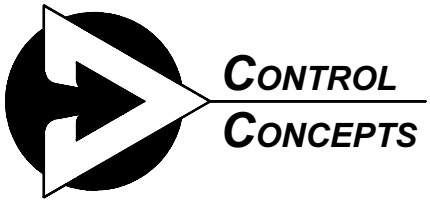
CONTROL CONCEPTS INC.

INSTRUCTION MANUAL
MODEL 3027



Distributed Worldwide By
www.mcgoff-bethune.com
1-800-303-4705
+1-770-840-9811

DESCRIPTION:

The model 3027 SCR power controller, linearly controls, with respect to a command signal, the electrical power applied to three-phase resistive load by zero-cross operation of silicon controlled rectifiers (SCRs) which are connected in two of the three load leads.

The command signal may be a mA current signal, a DC voltage signal or a potentiometer. The 3027 provides electrical isolation of the command signals from the line and load voltages allowing either grounded or ungrounded commands. The controller also provides line voltage compensation which maintains the load power constant independent of line voltage variations.

Three fast acting fuses within the controller protect the SCRs from fault currents. These fuses can, in many situations, also be relied upon to protect the load from fault currents.

The 3027 controller has two unique features called "Sync-Guard" and "Trans-Guard".

"Sync-Guard" reduces the possibility of two or more controllers operating sychronously, thereby reducing the possibility of all controllers being on and off simultaneously. The "Sync-Guard" feature provides a more uniform or continuous power demand and therefore reduces the variations in the supply voltage that can occur when multiple controllers operate synchronously.

WHEN USING THE SYNC-GUARD FEATURE, THE mA CONTROL SIGNALS MUST BE ISOLATED FROM EACH OTHER.

The "Trans-Guard" feature eliminates the DC load voltage and current that can exist with zero-cross operation. The "Trans-Guard" feature therefore prevents saturation and over heating of supply transformers due to DC voltage which can occur on the transformer primary because of secondary DC currents.

Control Concepts, Inc.
Model 3027 Controller
rated: 10 to 600 Volts
85 to 425 Amps

c UL US

UL FILE No. E136219 LISTED 3L32
INDUSTRIAL CONTROL EQUIPMENT

THEORY OF OPERATION:

In zero-cross control, load power is turned on or off only when the instantaneous value of the sinusoidal waveform is zero. Load power is controlled by switching the SCRs "on" for a number of complete electrical half-cycles and then "off" for a number of complete electrical half-cycles.

Because of the Trans-Guard feature, the 3027 always applies an odd number of "on" half cycles and an even number of "off" half cycles. The following tabulation shows the number of "on" and "off" electrical half-cycles of power that are applied to the load to acheive the percentage of load power indicated. The percentage of load power is equal to the ratio of the number of electrical half-cycles that power is applied to the total number of electrical half-cycles.

LOAD POWER				
10%	**25%**	**50%**	**75%**	**85%**
5 on	5 on	9 on	17 on	23 on
46 off	14 off	8 off	6 off	4 off
5 on	5 on	7 on	19 on	23 on
44 off	16 off	8 off	6 off	4 off
				23 on
				4 off
				23 on
				4 off
				23 on
				4 off
				21 on
				4 off

Table 1. Percentage of ON-OFF time.

From the above tabulation, it can be seen that power is applied for 16 out of 32 electrical half-cycles to acheive 50% load power and that power is applied for 136 out of 160 electrical half-cycles to obtain 85% power. When operated with a 60 hertz supply, the sequence of on and off cycles repeats every 0.266 seconds at 50% and every 1.33 seconds at 85% power. Note that even though it takes 1.33 seconds to obtain precisely 85% power, the load power during the 23 on and 4 off cycles is 23/27 or 85.185% power and that this cycle is repeated every 0.225 seconds.

SPECIFICATIONS:

CONTROL MODE:
Zero-cross, two-leg distributive power control to three-phase resistive loads.

CURRENT RATING:
The "[AAA]A" term within the model number specifies the maximum continuous RMS current rating at the maximum operating ambient temperature of 55°C.

COMMAND SIGNAL:

	Input Resistance
4/20mA	300 ohms
0-10 Vdc	240K ohms
0-5 Vdc	120K ohms
Potentiometer	240K ohms

(1K recommended; 20K permissible, 1/2 watt)

POWER CIRCUIT:
Inverse parallel silicon controlled rectifiers (SCRs). Two leg control.

OPERATING VOLTAGE:
208, 240 OR 480 Vac 50/60 Hertz +10 -15%
Other voltages available; consult factory

ENVIRONMENT:

Operating	0 to 55ºC
Storage	-40 to 80ºC
Humidity	0 to 95% non - condensing

ISOLATION:
Isolation between power circuit, command signal and ground is greater than 2500 Vrms.

LINEARITY:
The load power is linear within 2% of span with respect to the command signal.

VOLTAGE COMPENSATION:
The load power remains constant within 2% of span for line voltage changes of +10% and -15% variations.

CONTROL RANGE:
0 to 99.5% of supply voltage.

SCR VOLTAGE RATING:
1400 volts peak

DV/DT AND TRANSIENT VOLTAGE PROTECTION:
DV/DT rating exceeds 200 volts per microsecond. DV/DT snubber circuit and MOVs are provided to protect against high frequency transients (dv/dt) and high voltage transients.

ZERO AND SPAN:
±20% of span.

COMMAND INDICATOR:
An LED is turned on when the SCRs are turned on.

HEAT DISSIPATION:
3.0 watts per amp of line current (1.5 watt per amp of SCR current)

INSTALLATION:

MOUNTING:

BEFORE MOUNTING, DETERMINE THAT THE TRANSFORMER TAP IS SET TO A VALUE CORRESPONDING TO THE SUPPLY VOLTAGE.

POWER CONNECTIONS:
Wire the controller in accordance with the electrical codes for the area in which it will be used.

In the case of an LV (low voltage) controller, a connector is provided for 120Vac power input to the fan(s) and the transformer which supplies 24Vac to the firing circuit.

Connect the supply power and load as shown in the power connenctions drawing on page 4.

NOTE: The controller is not phase rotation dependent.

An oxide inhibitor such as Burndy Pentrox A, Ilsco De-OX, etc. should be used between electrical connections to insure good electrical contact.

The connectors, ILSCO No. CA6RP, are rated for use with wire sizes from 250MCM to 6ga. Type THWN or THNN wire is suggested.

RECOMMENDED TIGHTENING TORQUE FOR THE LINE AND LOAD CONNECTORS
(MCM = Thousand circular mills.)

AWG or Circular Mills	Torque inch-pounds
6ga	100
4ga	100
2ga	125
1ga	125
0ga	150
00ga	150
000ga	200
0000ga	200
250MCM	250

Table 2.

REPLACEMENT PARTS

FRAME SIZE	FUSE 3 required / unit Stock #	SCR 2 required / unit Stock #	CONTROL Transformer Fuse 2 required / unit
85 AMPS	42110-0460-411	28325-0395-514	42130-0460-210
145 AMPS	42110-0460-417	28325-0395-514	42130-0460-210
175 AMPS	42110-0460-420	28345-0413-514	42130-0460-210
240 AMPS	42110-0460-430	28355-0416-514	42130-0460-210
295 AMPS	42110-0460-435	28355-0416-514	42130-0460-210
370 AMPS	42110-0460-445	28355-0421-514	42130-0460-210
425 AMPS	42110-0460-450	28355-0425-514	42130-0460-210

FIRING CIRCUIT BOARD

3027 - FC - CS[XX]
FC = replacement firing circuit board.
CS[xx] = command signal required. (Potentiometer, 0 to 5Vdc. 0 to 10Vdc or 4/20mA.
Other command signal inputs may be available, consult factory for details.)

MODEL NUMBER IDENTIFICATION:

3027 - [VVV]V - [AAA]A - CS[XX] - SP[xxxx]

The term 3027 specifies a three-phase SCR controller which provides zero-cross distributive control by controlling the current in two of the three load leads.

The **"[VVV]V"** term specifies the operating voltage.
10 to 110V, 120V, 208V, 240V, 277V, 380V, 415V, 480V or 575V.
Other voltages may be available. Please consult factory for information.

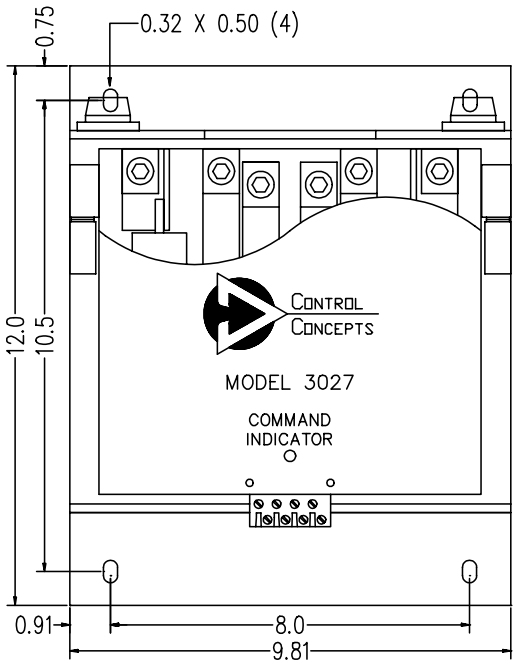
The **"[AAA]A**" terms specifies the maximum continuous RMS current rating.
85A, 145A, 175A, 240A, 295A, 370A or 425Amps.

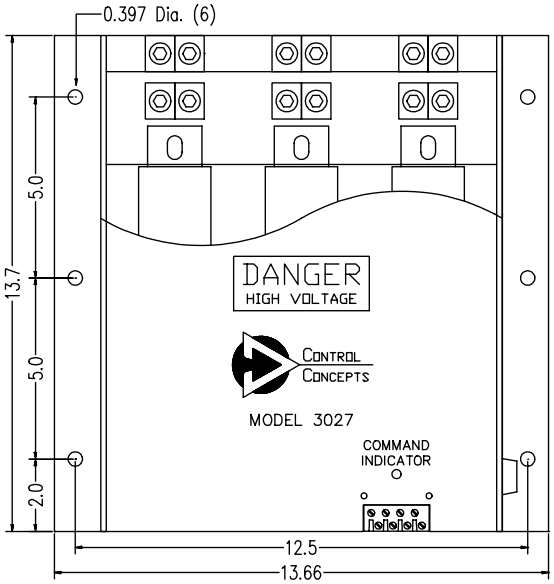
The **"CS[XX]"** (optional) . If this term is left blank, the controller will accept a potentiometer input or a 0 to 5 Vdc or a 0 to 10 Vdc command signal. When included, this term specifies the type of special command signals the controller has been factory calibrated to operate with.
Use a one (1) K potentiometer for maximum linearity. Up to Twenty (20) K ohms is permissible.

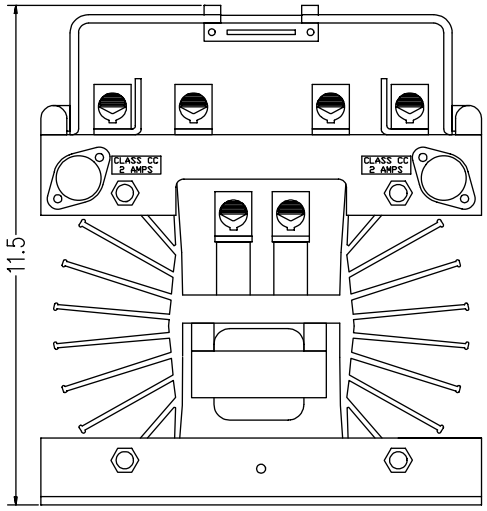
The **"SP[xxxx]"** (optional) term, if shown, specifies special calibrations.

For example, the number **3027-480V-85A-4/20mA** specifies a model 3027 controller with 480 volt operation, 85 amps continuous current rating, and requires a 4/20mA command signal.

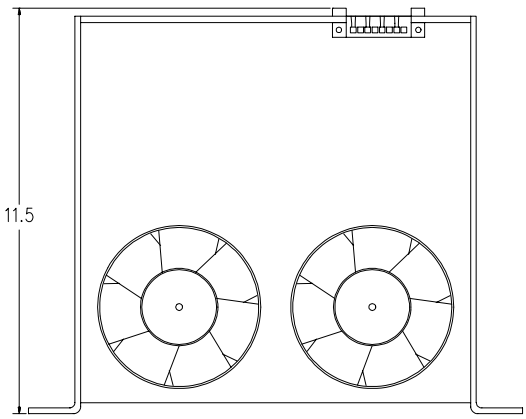
INSTALLATION DRAWINGS:



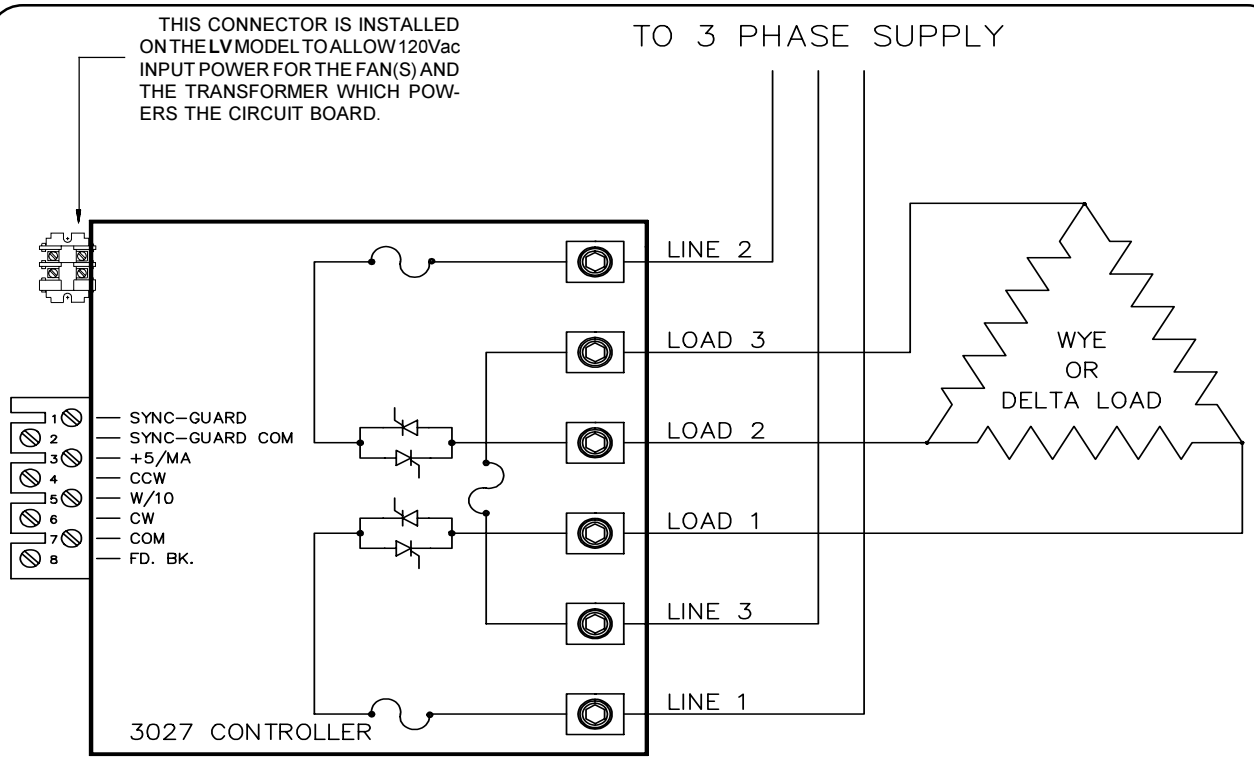




85, 145 & 175 Amp Controller
(145 & 175 Amp units have forced air cooling.)

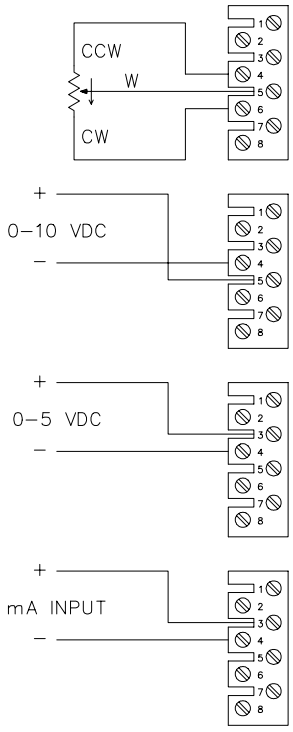


240, 295, 370 & 425 Amp Controller

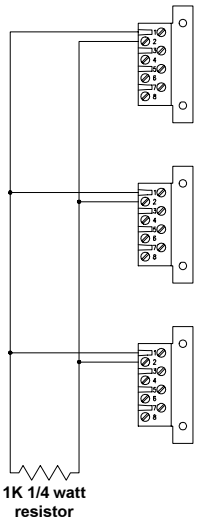


Power connections

1 lug per connection on 85, 145 & 175 amp unit.
2 lugs per connection on larger units.



Command signal connections



WHEN USING THE SYNC-GUARD FEATURE, THE mA CONTROL SIGNALS MUST BE ISOLATED FROM EACH OTHER.

Sync-Guard connections

CONTROL CONNECTIONS:

Connect the control wiring as shown in the *command signal connections* drawing on page 4.
Note: Shielded control wiring is not required, however, it is recommended that the control wiring not be placed adjacent to the power wiring.

POTENTIOMETER INPUT:
1K ohm recommended, 20K ohm maximum, 1/2 watt
Clockwise term of pot to terminal 6 on controller
Wiper to terminal 5 on controller
Counterclockwise term of pot to terminal 4 on controller

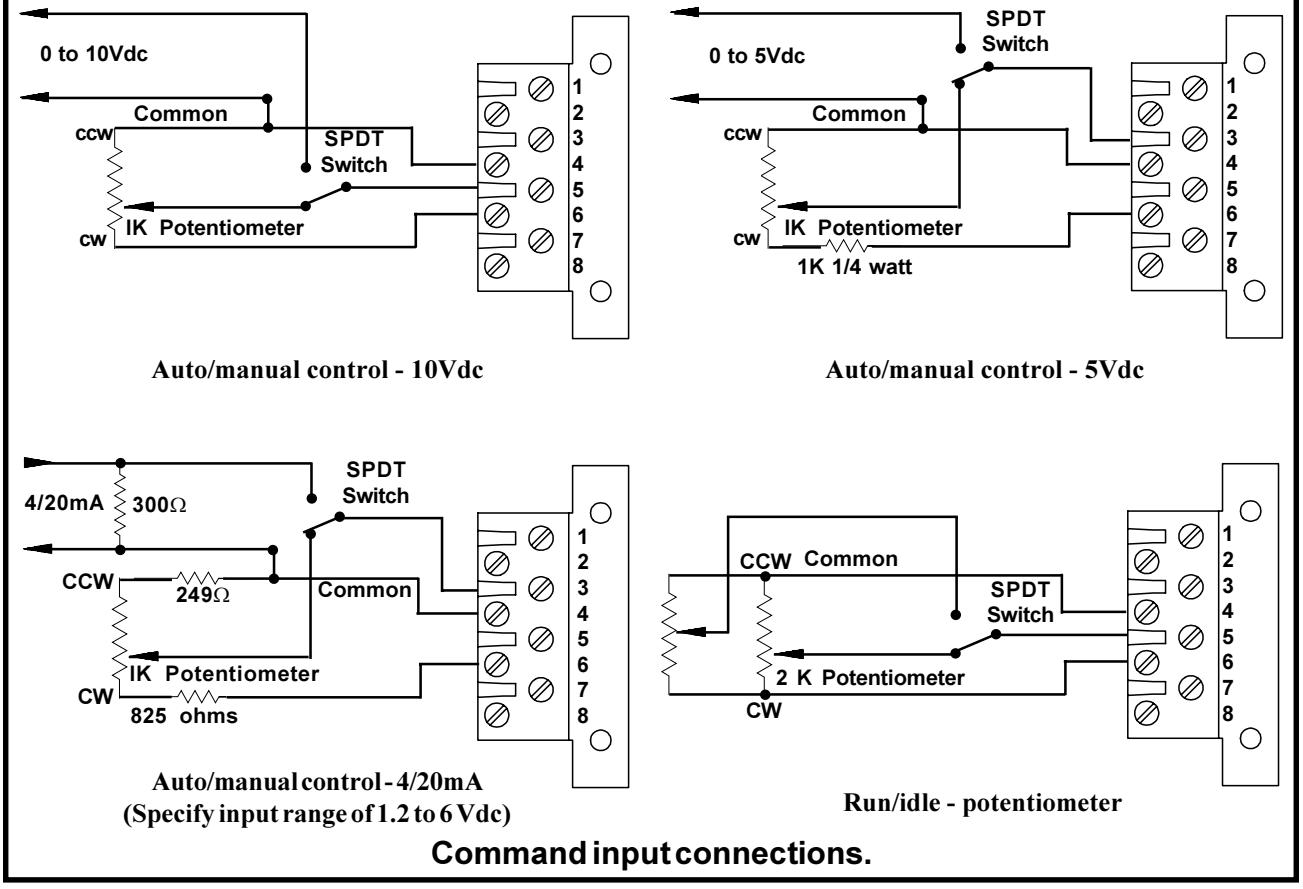
Note: If multiple controllers are controlled by one potentiometer, make the connections as described above for one controller and connect all terminal 4 together and connect all terminal 5s together. If run/idle control is desired, use two potentiometers (2K minimum resistance) and switch the appropriate potentiometer wiper to the controller.

mA INPUT:
Common to terminal 4,
Positive input to terminal 3

VOLTAGE INPUT:
0 to 10 Vdc: Common to terminal 4,
Positive input to terminal 5 (W)
0 to 5 Vdc: Common to terminal 4,
Positive input to terminal 3

SYNC-GUARD:
The Sync-Guard feature is implemented by connecting terminal 1 from all controllers together, and terminal 2 from all controllers together.
Then connecting a 1K resistor across terminals 1 & 2 on only one of the controllers.
See sync-guard connections drawing on page 4.
This circuit is electrically isolated from the line and load voltages.
Any number of controllers regardless of the current ratings can be connected in this manner.

WHEN USING THE SYNC-GUARD FEATURE WITH A mA CURRENT CONTROL SIGNAL, THE mA CONTROL SIGNALS MUST BE ISOLATED FROM EACH OTHER.



Command input connections.

CHECKOUT:

CAUTION: Portions of the electronic circuit and other parts of the controller are at line voltage.

USE EXTREME CAUTION TO AVOID ELECTRICAL SHOCK

Before applying power, determine that the transformer tap is set at a value corresponding to the supply voltage.

Set the command signal to minimum and apply system power. The command indicator light should be off and no power should be applied to the load. Slowly increase the command signal. The command indicator should blink on and off proportional to the magnitude of the command signal and load power should increase.

If the command indicator blinks on and off with no command signal, adjust the "zero" potentiometer until the indicator no longer turns on. If the command indicator blinks when the maximum command signal is applied, adjust the "span" potentiometer until the indicator just remains on continuously.

TROUBLE SHOOTING:

USE EXTREME CAUTION TO AVOID ELECTRICAL SHOCK

DO NOT ATTEMPT TO OPERATE THE CONTROLLER WITH THE CATHODE OR GATE LEADS REMOVED

The following are possible symptoms and procedures to follow.

No load power: command indicator does not function.

1. Check main fuses.
2. Check transformer fuses.
3. Determine that the command signal is present.
4. Determine that 10 Vdc is present between terminal 6 and terminal 4 on the input connector. If the voltage is greater than 11 Vdc the circuit board has probably failed. If the voltage is less than 9 Vdc the circuit board or transformer has probably failed. (Check that correct transformer tap is selected.)

No load power: command indicator functions correctly.

1. Remove system power and visually inspect circuit board for damage.
2. It is unlikely that both SCR modules have failed.
3. Check load connections and load fuses.

Partial or full load power: command indicator off.

1. One or both SCRs may have failed. Remove system power and remove circuit board from the controller. Reapply system power. An SCR or both SCR's have failed if load voltage exists. If the voltage between the line 1 and load 1 terminals is zero, or the voltage between the line 2 and load 2 terminals is zero, the SCR connected between those terminals has failed.
   If no load voltage exists with the circuit board removed, the board has failed.

Full load power: command indicator is on.

1. Check that the command signal is zero and correctly connected. (A convenient method to apply zero command is to remove the input connector from the controller.) If the command indicator remains on with zero command signal, the circuit board has failed. If the command indicator goes off, the problem is likely in the command signal or wiring.

Full load power can not be obtained: command indicator is on.

1. Check the fuse between line 3 and load 3.
2. Visually inspect the circuit board for damage.
3. With the command signal at maximum the voltage between the corresponding line and load terminals should be less than 2 vdc. SCR modules which have a voltage greater than 2 volts have probably failed.

REFERENCE DRAWINGS

Firing Circuit Schematic	C1000367C
Frame Wiring Diagrams	
85 Amp frame	S1360A
145 - 175 Amp frame	S1359A
240 - 425 Amp frame	S1361
Low voltage diagrams	
85 Amp frame	S1358
145 - 175 Amp frame	S1357
240 - 425 Amp frame	S1356

CONTROL CONCEPTS