On
Phase Reversal	On, Disable	On
Overload	On, Disable	On

Programming Settings

General

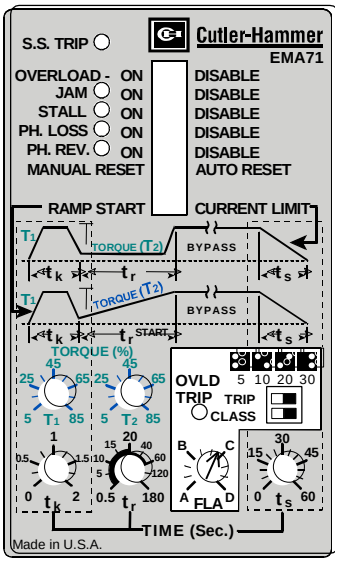


Figure 20:
Soft Start Control Interface Module (CIM)

To program and operate the *IT.* Soft Starter, a "Control Interface Module" (CIM) is required. The CIM (Catalog number EMA71) is for use with all models: S801N, S801R, S801T, and S801V. The CIM serves as the interface between the operator and the Soft Starter control circuitry to program the Soft Starter. The CIM dip switches and rotary controls are used to select the Soft Starter settings. When making adjustments to the CIM under normal operation, the LED's will function as follows:

A change to any dip switch will cause all LED's to flash momentarily.

An adjustment to any POT will cause all LED's to light and stay lit until the adjustment of the POT has been completed.

While selecting these parameters, 24V DC power may be applied to the Soft Starter, but it is not required.

Note: The *IT.* Soft Starter does not have to be powered to make adjustments to the control interface module. Once the unit is energized, it will communicate with the CIM and load the set parameters into the Soft Starter. Allow the unit 2 seconds to ensure communication checks are complete and values are set. To verify CIM is operational, press the "Fault Reset" button below the CIM, or apply 24V DC to terminal 4. If the CIM is powered and communicating, all the LEDs will momentarily flash.

Trip Class

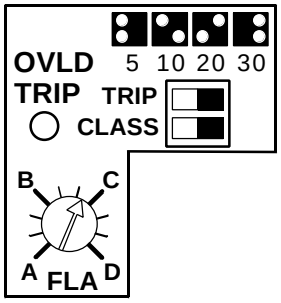


Figure 21:
Setting Trip Class on the CIM

To begin programming the soft starter, choose the trip class and FLA settings desired.

The trip class setting is made by moving the dip switches into the appropriate position to match the class overload desired.

Find the motor FLA value on the table on Page 29. Set the FLA dial to the proper position. See Figure 22 for the thermal overload trip curves.

Example: For a trip Class 5, both DIP switches should be set up to the left.

Overload Trip Curves

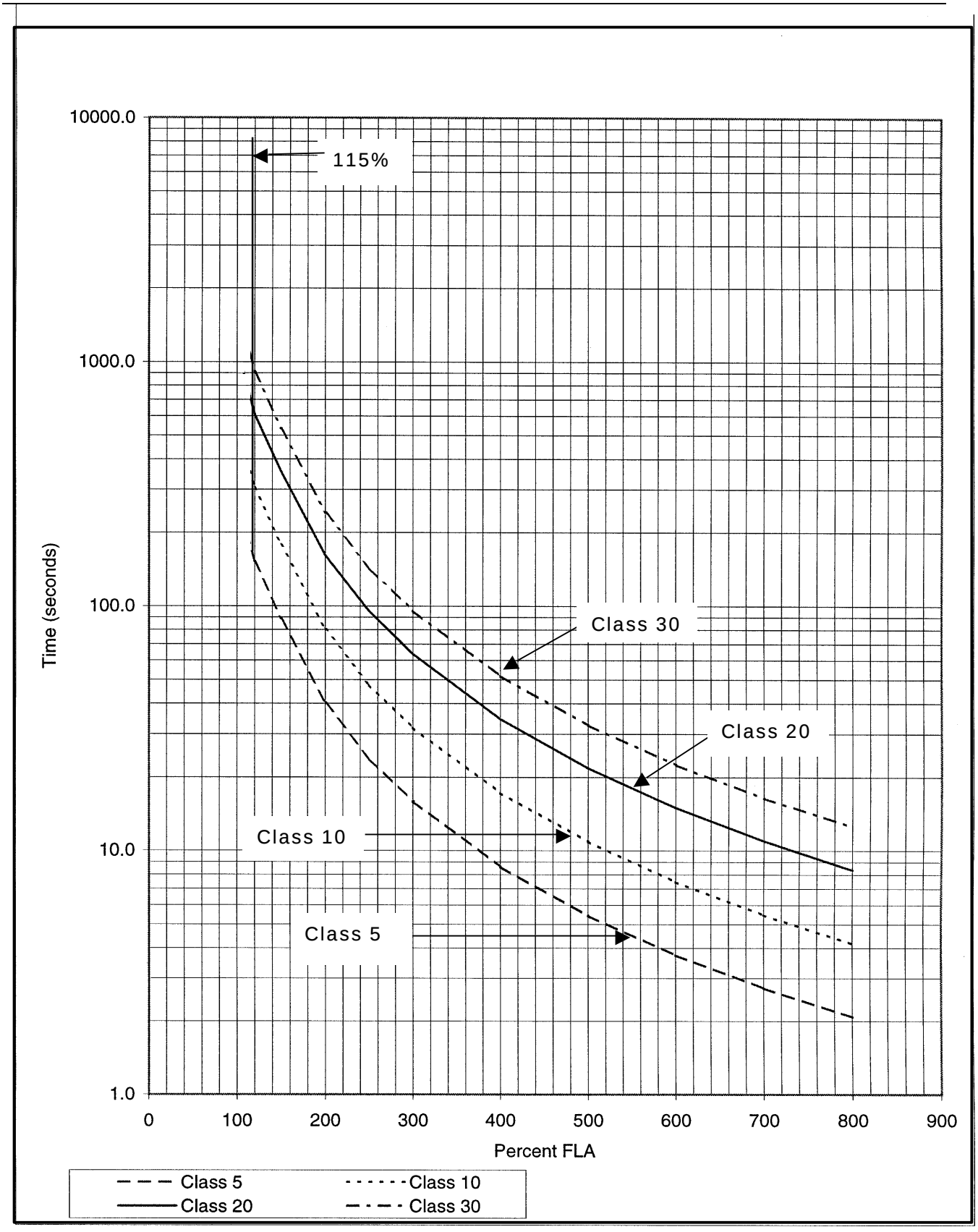


Figure 22

Protective Features

You may choose to enable or disable each of the following motor protective features found at the top of the CIM. These include:

- Overload
- Jam
- Stall
- Phase loss – Load Disconnect
- Phase Reversal Protection

To enable a feature, move its dip switch to "ON."

To disable a feature, move its dip switch to "DISABLE."

Note: Disabling any of the motor protective features does not disable any of the *IT.* Soft Starter's protective features as shown in the flash code table on Page 45.

Manual/Auto Fault Reset

Select auto or manual reset on the Control Interface Module.
When a fault is present, if auto-reset is on, it will attempt to reset the fault every 2.5 seconds. If the cause of the fault has been eliminated, the fault will be reset. If the fault has not been eliminated, the fault status will be maintained. After the fault is reset, the soft starter can be restarted as normal.
To manually reset the fault after its cause has been cleared if auto reset is off, press the "Fault Reset" button below the CIM or apply 24V DC to terminal 4 of the control terminal block.
Note: Note: The motor does NOT automatically restart after a fault is reset UNLESS the soft starter is equipped for Level Sensing Control. See the Edge and Level Sensing Control section of this manual for details.

Special Function S.F.

On occasion, a special function option is purchased and installed on the *IT.* Soft Starter. The special function may be enabled or disabled with this dip switch.

The pump control option is a special function option. It is addressed in the Special Functions Option section, Page 57.

Options

Edge sensing is denoted with an "S" in the last character of catalog number.
Ex. S801…….N3S

Level sensing is denoted with an "B" in the last character of catalog number.
Ex. S801…….N3B

690V rated S801 are denoted with an "V" in the last character of catalog number.
Ex. S801…….V3S

Programming the Start

This procedure covers programming the start characteristics of the soft starter. There are two configurations to choose from.

- Ramp Start sequence
- Current Limit Start sequence

Set the bottom dip switch to make your choice.

A kick-start is available for either ramp or current limit start.

The pump control option includes a variation of the ramp start suitable for centrifugal pump applications. See the Pump Control Option section, Page 57, for specific information.

Programming the Kick Start Sequence

Kick Start

The first set of parameters to be set on the CIM is for Kick Start **Figure 23**. This feature is designed to assist the starter in overcoming a high-friction load and break the rotor free, prior to the normal start.

Two parameters must be set. The kick start torque value (T_1) can be set from 5% to 85% of the motor's across-the-line starting torque. This setting also equates to a percentage of locked rotor current of 23% to 92%.

For example: For a motor with a across-the-line locked rotor current of 6 x FLA, the initial current would be limited to 5.5 x FLA or (0.92 x 6 x FLA) for a T_1 setting of 85% or 92% of locked rotor current. The across-the-line locked rotor torque versus equivalent starting current values are found in Table M.

Table M

Torque Setting	Percent Locked Rotor Current*
85%	92%
71%	84%
56%	75%
45%	67%
36%	60%
27%	52%
19%	44%
14%	37%
9%	30%
5%	23%
3%	16%
1%	10%

*These are typical values for a NEMA design B type motor. The starting torque versus locked rotor current relationship will vary for other NEMA design types as determined by the manufacturer.

Next, adjust the time setting (t_k) to apply the kick start torque from 0 to 2 seconds.

Note: If a kick-start is not required for your application, set T_1 to 5% and t_K to 0.

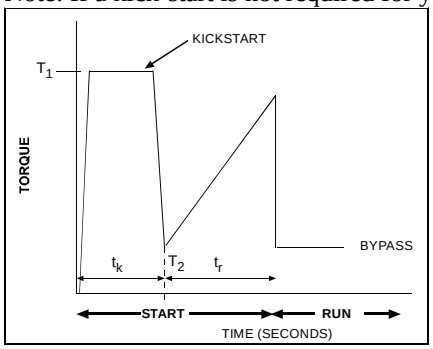


Figure 23

Programming the Start (continued)

Programming the Ramp Start Sequence

Ramp Start

The next element to be determined is the start configuration, either ramp **Figure 24** or current limit **Figure 25**, page 38. To select the ramp start, move the bottom dip switch toward "RAMP START". In this mode, the motor torque is ramped up from an initial start level by increasing the motor current until the motor is started or the ramp time has elapsed. The initial starting torque point is selected by adjusting the T_2 dial to the level required by the application. T_2's range is 5% to 85% of the motor's across-the-line locked rotor torque. Equivalent values of across-the-line locked rotor current versus torque are shown in Table M, Page 36.

Once the initial torque point is determined, the ramp time must be selected by adjusting the t_r dial from 0.5 to 180 seconds.

At the end of the ramp time, the motor should be at full speed. If the motor is at 90% of rated speed or more and its current is less that 2 x FLA, the bypass contacts will close, connecting the motor directly across the input line power. If the motor has not reached 90% speed, or its current is greater than 2 x FLA at the end of the ramp time, the soft starter will trip. A stall fault will be indicated on the CIM. This could indicate that the load characteristics have changed (load is jammed, full, damaged, etc.). If it occurs during the initial commissioning of the unit, you will need to increase the initial torque setting, adjust the ramp time, or both.

Note: The t_r control is not linear to allow finer setting of short ramp times. The first half of the pot adjusts from 0.5 to 20 seconds, the next quarter from 20 to 60 seconds, and the last quarter from 60 to 180 seconds. The maximum value of t_r can be modified at the factory for special orders/applications. Contact Cutler-Hammer for more information.

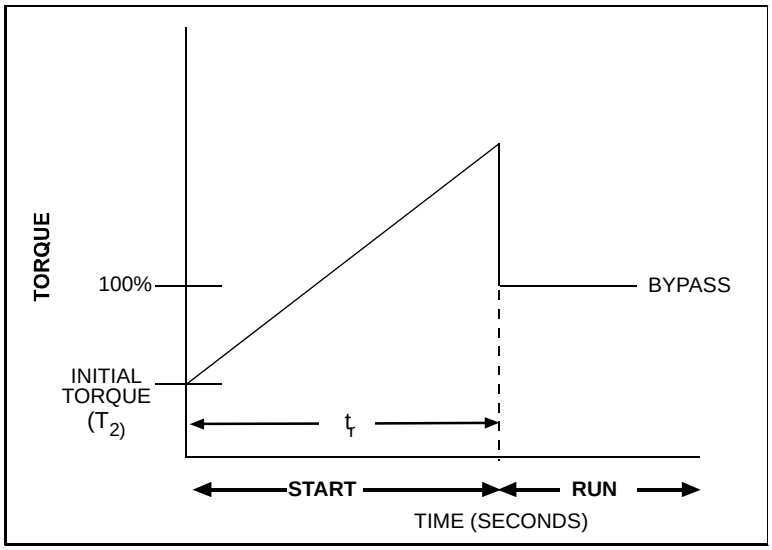


Figure 24

Continued on next page…

Programming the Start (continued)

Programming the Current Limit Start

The process for programming with the Current Limit Start **Figure 25,** is similar to the process for the Ramp Start.

To select the Current Limit Start option, move the dip switch to the right. This will activate the current limit start-up profile.

In the current limit startup mode, you set a maximum current during the start. This value (T_2) can be set from 5% to 85% of the across-the-line locked rotor torque. (See Table M page 36 for values). Next, set the start time (t_r) for the start. This value can be set from 0.5 to 180 seconds. NOTE: The ramp time is set to zero automatically.

At the end of the ramp, the motor should be at full speed. If the motor is at 90% of rated speed or greater of this value and current is less than 2 x FLA, the bypass contacts will then close, and the unit will run at full speed. If it has not reached 90% of speed at the end of ramp, the unit will trip off line and you will receive a stall indication on the control interface module. This could indicate that the load characteristics have changed (load is jammed, full, damaged, etc.). If it occurs during initial commissioning of the unit, you will need to increase the current limit setting, increase the length of the ramp, or both to allow enough time and energy to bring the motor up to speed.

Note: The t_r pot is not linear to allow finer setting of short ramp times. The first half of the control adjusts from 0.5 to 20 seconds, the next quarter from 20 to 60 seconds, and the last quarter from 60 to 180 seconds. The maximum value of t_r can be modified at the factory for special orders/applications. Contact Cutler-Hammer for more information.

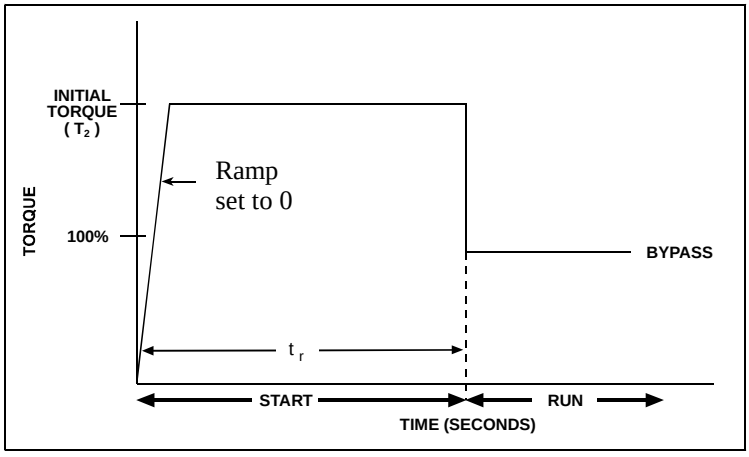


Figure 25

Programming the Soft Stop

Soft Stop

The last item to be programmed is the soft stop. This feature slowly reduces the voltage applied to the motor to extend its stop time.

⚠ Caution	⚠ Attention
Soft Stop is not an emergency stop. If a quick stop is desired, additional control is required to open up the 24V DC to terminal +. Using terminal P for a quick stop is not recommended.	Un arrêt à tension réduite n'est pas un arrêt d'urgence. Pour un arrêt rapide, prévoir un bouton additionnel afin d'ouvrir le circuit de +24 V c.c. à la borne +. L'utilisation de la borne P comme arrêt rapide n'est pas recommandée.

⚠ Caution	⚠ Attention
Soft Stop does not provide any braking. It cannot cause the motor and its load to stop faster than their normal unpowered coast down time.	Un arret a tension réduite n'assure aucun freinage.l Il ne peut assurer le freinage du moteur et de sa charge plug rapidement qu'en mode débrayé.

The soft stop feature has one setting, ramp time t_s, programmable from 0 to 60 seconds. If t_s is set to 0 when a stop command is given, the bypass contacts will open and the de-energized motor will coast to a stop as if connected to an electromagnetic starter. If t_s is set longer than this coast down time, the soft stop output voltage will linearly decrease upon a stop command, extending the stop time. Note that in some applications the motor will come to a stop in less than the selected t_s time if t_s is set too long.

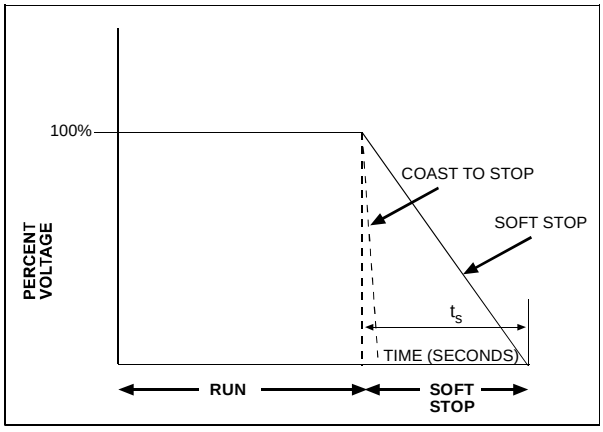


Figure 26

The pump control option includes a special soft stop feature intended to prevent water hammer upon shutdown in centrifugal pump applications. See the Pump Control Option section, for specific information.

Procedure for Starting

Line Power

- Line power must be applied prior to the application of the 24V DC control power to prevent a phase loss or zero voltage crossing protection fault.
- Terminal P must have 24V DC applied to ENABLE the soft starter.
- The soft starter will start when 24V DC is applied to terminal P and either terminal 1 or 2 goes from 0V DC to 24V DC.
- Remove 24V DC from terminal P to initiate a stop.
- If either terminal 1 or 2 remains connected to 24V DC when terminal P is opened, the soft starter will stop.
- Terminals 1 through 4 are activated by momentarily applying 24V DC.
- If either terminal 1 or 2 remains connected to 24V DC when terminal P is opened, the soft starter will stop.
- On the R, S, and T frame soft starters, when the bypass contactors close, a momentary sound similar to contactor chattering can be heard. The three single phase contactors closing in a staggered manner over a very short period of time cause this sound. This is part of normal operation, and should not be misinterpreted as a dirty pick-up.
- For two-wire control, jumper terminals P and 1 together.

Jog

- Terminal P must have 24V DC applied.
- Terminal 2 is edge sensitive. This means that there must be a transition for 0 to 24V DC to jog.
- In jog, the unit will follow the normal start ramp as long as terminal 2 is at 24V DC.
- To stop, remove the 24V DC from terminal 2
- Jog operates the same as a normal start, except that the bypass contactors will not close and the soft stop is not functional.

Note: Jog is only intended for short term jogging of the motor and not for long term two-wire control. For two-wire control, tie terminals P and 1 together and connect to 24V DC to start and disconnect from 24V DC to stop.

Troubleshooting

General

In this section of the manual, we present a procedure you can follow to diagnose a problem with your *IT.* Soft Starter.

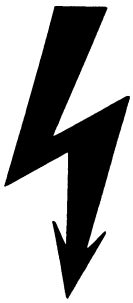
While many potential situations are outlined in this section, it is possible you may run into a problem that is not covered here. If you have worked through the following troubleshooting procedure and find that you require further assistance, please contact Cutler-Hammer. You will find contact information on the back cover of this manual.

Please have the following information ready when you call:

Order No. (if available)
Catalog No.
Style no.
Serial no.
CIM DIP Switch Settings
CIM Pot Settings

Before You Begin to Troubleshoot

⚠ Warning	⚠ Avertissement
Make sure you read and understand all of the safety statements in the safety section of this manual before you begin troubleshooting.	S'assurer de lire et de comprendre tous les enonces relatifs a la securite de la section securite de ce manuel avant de proceder au depannage.

	⚠ Danger High Voltage	⚠ Danger (Haute tension)
	Do not work on energized equipment unless absolutely required. If troubleshooting procedure requires equipment to be energized, all work must be performed by properly qualified personnel, following appropriate safety practices and precautionary measures.	Ne pas travailler sur de l'equipement sous tension sauf si absolutment necessaire. Si les methodes de depannage exigent que l'equipment soit sous tension, les travaux doivent etre executes par personnel qualifie, et les pratiques de securite et mesures preventives etre observees.

We highly recommend that you read this entire section of the manual before you begin to troubleshoot the *IT.* Soft Starter.

You may want to obtain the following equipment to aid you in troubleshooting:

- Multimeter
- Clamp-on ammeter

Define the Problem

There are four basic problem types you may encounter with the *IT.* soft starter. To begin, select the situation below that most closely matches your problem.

1. **The *IT.* Soft Starter fails to start. No power is applied to the motor.**

   Go to Figure 27 - Troubleshooting Flowchart #1.

2. **The *IT.* Soft Starter trips during start up, or fails to reach rated speed before going into bypass.**

   Go to Figure 27 - Troubleshooting Flowchart #1.

3. **The *IT.* Soft Starter trips or stops running during normal running conditions.**

   Go to Figure 27 - Troubleshooting Flowchart #1.

4. **None of the above situations match the problem.**

   Go to Figure 28- Troubleshooting Flowchart #2.

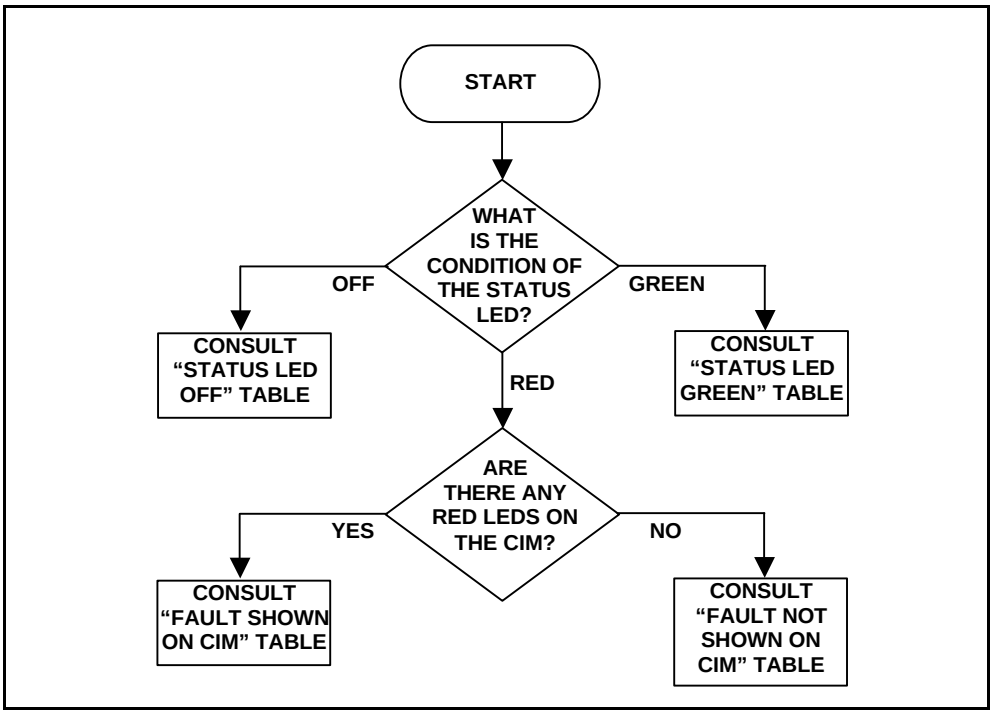


Figure 27: Troubleshooting Flowchart #1

Continued on next page…

Define the Problem (continued)

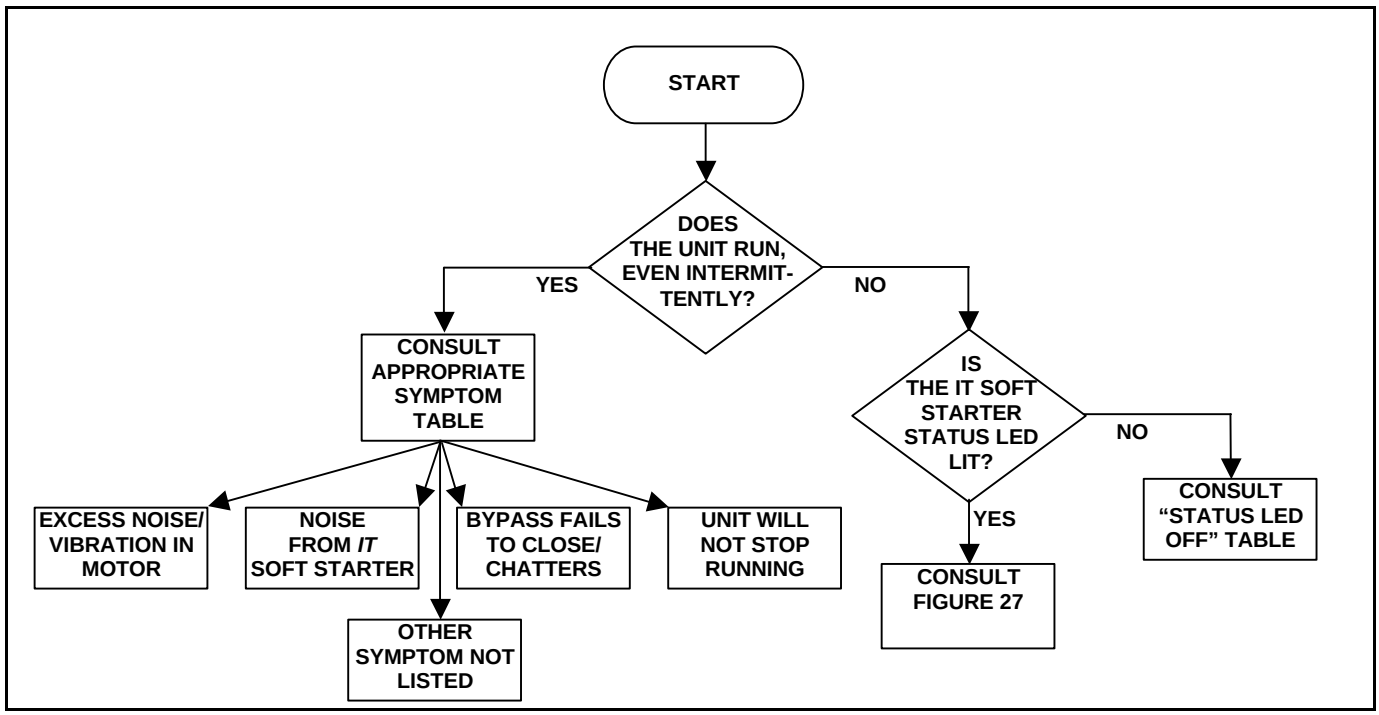


Figure 28: Troubleshooting Flowchart #2

Status LED Off

Symptom/ Indication	Possible Problem	Possible Solution
No indication on the unit or on the CIM.	Loss of 24V DC power.	Check control wiring.
		Verify 24V DC power available from power supply.
		Check power supply fuse/circuit breaker.
	Failed CIM	Disconnect the CIM. If the Status LED lights, Replace the CIM. If not, control board may be defective. Contact Cutler-Hammer
	Failed control board	Contact Cutler-Hammer.
No status light, but CIM is powered.	Failed LED indication.	Reset the unit, verify operation.
		Cycle 24V DC control power to the unit.

Status LED Green

Symptom/ Indication	Possible Problem	Possible Solution
Status LED green, no indication on the CIM.	Line power fault.	Check wiring connection on load and line side.
		Check line power breakers/fuses.
		Verify 24V DC power on "P" terminal. Then, verify power is cycled to terminal 1.

Fault Shown on CIM

Indication	Possible Problem	Possible Solution
S.S. LED is lit. (Overtemperature t_r setting, hardware failure or load disconnect)	High temperature – see flash codes	Allow system to cool down with 24V DC applied to + and -.
		Verify operation of unit cooling fans.
		Clear any blockage or restriction of air flow.
	Possible hardware failure – see **flash codes**	If code 32 is indicated, check actual motor start time vs. t_r set time. t_r should not be set more than 2-3 seconds longer than the actual motor start time. Reset t_r
		Contact Cutler-Hammer.
	Load Disconnect	Check shaft coupler between motor and load
JAM LED is lit.	Fault exists in memory.	Press the RESET button located below the CIM to clear the fault.
	Current has exceeded Jam program level.	Clear the cause of the jam.
		FLA setting too low for application. Check that it matches motor nameplate current.
STALL LED is lit.	Fault exists in memory.	Press the RESET button located below the CIM to clear the fault.
	Unit failed to reach rated speed (90%) at end of ramp.	Clear the cause of the stall in the application.
		Verify ramp time is sufficient for application.
		Verify initial torque setting is sufficient for application.
		FLA setting too low for application. Check that it matches motor nameplate current.
PH. LOSS LED is lit. (Phase loss or unbalanced line current)	One or more line voltages are missing or low.	Verify proper line voltage present and that no other equipment was affected.
		Confirm line power connections are correct and tight.
		Check line power fuses, circuit breakers, and disconnects.
		Press the RESET button located below the CIM to clear the fault.
	Phase voltages or currents unbalanced	Check same solutions as for phase loss.
		Confirm motor current balanced when connected across the line with balanced line voltage. If not, replace motor.
		If line voltage balance but load voltage not, contact Cutler-Hammer
		Check load connections at soft starter and at motor terminal box.
PH REV LED is lit.	Line voltage is not in ABC configuration.	Verify proper wiring arrangement.
OVLD TRIP LED is lit.	Motor is overloaded.	Check motor for load problems.
	FLA not set to motor ratings.	Verify that the FLA setting matches the motor nameplate current. (Consider any Service Factor being used.)
	Trip class set improperly.	Adjust trip class setting on CIM.
	Fault exists in memory.	Press the RESET button located below the CIM to clear the fault. If the fault remains, maintain 24V DC power applied to the unit, and allow the system to cool down for at least 9 minutes and try again.
	Failed current sensor.	Contact Cutler-Hammer.

Soft Starter Fault Flash Codes Sent to CIM

To obtain the fault flash codes from the CIM, hold the RESET button (located below the CIM) down or apply 24V DC to terminal 4 and count the number of times all the LEDs on the CIM flash.

For example, if you see three flashes, and then two more flashes after a short pause, the flash code is 32.

The CIM can provide multiple flash codes, if more than one error condition caused a stop. Once you see the same flash code repeated, you have seen all the flash codes for the error conditions that caused the stop.

For example, if you see three flashes, a pause, then two flashes, a pause, then four flashes, a pause, then one flash, the flash codes are 32 and 41. If you then see three flashes, a pause, then two flashes, you are seeing the first code again. This means you have seen all the flash codes for this stop. You may now release the RESET button or remove 24V DC from terminal 4. (Note that if an overload trip has occurred, 24V DC power must be applied to allow the overload thermal memory to reset. Depending on the overload history prior to the latest trip, this may be as long as 9 minutes.)

A list of flash codes and the faults they represent is shown here.

Code	Fault	Possible Cause
11	Thermal overload	See Page 42
12	Motor stall	See Page 42
13	Motor jam	See Page 42
14	Phase sequence ACB	See Page 42
15	Pole over-temperature	See Page 42
16	SCR failed to fire	Extreme settings on lightly loaded motor. Loose connection or defective unit
21	15V power supply low	Weak control power or defective unit
22	Phase loss	See Page 42
23	Bypass dropout	Weak control power or defective unit
24	SCR/Contactor overcurrent	Only if stall or jam disabled, load amps excessive
25	Phase unbalance	See Page 42
26	Non-volatile memory error	Internal control board fault
31	Zero voltage cross failure	Control power applied out of sequence or power factor correction capacitors on motor
32	Shorted SCR, phase loss, load disconnect	See Page 42
33	Load Disconnect	Load Current falls below 1/16 of FLA setting. Can be disabled by setting phase loss to disable.
34	SCR instantaneous overcurrent	Current exceeded start ratings during the starting or stopping mode
41	24V power supply low	Improper 24V DC supply or weak control power
42	Timer system fault	Internal control board fault
43	Watchdog reset occurred	External electrical noise or internal control board fault
44	PLL (DSP)	Internal control board fault
45	Illegal address (DSP)	Internal control board fault

Fault Not Shown on CIM

Symptom/ Indication	Possible Problem	Possible Solution
Status LED is lit, no indication on CIM.	No communication with CIM.	Verify connection between Soft Starter and CIM. Press the RESET button (located below the CIM). All LEDs should momentarily light.
	Sensor failure.	Cycle 24V DC control power to the unit. Allow unit to reset.
	Bypass opened during run.	Press the RESET button (located below the CIM) to reset the fault.
		Verify that the 24V DC power supply rating is large enough to close the bypass contacts with a minimum output rating of 250 watts for 0.15 seconds.

Excess Noise/Vibration in Motor

Symptom/ Indication	Possible Problem	Possible Solution
Motor vibration during start up.	Load fluctuations.	Check load conditions.
	Misapplication.	Verify that motor is a standard squirrel cage induction motor.
		Ramp time set too low for application.
		Torque set too low for application.
	Load voltage or current unbalanced but line voltage is balanced.	Check line and load connections to soft starter and connections at motor terminal box.
	Hardware failure.	Contact Cutler-Hammer.
Motor vibration during normal run.	Load fluctuations.	Check load conditions.
		Check motor connections.

Audible Noise From Soft Starter – Bypass Fails to Close/Chatters

Symptom/ Indication	Possible Problem	Possible Solution
Audible Noise from Soft Starter.	Bypass contact chatter.	Check 24V DC control power to Soft Starter.
		Verify 24V DC power supply meets power inrush requirements (250 watts for 0.15 seconds.)
	Loose connections.	Remove power from unit, check all connections.
	Loose mountings.	Remove power from unit, check all mounting hardware.

Unit Will Not Stop

Symptom/ Indication	Possible Problem	Possible Solution
Motor will not shut off.	Control wiring is incorrect.	Verify 24V DC is removed from “P” terminal.
		Verify no strands from “+24V DC” are in contact with “P” terminal.
	Bypass fails to open.	Open disconnect. Remove all power from unit and check continuity of poles.
	Shorted SCR.	Open disconnect. Remove all power from unit and check continuity of poles.

Other Symptoms Not Listed

Symptom/ Indication	Possible Problem	Possible Solution
Motor short circuited.	Winding fault.	Identify and correct motor fault.
		Verify all power connections are secure.
		Verify no shorts exist in cabling or the motor terminal box.
Motor stops too quickly under soft stop.	t_S (soft stop) is set too low.	Adjust t_S time longer.
	Misapplication.	If friction load is too great, motor may stall during soft stop; reduce load if possible.
Motor stops too slowly under soft stop.	t_S (Soft Stop) is set too long.	Adjust t_S time as required.
	Misapplication.	Soft stop is designed to increase stopping time for loads that would otherwise stop suddenly upon removal of power. It cannot cause the motor to stop faster than its normal coast-down time.
Motor starts too slowly.	Incorrect setting.	Increase initial torque (T_2).
		Decrease ramp time (t_r).
		Increase current limit setting (T_2)
		Increase kick start torque (T_1).
		Increase kick start time (t_k).
Motor starts too quickly.	Incorrect setting.	Increase Ramp Time (t_r).
		Decrease initial torque (T_2).
		Decrease current limit setting (T_2).
		Decrease kick start torque (T_1).
		Decrease kick start time (t_k).

Removing Controller Interface Module (CIM)

1. To remove, release the catch lever, located in the cover just above center of the CIM. Move it upward.
2. Disconnect the communication cable from the bottom of the CIM assembly by pressing the lever to unlatch the communication plug.
3. Reinstall CIM in the reverse sequence.

NOTE: The bottom of the CIM must be inserted into the cover first, prior to snapping the CIM into the top latch.

Ratings

HP and kW Ratings

Duty Ratings

Standard Duty Ratings

15 Second Ramp, 4 Starts per Hour, 300% Current Limit @ 40°C

Frame Width	Max Current	Three-Phase Motor											Catalog Number
		kW Rating (50 Hertz)			hp Rating (60 Hertz)								
		230	380-400	440	200V		230V		460V		575V-690V		
		Volt	Volt	Volt	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	
N	37	10	18.5	18.5	10	10	10	10	25	20	30	30	**S801N37N3S**
	66	18.5	30	37	20	15	20	20	50	40	60	50	**N66N3S**
R	105	30	55	59	30	25	40	30	75	60	100	75	**S801R10N3S**
	135	40	63	80	40	30	50	40	100	75	125	100	**R13N3S**
T	180	51	90	110	60	50	60	60	150	125	150	150	**S801T18N3S**
													T18V3S
	240	75	110	147	75	60	75	75	200	150	200	200	**T24N3S**
													T24V3S
	304	90	160	185	100	75	100	100	250	200	300	250	**T30N3S**
													T30V3S
V	360	110	185	220	125	100	150	125	300	250	350	300	**S801V36N3S**
													V36V3S
	420	129	220	257	150	125	175	150	350	300	450	350	**V42N3S**
													V42V3S
	500	150	257	300	150	150	200	150	400	350	500	450	**V50N3S**
													V50V3S
	650	200	355	425	250	200	250	200	500	450	600	500	**V65N3S**
													V65V3S
	720	220	400	450	---	---	300	250	600	500	700	600	**V72N3S**
													V72V3S
	850	257	475	500	---	---	350	300	700	600	900	700	**V85N3S**
													V85V3S
	1000	277	525	50	---	---	400	350	800	700	900	800	***V10N3S**

*See Application Notes, Page 59

HP and kW Ratings

25-Second Ramp, 4 Starts per Hour, 300% Current Limit @ 40°C

Frame Width	Max Current	Three-Phase Motor											Catalog Number
		kW Rating (50 Hertz)			hp Rating (60 Hertz)								
		230	380-400	440	200V		230V		460V		575V-690V		
		Volt	Volt	Volt	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	
N	34	9	15	18.5	10	7.5	10	10	25	20	30	25	**S801N37N3S**
	63	15	30	33	20	15	20	20	40	40	60	50	**N66N3S**
R	96	25	45	55	30	25	30	30	75	60	75	75	**S801R10N3S**
	120	33	63	63	40	30	40	40	75	75	100	100	**R13N3S**
T	150	45	80	90	50	40	50	50	100	100	150	125	**S801T18N3S**
													T18V3S
	215	63	110	132	60	60	75	60	150	150	200	150	**T24N3S**
													T24V3S
	278	80	147	160	75	75	100	75	200	200	250	250	**T30N3S**
													T30V3S
V	320	90	160	185	100	75	125	100	250	200	300	250	**S801V36N3S**
													V36V3S
	380	110	200	220	125	100	150	125	300	250	350	300	**V42N3S**
													V42V3S
	460	140	250	280	150	125	150	150	350	300	450	400	**V50N3S**
													V50V3S
	610	185	315	375	250	150	200	200	500	450	600	500	**V65N3S**
													V65V3S
	680	200	375	445	---	200	250	200	600	500	700	600	**V72N3S**
													V72V3S
	810	250	450	500	---	---	300	300	700	600	900	700	**V85N3S**
													V85V3S
	890	290	510	560	---	---	400	350	700	600	900	700	***V10N3S**

*See Application Notes, Page 59

HP and kW Ratings (continued)

15-Second Ramp, 4 Starts per Hour, 300% Current Limit @ 50°C

Frame Width	Max Current	Three-Phase Motor											Catalog Number
		kW Rating (50 Hertz)			hp Rating (60 Hertz)								
		230	380-400	440	200V		230V		460V		575V-690V		
		Volt	Volt	Volt	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	
N	34	9	15	18.5	10	7.5	10	10	25	20	30	25	**S801N37N3S**
	63	15	30	33	20	15	20	20	40	40	60	50	**N66N3S**
R	96	25	45	55	30	25	30	30	75	60	75	75	**S801R10N3S**
	120	33	63	63	40	30	40	40	75	75	100	100	**R13N3S**
T	150	45	80	90	50	40	50	50	100	100	150	125	**S801T18N3S**
													T18V3S
	215	63	110	132	60	60	75	60	150	150	200	150	**T24N3S**
													T24V3S
	278	80	147	160	75	75	100	75	200	200	250	250	**T30N3S**
													T30V3S
V	320	90	160	185	100	75	125	100	250	200	300	250	**S801V36N3S**
													V36V3S
	380	110	200	220	125	100	150	125	300	250	350	300	**V42N3S**
													V42V3S
	460	140	250	280	150	125	150	150	350	300	450	400	**V50N3S**
													V50V3S
	610	185	315	375	250	150	200	200	500	450	600	500	**V65N3S**
													V65V3S
	680	200	375	445	---	200	250	200	600	500	700	600	**V72N3S**
													V72V3S
	830	257	450	500	---	---	300	300	700	600	900	700	**V85N3S**
													V85V3S
	960	302	510	540	---	---	350	300	800	700	900	800	***V10N3S**

*See Application Notes, Page 59

HP and kW Ratings (continued)

50-Second Ramp, 2 Starts per Hour, 300% Current Limit @ 50°C

Frame Width	Max Current	Three-Phase Motor											Catalog Number
		kW Rating (50 Hertz)			hp Rating (60 Hertz)								
		230	380-400	440	200V		230V		460V		575V-690V		
		Volt	Volt	Volt	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	
N	21	5.5	10	11	5	5	5	5	15	10	15	15	**S801N37N3S**
	42	11	18.5	22	10	10	15	10	30	25	40	30	**N66N3S**
R	60	15	30	33	15	15	20	15	40	40	50	50	**S801R10N3S**
	80	22	40	45	25	20	30	25	60	50	75	60	**R13N3S**
T	115	33	59	63	30	30	40	30	75	75	100	100	**S801T18N3S**
													T18V3S
	150	45	80	90	50	40	50	50	100	100	150	125	**T24N3S**
													T24V3S
	192	55	100	110	60	50	60	60	150	125	200	150	**T30N3S**
													T30V3S
V	280	80	150	160	75	75	100	75	200	200	250	250	**S801V36N3S**
													V36V3S
	340	100	180	200	100	100	125	100	250	200	350	300	**V42N3S**
													V42V3S
	380	110	200	220	125	100	150	125	300	250	350	300	**V50N3S**
													V50V3S
	420	129	220	257	150	125	150	150	350	300	450	350	**V65N3S**
													V65V3S
	480	147	257	295	150	150	200	150	400	350	500	450	**V72N3S**
													V72V3S
	590	180	315	375	200	150	200	200	500	400	600	500	**V85N3S**
													V85V3S
	650	205	370	415	250	200	250	200	500	450	600	500	***V10N3S**

*See Application Notes, Page 59

HP and kW Ratings (continued)

15-Second Ramp, 4 Starts per Hour, 450% Current Limit @ 40°C

Frame Width	Max Current	Three-Phase Motor											Catalog Number
		kW Rating (50 Hertz)			hp Rating (60 Hertz)								
		230	380-400	440	200V		230V		460V		575V-690V		
		Volt	Volt	Volt	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	
N	29	7.5	12.5	15	7.5	7.5	10	7.5	20	15	25	20	**S801N37N3S**
	49	12.5	22	25	15	10	15	15	30	30	40	40	**N66N3S**
R	73	18.5	37	40	20	20	25	20	50	40	60	60	**S801R10N3S**
	94	25	45	55	30	25	30	30	60	60	75	75	**R13N3S**
T	155	45	80	90	50	40	60	50	100	100	150	125	**S801T18N3S**
													T18V3S
	219	63	110	132	60	60	75	60	150	150	200	150	**T24N3S**
													T24V3S
	280	80	150	160	75	75	100	75	200	200	250	250	**T30N3S**
													T30V3S
V	345	100	185	200	100	100	125	100	250	200	350	300	**S801V36N3S**
													V36V3S
	405	110	200	250	125	100	150	125	300	250	400	350	**V42N3S**
													V42V3S
	465	140	250	280	150	125	150	150	350	300	450	400	**V50N3S**
													V50V3S
	530	160	280	335	150	150	200	150	450	350	500	450	**V65N3S**
													V65V3S
	590	180	315	375	200	150	---	200	500	400	600	500	**V72N3S**
													V72V3S
	651	200	355	425	---	---	---	---	600	450	700	600	**V85N3S**
													V85V3S
	754	220	400	465					600	500	800	700	***V10N3S**

*See Application Notes, Page 59

HP and kW Ratings (continued)

30-Second Ramp, 4 Starts per Hour, 450% Current Limit @ 40°C

Frame Width	Max Current	Three-Phase Motor											Catalog Number
		kW Rating (50 Hertz)			hp Rating (60 Hertz)								
		230	380-400	440	200V		230V		460V		575V-690V		
		Volt	Volt	Volt	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	
N	21	5.5	10	12.5	5	5	5	5	15	10	15	15	**S801N37N3S**
	40	11	18.5	22	10	10	10	10	30	25	30	30	**N66N3S**
R	55	15	25	30	15	15	20	15	40	30	50	40	**S801R10N3S**
	75	22	37	45	20	20	25	20	50	50	60	60	**R13N3S**
T	151	45	80	90	50	40	50	50	100	100	150	125	**S801T18N3S**
													T18V3S
	215	63	110	132	60	60	75	60	150	150	200	150	**T24N3S**
													T24V3S
	264	80	140	160	75	75	100	75	200	150	250	200	**T30N3S**
													T30V3S
V	300	90	160	185	100	75	100	100	200	200	300	250	**S801V36N3S**
													V36V3S
	340	100	180	200	100	100	125	100	250	200	350	300	**V42N3S**
													V42V3S
	380	110	200	220	125	100	150	125	300	250	350	300	**V50N3S**
													V50V3S
	420	129	220	257	150	125	150	150	350	300	450	350	**V65N3S**
													V65V3S
	460	140	250	280	150	125	150	150	350	300	450	400	**V72N3S**
													V72V3S
	500	150	257	300	150	150	200	150	400	350	500	450	**V85N3S**
													V85V3S
	560	160	277	325	200	150	250	200	500	400	600	500	***V10N3S**

*See Application Notes, Page 59

HP and kW Ratings (continued)
Severe Duty Ratings

Frame Width	Max Current	Three-Phase Motor											Catalog Number
		kW Rating (50 Hertz)			hp Rating (60 Hertz)								
		230	380-400	440	200V		230V		460V		575V		
		Volt	Volt	Volt	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	
N	22	5.5	10	11	5	5	7.5	5	15	10	20	15	S801N37N3S
	42	11	18.5	22	10	10	15	10	30	25	40	30	N66N3S
R	65	15	30	33	15	15	20	15	50	40	50	50	S801R10N3S
	80	22	40	45	25	20	30	25	60	50	75	60	R13N3S
T	115	33	59	63	30	30	40	30	75	75	100	100	S801T18N3S
													T18V3S
	150	45	80	90	50	40	50	50	100	100	150	125	T24N3S
													T24V3S
	192	55	100	110	60	50	75	60	150	125	200	150	T30N3S
													T30V3S
V	240	75	110	147	75	60	75	75	200	150	200	200	S801V36N3S
													V36V3S
	305	90	160	185	100	75	100	100	250	200	300	250	V42N3S
													V42V3S
	365	110	185	220	125	100	150	125	300	250	350	300	V50N3S
													V50V3S
	420	129	220	257	150	125	150	150	350	300	450	350	V65N3S
													V65V3S
	480	147	257	295	150	150	200	150	400	350	500	450	V72N3S
													V72V3S
	525	160	280	335	150	150	200	150	450	350	500	450	V85N3S
													V85V3S
	575	172	303	370	200	150	250	200	500	450	600	500	*V10N3S

*See Application Notes, Page 59

Severe Duty Ratings are defined as any combination of parameters that exceed the Standard Duty Ratings where the ramp time is over 30 seconds, the number of starts per hour exceeds 4, or the current limit set- is over 300%. Example; 35-Second Ramp, 5 Starts per Hour, 350% Current Limit @ 40ºC Ambient.

Cooling

Fans are used to cool the *IT.* Soft Starter. The fans are turned on when the temperature of any of the thermal sensors exceeds a preset value. If the temperature is below this value, the fans will be off.

The fans will also be turned on whenever the *IT.* is started, stopped, or jogged. The fans will remain on for 15 minutes to assure the SCRs are adequately cooled prior to the next start or jog.

If a temperature is sensed above a second preset level, a Pole Over-Temperature Fault will occur. This fault cannot be reset until the temperature returns to a safe level.

Note that the fans will only operate if 24V DC is applied to the + and – terminals.

The following table lists the maximum power loss for each *IT.* Soft Starter when it is operating in the across-the-line mode with its bypass contactor pulled in. These losses should be used in conjunction with the losses of another cabinet mounted devices to determine the enclosure size and any cooling requirements.

Cooling (continued)

Frame Size	Catalog Number	Current Range	Across-the Line-Losses (Watts)
N	S801N37N3S	11 – 37	30
	S801N66N3S	20 – 66	33
R	S801R10N3S	32 – 105	47
	S801R13N3S	42 – 135	55
T	S801T18N3S S801T18V3S	56 – 180	37
	S801T24N3S S801T24V3S	75 – 240	40
	S801T30N3S S801T30V3S	95 – 304	45
V	S801V36N3S S801V36V3S	112 – 360	56
	S801V42N3S S801V42V3S	131 – 420	64
	S801V50N3S S801V50V3S	156 – 500	78
	S801V65N3S S801V65V3S	203 – 650	109
	S801V72N3S S801V72V3S	225 – 720	127
	S801V85N3S S801V85V3S	265 – 850	164
	S801V10N3S	310 – 1000	215

Short Circuit Ratings

Soft Starter Frame Size	Three-Phase Short Circuit Rating			
	240V	480V	600V	690V
N	10KA	10KA	10KA	---
R	10KA	10KA	10KA	---
T	18KA	18KA	18KA	See Notes 1 and 3
V	42KA	42KA	42KA	See Notes 2 and 4

Note 1 – Catalog No. S801T__**V**3S devices are UL Listed and suitable for use on a circuit capable of delivering not more than 18kA symmetrical amperes, 690 volts maximum, *when protected by a* Ferraz-Shawmut "Amp-Trap" Form 101 (Cat. No. A70QS800-4) 800 Amp, 700 Volt Semiconductor Protection Fuse.

Note 2 – Catalog No. S801V__**V**3S devices are UL Listed and suitable for use on a circuit capable of delivering not more than 42kA 690 volts maximum, *when protected by a* Ferraz-Shawmut Type PSC (Cat. No. A070URD73I1600) 1600 Amp, 700 Volt Semiconductor Protection Fuse.

Note 3 – Catalog No. S801T__**V**3S devices tested per IEC 60947-4-2 to Type 1 Short Circuit Withstand Requirements to 18kA, 690 volts with Cutler-Hammer Cat. No. NW3800T33W 800 Amp 690 Volt circuit breaker.

Note 4 – Catalog No. S801V__**V**3S devices tested per IEC 60947-4-2 to Type 1 Short Circuit Withstand Requirements to 42kA, 690 volts with Cutler-Hammer Cat. No. RW420T33W 2kA 690 Volt circuit breaker.

Special Function Options

Pump Control Option

This option is intended to reduce the potential for water hammer in a centrifugal pump system by utilizing a starting and stopping algorithm developed for pump control. Upon a start command, the speed of the motor is increased, under the control of the *IT.* Soft Starter microprocessor, to achieve a gentle start. After the speed has reached its nominal value, the bypass contactors close and the pump operates as with any other starter. Upon a stop command, the bypass contactors are opened and the motor speed is decreased in a tapered manner, to gradually slow the flow until the motor is brought to a stop. The start and stop ramp times are user adjustable and are to be set for the application requirements.

The pump control option is a factory installed feature. Factory installed options are designated by the eighth character in the catalog number. Unmodified *IT.* Soft Starters have an "N" as their eighth character. *IT.* Soft Starters with the pump control option have a "P" as their eighth character, as in S801XXX**P**3S.

Installation

Install and wire your *IT.* Soft Starter per the instructions found in the beginning of this manual.

Setup

The pump control option is enabled by the S.F. – ENABLE/DISABLE dip switch located on the control interface module (CIM). To enable this feature, position this switch in the ENABLE position. When the pump control is enabled, the RAMP START/CURRENT LIMIT dip switch is disabled. The default becomes RAMP START. See Figure 20, Page 33.

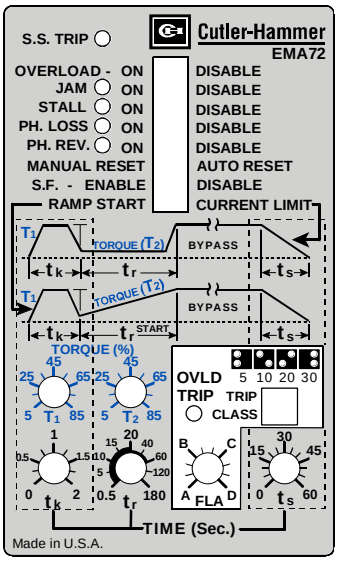


Figure 29: *IT.* Soft Starter CIM

Pump Control Option (continued)

Adjustment

All of the adjustments to the *IT.* Soft Starter are made as noted in the user manual. The major difference between the standard *IT.* Soft Starter and one with the pump start option is the special algorithm for gentle start and stop with centrifugal flow loads to minimize the potential for water hammer.

Tr, located on the CIM adjusts the start ramp. It has a range of 0.5 to 180 seconds. The factory default is 9 seconds. The soft stop time is adjusted by t_s, which has a range of 0.0 to 120 seconds (multiply the scale value for t_s by 2 to determine the actual time setting), with the factory default being 0.0 seconds. These adjustments are application dependent, and should be made to minimize any surge or water hammer effects. Typically t_s would not be set short, since the stop might not differ much from a coast-to-stop. The soft stop time adjustment may often be in the range of 30 to 40 seconds, but needs to be set appropriately for the system requirements. If reduction or elimination of water hammer is not achieved, it may be necessary to lengthen t_s to achieve the desired result. Note that long stop times will result in greater motor heating than shorter stop times. This can affect the number of start/stop cycles allowed per hour due to the *IT.* Soft Starter or motor thermal limits.

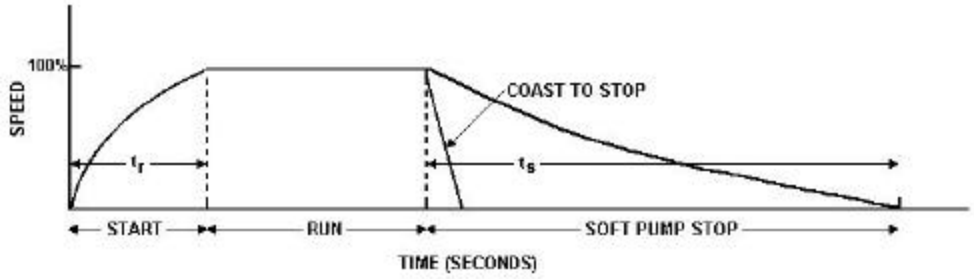


Figure 30: Pump Start Ramp and Soft Pump Stop

The t_r adjustment is tapered to provide for easier setting of both long and short times. The first half of the control adjusts from 0.5 to 20 seconds, the next quarter from 20 to 60 seconds, and the last quarter from 60 to 180 seconds. The t_s adjustment is linear with a time scale twice that shown in the CIM.

Application Notes

S801V10N3S – Optimum Performance

1. Install the device in a minimum enclosure size 30 ft^3
2. Two (2) forced air ventilation fans with a min. 500 ft^3/min, at a location for "air in" – bottom right or left corner and "air out" – opposite upper right or left corner.
3. RD circuit breaker
4. For power wiring: Use four (4) 500 MCM cables for each phase between RD circuit breaker and Soft Starter.
   OPTIONAL: Two (2) 3" x ¼" bus with a ¼" spacer per terminal.
   NOTE: see **Figure 1** for alternative layouts.
5. Line and load service entrance wiring must not cross in the enclosure.

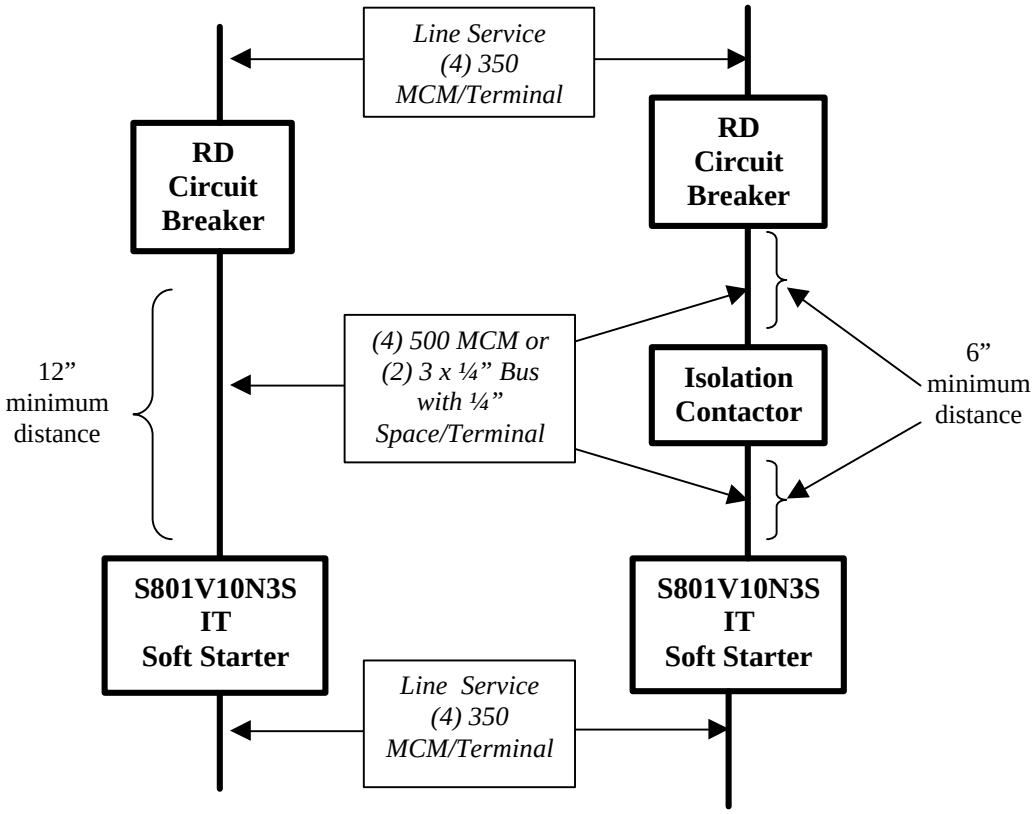


Figure 1

1.5 Service Entrance

1.5.1 Line and load service entrance wiring must not cross in the enclosure.

CE Conformity

S801N will meet EN60947-4-2 Radiated Immunity Test requirements, except for the following frequency bands:

80 to 89.2 MHz @ 9 V/m
90.1 to 92 MHz @ 6 V/m

S801R will meet EN60947-4-2 Radiated Immunity Test requirements, except for the following frequency bands:

90.04 to 92.87 MHz @ 6 V/m
91.9 to 92.8 MHz @ 9 V/m

S801T will meet EN60947-4-2 Radiated Immunity Test requirements, except for the following frequency bands:

223 to 225 MHz @ 7 V/m
261 to 283 MHz @ 6 V/m

S801V will meet EN60947-4-2 Radiated Immunity Test requirements, except for the following frequency bands:

289 to 294 MHz @ 8 V/m

S801T and S801V will meet CISPR Radiated Emission Test requirements except for the following frequency bands:

30 TO 38 MHz @ 5.345 dB out

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