

**EAT•N** | **Cutler-Hammer**

 **Intelligent Technologies**

## **S751 Soft Starter User Manual**

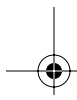


**EAT•N** | **Cutler-Hammer**

Pub 49907  
Catalog No. S751USERMAN  
A



49907.fm Page -2 Monday, February 25, 2002 4:08 PM




### **Important Notice — Please Read**

The product discussed in this literature is subject to terms and conditions outlined in appropriate Eaton's Cutler-Hammer selling policies. The sole source governing the rights and remedies of any purchaser of this equipment is the relevant Eaton's Cutler-Hammer selling policy.

NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY, OR WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OF TRADE, ARE MADE REGARDING THE INFORMATION, RECOMMENDATIONS AND DESCRIPTIONS CONTAINED HEREIN. In no event will Cutler-Hammer be responsible to the purchaser or user in contract, in tort (including negligence), strict liability or otherwise for any special, indirect, incidental or consequential damage or loss whatsoever, including but not limited to damage or loss of use of equipment, plant or power system, cost of capital, loss of power, additional expenses in the use of existing power facilities, or claims against the purchaser or user by its customers resulting from the use of the information, recommendations and descriptions contained herein.

The information contained in this manual is subject to change without notice.

Cover Photo: *IT*. S751L Soft Starter — S751L27N3S



February 2002

## Table of Contents

<b>PRODUCT OVERVIEW</b>	<b>1</b>
<b>SAFETY</b>	<b>2</b>
<b>CATALOG NUMBERS</b>	<b>3</b>
<b>GENERAL APPEARANCE</b>	<b>4</b>
<b>INSTALLATION</b>	<b>5</b>
Specifications	5
Mounting	5
Power Source and Protection Requirements	6
<b>POWER WIRING INTRODUCTION</b>	<b>6</b>
<b>CONTROL WIRING GENERAL</b>	<b>9</b>
<b>CONTROL WIRING</b>	<b>9</b>
2-Wire Control	9
3-Wire Control	11
<b>24V DC POWER SUPPLY SELECTION</b>	<b>12</b>
<b>MOTOR/APPLICATION CONSIDERATIONS</b>	<b>13</b>
Squirrel Cage Motor	13
Wye-Delta Motor	13
Part Winding Motor	13
Dual Voltage Motor	14
Multi-Speed Motor	14
Other Winding Configurations	14
Power Factor Correction Capacitors	14
<b>IT. S751 SOFT STARTER DUTY RATINGS</b>	<b>15</b>
Standard Duty	15
Severe Duty	15
<b>IT. S751 SOFT STARTER SETUP</b>	<b>16</b>
Start	16
Soft Stop [STOP RAMP TIME]	17
Overload Class Setting	18
Overload FLA Setting	20
Protective Trip	22
Phase Loss and Current Unbalance Protection	23
General	23
Phase Loss	24
Phase Current Unbalance	24
Overload Protection	24
Trip Reset	25
Manual Reset	26
Remote Reset	26
Auto Reset	26
Reset Summary	26
Alarm Output	26
<b>TROUBLESHOOTING AND MAINTENANCE</b>	<b>28</b>
Renewal/Replacement Parts	28
Control Terminal Block	28
Control Terminal Block Removal and Installation	28
Auxiliary Contacts	29
TEST Button Operation	30
Troubleshooting Chart	31
<b>STANDARDS CONFORMITY AND APPROVALS</b>	<b>34</b>



February 2002

## Product Overview

The Intelligent Technologies, *IT. S751* Soft Starter by Eaton Corporation is an electronic, self-contained, panel or enclosure mounted, motor soft starting device. It is intended to provide three-phase induction motors with a smooth start and stop, both mechanically and electrically. The *IT. S751* Soft Starter 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 *IT. S751* Soft Starter is designed to fulfill the industrial service requirements for applications such as Chillers, Pumps and Machine Tools, which require less than 95% of the motor's rated starting torque for the worst case starting condition.

The *IT. S751* 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. S751* 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.










Eaton's Cutler-Hammer *IT. S751* Soft Starter includes the following significant features:

- 24V DC control power, a safe reliable global standard
- Unique Pulse Width Modulated bypass contactor coil providing high efficiency and low energy consumption
- Wide operating temperature range of -40°C to 65°C [-40°F to 149°F]
- DIN rail or panel mounting with highly accessible mounting feet
- Easy field assembly of control wiring with removable locking terminal block
- Micro controller based
- Phase loss and current unbalance protection, user selectable
- Selectable Trip Class — 10, 20 or 30
- Ambient compensation
- Motor overtemperature protection with Thermal Memory at power-up
- Running motor thermal capacity utilization indication
- Front mounted auxiliary interlocks
- Long-life silver nickel bypass contacts provide excellent conductivity
- IP20 finger protection
- Lockable cover protects adjustment and reset functions
- Seven segment display for status and fault indication
- Selectable Manual, Remote or Auto Reset



## Safety

The following safety statements relate to the installation, setup and operation of Cutler-Hammer IT. S751 Soft Starters.

Notice	Avis	Aviso
Make sure you read and understand the procedures in this manual <b>before</b> you attempt to operate or set up the equipment.	Bien lire et comprendre les procédures contenues dans ce manuel <b>avant</b> de tenter le fonctionnement ou la mise en place de l'équipement.	Asegúrese de leer y entender los procedimientos en este manual <b>antes</b> de intentar operar o configurar el equipo.
 WARNING	 AVERTISSEMENT	 ADVERTENCIA
This instruction manual should be used for proper installation, setup and operation of an IT. S751 Soft Starter. Improperly installing and maintaining this product can result in serious personal injury or property damage. Before attempting installation, setup or operation, read and understand all of this manual.	Ce manuel d'instructions doit être utilisé pour le bon fonctionnement, l'installation et la mise en place d'un IT. S751 Soft Démarreur (démarrage doux). L'installation et l'entretien incorrectes de ce produit entraîneront de sérieuses blessures corporelles, ou des dommages matériels. Avant de tenter quoique ce soit, veuillez lire et comprendre toutes les procédures de ce manuel.	Este manual de instrucciones debe utilizarse para la correcta instalación, configuración y operación del arrancador IT. S751 Soft Starter. La instalación o el mantenimiento inadecuado de este producto puede ocasionar serias lesiones personales o daños al material. Antes de intentar la instalación, la configuración o la operación lea y entienda todo el manual.
 DANGER	 DANGER	 PELIGRO
High Voltage	Haute tension	Alto voltaje
Hazardous voltage can cause electric shock and burns. Always disconnect power before proceeding with any work on this product.	Une tension électrique dangereuse peut causer des chocs électriques et des brûlures. Il faut toujours débrancher l'alimentation électrique avant de travailler sur ce produit.	Voltajes peligrosos que pueden causar descargas eléctricas y quemaduras. Siempre desconecte la energía eléctrica antes de efectuar cualquier trabajo en el equipo.
 CAUTION	 ATTENTION	 PRECAUCIÓN
Only apply 24V DC to any of the terminals of the control terminal block. Use of any other voltage may result in personal injury, property damage and damage to the IT. S751.	Monter seulement qu'un DC 24V sur n'importe quel des terminaux du bloc de jonction de la commande de Soft IT. S751. Usage d'une autre tension électrique peut entraîner des dommages matériels, des blessures corporelles et peut endommager le dispositif IT.	Aplique únicamente 24 V CD a cualquiera de los terminales del barral de terminales de control. El uso de otro voltaje puede ocasionar lesiones personales, daños al material y al arrancador IT. S751.



February 2002

<b>⚠ WARNING</b>	<b>⚠ AVERTISSEMENT</b>	<b>⚠ ADVERTENCIA</b>
To provide continued protection against fire or shock hazard, the complete <i>IT. S751</i> Soft Starter must be replaced if it becomes defective.	Pour fournir une protection continue contre le feu ou les chocs dangereux, le Soft Starter <i>IT. S751</i> doit être remplacé complètement s'il devient défectueux.	Para brindar protección continua contra incendio o descargas eléctricas, el arrancador Soft Starter <i>IT. S751</i> debe ser reemplazado en su totalidad si funciona incorrectamente.
<b>⚠ DANGER</b> High Voltage	<b>⚠ DANGER</b> Haute tension	<b>⚠ PELIGRO</b> Alto voltaje
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 the thyristors. Always disconnect input power before servicing the 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.	Puede estar presente el voltaje de línea en los terminales de la carga del motor, aun con el motor desactivado. Esto se debe a una posible fuga a través de los tiristores. Desconecte siempre la alimentación antes de trabajar sobre el arrancador o el motor.
<b>Notice</b>	<b>Avis</b>	<b>Aviso</b>
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.	Capacitores correctores del factor de potencia: No conecte estos capacitores del lado de la carga del arrancador. Esto ocasionará la falla de este último. Si se usan capacitores, deben conectarse del lado de la línea del arrancador, tan lejos de la entrada como sea posible.

## Catalog Numbers

The catalog numbers for the *IT. S751* Soft Starters are given in **Table 1**.

**Table 1: IT. S751 Catalog Numbers**

Catalog Number	Overload Current Range
S751L01N3S S751L02N3S S751L04N3S	0.24 – 0.8 0.57 – 1.9 1.3 – 4.4
S751L09N3S S751L16N3S S751L27N3S	2.7 – 9.0 4.8 – 16 8.0 – 27



## General Appearance

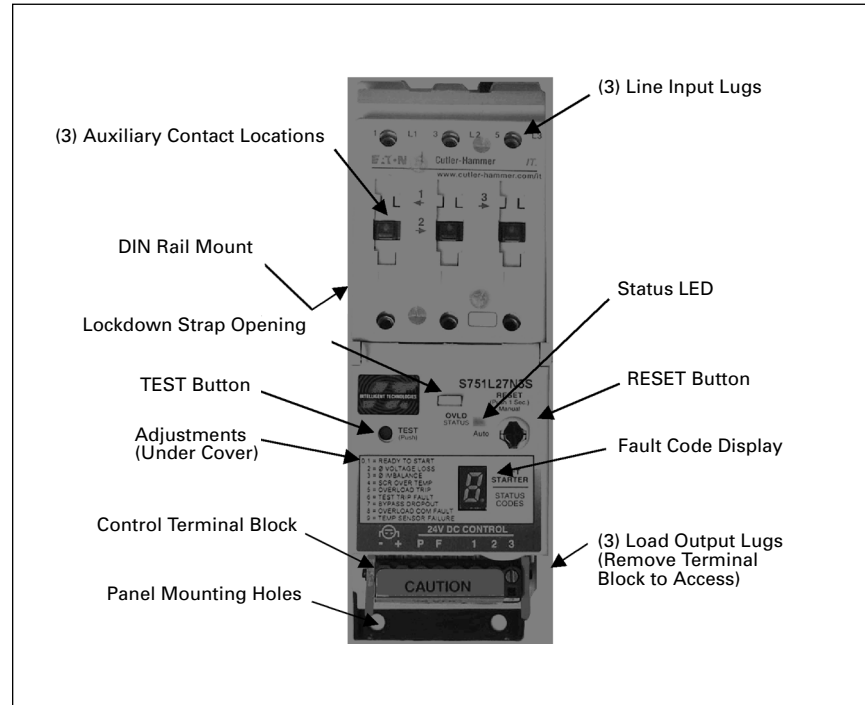


Figure 1: Illustration of Major 17. S751 Soft Starter Features

February 2002

## Installation

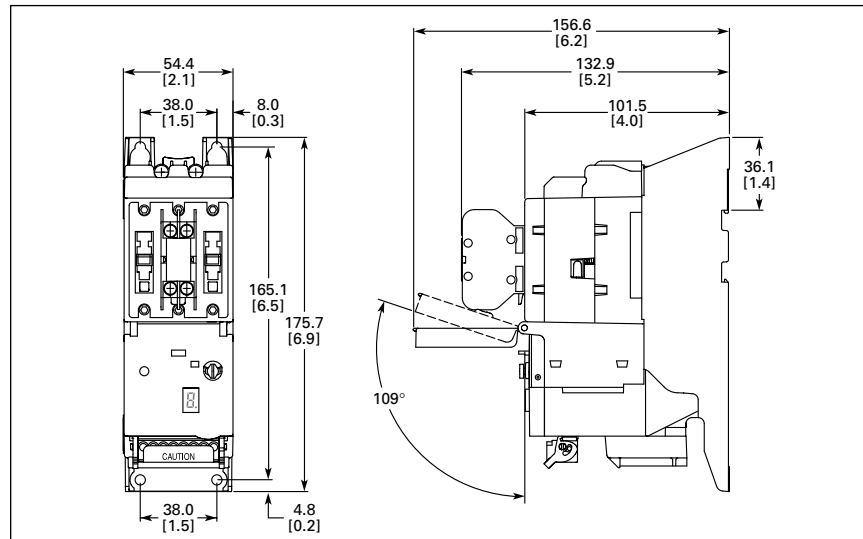
### Specifications

**Table 2: Environmental Specifications**

<b>Transportation</b>	Temperature	-50°C to 80°C [-58°F to 176°F]
	Humidity	0% and 95% non-condensing
	Shock	15g's half-wave sinusoidal 11 msecs
	Vibration (IEC 60068-2-6)	5g in any direction, 2 – 2000 Hz
<b>Storage</b>	Temperature	-50°C to 80°C [-58°F to 176°F]
	Humidity	0% and 95% non-condensing
<b>Operating</b>	Temperature – Adjacent to Unit	-40°C to 65°C [-40°F to 149°F]
	Humidity	Functional to 95% non-condensing
	Altitude	Above 2000 meters [6600 feet] derate 0.5% per 100 meters [330 feet]
	Shock (IEC 60068-2-27)	15g's half-wave sinusoidal 11 msecs
	Vibration (IEC 60068-2-6)	3g in any direction, 5 – 2000 Hz
	EMC Environment (IEC 60947-4-1 & EN 60947-4-1)	1
	Pollution Degree (IEC 60947-1)	3
	Protection Degree (IEC 60947-1)	IP20
	Orientation	Vertical only
	Starts per Hour	See Duty Ratings, <b>Page 15</b>

### Mounting

Mounting requirements and overall dimensions of the *IT. S751* Soft Starter are shown in **Figure 2** and **Table 3**.

**Figure 2: S751 Soft Starter Approx. Dimensions in mm [in]**

February 2002

**Table 3: Mounting Requirements**

Screw Size	Washer Size	Qty.	Torque	Weight	DIN Rail	Grounding Required
5 mm [#10-32 x 0.5]	Standard #10 Lockwasher and Flat Washer	4	1.7 Nm [15 lb-in]	1.7 kg [2.8 pounds]	Heavy Duty <sup>①</sup> 35 mm x 15 mm C383TS35 Type and End Stops Series C383 as Required	Yes

<sup>①</sup> Lightweight, 7.5 mm deep, DIN rail should not be used.

### Power Source and Protection Requirements

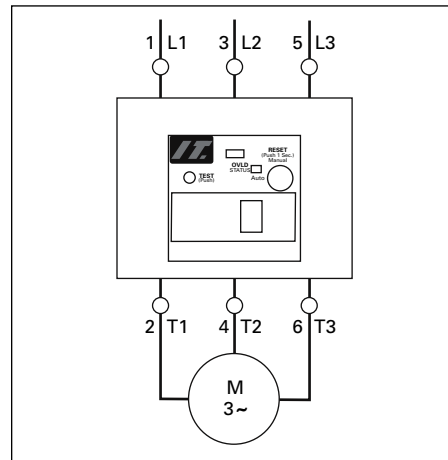
Eaton's Cutler-Hammer IT. S751 Soft Starters are designed for use with three-phase line voltages of 200, 208, 230, 240, 380, 415, 460, 480 and 600 at a line frequency of 50 or 60 Hz.

IT. S751 Soft Starters must be installed with additional upstream protection and/or disconnecting devices as required by national and local installation codes and rules.

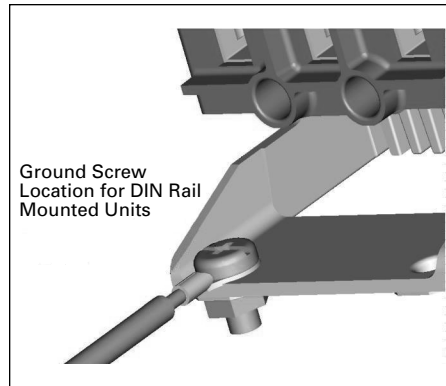
IT. S751 Soft Starters are suitable for installation, in combination with a 60 ampere maximum, 600 volt, Class J fuse only, on a circuit with a symmetrical RMS fault current capability not exceeding 5000 amperes rms.

### Power Wiring Introduction

The three AC line power connections are made to the IT. S751 Soft Starter inputs marked 1, 3 and 5 and L1, L2 and L3. The three motor power connections are made to the terminals marked 2, 4 and 6 and T1, T2 and T3. An example is shown in **Figure 3**. Use Class B, 75°C copper wire only (or 90°C copper wire oversized for 75°C operation) in accordance with the National Electric Code (NEC) and other local regulations as applicable. Note that the control terminal block must be removed before wiring the T1, T2 and T3 output leads, see **Figures 19 and 20** on **Page 28 and 29**.

**Figure 3: S751 Soft Starter Power Wiring**


February 2002

**Figure 4: S751 Soft Starter Ground Terminal Wiring**

The /T. S751 Soft Starter must be properly grounded. For DIN rail mounted units install the ground wire using the provided #10-32 pan head screw and nut. See **Figure 4**. If the unit is panel mounted to a grounded panel, use one of the mounting screws for the ground wire.

The wire size ranges, lug torques and tool types for these connections are shown in **Table 4**.

**Table 4: Power Wire Size, Lug Torque and Tool Size**

POWER WIRING (75 °C copper wire only)					
Identification	Wire Size Range mm <sup>2</sup> [AWG]	Torque		Terminal Type	Tool
		Nm [lb-in]	Wire Size mm <sup>2</sup> [AWG]		
L1, L2, L3 and T1, T2, T3	1 of 1.5 – 16 [14 – 4] or 2 of 1.5 – 16 [14 – 6]	4 [35] 4.5 [40] 5 [45]	1.5 – 6 [14 – 10] 10 [8] 16 [6 – 4]	Box Lug Pressure Type	 3 mm Hex Key

The /T. S751 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 not be wired internally between motor windings. Refer to the motor nameplate for correct wiring information for normal across-the-line operation. Contact Eaton's Cutler-Hammer if a special motor wiring requirement exists before wiring your starter.

If the application requires a reversing contactor, it should typically 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 /T. S751 Soft Starter. In this case all of the standard application requirements noted in the previous paragraph still apply.

See the *Motor/Application Considerations* section of this manual on **Page 13** for information on typical motor winding configurations.












## IT. S751 Soft Starter

E.T.N

Cutler-Hammer

February 2002

 <b>DANGER</b>	 <b>DANGER</b>	 <b>PELIGRO</b>
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.	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.	Para evitar descargas eléctricas, desconecte la alimentación del controlador, del motor u otros dispositivos de control antes de efectuar cualquier trabajo en el equipo. El incumplimiento de estas medidas ocasionará lesiones personales, la muerte o daños importantes al material.
 <b>CAUTION</b>	 <b>ATTENTION</b>	 <b>PRECAUCIÓN</b>
The IT. S751 Soft Starter must be properly grounded. Failure to do so could result in personal injury, death or property damage.	Le IT. S751 Soft Démarreur doit être mis à la terre correctement. L'inobservation de cette mesure entraînera des blessures corporelles, la mort ou des dommages matériels.	El arrancador IT. S751 Soft Starter debe ser conectado a tierra correctamente. De lo contrario, pueden ocasionarse lesiones personales, la muerte o daños al material.
 <b>CAUTION</b>	 <b>ATTENTION</b>	 <b>PRECAUCIÓN</b>
Do not apply a disconnect device on the output of the IT. S751 Soft Starter unless a means to turn off the soft starter when the disconnect switch is open is utilized. Opening the disconnect while the IT. S751 Soft Starter is operating may cause a malfunction. Closing the disconnect switch while the IT. S751 Soft Starter is operating will result in a Soft Starter failure and potential equipment damage and personnel hazard.	Ne pas exercer une sortie sur le dispositif de désaccouplement du Soft Starter IT. S751 à moins qu'un moyen de mettre le Soft Starter hors tension lorsque l'interrupteur d'arrêt est ouvert est utilisé. Ouvrir le découplage pendant que le Soft Starter IT. S751 est en marche peut causer un mauvais fonctionnement. Fermer le découplage pendant que le Soft Starter IT. S751 est en marche, entraînera une panne du Soft Starter et probablement des dommages matériels et des blessures corporelles.	No aplique un dispositivo de desconexión a la salida del arrancador IT. S751 Soft Starter a menos que se utilice un medio para apagar el arrancador cuando el interruptor de desconexión está abierto. La apertura del interruptor de desconexión mientras el arrancador IT. S751 está operando puede ocasionar un funcionamiento incorrecto. El cierre del interruptor de desconexión mientras el arrancador IT. S751 está operando producirá una falla de dicho arrancador, como también potenciales daños a los equipos y riesgo para el personal.



February 2002

## Control Wiring General


All of the control connections are made to the *IT. S751* Soft Starter terminal block.

The functions of the various terminals will be described later in this manual. This section describes the requirements for the connections to each of these terminals.

Control wire size range, lug torque and tool type are shown in **Table 5**.



**Note:** The wire used for the + and - 24V DC power supply connections to the *IT. S751* Soft Starter terminal block should take into account voltage drop due to coil inrush requirements. Refer to the application note on 24V DC Voltage Drop, available on-line at [www.cutler-hammer.com](http://www.cutler-hammer.com). Typically a 24V DC control power supply requires some form of grounding. Refer to the control power supply instruction guide for proper installation information.

**Table 5: Control Wire Size, Lug Torque and Tool Size**

CONTROL TERMINAL BLOCK WIRING					
Wire Size Range mm <sup>2</sup> [AWG]		Strip Length	Torque Nm [lb-in]	Terminal Type	Tool
All but (-) & (+)	(-) & (+)				
1 of 0.5 – 2.5 [22 – 12] or 2 of 0.75 – 1.5 [18 – 14]	1 of 1.5-2.5 [14-12] or 2 of 1.5 [14]	7 mm [0.25 in]	0.5 [4.5]	Box Lug Pressure Type	Slotted 3.5 mm [1/8"] 

## Control Wiring

### 2-Wire Control

 <b>CAUTION</b>	 <b>ATTENTION</b>	 <b>PRECAUCIÓN</b>
When using the auto reset, remote reset or E-stop features, caution must be exercised to prevent an unintended restart from causing personal injury or equipment damage.	Lorsqu'on utilise les variétés suivantes, une remise en circuit automatique, télécommande ou arrêt-Emetteur, une attention particulière doit être exercée pour éviter un redémarrage involontaire qui causerait des dommages matériels ou des blessures corporelles.	Cuando use el Auto Reset o funciones de reinicialización o de parada de emergencia remotas, tenga precaución de evitar un arranque accidental que cause daño a personas o equipos.

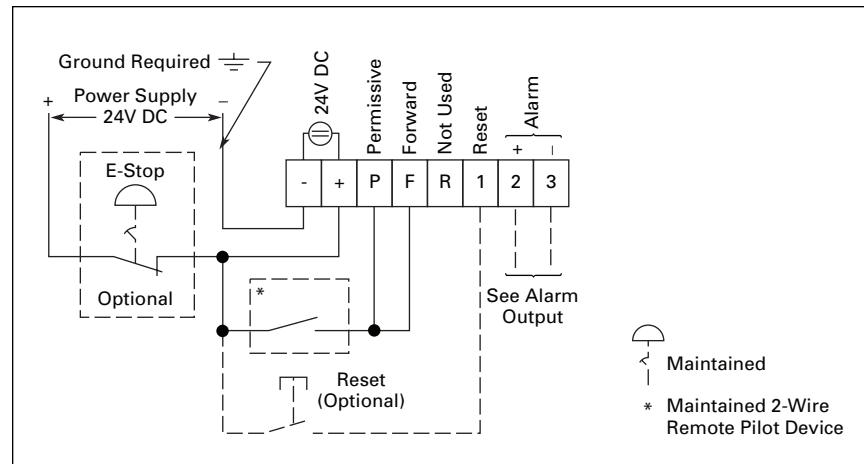
**Figure 5** illustrates 2-wire control terminal connections. The ON/OFF control pilot device must be rated for use with a 24V DC low current (3 mA DC) dry circuit to assure reliable operation. See **Table 6** for recommendations.

**Table 6: Low Energy Pilot Device Contact Blocks**

Pilot Device Recommended Cutler-Hammer Contact Blocks	
Catalog Number	Circuit
E22B1E E22B2E	1NC 1NO
E30KLAE1 E30KLAE2 E30KLAE3	1NO 1NC 1NO, 1NC
E30KLAE4 E30KLAE5	2NO 2NC
10250T51E 10250T53E	1NC 1NO
10250T1E 10250T3E 10250T2E	1NO, 1NC 2NC 2NO

A remote trip reset contact may be used, if desired, to reset the 17. S751 Soft Starter after a trip. Refer to the Protective Trip (**Page 22**) and Trip Reset (**Page 25**) sections for further information on the remote reset feature. If the auto reset feature is used, caution must be exercised to assure that any restart occurs in a safe manner.

An E-stop maintained contact is optional for installations requiring the removal of power from the control circuitry to open the starter independently of the normal stop pilot device.

**Figure 5: 2-Wire Control**

February 2002

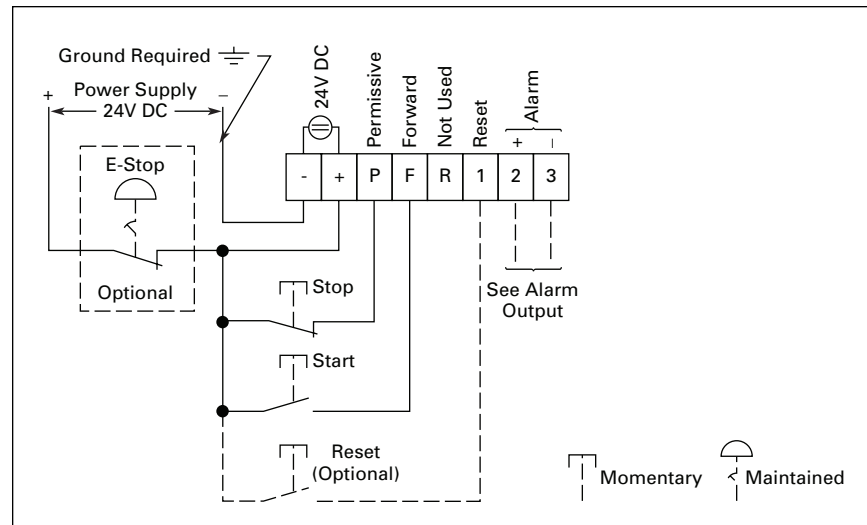
**3-Wire Control**

<b>⚠ CAUTION</b>	<b>⚠ ATTENTION</b>	<b>⚠ PRECAUCIÓN</b>
When using the auto reset, remote reset or E-stop features, caution must be exercised to prevent an unintended restart from causing personal injury or equipment damage.	Lorsqu'on utilise les variétés suivantes, une remise en circuit automatique, télécommande ou arrêt-Emetteur, une attention particulière doit être exercée pour éviter un redémarrage involontaire qui causerait des dommages matériels ou des blessures corporelles.	Cuando use el Auto Reset o funciones de reinicialización o de parada remotas, tenga precaución de evitar un arranque accidental que cause daño a personas o equipos.

**Figure 6** illustrates the terminal connections for the 3-wire control. The start and stop contacts must be rated for use with a 24V DC low current (3 mA DC) dry circuit to assure reliable operation. See **Table 5** for recommendations.

A remote trip reset contact may be used, if desired, to reset the *IT. S751* Soft Starter after a trip. Refer to the Protective Trip (**Page 22**) and Trip Reset (**Page 25**) sections for further information on the remote reset feature. If the auto reset feature is used, caution must be exercised to assure that any restart occurs in a safe manner.

An E-stop maintained pushbutton is optional for installations requiring the removal of power from the control circuitry to open the starter independently of the normal stop circuit.

**Figure 6: 3-Wire Control**

February 2002

## 24V DC Power Supply Selection

The IT. S751 Soft Starter requires 24V DC control power.

**Note:** The wire used for the + and - 24V DC power supply connections to the control terminal blocks should take into account voltage drop due to coil inrush requirements. Refer to the application note on 24V DC Voltage Drop, available on-line at [www.cutler-hammer.com](http://www.cutler-hammer.com). Typically a 24V DC control power supply requires some form of grounding. Refer to the control power supply instruction guide for proper installation information.

Wire size ranges, lug torques and tool types were previously listed in **Table 5**.

⚠ CAUTION	⚠ ATTENTION	⚠ PRECAUCIÓN
Only apply 24V DC to any of the terminals of the IT. S751 control terminal block. Use of any other voltage may result in personal injury, property damage, and will damage the IT. device.	Monter seulement qu'un DC 24V sur n'importe lequel des bornes du bloc de jonction de la commande de Soft IT. S751. Usage d'une autre tension électrique peut entraîner des dommages matériels, des blessures corporelles et peut endommager le dispositif IT.	Aplique únicamente 24 V CD a cualquiera de los terminales del barral de terminales de control del arrancador IT. S751 Soft Starter. El uso de otro voltaje puede ocasionar lesiones personales, daños al material o al arrancador IT. S751.

The power supply selected must meet the **sealed in** and **inrush** characteristics as outlined in **Table 7**.

**Table 7: 24V DC Power Supply Requirements**

24V DC POWER SUPPLY REQUIREMENTS @20°C (68°F) See Note					
Starter Size	Sealed In		Inrush		
mm	Wattage	Amps	Wattage	Amps	Duration (msecs)
54	5.0	0.21	90	3.8	50

Note: At other temperatures expressed in °C, for either inrush or sealed, use the 20°C value from the table in the following:

$$\text{Watts} = W_{20}[1.1 - 0.005(T)] \quad \text{and} \quad \text{Amps} = A_{20}[1.1 - 0.005(T)]$$

For example, inrush requirements at -25°C would be:

$$\text{Watts} = 90[1.1 - 0.005(-25)] = 110$$

$$\text{Amps} = 3.8[1.1 - 0.005(-25)] = 4.7$$



February 2002

Control voltage must be in the range of 20 – 28V DC under all conditions. The Eaton's Cutler-Hammer control power supplies listed in **Table 8** are recommended.

**Table 8: Standard Power Supply Recommendations**

24V DC Power Supplies					
Catalog Number	Continuous		Peak		Input Voltage
	Wattage	Amps	Wattage	Amps	
PSS25E	25	1.0	165	6.5	90 – 264V AC
PSS25F	25	1.0	165	6.5	380 – 480V AC
PSS55A	55	2.3	250	10.4	115V AC
PSS55B	55	2.3	250	10.4	230V AC
PSS55C	55	2.3	250	10.4	360 – 480V AC
PSS160E	—	—	—	—	90 – 260V AC
PSS160C	—	—	—	—	360 – 500V AC
PSS300E	—	—	—	—	90 – 260V AC
PSS300C	—	—	—	—	360 – 500V AC
PSS600C	—	—	—	—	360 – 500V AC

Multiple starters may be used with one power supply as long as the power supply has the peak and continuous wattage capacity required while maintaining its output voltage within the limits specified.

## Motor/Application Considerations

### Squirrel Cage Motor

This is the most common application. The motor is configured with three motor leads available for external connection.

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 the 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. S751* 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 not be wired internally between motor windings in an inside-the-delta configuration.**

### 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 start-up. 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, dependent 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.

### 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 17. 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 17. Soft Starter as far upstream as practical.

⚠ CAUTION	⚠ ATTENTION	⚠ PRECAUCIÓN
Never meggar a motor while it is connected to the 17. S751 Soft Starter to prevent soft starter damage. Disconnect the leads at the 17. S751 Soft Starter before meggaring the motor.	Ne jamais mesurer un moteur au mégohmmètre lorsqu'il est branché au 17. S751 Soft Starter pour prévenir des dommages au Soft Starter. Débrancher les conducteurs du Soft Starter 17. S751 avant de mesurer directement le moteur.	Nunca efectúe pruebas del motor con un megóhmetro mientras esté conectado al arrancador Soft Starter 17. S751 para evitar daños al arrancador. Desconecte los cables en el arrancador 17. S751 antes de usar el megóhmetro.



February 2002

**IT. S751 Soft Starter Duty Ratings****Standard Duty**

Typical standard duty ratings for the *IT. S751* Soft Starter are shown in **Table 9**.

Standard duty ratings are defined as those that do not exceed any of the following combinations:

- 25 second ramp, 2 starts per hour, 40°C ambient
- 15 second ramp, 4 starts per hour, 40°C ambient
- 10 second ramp, 6 starts per hour, 40°C ambient
- 7.5 second ramp, 8 starts per hour, 40°C ambient
- 3 second ramp, 15 starts per hour, 40°C ambient

**Note:** For applications above 40°C, derate 0.5 Amps per °C.

**Table 9: Standard Duty Ratings**

Maximum Current	kW Rating (50 Hz)			Horsepower Rating (60 Hz)			
	230 Volt	380 – 400 Volt	440 Volt	200 Volt	230 Volt	460 Volt	575 Volt
0.8	0.3	0.37	0.55	1/8	1/6	1/3	1/3
1.9	0.6	1.1	1.1	1/3	1/3	3/4	1
4.4	1.5	2.2	3	3/4	1	2	3
9	3	5.5	5.5	2	2	5	7-1/2
16	5.5	10	11	3	5	10	10
27	10	15	18.5	7-1/2	7-1/2	20	25

**Severe Duty**

Severe duty ratings for the *IT. S751* Soft Starter are shown in **Table 10**. Severe duty is defined as any requirement which exceeds the length or ramp or number of starts per hour of the standard duty combinations noted above.

**Table 10: Severe Duty Ratings**

Maximum Current	kW Rating (50 Hz)			Horsepower Rating (60 Hz)			
	230 Volt	380 – 400 Volt	440 Volt	200 Volt	230 Volt	460 Volt	575 Volt
0.8	0.3	0.37	0.55	1/8	1/6	1/3	1/3
1.9	0.6	1.1	1.1	1/3	1/3	3/4	1
4.4	1.5	2.2	3	3/4	1	2	3
9	3	5.5	5.5	2	2	5	7-1/2
16	4	7.5	7.5	2	2	5	7-1/2
27	7.5	12.5	15	3	5	10	15



## 17. S751 Soft Starter Setup

### Start

The motor is accelerated, as shown in **Figure 7**, using an initial torque ( $T_q$ ) value of 5% to 95% of across-the-line locked rotor torque, corresponding to 23% to 95% of the motor's across-the-line locked rotor current. The factory default is 30%. 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 30 seconds. The factory default is 5 seconds. At the end of the ramp time, the soft starter will go into bypass. The  $T_q$  and  $T_r$  adjustment potentiometers are shown in **Figure 8**.

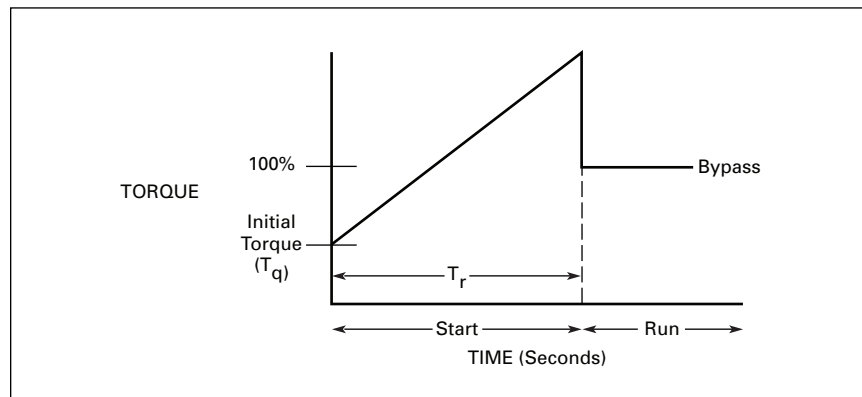


Figure 7: Start

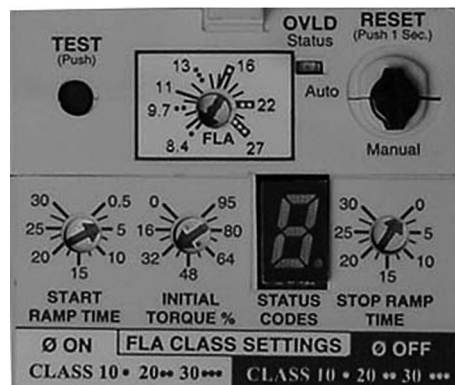


Figure 8: Adjustment Potentiometer Locations

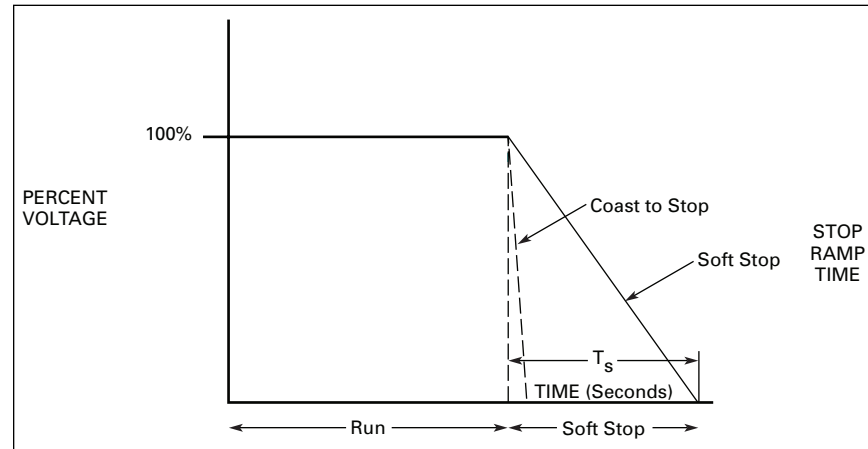


February 2002

**Soft Stop [STOP RAMP TIME]**

This feature provides for a controlled extended stop. It is designed to prevent the sudden stop of high frictional loads which occurs when voltage is suddenly removed from the motor.

The soft stop ramp-down time is programmable from 0 to 30 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 as shown in **Figure 9**. If the load is inertial or if a soft stop is not desired,  $T_s$  should be set for 0 seconds. The  $T_s$  adjustment potentiometer is shown in **Figure 8**.

**Figure 9: 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.

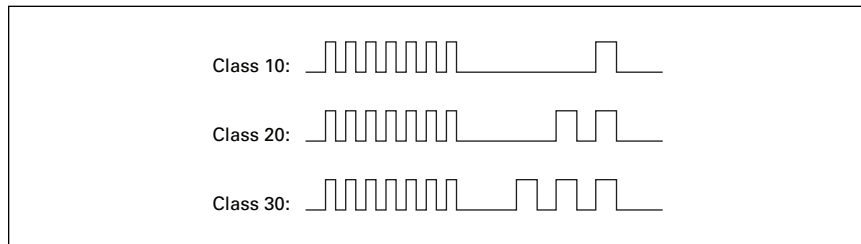
<b>CAUTION</b>	<b>ATTENTION</b>	<b>PRECAUCIÓN</b>
Soft Stop is not an emergency stop, and cannot make the load stop faster than its normal coast-to-stop time. If removal of power is desired, additional control is required to open up the 24V DC to terminal +. Using terminal P to initiate power removal is not recommended.	Un arrêt Soft n'est pas un arrêt d'urgence, et ne peut exécuter un arrêt plus rapidement que son temps normal de ralentissement. Si l'on désire couper l'alimentation électrique, une commande additionnelle est requise pour desserrer le 24V DC du terminal +. On ne recommande pas d'utiliser le terminal P pour déclencher la coupure de l'alimentation électrique.	El modo de parada suave Soft Stop no es una parada de emergencia y no puede hacer que la carga se detenga más rápido que su tiempo de rodadura libre normal. Si se desea desconectar la alimentación, se requiere un control adicional para abrir los 24 V CD al terminal +. No es recomendable usar el terminal P para iniciar la desconexión de la alimentación.

### Overload Class Setting

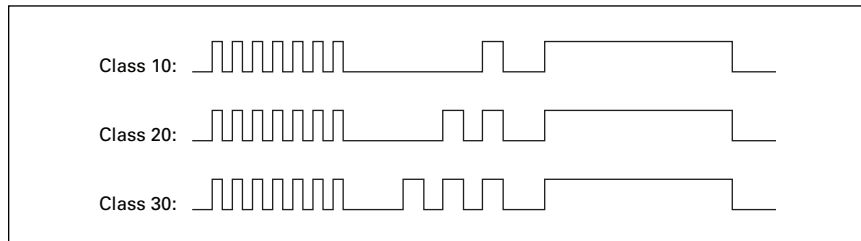
The /T. S751 Soft Starter overload can be set to provide Class 10, 20 or 30 protection, with or without phase loss/unbalance protection. The factory default is Class 10, with phase loss/unbalance protection enabled, and the motor FLA level set to minimum.

When the 24V DC control power is first applied, the status LED on the overload will flash to indicate the current Class setting and phase protection status. See **Figures 10** and **11**. If a different Class or phase protection choice is desired, the selection can be changed with the TEST button and FLA/CLASS dial using the following procedure.

1. Remove the main 3-phase input power. Connect the 24V DC control power. Note that the STATUS LED will flash rapidly, followed by the Trip Class code as shown in **Figure 10** or **11**. The STATUS LED must be off to adjust the CLASS setting. If the STATUS LED is on or blinking, see the Protective Trip section on **Page 22**.



**Figure 10: STATUS LED at 24V DC Power-Up —  
Phase Loss/Current Unbalance Enabled**



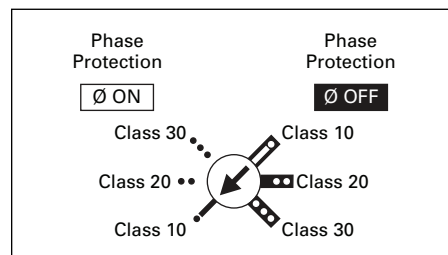
**Figure 11: STATUS LED at 24V DC Power-Up —  
Phase Loss/Current Unbalance Disabled**

2. To access the FLA/CLASS dial for this adjustment, the hinged cover over the dial must be opened. If the cover has been tied closed by a wire tie or other tie down through the slotted lock bar, the tie down will need to be removed first. The closed cover is illustrated in **Figure 12**.

February 2002

**Figure 12: Hinged Access Cover**

3. Referring to **Figure 13**, turn the FLA/CLASS dial fully clockwise until it stops.
4. Push and hold the TEST button.
  - a. When the STATUS LED begins to flash, rotate the FLA/CLASS dial fully counterclockwise smoothly, *without pausing* during the rotation, before 4 flashes have occurred. Note that if more than four flashes have occurred, the overload is in the test mode and Class cannot be set. If the test mode is entered, reset the overload (see Trip Reset section, **Page 25**) and redo this procedure from step 3.
  - b. After three seconds, the STATUS LED will begin to flash the Class 10 code as shown in **Figure 10**. Rotate the FLA/CLASS dial to one of the six positions as indicated on the label — 10, 20 or 30 with Phase Protection ON or 10, 20 or 30 with Phase Protection OFF and as illustrated in **Figure 13**.

**Figure 13: Class Setting**

5. The STATUS LED will continuously indicate the Trip Class code (one flash for Class 10, two for Class 20, and three for Class 30) and repeat as long as the TEST button is depressed.
6. Release the TEST button. The STATUS LED will flash rapidly, followed by the Trip Class code as shown in **Figure 10** or **11** for the Class and phase loss protection selected. If not, the Class setting was not changed, likely due to the dial rotation not being smooth or the TEST button being released early. Press the RESET button until the STATUS LED stops flashing and repeat this procedure starting with step 3.

February 2002

- The motor FLA setting must now be reset. Proceed to the overload FLA setting section.

**Note that the overload trip class must be set prior to adjusting the overload FLA setting if it is to be different than the factory default of Class 10.**

The trip curves for each of the overload Classes are shown in **Figure 15**.

### Overload FLA Setting

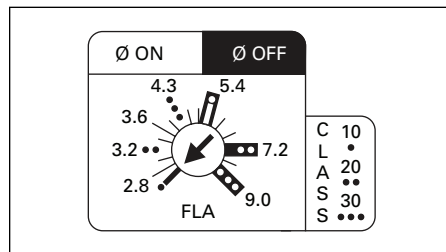
The overload FLA setting customizes the 17. S751 Soft Starter for the motor being used. It must be set after the overload Trip Class setting is made. The 17. S751 Soft Starter is calibrated for a 1.15 service factor motor, with an ultimate trip at 1.2 times the FLA setting as illustrated in **Figure 15**. This is consistent with the operation of other types of overload devices for 1.15 service factor motors.

**Note:** The overload Trip Class must be set before adjusting the overload FLA setting if the Trip Class is to be different than the factory default setting of Class 10. See the Overload Class Setting section on **Page 18** for setup information.

To access the FLA/CLASS dial for this adjustment, the hinged cover over the dial must be opened. If the cover has been tied closed by a wire tie or other tie down through the slotted lock bar, the tie down will need to be removed first. The closed cover is illustrated in **Figure 12**.

To set the FLA:

- Open the overload cover.
- Turn the FLA/CLASS dial from the default minimum overload level to the motor's full load current rating, see **Figure 14** and **Table 9**. The FLA markings will vary by catalog number.





















**Figure 14: FLA Setting**



February 2002

**Table 11: FLA Dial Calibration Markings**

Catalog Number	Overload Current Range	Dial Calibration					
							
S751L01N3S	0.24 – 0.8	0.24	0.25	0.26	0.27	0.29	0.30
S751L02N3S	0.57 – 1.9	0.57	0.59	0.61	0.65	0.68	0.72
S751L04N3S	1.3 – 4.4	1.3	1.4	1.4	1.5	1.6	1.7
S751L09N3S	2.7 – 9	2.7	2.8	2.9	3.1	3.2	3.4
S751L16N3S	4.8 – 16	4.8	5.0	5.1	5.4	5.8	6.1
S751L27N3S	8 – 27	8.0	8.4	8.6	9.2	9.7	10.3
Catalog Number	Overload Current Range						
S751L01N3S	0.24 – 0.8	0.32	0.36	0.38	0.42	0.45	0.48
S751L02N3S	0.57 – 1.9	0.76	0.84	0.91	1.0	1.1	1.14
S751L04N3S	1.3 – 4.4	1.8	1.9	2.1	2.3	2.5	2.6
S751L09N3S	2.7 – 9	3.6	4.0	4.3	4.7	5.0	5.4
S751L16N3S	4.8 – 16	6.4	7.0	7.7	8.0	9.0	9.6
S751L27N3S	8 – 27	11	12	13	14	15	16
Catalog Number	Overload Current Range						
S751L01N3S	0.24 – 0.8	0.53	0.58	0.63	0.64	0.72	0.8
S751L02N3S	0.57 – 1.9	1.3	1.4	1.5	1.5	1.7	1.9
S751L04N3S	1.3 – 4.4	2.9	3.2	3.4	3.5	4.0	4.4
S751L09N3S	2.7 – 9	5.9	6.5	7.0	7.2	8.1	9.0
S751L16N3S	4.8 – 16	11	12	13	13	14	16
S751L27N3S	8 – 27	18	19	21	22	24	27

- 1.0 Service Factor Motor Adjustment (default is for > 1.15 SF). Rotate the FLA/CLASS dial counterclockwise 15 degrees or one minor division for a setting 7% less than the ampere level shown on the FLA/CLASS dial label as seen in **Table 11**. This adjustment reduces the trip current to a level corresponding to the requirements for a 1.0 SF motor. The highlighted values correspond to **Figure 14**.
- After setting the overload FLA setting, close the overload's hinged cover and retie through the slotted lock bar, if required.

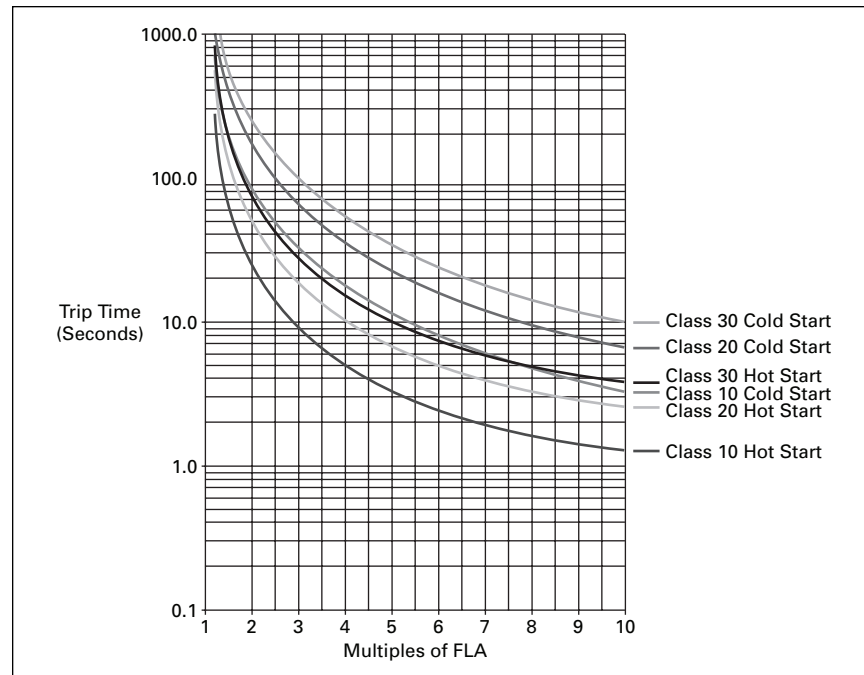


Figure 15: Overload Trip Curves

### Protective Trip

The 17. S751 Soft Starter provides integrated fault protection for both internal and external fault conditions. The soft starter status and fault trips are indicated on a seven segment display and on the STATUS LED. During initial power-up all seven segments of the display and the decimal point are lit for one second to indicate the power-up sequence. Next the software version is indicated by the next three figures, for one second each. For example, software version 1.20 would be indicated by a 1 and a decimal point for one-half second, followed by a 2 for one-half second and then a 0 for one-half second. Following a one half second delay, the pot and phase rotation information is collected. During this time the decimal point flashes slowly to indicate the various pot settings are being read, followed by a short delay and further flashing indicating that the remaining settings are being read. The present status then is indicated as shown in **Table 12**. When the soft starter is started and the ramp is underway, the seven segment will display a set of rotating segments. When the ramp time expires, only the middle segment is displayed to indicate that the bypass contactor is closed.

If the  $T_q$ ,  $T_r$ , or  $T_s$  settings are changed after power-up, the decimal point of the seven segment display will flash for 1.5 seconds indicating that the newly set value is being read.


**Table 12** lists the various indications and a description of each fault displayed on the seven segment display. The Phase Loss and Current Unbalance (**Page 23**) and Overload Protection (**Page 24**) sections illustrate the faults shown on the STATUS LED.

February 2002

**Table 12: Status and Fault Indications**

Display	Type	Description
0	Status	Line phase rotation ABC, ready to start
1	Status	Line phase rotation ACB, ready to start
2	Fault	Phase voltage loss
3	Fault	Phase current unbalance
4	Fault	SCR overtemperature
5	Fault	Thermal overload trip
6	Fault	Test Trip failure
7	Test	Bypass Contactor Dropout
8	Fault	Overload Com failure
9	Fault	Temperature sensor failure
Rotating	Status	Ramping
–	Status	In bypass
Flashing	Status	Reading settings

In the case of a fault trip, if multiple causes are present, they will be indicated in sequence on the seven segment display. The sequence does not indicate which fault was first, only that multiple causes are present. The decimal point of the seven segment display indicates by flashing rapidly when the manual reset button is pushed, the remote reset is closed, or auto reset has been selected.

 <b>CAUTION</b>	 <b>ATTENTION</b>	 <b>PRECAUCIÓN</b>
When using the auto reset or remote reset features, caution must be exercised to prevent an unintended restart from causing personal injury or equipment damage.	Lorsqu'on utilise les variées suivantes, une remise en circuit automatique, télécommande ou arrêt-Emetteur, une attention particulière doit être exercée pour éviter un redémarrage involontaire qui causerait des dommages matériels ou des blessures corporelles.	Cuando use el Auto Reset o funciones de reicalización o de parada remotas, tenga precaución de evitar un arranque accidental que cause daño a personas o equipos.

### Phase Loss and Current Unbalance Protection

#### General

Phase loss and current unbalance protection will occur as described in the following two sections. These indications are accurate when the actual line currents are at least 75 percent of the minimum FLA rating for the 17. S751 catalog number selected. For example, if the current range is 5 to 16 amps, the minimum value for accurate sensing is  $0.75 \times 5 = 3.75$  amps.

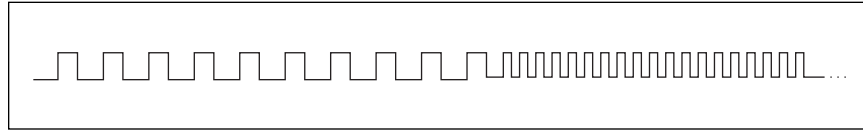
If desired, the phase loss and phase current unbalance protection functions, may be disabled during the Class selection process. See the Overload Class Setting section on **Page 18** for more information.

If the 24V DC control power is removed during the phase loss or unbalance trip condition, when the 24V DC control power is restored, the STATUS LED and ALARM indication will activate for 2.5 minutes. After the delay, the STATUS LED will begin to flash rapidly. A reset is not possible until this rapid flash occurs.



**Phase Loss**

If one phase of the input line power is lost, the line current will go to zero, and after 10 seconds, a phase loss trip will occur. The starter is tripped, and the alarm output is set on. The STATUS LED will flash at a 0.5 seconds on then 0.5 seconds off rate for 10 seconds, after which it will flash rapidly as shown in **Figure 16**, until the trip is reset. The rapid flash indicates that the trip may be reset. When the trip is reset, the ALARM OUTPUT is also reset.

**Figure 16: Phase Loss and Current Unbalance Trip Indication**

See the Trip Reset section on **Page 25** for more reset information.






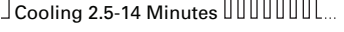
**Phase Current Unbalance**

A phase current unbalance trip will occur if one or two of the line currents are 50 percent or less of the remaining line(s) for longer than 10 seconds. The starter is tripped, and the alarm output is set on. The STATUS LED will flash at a 0.5 seconds on then 0.5 seconds off rate for 10 seconds, after which it will flash rapidly as shown in **Figure 16**, until the trip is reset. The rapid flash indicates that the trip may be reset. When the trip is reset, the ALARM OUTPUT is also reset.

See the Trip Reset section on **Page 25** for more reset information.

**Overload Protection**

The overload protection is based on a calculation using the motor full load amp setting, the overload Class selection, the actual measured current, the motor operating time and its off time. This information is used by the microprocessor to create a thermal estimate, which simulates the motor's thermal condition. The thermal estimate is indicated by the blink rate of the STATUS LED, which is proportional to the motor's calculated thermal condition as shown in **Figure 17**, expressed as a percentage of the motor's full load value.

Thermal Memory	Status LED
Less than 70%	Off 
70% – 80%	1 flash 
80% – 90%	2 flashes 
90% – 95%	3 flashes 
95% < 100%	4 flashes 
≥100%	Steady On (Fault) 

**Figure 17: Thermal Estimate Status Indication**

February 2002

The STATUS LED will indicate the motor's thermal condition, even when the starter is not closed, as long as the 24V DC control power is applied to the + and - terminals. If an overload condition occurs, the soft starter is tripped and the ALARM OUTPUT is turned on. The microprocessor will continue to calculate the motor's thermal condition. When it is at 75% or less, the STATUS LED will begin flashing rapidly indicating that the trip may be reset. Upon reset, the STATUS LED will blink at a rate which is proportional to the present motor thermal condition.

Notice	Avis	Aviso
The thermal estimate is saved when the starter is closed or tripped. If 24V DC control power is removed and then reapplied, this thermal estimate level is used for the thermal cool down algorithm, which might cause a trip. This is normal and will automatically clear if no trip occurs. If a trip occurs, the starter can be reset when the thermal estimate is below 75%.	L'estimation thermique est sauvegardée lorsque le démarreur est fermé ou en position de déclenchement. Si l'alimentation de la commande 24V DC est coupée et ensuite réactivée, le niveau de l'estimation thermique est utilisé pour le refroidissement de l'algorithme thermique, lequel peut provoquer un déclenchement. Ceci est normal et se dégagera automatiquement si aucun déclenchement ne se produit. Si par contre ceci arrive, le démarreur peut être remis en marche lorsque l'estimation thermique est plus basse que 75%.	La estimación térmica queda guardada cuando el arrancador se cierra o se dispara. Si se desconecta y luego se vuelve a aplicar la alimentación de control de 24 V CD, este nivel de estimación térmica se usa para el algoritmo de enfriamiento, que puede causar un disparo. Esto es normal y se despejará automáticamente si no se produce un disparo. En caso que se produzca, el arrancador se puede reinicializar cuando la estimación térmica esté por debajo del 75%.

If the auto reset feature is enabled when the motor's thermal condition returns to 75% or less, the trip will automatically be reset and the ALARM OUTPUT will clear.

### Trip Reset

 CAUTION	 ATTENTION	 PRECAUCIÓN
When using the auto reset or remote reset features, caution must be exercised to prevent an unintended restart from causing personal injury or equipment damage.	Lorsqu'on utilise les variétés suivantes, une remise en circuit automatique, télécommande ou arrêt-Emetteur, une attention particulière doit être exercée pour éviter un redémarrage involontaire qui causerait des dommages matériels ou des blessures corporelles.	Cuando use el Auto Reset o funciones de reinicialización o parada remotas, tenga precaución de evitar un arranque accidental que cause daño a personas o equipos.

After a trip condition has occurred, the IT. S751 Soft Starter must be reset before operation may resume. There are three choices for resetting the trip: manual, remote and auto. After the fault cause has been cleared and the thermal estimate of the overload function is below 75%, the STATUS LED will begin to flash rapidly. At this time the trip may be reset.

Note that line power must be present in order to obtain a ready-to-start condition after a reset occurs. The 24V DC control power must be maintained in order to clear an overload or overtemperature fault. If the 24V DC control power is removed and then reapplied, the last saved thermal estimate level is used for the thermal cool down algorithm.



### Manual Reset

If the RESET button located on the IT. S751 Soft Starter is in the MANUAL position, to reset, depress the RESET button for one to two seconds. The decimal point on the seven segment display will begin to flash. This will clear the ALARM OUTPUT and allow the IT. S751 Soft Starter to be closed when the P and the F terminals are energized.

### Remote Reset

If remote reset capability is desired, a normally open low energy contact, such as a pushbutton or PLC output, must be wired between the IT. S751 Soft Starter terminals + and 1 as shown in the *Control Wiring* section on **Page 10** of this manual. After the fault cause has been cleared and the thermal estimate of the overload function is below 75%, the STATUS LED will begin to flash rapidly. Closing this remote reset contact will clear the ALARM OUTPUT and allow the IT. Soft Starter to be operated. The remote reset device may be mounted on the enclosure door to provide similar operation to that of a through-the-door reset mechanism. Note that the remote reset contact must be rated for use with a 24V DC low current (3 mA) dry circuit to assure reliable operation. See **Table 6** for recommendations.

### Auto Reset

The IT. S751 Soft Starter may be set up to reset a trip automatically, if desired. Caution must be exercised when using the auto reset feature to prevent unintended operation. To set the IT. S751 Soft Starter for automatic reset, open the cover and rotate the RESET button to the AUTO position.

After a fault trip and when the thermal estimate of the overload function is below 75%, the trip will automatically be reset and the ALARM OUTPUT will clear.

If the protective trip was due to a phase loss or unbalance condition, which was momentary in nature, and the auto reset feature is enabled, the fault will automatically clear after a delay of 10 seconds.

### Reset Summary

Table 13: Reset Summary

Type of Reset	Reset Method
Manual	RESET button must be in MANUAL position, depress the RESET button for one to two seconds. Unit is reset when display decimal point flashes.
Remote	Close a low energy contact between terminals + and 1 of the IT. Overload.
Auto	RESET button must be in AUTO position. Will reset automatically.

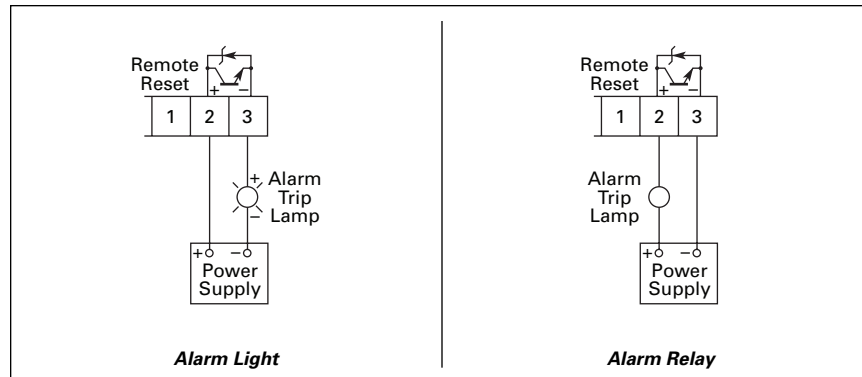
### Alarm Output

The ALARM OUTPUT is a solid-state output. This output is not a dry contact. It must be used in conjunction with an indicating light, LED, PLC input or relay to provide a status indication. This output is rated for a maximum current of 250 mA DC with a nominal voltage of 24V DC. The power supply for this output is to be supplied by the user. It must not exceed 28V DC under any conditions. If a visual indication is desired, connect a 24V DC LED or incandescent lamp, such as Eaton's Cutler-Hammer E22H22X40 or E30BJ/E30KF10 series, to terminals 2 and 3 of the IT. S751, as shown in **Figure 18**. If a relay output is desired, the relay may be connected as shown in **Figure 18**. The relay coil pickup current must not exceed 250 mA DC. A relay such as Eaton's Cutler-Hammer D3 Series may be used. For larger contact current requirements, the D3 may be used as an interposing relay for a larger relay.



February 2002

The incandescent lamp, LED or relay can be connected either in the + or - lead, with the ALARM OUTPUT being used as a current sink or current source.

**Figure 18: Alarm Output**

Notice	Avis	Aviso
The alarm output is not a positive indication that there is not a voltage present on the output of the <i>IT. S751</i> Soft Starter. The alarm output only indicates that an alarm condition exists.	La sortie d'alarme n'indique pas nécessairement qu'il n'y a pas de tension électrique présente dans la sortie du Soft Starter <i>IT. S751</i> . La sortie d'alarme indique seulement qu'un état d'alarme existe.	La salida de alarma no es una indicación positiva de que no existe un voltaje presente a la salida del arrancador <i>IT. S751</i> Soft Starter. La salida de alarma sólo indica la existencia de una condición de alarma.

## Troubleshooting and Maintenance

### Renewal/Replacement Parts

The only replacement part available for the /T. S751 Soft Starter is the lockable cover on the front of the unit, catalog number S751LCOVER. There are no serviceable or replaceable internal parts.

### Control Terminal Block

Spare control terminal connectors are available as shown in **Table 14**.

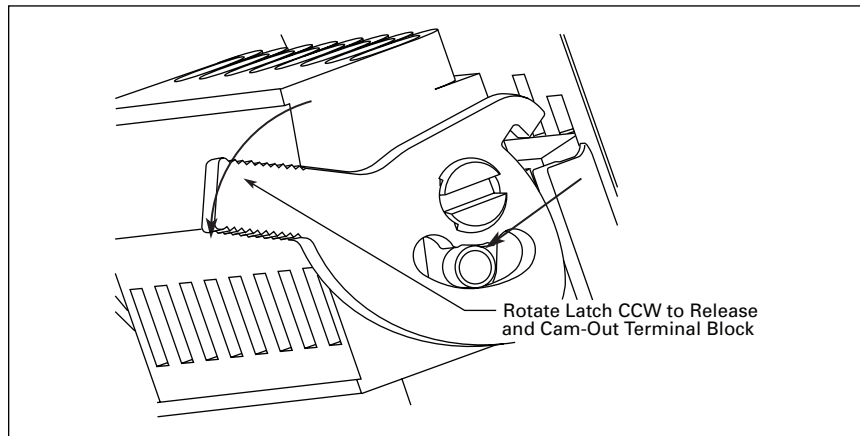
**Table 14: /T. S751 Control Terminal Connectors**

Part No. <sup>①</sup>	Description	# Pins	Pitch	Terminals
EMA76	Non locking version	8 Pin	5 mm	- + P F R 1 2 3
EMA76L	Locking version	8 Pin	5 mm	- + P F R 1 2 3

<sup>①</sup> Suffix "L" indicates locking.

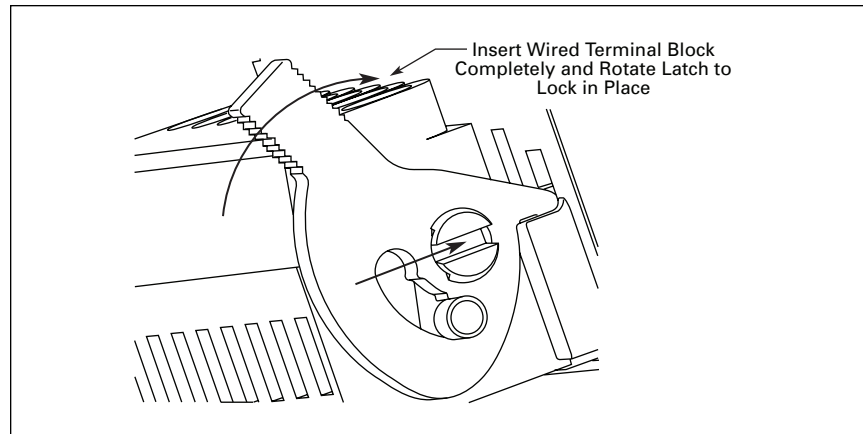
### Control Terminal Block Removal and Installation

The control terminal block can be removed for wiring and easily re-installed by following the graphical illustration in **Figures 19** and **20** for the locking type terminal blocks.



**Figure 19: Removing the Terminal Block**

February 2002

**Figure 20: Reinstalling the Terminal Block****Auxiliary Contacts**

Auxiliary contacts are available for mounting on /T. S751 Soft Starters. The choices available are shown in **Table 15** and their ratings in **Tables 16, 17, 18 and 19**.

**Table 15: Auxiliary Contacts**

Front Mounted (Maximum Circuits per Contactor/Starter)					
EMA13 1NO	EMA14 1NC	EMA15 1NO-1NC	EMA16 2NO	EMA17 2NC	EMA70 Logic Level 1NO-1NC
3	3	2 <sup>①</sup>	2 <sup>①</sup>	2 <sup>①</sup>	3

<sup>①</sup> One EMA70 or a single auxiliary contact may be used in the center position in conjunction with the two EMA15, EMA16 or EMA17 contacts in the outer positions.

**Table 16: Auxiliary Contact — IEC Rating (All except EMA70)**

DC-13		AC-15	
$U_e$ Voltage	$I_e$ Amps	$U_e$ Voltage	$I_e$ Amps
24	5	48	8
48	2.5	120	6
125	1.1	240	4
250	0.55	440	2

**Table 17: Auxiliary Contact — NEMA A600 Rating (All except EMA70)**

Current	AC Voltage			
	120	240	480	600
Make and Interrupting	60	30	15	12
Break	6	3	1.5	1.2
Thermal Continuous	10	10	10	10



**Table 18: Auxiliary Contact — NEMA P300 Rating (All except EMA70)**

Current	DC Voltage	
	125	250
Make and Interrupting	1.1	0.55
Break	1.1	0.55
Thermal Continuous	5	5

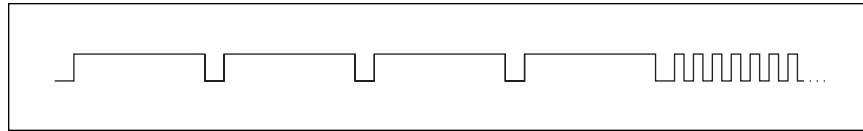
**Table 19: EMA70 Auxiliary Contact Rating**

$U_e$ Voltage	$I_t$ Amps
125 – 250	0.1

**TEST Button Operation**

The TEST button is used to check the operation of the overload trip and ALARM OUTPUT. When the TEST button is pressed, the ALARM OUTPUT will turn on, and the STATUS LED will begin to flash at a rate of 0.8 seconds on, 0.2 seconds off. The seven segment display will indicate that the TEST trip, fault 7, has occurred, and the Soft Starter will trip off-line.

The STATUS LED flash rate will continue until the TEST button is released, and up to 10 seconds after the TEST button was released. The STATUS LED will then begin to flash rapidly indicating that the trip may be reset as shown in **Figure 21**.

**Figure 21: STATUS LED — Test Button Pushed**

The rapid flashing of the STATUS LED, the ALARM OUTPUT, and the seven segment display of fault 7 will be maintained until the trip is reset. Depress the RESET button on the IT. S751 Soft Starter or close the remote reset device to end the test. If auto reset has been selected, the trip will automatically be reset after a time delay of up to 10 seconds.

 <b>CAUTION</b>	 <b>ATTENTION</b>	 <b>PRECAUCIÓN</b>
Before operating the TEST button, it should be determined that the resulting operation of the ALARM OUTPUT or trip of the IT. S751 Soft Starter will not cause any misoperation of any circuitry or systems or create hazards external to the IT. S751 Starter.	Avant de fonctionner le bouton TEST, on doit tout d'abord s'assurer que la dite opération de la SORTIE D'ALARME ou le déclenchement du Soft Starter IT. S751 ne causera pas un mauvais fonctionnement à aucun circuit ou système ou pourrait créer des dangers externes au Starter IT. S751.	Antes de operar el botón TEST, se debe determinar que la operación resultante de la salida de alarma (ALARM OUTPUT) o el disparo del arrancador IT. S751 Soft Starter no causará fallas en ningún circuito o sistema, así como riesgos externos al arrancador IT. S751.



February 2002

**Troubleshooting Chart****Table 20: Troubleshooting**






Observation	Possible Cause/Corrective Action
STATUS LED always on, Starter will not close	Overload has tripped on a fault. Wait between 2.5 – 14 minutes for thermal memory to reach 75% level if tripped on overload. Do not remove 24V DC control power to avoid thermal memory reset to the prior fault trip level. If overload cannot be reset, replace.
STATUS LED does not flash on power-up	Check 24V DC control power supply at control terminal block +/- connections.
	Control terminal block not seated or connected properly.
	Check control wiring. See <i>Control Wiring</i> on <b>Page 9</b> .
STATUS LED flashing, Starter closed	The calculated motor thermal condition is above 70% as shown by flash rate. This is normal operation. See Overload Protection section on <b>Page 24</b> . 
STATUS LED flashing, Starter open	Slow flash. TEST button pressed or jammed. See TEST Button Operation on <b>Page 30</b> . 
	Phase loss/unbalance trip just occurred. LED should begin to flash rapidly after approximately 10 seconds. 
	Fast to slower to off. Calculated motor thermal condition above 70%. With cooling time, the flash rate will decrease until off. This is normal operation. See Overload Protection section on <b>Page 24</b> . 
	Fast rate. Unit is ready to be reset. Press RESET button to clear.  Note after reset, the STATUS LED may flash if calculated motor thermal condition is above 75%.
Starter trips shortly after start — STATUS LED on	Verify correct FLA setting. See Overload FLA Setting on <b>Page 20</b> .
	Verify correct Class setting. See Overload Class Setting on <b>Page 18</b> .
	Very high current. Normal operation is the unit should trip and STATUS LED is on steady. Check motor, load and wiring. There may be short circuit or load mechanical problem.
	/T. S751 Soft Starter undersized.
STATUS LED does not flash rapidly after trip times out, it just goes out	/T. S751 Soft Starter set for auto reset. Check position of integral RESET button.
	Remote RESET button is pressed or closed.
	Check terminal block wiring to remote RESET input. See <i>Control Wiring</i> on <b>Page 9</b> .



Table 20: Troubleshooting (continued)

Observation	Possible Cause/Corrective Action
Seven segment display — 2	Phase loss. See Phase Loss/Phase Current Unbalance trip in this table.
Seven segment display — 3	Phase current unbalance. See Phase Loss/Phase Current Unbalance trip in this table.
Seven segment display — 4	SCR overtemperature trip. Check that the ambient temperature and altitude at the mounting location are within specifications. Confirm that the bypass contactor closes after ramp-up at start.
Seven segment display — 5	Thermal overload trip. Motor load too high. See Overload Protection on <b>Page 24</b> .
	Verify correct FLA setting. See Overload FLA Setting on <b>Page 20</b> .
	Verify correct Class setting. See Overload Class Setting on <b>Page 18</b> .
Seven segment display — 6	Internal communication failure. Replace soft starter.
Seven segment display — 7	Trip caused by pressing TEST button. See TEST Button Operation on <b>Page 30</b> .
Seven segment display — 8	Bypass contactor dropout. Verify 24V DC power supply meets inrush requirements. A fault was sensed by overload section which tripped bypass contactor and then SCRs.
Seven segment display — 9	Temperature sensor malfunction. Hardware failure, contact Eaton's Cutler-Hammer.
ALARM OUTPUT not functional	Check wiring of user supplied power supply. If more than 28V DC was applied to terminals, the output could be damaged. See Alarm Output section on <b>Page 26</b> .
	Is unit tripped? Alarm output is active only if unit is tripped or TEST button is pressed. Use TEST button to verify operation. See TEST Button Operation section on <b>Page 30</b> .
Starter will not energize or bypass contactor does not close	Control terminal block not seated or connected properly.
	Check 24V DC control power supply, verify inrush capability. See <i>24V DC Power Supply Selection</i> section on <b>Page 12</b> .
	<b>Check control wiring.</b> Make sure permissive(s) closed.
	<b>Check control wiring.</b> Check to make sure the forward control input is wired to the F terminal and not the blank terminal.
Starter drops out immediately when START button is released	<b>Check control wiring.</b> Remove permissive (press STOP) and try again.
	Permissive is opening up when START button is released. Miswired or more than two wires used per terminal. Refer to <i>Control Wiring</i> on <b>Page 9</b> for proper wiring diagram. Use auxiliary terminal blocks to limit wiring to two wires per control terminal.
Starter attempts to close when START is commanded but won't stay in	Check 24V DC control power supply, verify inrush capability. See <i>24V DC Power Supply Selection</i> on <b>Page 12</b> .



February 2002

**Table 20: Troubleshooting (continued)**

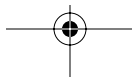
Observation	Possible Cause/Corrective Action
Phase Loss/Phase Current Unbalance trip	Monitor each motor phase current for loss or unbalance. Use ammeter or measure voltages for all three phases.
	If a current(s) is missing, with power off, check bypass contactor poles for binding.
	Make sure power lug connections are tight. Use proper tool and torque lugs to specified level. See Power Wiring on <b>Page 6</b> .
	Not recommended for use on the output of an adjustable frequency drive. Phase loss/phase current unbalance trips may occur.
	Not for use on single-phase loads.
RESET button does not reset the Soft Starter (Local or remote)	17. Soft Starter not ready to be reset. STATUS LED must be flashing rapidly before reset can occur. Wait and try again. See Trip Reset on <b>Page 25</b> .
	RESET button not pressed long enough. Must be pressed for at least 1 second.
Cannot set Class	Proper procedure not followed. See Overload Class Setting on <b>Page 18</b> .
	Unit tripped — STATUS LED on constant. Cannot set Class if tripped. Wait for STATUS LED to begin flashing rapidly, reset and then try again.
Motor vibration during start-up	Load fluctuations. Check load conditions.
	Misapplication. Ramp time set too low. Initial torque set too low.
	Load voltage or current unbalanced but input voltage is balanced. Check line and load connections to soft starter and connections in motor conduit box.
	Hardware failure. Contact Eaton's Cutler-Hammer.
Audible noise from soft starter	Bypass contactor chatter. Verify 24V DC power supply meets inrush requirements.
	Remove power and verify tightness of control and power connections.
	Remove power and verify tightness of mounting hardware.
Motor will not stop	Control wiring incorrect. Verify 24V DC control power removed from P terminal at stop. Verify no loose wire strands are bridging terminals.
	Bypass contactor fails to open. Remove power from soft starter and check continuity of bypass contactor poles.
	Shorted SCRs or welded bypass contacts. Remove power and power wiring from soft starter and check continuity of poles using an ohmmeter.

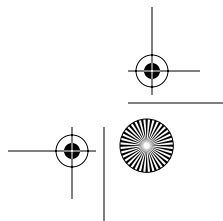
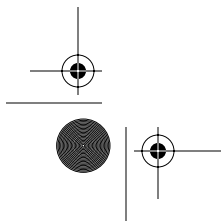
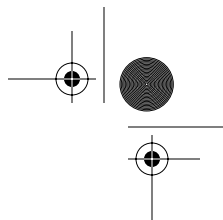
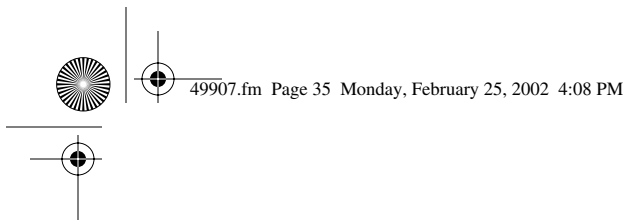


February 2002

## Standards Conformity and Approvals

- UL 508
- CSA C22.2 No.14-95
- IEC 60947-4-1 and IEC 60947-4-2
- EN 60947-4-1 and EN 60947-4-2
- NEMA ICS 1, ICS 2 and ICS 5
- CE Marked





## **Eaton's Cutler-Hammer Aftermarket Services**

- Technical/telephone support
- Resident service engineers in major trading centers
- Factory repair services
- Warranty administration
- Equipment modification and upgrading services
- Training seminars

**For additional information on this product,  
please call our Customer Support Center at:**

**1-800-356-1243**

**or find on-line at:  
[www.cutler-hammer.eaton.com/it](http://www.cutler-hammer.eaton.com/it)**

**For service or start-up assistance  
24 hours/day, 7 days/week,  
please call:**

**1-800-498-2678**

## **A response network that gives new meaning to customer service**

- Personalized
- Comprehensive
- Professional

Eaton Corporation  
Cutler-Hammer business unit  
1000 Cherrington Parkway  
Moon Township, PA 15108-4312  
USA  
tel: 1-800-525-2000  
[www.cutler-hammer.eaton.com](http://www.cutler-hammer.eaton.com)

**EAT•N** | **Cutler-Hammer**

© 2002 Eaton Corporation  
All Rights Reserved  
Publication No. 49907  
February 2002  
Printed in USA