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SY6 HEAVY DUTY SOLID STATE CONTROLLER

CAUTION

Equipment is at possibly lethal AC line voltage when AC power is connected. Pressing the STOP pushbutton does not remove AC line voltage. All phase must be disconnected before it is safe to touch motor terminals or control equipment parts.

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1.0 Description

1.1 Overview

The SY6 is a heavy duty solid state reduced voltage controller containing 6 SCR's (silicon controlled rectifiers), designed to control the current supplied to an induction motor. The SCR's are connected in 3 back-to-back pairs, phase controlled over 180 degrees of each cycle of power line frequency by a digital firing circuit, containing a unique circuit which continuously synchronizes to any frequency variations and which requires no customer adjustment.

Since a motor's torque varies as the square of applied current, SY6 controllers can be programmed to provide a gradual build-up of torque from a low value to almost full motor locked rotor torque (step ramp mode), to provide gentle, jolt-free starting of any induction motor. In addition, for light load applications such as pumps and fans, they can be programmed to limit peak starting currents to a constant low value (constant current mode), and so prevent excessive voltage drops during motor starting.

Units rated over 40 amps are designed for use with a bypass contactor which is supplied as standard on packaged starters. The bypass contactor carries the motor current after the SY6 brings the motor up to full speed. This minimizes the heat generated by the SY6 and eliminates the need for a large heatsink. Nema 12 enclosed units above 18 amps also utilize this feature.

1.2 Standard Features • **Universal Source Matching**

The SY6 controller automatically adjusts itself to whatever input voltage and frequency is applied between 200 to 600 volts, and 45 to 65 Hertz, irrespective of phase rotation.

- **Closed Loop Starting**

The SY6 starts a motor in a continuous controlled current mode, eliminating any motor jerking or hunting that could be experienced in open loop types of reduced voltage starting.

- **LED Diagnostics**

- 1) Control voltage. On when 120 VAC is applied.
- 2) Starter On. On when controller is activated.
- 3) Line present. On when line power and 120V control power is applied.

- **Motor Overload Protection (Packaged Starters Only)**
Class 10 ambient compensated bimetallic with phase differential protection.

- **Dual Starting Mode**

Mode selection provides optimum performance to match the SY6 to the motor's load characteristics. (See below and section 4.2).

- **Constant Current**

In this mode, the current during starting is maintained at an adjustable value between 200% and 400% of the motor full load amperes (FLA). At full speed the current is determined by the motor load.

- **Step Ramp**

In this mode, the SY6 provides an initial current step adjustable between 200% and 400% of FLA, as above, and then increases to 600% of FLA over a time period adjustable between 1 and 30 seconds. At full speed the motor current is determined by the load.

- **User Friendly Start-up**

Quick and easy start-up is accomplished with no special tools or electrical skills.

2.0 Specifications

2.1 Electrical

- **Line Power**

Three phase 200 to 600 VAC, 45 to 65 Hz.

- **Control Power**

Single phase 120 VAC, 45 to 65 Hz.

50 VA units without bypass contactor.

150 VA units with bypass contactor.

- **Operator Devices**

3 wire control via start/stop push-button.

2 wire control via dry contact rated 1A, 120 VAC.

Fault interlock in series with stop circuit.

Other factory options available (Consult factory).

- **Output Contacts**

Run, 1 N.O. contact for latching of start circuit.

Run, 1 N.O./N.C. auxiliary rated 1A, 230 VAC.

Up to speed, available as an auxiliary contact on units with bypass contactor.

- **Overload Capacity**

600% for 10 seconds.

500% for 30 seconds.

- **Duty Cycle**

2 500% starts from cold in first minute.

1 500% start each 15 minutes thereafter.

- **Maximum Horsepower by Voltage**

Model	Maximum Horsepower			
	200V	230V	460V	575V
9	2	2	5	7.5
18	5	5	10	15
40	10	15	30	40
80	25	30	60	75
125	40	50	100	125

Note: SY6-80 and SY6-125 heatsink assemblies are suitable for bypass applications only. These units do not have a continuous duty rating.

2.2 Electrical Protection

- **Short Circuit Protection and Disconnect Capability**
Short circuit protection and disconnect means is provided by the user in the form of a circuit breaker or fused disconnect. Fuses should be either type J or RK1, capable of interrupting 200,000 amps, and should be sized according to all applicable codes. Enhanced short circuit protection may be added by using either a series contactor or a circuit breaker shunt trip, wired to remove power in the event of an overload trip.
- **Motor Overload Protection**
Class 10 ambient compensated bimetallic with phase differential protection. If the unit is supplied as a soft start module only, customer must provide motor overload protection.
- **Single Phase Protection (Active in 3 phase Mode)**
The SY6 will not operate if a phase loss is detected prior to starting and will trip if a phase is lost while running at load.
- **Surge Voltage Transient Protection**
High energy metal oxide varistors protect each SCR against damage caused by over voltage.
- **Heatsink Overtemperature Protection**
Thermal switches are provided on the 40, 80, and 125 amp sizes to detect excessive temperatures and shut down the controller before SCR damage occurs. Once the temperature drops to an acceptable level the unit may be restarted.

2.3 Mechanical

For dimensional information see section 7.0.

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3.0 Receiving & Installation

3.1 Installation

The cabinet containing the SY6 must be installed in an area where the following conditions exist:

- Ambient temperature does not exceed 40°C (104°F).
- Ambient temperature is not less than 0°C (32°F).
- Altitude above sea level is 3300 feet (1000m) or less.
- Ambient air is reasonably clean, dry and free of flammable or combustible vapors, steam or corrosive gases.

The cabinet must be installed away from any heat source, and a minimum of 1 foot (30 cm) is required around the air inlet and outlet on ventilated units. The SY6 has been designed for 50°C inside the enclosure.

3.2 Derating Data

When the unit is installed in poor environmental conditions, it must be derated as follows:

- 1.5% per °C above 40°C, or 0.75% per °F above 104°F.
- 1% for every 100m above 1000m, or for every 300 feet above 3300 feet.

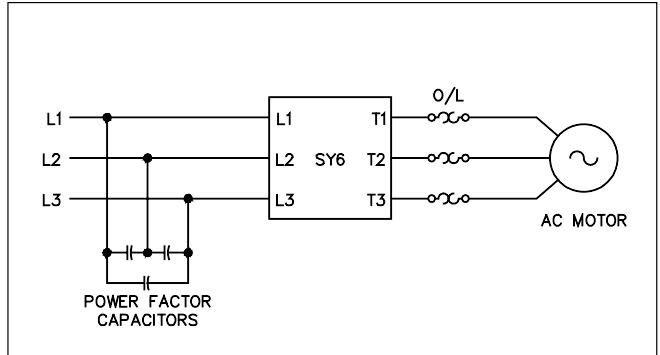
3.3 Wiring

The SY6 is to be connected according to the NEC and any other applicable electrical codes in the customer's area.

The customer is responsible for providing adequate short circuit protection (See section 2.2).

Power Factor Capacitor Connection

CAUTION: Power factor correction capacitors, when utilized, must be connected to the line side of the controller, and never to the load side.

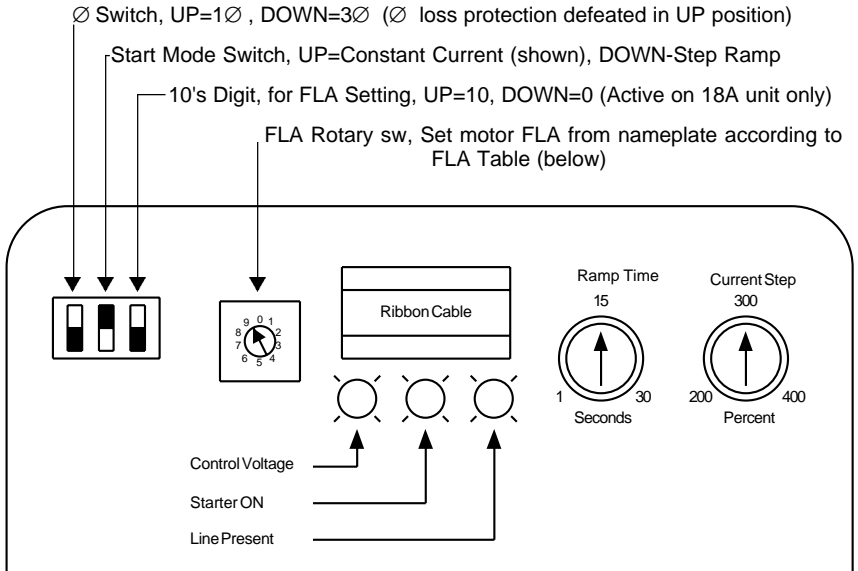


4.0 Start-Up

4.1 Inspection

Ensure that the controller has been installed according to the previous guidelines. Also, ensure that the unit has been wired according to the schematics. Check that all connections are tight. Check that the motor can rotate freely.

4.2 Pre-start Adjustments



Customer Adjustments (AA1009 Circuit Board)

SY6	FLA per Rotary Switch Position									
	0	1	2	3	4	5	6	7	8	9
9	0	1	2	3	4	5	6	7	8	9
18*	0	1	2	3	4	5	6	7	8	9
40	13	16	19	22	25	28	31	34	37	40
80	26	32	38	44	50	56	62	68	74	80
125	35	45	55	65	75	85	95	105	115	125

*10 Amps is added to this value by turning the (10's) switch to the ON position.

- **Phase Select**
Set to 3Ø (down) unless 1Ø operation is desired. Consult factory for single phase overload modification.
- **Starting Mode**
Select either "constant current" or "step ramp" starting mode as required by the application. This selection is made by the Start Mode switch. Constant current is recommended for light and moderate inertial type loads. Current ramp is recommended for heavy inertia and friction type loads.
- **Motor FLA**
Set switches to the setting indicated on the current setting label or in the table on the previous page.
- **Current Step**
The initial current step is adjustable between 200% and 400% of motor FLA. In the constant current mode, the accelerating current during starting is maintained at the value set by this adjustment. In the step ramp mode, this adjustment sets the initial value from which the current begins to ramp to 600% FLA during acceleration. As an initial setting, the current step should be set at 300%, or approximately mid-position.
- **Ramp Time**
Ramp time, which operates only in the step-ramp mode, is adjustable from 1 to 30 seconds and sets the rate at which the current rises from its initial setting to its maximum or 600%. Initially, ramp time should be set at 15 seconds, or approximately mid-position.

4.3 Starting

A clamp-on ammeter is recommended to continuously monitor the motor current during the start-up procedure.

- **Power-up**
Once the SY6 has been checked and set up, it is ready for power. Check that all personnel are clear of the controller and motor, then apply power. All LED's on the control card must be on except STARTER ON (See section 1.2 LED diagnostics). If they are not, see section 5.0 Troubleshooting below.
- **Starting**
Press the "start" push-button and determine if the motor accelerates smoothly to full speed. If the motor does not accelerate, increase the current step setting to 400%, full CW, immediately. If the motor still fails to accelerate,

press stop immediately and ensure that the motor is mechanically free to rotate. For a remotely located motor, it will be necessary to have another person stand by the motor, to communicate conditions during start-up. With the clamp-on ammeter, check that all three line currents are in balance.

- **Readjustment**

After the motor has been started, a fine adjustment might be required. It is good practice to set the controller to reach full speed in the minimum time permissible, without causing any appreciable power dip or excessive mechanical stress. The longest acceleration time is not necessarily the best setting because this may result in unnecessary motor rotor heating.

5.0 Troubleshooting

5.1 Diagnostics

- **Control Power LED**

If the control power LED does not light check terminals 1 and 2 on the AA1009 (main control card) for 120 VAC control power. If 120 VAC is present, check terminals 2 and 3. If the same voltage is not present, the fuse (F1) on the control card is blown or the card is defective and needs repair or replacement.

- **Line Present LED**

If the line present LED does not light, check the line voltages at terminals L1, L2, and L3. If correct voltage is present, check the SCR gate leads to insure proper connection and try again. If the LED still fails to light, repair or replace the AA1009 card.

- **Unit Will Not Start**

If both the control power and line present LED's are illuminated, and the control unit will not start, use a

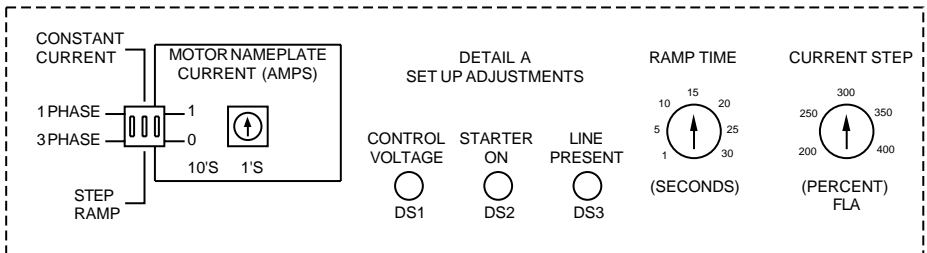
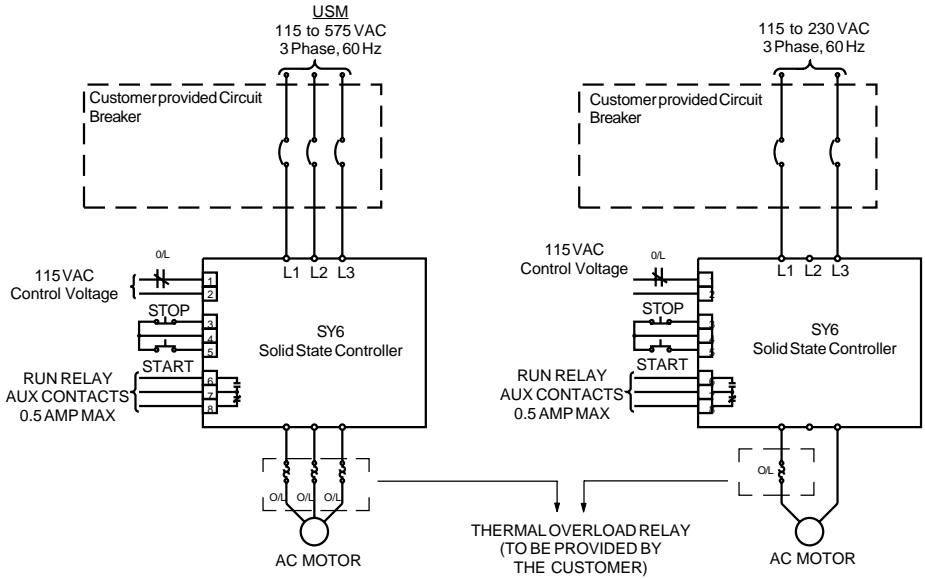
wire jumper to momentarily connect terminals 3 and 5 on the AA1009 card. If the unit starts, there is an open circuit in the start/stop circuit or fault interlock that must be corrected. If the unit does not start, the AA1009 card may need repair or replacement.

- **Unit Starts then Shuts Down**

If the unit starts, but shuts down after a short period of running, the bypass contactor may not be operating (causing the unit to trip on overtemperature). Start the unit (after allowing about 15 minutes for cool down) and observe the bypass contactor. It should close within 45 to 60 seconds. Once the contactor closes, check the AC voltages L1-T1, L2-T2, and L3-T3. In each case the voltage should be less than 0.5 VAC. If the voltage is higher, the bypass contactor may be defective and require repair or replacement.

6.0 Wiring Diagrams - Soft Start Module Only

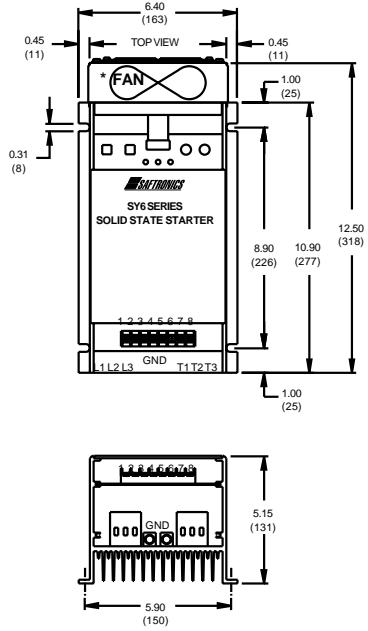
CAUTION: CUSTOMER MUST PROVIDE ADEQUATE SHORT-CIRCUIT PROTECTION (HRC FUSES OR CIRCUIT BREAKER) AND MOTOR THERMAL OVERLOAD PROTECTION.



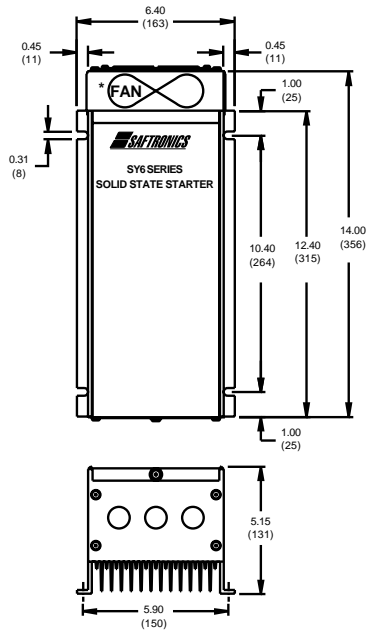
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Dimensional Drawing SY6 - 09, 18, and 40

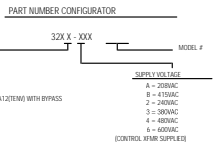
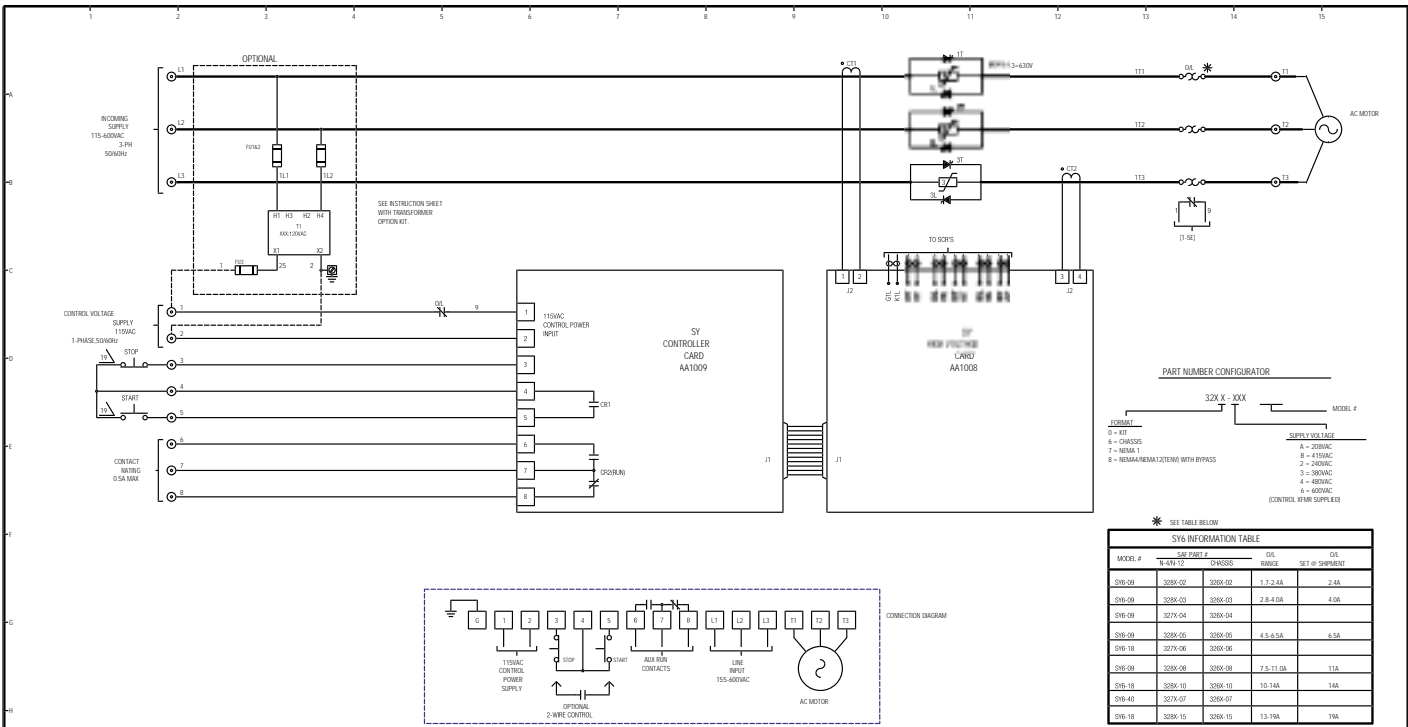
CHASSIS
(FRONT VIEW)



NEMA-1
(FRONT VIEW)

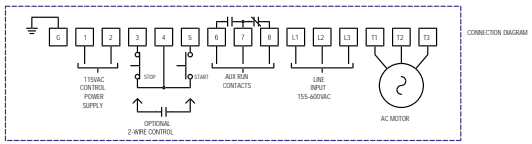


**NOTE: FAN IS USED
WITH SY6-40 ONLY**

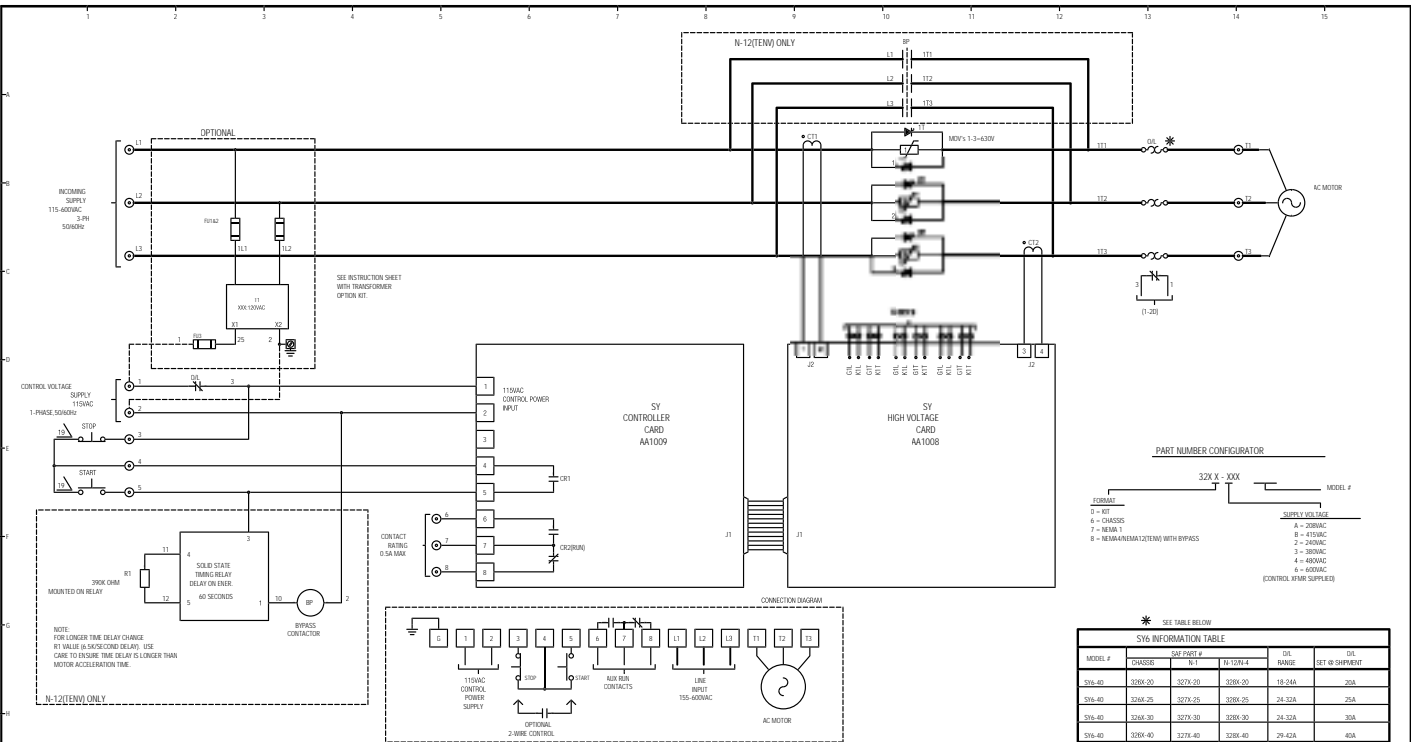


SEE TABLE BELOW

SY6 INFORMATION TABLE					
MODEL #	N-421-12	CHASSIS	VOLTAGE RANGE		OIL SET @ SHIPMENT
			MIN	MAX	
SY6-09	328K-00	328K-00	1.7-2.44	2.44	2.44
SY6-09	328K-00	328K-00	2.5-4.04	4.04	4.04
SY6-09	327K-04	328K-04	4.5-6.5A	6.5A	6.5A
SY6-18	327K-04	328K-04	7.5-11.0L	11A	11A
SY6-09	328K-08	328K-08	10-14A	14A	14A
SY6-18	327K-07	328K-07	13-19A	19A	19A



REVISIONS DATE: 23 AUG 93 DRAWN BY: WCA CHECKED BY: WCA	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES & TOLERANCES ARE ANGLES REVERSE	ENG: WCA 23 AUG 93 DRAWN: WCA 23 AUG 93 APP'D:	THE INFORMATION, DATA, AND DESIGNS CONTAINED ON THIS DRAWING ARE CONSIDERED THE PROPERTY OF SAFTRONICS, INC. EXCESS DISSEMINATION AND USE WITHOUT THE EXPRESS WRITTEN CONSENT OF SAFTRONICS, INC. IS PROHIBITED.
	MATERIAL SPECIFICATION	AUTO CAD P: SHEET: 1 OF 1 DRAWING/PART NUMBER: 32XX-18.DWG 32XX-02/15	



PART NUMBER CONFIGURATOR

32XX - XXXX MODEL #

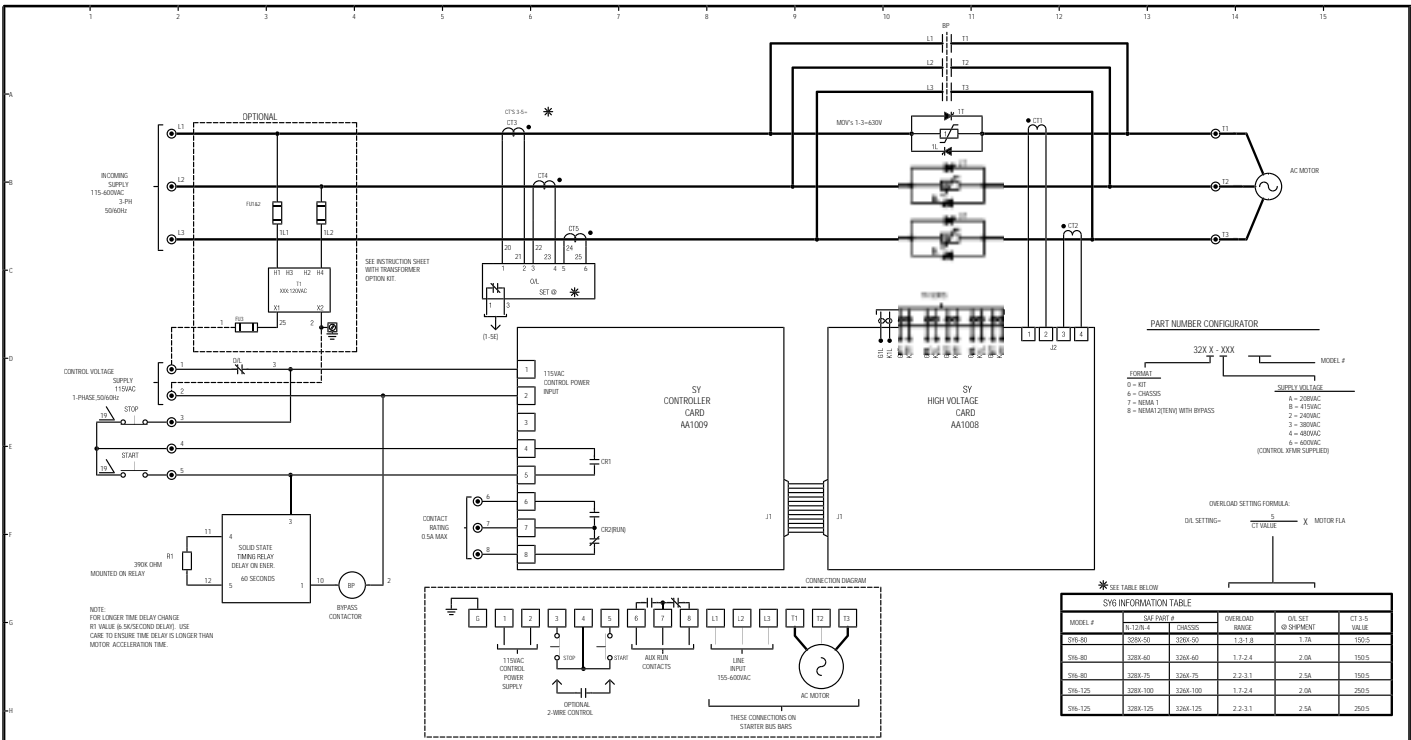
FORMAT: 0 = KIT, 4 = CONTACTS, 7 = NEMA 1, 8 = NEMA 4X(NEMA12(TENV)) WITH BYPASS

SUPPLY VOLTAGE: A = 208VAC, B = 415VAC, 2 = 240VAC, 3 = 300VAC, 4 = 480VAC, 6 = 600VAC (CONTROL RTMR SUPPLY)

* SEE TABLE BELOW

MODEL #	TRANSFORMER	CAF PART #	PH	V _L	V _L 12/24/4	CTL RANGE	CTL RANGE RT & RH/MTW
32X-40	320X-20	3279-00	320X-00	10	24/24	25A	
32X-40	326X-25	3279-25	326X-25	24	24/24	25A	
32X-40	326X-30	3279-30	326X-30	24	24/24	30A	
32X-40	320X-40	3279-40	320X-40	20	24/24	40A	

<p>REVISIONS</p> <p>11/20/04 BY PROLOGUE</p> <p>11/21/04 BY</p> <p>11/21/04 BY</p>															
	<p>UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES & TOLERANCES ARE DECIMALS</p> <p>+ = .0000 - .0005 .XX</p> <p>* = .0005 - .0010 .XXX</p> <p>MATERIAL SPECIFICATION</p>				<table border="1"> <tr> <td>ENG:</td> <td>WCA</td> <td>23 AUG 93</td> </tr> <tr> <td>DESIGN:</td> <td>WCA</td> <td>23 AUG 93</td> </tr> <tr> <td>APP'D:</td> <td></td> <td></td> </tr> </table>	ENG:	WCA	23 AUG 93	DESIGN:	WCA	23 AUG 93	APP'D:			<p>SAFTRONICS</p>
	ENG:	WCA	23 AUG 93												
	DESIGN:	WCA	23 AUG 93												
APP'D:															
<p>THE INFORMATION, DATA, AND DESIGNS CONTAINED ON THIS DRAWING ARE CONSIDERED PROPRIETARY INFORMATION OF SAFTRONICS, INC. DISCLOSURE, PUBLISHING, AND USE WITHOUT THE EXPRESS WRITTEN CONSENT OF SAFTRONICS, INC. IS PROHIBITED.</p>				<p>SOLD STATE MOTOR CONTROLS</p> <p>SY6-40 CH-N-1, N-12(TENV) & N4 WITH OVERLOAD WIRING DIAGRAM</p>		<p>REVISION #</p> <p>32XX-40.DWG</p>	<p>SHEET</p> <p>1 OF 1</p>	<p>DRAWING PART NUMBER</p> <p>32XX-20/40</p>							
<p>SAFTRONICS</p>															



PART NUMBER CONFIGURATOR

32X X - XXXX MODEL #

FORMAT

- 0 = KIT
- 6 = CHASSIS
- 7 = NEMA 1
- 8 = NEMA 2/3/5 WITH BYPASS

SUPPLY VOLTAGE

- A = 208VAC
- B = 415VAC
- Z = 240VAC
- 3 = 300VAC
- 4 = 480VAC
- 6 = 600VAC

(CONTROL VOLTAGE SUPPLIED)

OVERLOAD SETTING FORMULA:

OIL SETTING = $\frac{S}{CT\ VALUE} \times MOTOR\ FLA$

*SEE TABLE BELOW

SY6S INFORMATION TABLE

MODEL #	115VAC SUPPLY RANGE	115VAC CHASSIS RANGE	OVERLOAD RANGE	OIL SET EQUIPMENT VALUE	CT 3.5 VALUE
SY6-80	328X-50	328X-50	1.3:1.8	1.7A	150S
SY6-80	328X-66	328X-66	1.1:2.4	2.0A	150S
SY6-80	328X-75	328X-75	2.2:3.1	2.5A	150S
SY6-125	328X-100	328X-100	1.1:2.4	2.0A	250S
SY6-125	328X-125	328X-125	2.2:3.1	2.5A	250S

NOTE:
FOR LONGER TIME DELAY CHANGE RT VALUE & REPROGRAM DELAYS. USE CARE TO ENSURE TIME DELAY IS LONGER THAN MOTOR ACCELERATION TIME.

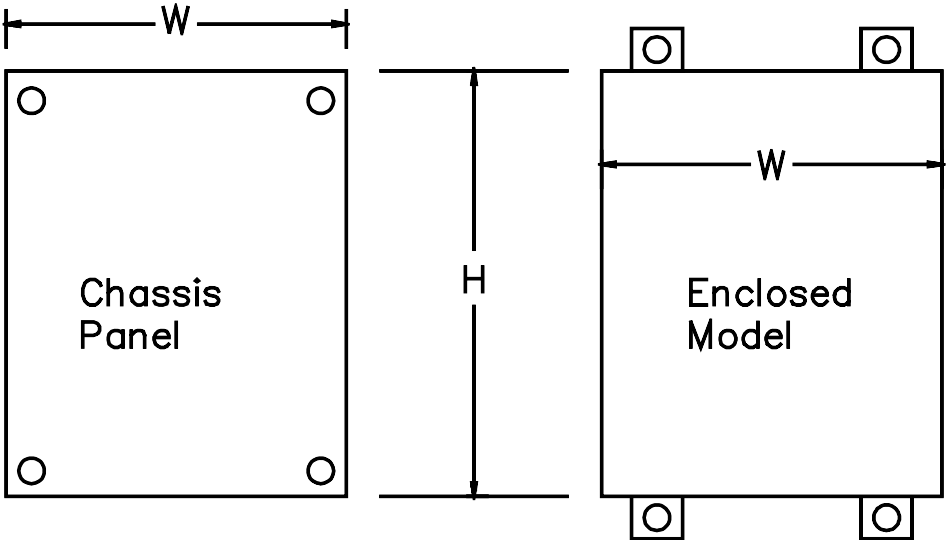
<p>REVISIONS</p> <p>DATE: _____</p> <p>BY: _____</p> <p>REASON FOR CHANGE: _____</p>	<p>ENC: WCA 24 AUG 93</p> <p>DESIGN: WCA 24 AUG 93</p> <p>APPD:</p>	<p>THE INFORMATION, DATA, AND DESIGNS CONTAINED ON THIS DRAWING ARE CONSIDERED PROPER EARLY INFORMATION OF SAFTRONICS, INC. DISCLOSURE, PUBLISHING, AND USE WITHOUT THE EXPRESS WRITTEN CONSENT OF SAFTRONICS, INC. IS PROHIBITED.</p>	<p>SAFTRONICS</p> <p>SOLID STATE MOTOR CONTROLS</p> <p>SY6-80 & SY6-125 CHASSIS & N-12/N-4 WITH BYPASS AND OVERLOAD - DIAGRAM</p>	<p>NOTE CAD # _____ SHEET _____</p> <p>32XX-125.DWG 1 OF 1</p>	<p>DESIGN/PART NUMBER</p> <p>32XX-50/125</p>
				<p>UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES & TOLERANCES ARE ANGLES DEGREES</p> <p>+ . = . + = . XXX</p> <p>+ . = . + = . XXXX</p> <p>MATERIAL SPECIFICATION</p>	

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7.0 Weights & Dimensions

Size	Packaged Starter		
	Chassis	NEMA 1	NEMA 12
	Dimensions/Weight H x W x D in. H x W x D mm. Lbs.* Kg.*		
9 & 18	17 x 13 x 6.25	N/A	20 x 16 x 12
	432 x 330 x 159		508 x 406 x 305
	9 Lbs. 8.6 Kg.		50 Lbs. 22.7 Kg.
40	17 x 13 x 6.25	20 x 16 x 12	20 x 16 x 12
	432 x 330 x 159	508 x 406 x 305	508 x 406 x 305
	21 Lbs. 9.5 Kg.	53 Lbs. 24 Kg.	53 Lbs. 24 Kg.
80 & 125	21 x 17 x 8.5	N/A	24 x 20 x 12
	533 x 432 x 216		610 x 508 x 305
	33 Lbs. 15 Kg.		80 Lbs. 36.3 Kg.

* Weights listed are net. Add 20% for shipping weight.



8.0 SY6 Series Spare Parts

Size	Part Number	Description	Qty. Used	Qty. Sug*
9	AA1009	Control Board SY6-8/18	1	1
	AA1008	High Voltage Card SY6-9/18/40	1	1
	N450003	SCR Module	3	1
	W16XR-06	Ribbon Cable, 6"	1	1
	T5004-01	Current Transformer 1500:1	2	1
18	AA1009	Control Board SY6-9/18	1	1
	AA1008	High Voltage Card SY6-9/18/40	1	1
	N10SP03A	SCR Module	3	1
	W16XR-06	Ribbon Cable, 6"	1	1
	T5004-01	Current Transformer 1500:1	2	1
40	AA1009A	Control Board SY6-40	1	1
	AA1008	High Voltage Card SY6-9/18/40	1	1
	N10SP06A	SCR Module	3	1
	W16XR-06	Ribbon Cable, 6"	1	1
	T5004-01	Current Transformer 1500:1	2	1
	S523002-03	Overtemp Sensor, 85°C	1	1
	G010001	Fan 4", 115 VAC	1	1
	G010006	Fan 4", 230 VAC (alternate)	Opt.	Opt.
80	AA1009B	Control Board SY6-80	1	1
	AA1123	High Voltage Card SY6-80/125	1	1
	N20SP10	SCR Module	3	1
	W16XR-06	Ribbon Cable, 6"	1	1
	T5003-02	Current Transformer 2500:1	2	1
	S523002-03	Overtemp Sensor, 85°C	1	1
	O210050	MOV 630V 20mm	3	3
	T300002	Current Transformer 150:5	3	1
125	AA1009F	Control Board SY6-125	1	1
	AA1123	High Voltage Card SY6-80/125	1	1
	N20SP08	SCR Module	3	1
	W16XR-06	Ribbon Cable, 6"	1	1
	T5003-02	Current Transformer 2500:1	2	1
	S523002-03	Overtemp Sensor, 85°C	1	1
	O210050	MOV 630V 20mm	3	3
	T300001	Current Transformer 250:5	3	1

* Suggested "On hand" quantity is to provide reasonable expectation of success in the event troubleshooting is required.

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9.0 WARRANTY

Saftronics warrants to buyer that products, and any services furnished hereunder will be free from defects in material, workmanship and title, and will be of the kind and quality specified in the quotation. The foregoing shall apply only to failures to meet said warranties (excluding any defects in title) which appear within one year from the date of shipment hereunder, provided, however, that if buyer, in the course of its regular and usual business, transfers title to or leases such products (including equipment incorporating such products) to a third party, such period shall run until one year from such transfer or lease or eighteen months from shipment by Saftronics whichever occurs first. The warranties and remedies set forth herein are conditioned upon (a) proper storage, installation, use and maintenance, and conformance with any applicable recommendations of Saftronics and, (b) buyer promptly notifying Saftronics of any defects and, if required, promptly making the product available for correction.

If any products or services fails to meet the foregoing warranties (except title), Saftronics shall thereupon correct any such failure either, at its option, (i) by repairing any defective or damaged part or parts of the products, or (ii) by making available FOB Saftronics plant or other point of shipment, any necessary repaired or replacement parts. The preceding paragraph sets forth the exclusive remedies for claims (except as to title) based on defect in or failure of products or services, whether claim in contract or tort (including negligence) and however instituted. Upon expiration of the warranty period, all such liability shall terminate. The foregoing warranties are exclusive and in lieu of all other warranties, whether written, oral, implied or statutory. No implied statutory warranty of merchantability or fitness for particular purpose shall apply and Saftronics will not be liable for any consequential damage arising from any product defect or failure to deliver on time. Saftronics does not warrant any products or services of others which buyer has designated.