Installation Instructions

CS1 Series Single Phase Solid State Relays

CHROMALOX
Advanced Thermal Technologies

PK521
0037-75549
June 2015
Important Safeguards

**WARNING**

*HIGH VOLTAGE* is used in the operation of this equipment; *DEATH ON CONTACT* may result if personnel fail to observe safety precautions.

Learn the areas containing high-voltage connections when installing or operating this equipment.

**WARNING**

Be careful not to contact high-voltage connections when installing or operating this equipment.

Before working inside the equipment, turn power off and ground all points of high potential before touching them.

**WARNING**

*ELECTRIC SHOCK HAZARD*: Any installation involving control equipment must be performed by a qualified person and must be effectively grounded in accordance with the National Electrical Code to eliminate shock hazard.
CS1 - Single Phase Solid State Relay Power Controller

General
The CS1 Series of solid state relays are an ideal, low cost power control solution for switching resistive loads found applications in such as furnaces, ovens, heat treating, injection molding, thermoforming, press platens, commercial food equipment, semiconductor, lighting and drying, just to name a few.

The CS1 Series power controllers feature:
• Rugged, industrial design & touch-safe exterior
• Conservative, continuous service ratings at 40˚C
• Up to 120 Amps and up to 600 VAC
• AC and DC Voltage command signals
• Zero cross firing
• Integrated heat sink
• SCR thermal protection with LED indication
• Optional over temperature alarm
• Optional load / line interrupt alarm
• Latching Alarm (DC gated versions only)
• USA & Canadian UL component recognition
• CE conformity

Installation and Operation

⚠️ CAUTION
The owner/installer must provide all necessary safety and protection devices and follow all current electrical wiring standards and regulations. Failure to do so may compromise the integrity of the controller and / or cause product failure resulting in a safety risk to operational and service personnel.

⚠️ CAUTION
This controller utilizes a heat sink which is designed to cool the unit during operation. Under no circumstance should air flow around the controller be compromised in any way. Failure to do so may result in the overheating of the controller, product failure, product temperatures and even fire.

⚠️ WARNING
During continuous operation, the heat sink can reach very high temperatures, and keeps a high temperature even after the unit is turned off due to its high thermal inertia.
Higher voltages may be present. DO NOT work on the power section without first cutting out electrical power to the panel. Failure to do so may cause serious injury or death.

To ensure proper performance, maximum safety and reliability, it is essential to install the unit correctly. This includes proper mounting, spacing, hardware and wiring. See below:

1. Maximum surrounding air temperature is 40°C in “Open Type Equipment” which is suitable for use in pollution degree 2.
2. Install the unit vertically (max 10° inclination from vertical axis).
Spacing:
- Minimum vertical distance between unit and panel wall: 3.94” (100 mm)
- Minimum horizontal distance between unit and panel wall: .79” (20 mm)
- Minimum vertical distance between adjacent power control units: 11.81" (300 mm)
- Minimum horizontal distance between adjacent power control units: .79” (20 mm)
Dimensions & Weights

<table>
<thead>
<tr>
<th>Model</th>
<th>Depth (without fan)</th>
<th>Weight (without fan)</th>
<th>Depth (with fan)</th>
<th>Weight (with fan)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS1 25 A</td>
<td>4.2” (107)</td>
<td>.71 lb (320 g)</td>
<td>5.6” (142)</td>
<td>2.9 lb (1300 g)</td>
</tr>
<tr>
<td>CS1 40 A</td>
<td>5.6” (142)</td>
<td>1.2 lb (540 g)</td>
<td>5.6” (142)</td>
<td>1.9 lb (900 g)</td>
</tr>
<tr>
<td>CS1 50 A</td>
<td>5.6” (142)</td>
<td>1.9 lb (900 g)</td>
<td>5.6” (142)</td>
<td>2.6 lb (1200 g)</td>
</tr>
<tr>
<td>CS1 60 A</td>
<td>5.6” (142)</td>
<td>2.6 lb (1200 g)</td>
<td>5.6” (142)</td>
<td>2.9 lb (1300 g)</td>
</tr>
<tr>
<td>CS1 75 A</td>
<td>(without fan)</td>
<td>(without fan)</td>
<td>5.6” (142)</td>
<td>(without fan)</td>
</tr>
<tr>
<td>CS1 90 A</td>
<td>(without fan)</td>
<td>(without fan)</td>
<td>5.6” (142)</td>
<td>(without fan)</td>
</tr>
<tr>
<td>CS1 120 A</td>
<td>(with fan)</td>
<td>(with fan)</td>
<td>5.6” (142)</td>
<td>(with fan)</td>
</tr>
</tbody>
</table>

Control & Power Connection Points & Indication Logic

LED 1
- Red: Input Control Signal Present
- Yellow: Overtemperature Condition, Input Control Signal Present
- Blank: No Input Control Signal

LED 2 (Optional)
- Red: Alarm Output Active
- Blank: No Alarm Output

<table>
<thead>
<tr>
<th>LOAD 2 /T1</th>
<th>LINE 1 /L1</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON (Red)</td>
<td>OVER TEMP (Yellow)</td>
</tr>
<tr>
<td>AL</td>
<td></td>
</tr>
</tbody>
</table>

Additional Diagrams:
- External - 24 VDC Power Supply
- External +24 VDC Power Supply
- Alarm Output See Wiring Diagrams

25 & 40 Amp

50 - 120 Amp
### Control Terminal Description – CS1 Models > 40 Amps

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Description</th>
<th>24 VDC Input Signal (Type 1) (6 – 32 VDC)</th>
<th>VAC/DC Input Signal (Type 2) (20 – 260 VAC/DC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not Used</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Control Signal Input &amp; VDC Power Supply</td>
<td>Control Signal Input (-) &amp; Optional -24 VDC Power Supply Input</td>
<td>VAC/DC Input</td>
</tr>
<tr>
<td>3</td>
<td>Control Signal Input</td>
<td>Control Signal Input (+)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>VDC Power Supply</td>
<td>Optional +24 VDC Power Supply Input</td>
<td>Not Used</td>
</tr>
<tr>
<td>5</td>
<td>Not Used</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Alarm Output</td>
<td>Alarm Options 1 &amp; 2: Solid State Switch</td>
<td>Alarm Option 1: Solid State Switch</td>
</tr>
<tr>
<td>7</td>
<td>Alarm Output</td>
<td>Alarm Options 3 &amp; 4: Internally connected to Terminal #4 (+VDC Power Supply)</td>
<td>PNP Digital Signal Output</td>
</tr>
<tr>
<td>8</td>
<td>Not Used</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### LED Status Definition

<table>
<thead>
<tr>
<th>LED</th>
<th>Color</th>
<th>Condition</th>
<th>LED</th>
<th>Color</th>
<th>Condition</th>
<th>LED</th>
<th>Color</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>BLANK</td>
<td>SCR OFF, no Alarm</td>
<td>ON</td>
<td>RED</td>
<td>SCR ON, No Alarm</td>
<td>ON</td>
<td>RED</td>
<td>SCR ON, Alarm Output is Active</td>
</tr>
<tr>
<td>AL</td>
<td>BLANK</td>
<td>SCR OFF, Alarm Output is Active</td>
<td>AL</td>
<td>BLANK</td>
<td>SCR OFF, Alarm Output is Active</td>
<td>AL</td>
<td>RED</td>
<td>SCR OFF, Alarm Output is Active</td>
</tr>
</tbody>
</table>

### Notes:

"ON" LED comes standard with ALL CS1 Models
"AL" LED is only available when optional Alarm Output feature is chosen. See order table.
Single Phase Load

CS1 with 20-260 VAC/DC Control Signal Input

CS1 with 6-32 VDC Control Signal Input

Load
Neutral
Ground

Fuse

Control Signal Output

Temperature / Process Controller

Control Signal Input

Temperature / Process Controller

Controlling 2 Phases (Legs) of a Three Phase (no Neutral) Wye (Star) or Delta Load Configuration

CS1 with 20-260 VAC/DC Control Signal Input

CS1 with 6-32 VDC Control Signal Input

Delta Load
Wye or Star Load

Phase L1
Phase L2
Phase L3
Ground

Fuse

Fuse
Three Phase Load in a Wye or Star Connection with Neutral

CS1 with 20–260 VAC/DC Control Signal Input

CS1 with 6–32 VDC Control Signal Input

Control Signal Output

Temperature / Process Controller

Neutral
Phase L1
Phase L2
Phase L3
Ground
Fuse
Fuse
Fuse

Optional Alarm Wiring (Alarms available on CS1 Models > 40 Amps)

Control Signal Input: 24 VDC (6–32 VDC)
Alarm Output: Solid State Switch
Alarm Option Code: 1 or 2 (See Order Table)

24 VDC Control Signal Input
24 VDC External Power Supply

24 VDC Control Signal Input
24 VDC External Power Supply

Optional Single 24 VDC Power Supply wiring method for DC alarms only
Jumper Terminals #4 & #6

Solid State Switch Alarm Output
24 VDC/AC External Power Supply Required

Note:
- Parallel connection required for multiple CS1 with Normally Open Alarm Switch (Code = 1)
- Series connection required for multiple CS1 with Normally Closed Alarm Switch (Code = 2)
Specifications

General
Category of use: ..................................................... AC1
Switching Mode: ......................................... Zero Cross
Input/Output Isolation Voltage: ............ 4,000 VAC RMS
Operational Voltage Range
• 480 VAC models: .................. 24 - 530 VAC
• 600 VAC models: .................. 24 - 660 VAC
Operational frequency: ................................. 45 - 65 Hz
Non-repetitive peak voltage
• 480 VAC models: .................. 1200 Vp
• 600 VAC models: .................. 1400 Vp
Zero Voltage Turn-on: .................. ≤ 20 V
Activation time: .................. = 1/2 cycle
Deactivation time: .................. = 1/2 cycle
Potential drop at rated current: .................. = < 1.4 Vrms
Power factor: ........................................................... = 1

Inputs
VDC Input (Type “1”)
Control voltage: ................................. 6 - 32 VDC
Maximum input: .................. < 10 mA @ 32 V
Maximum reverse voltage: .................. > 5.1 VDC
Activation voltage: .................. > 15 VDC
Deactivation voltage: .................. < 6 VAC/DC
Current draw: .................. ≤ 8 mAac/dc @ 260 VAC/DC

VAC Input (Type “2”)
Control voltage: .................. 20 - 260 VAC/DC
Activation voltage: .................. > 15 VAC/DC
Deactivation voltage: .................. < 6 VAC/DC
Current draw: .................. ≤ 8 mAac/dc @ 260 VAC/DC

Outputs

<table>
<thead>
<tr>
<th>Specification</th>
<th>CS1-025</th>
<th>CS1-040</th>
<th>CS1-050</th>
<th>CS1-060</th>
<th>CS1-075</th>
<th>CS1-090</th>
<th>CS1-120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Current (@ 40°C continuous service)</td>
<td>25 A</td>
<td>40 A</td>
<td>50 A</td>
<td>60 A</td>
<td>75 A</td>
<td>90 A</td>
<td>120 A</td>
</tr>
<tr>
<td>Max. Surge Current (t=20 ms)</td>
<td>400 A</td>
<td>600 A</td>
<td>1,150 A</td>
<td>1,300 A</td>
<td>1,500 A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. I²t for fusing (blowout)</td>
<td>645 A²s</td>
<td>1,010 A²s</td>
<td>6,600 A²s</td>
<td>8,000 A²s</td>
<td>11,200 A²s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Critical dV/dt Off-state (min.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,000 V/μs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off-state Leakage Current (@ Rated Voltage)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt; 3 mA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Environment Conditions
Operating Temperature Range: 0˚C to 80˚C
Maximum Relative Humidity: 50% @ 40˚C
Max. Installation Altitude: 2000 m above sea level
Pollution Level: 2
Storage Temperature: -20˚C to +85˚C
Junction Temperature: 125˚C

This device conforms to European Union Directive 2004/108/CE and 2006/95/CE as amended with reference to generic standards:
EN 61000-6-2 (immunity in industrial environment)
EN 61000-6-4 (emission in industrial environment)
EN 61010-1 (safety regulations).

Alarm Outputs
The alarms are only available only on models rated at 50 Amps and greater.
There are two types of alarm outputs:
1. Solid State Switch – Controls a connected device for an alarm event, such as a horn or light.
   a. Requires external 24 VAC/DC power supply
   b. Ratings:  Imax = 150 mA  
                 Vmax = 30 VAC/DC  
                 Z close < 15 Ω  (impedance)  
                 Z open > 1 MΩ  (impedance)
2. Digital Logic – PNP output signal for logic gated devices, such as PLCs
   a. Requires external 24 VDC (6-32 VDC) power supply
   b. Ratings:  Imax = 150 mA  
                 Vmax = 30 VAC/DC

Alarm Behavior
The functionality of the alarm switching varies depending on the type of gating signal
For Models with 24 VDC Input Control Signal
The alarm output function actuates (opens or closes) the isolated solid state output switch (or digital output signal) when it detects any of the following fault conditions:
The control signal is active, but:
• There is no current on the load (zero current or interrupted load)
• There is no line voltage power supply
• The internal temperature limit of the SSR has been exceeded

Latching Alarm Function
On the VDC gated CS1 controllers, the alarm state remains latched if the Control Signal is switched off. The Alarm Output will reset (unlatch) once the current load is restored or when the CS1 24 VDC power supply is cycled.

For Models with 20 - 260 VAC/DC Input Control Signal
The alarm output function closes the isolated solid state output switch when it detects any of the following fault conditions:
The control signal is active, but:
• There is no current on the load (zero current or interrupted load)
• There is no line voltage power supply
• The internal temperature limit of the SSR has been exceeded

Latching Note:
On the VAC gated CS1 controllers, in the absence of the control signal, the alarm output is always open. The alarm memory latch function is not possible as with the CS1 with VDC control signal.

Integrated Thermal Protection
The SSR temperature is constantly monitored. If the maximum temperature limit (230°F/110°C) is exceeded, current to the load is interrupted and the YELLOW over-temperature condition LED illuminates.

Derating Curves
Rated Current versus Ambient Temperature for each CS1 Model
(These curves reflect units tested complete with approved heat sinks and fans, if applicable)
**Ordering Information**

<table>
<thead>
<tr>
<th>Model</th>
<th>Single Phase, Solid State Relay Power Controller - DIN Rail Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS1</td>
<td>The CS1 Series are DIN Rail mounted, single-phase solid state relays with integrated heatsink for switching resistive loads in industrial applications. Standard features: Zero-voltage turn-on, LED input status indicator, internal over voltage protection (MOV), integrated SCR thermal protection with LED indication(^1), two logic input control signals, operating voltage up to 600 VAC. Optional features: &quot;Solid state switch or PNP Digital Signal alarm output during over-heated or interrupted line/load condition. Approvals: CE, UL, cUL.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Current @ 104°F (40°C) Ambient, continuous service</th>
</tr>
</thead>
<tbody>
<tr>
<td>025</td>
<td>25 Amps</td>
</tr>
<tr>
<td>040</td>
<td>40 Amps</td>
</tr>
<tr>
<td>050</td>
<td>50 Amps</td>
</tr>
<tr>
<td>060</td>
<td>60 Amps</td>
</tr>
<tr>
<td>075</td>
<td>75 Amps</td>
</tr>
<tr>
<td>090</td>
<td>90 Amps</td>
</tr>
<tr>
<td>120</td>
<td>120 Amps (requires fan choice from below)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Nominal Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>480 VAC (Range: 24 - 530 VAC)</td>
</tr>
<tr>
<td>60</td>
<td>600 VAC (Range: 24 - 660 VAC)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Input Control Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6 - 32 VDC</td>
</tr>
<tr>
<td>2</td>
<td>20 - 260 VAC/DC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Alarm Outputs (Note: Alarms only available on ≥ 50 Amp Models)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>None</td>
</tr>
<tr>
<td>1</td>
<td>Solid State Relay switch (normally open)</td>
</tr>
<tr>
<td>2*</td>
<td>Solid State Relay switch (normally closed)</td>
</tr>
<tr>
<td>3*</td>
<td>Digital Logic PNP Output (normally open)</td>
</tr>
<tr>
<td>4*</td>
<td>Digital Logic PNP Output (normally closed)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Fan (120 Amp Version Only), Inches (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No Fan (select for all models &lt; 120 Amp)</td>
</tr>
<tr>
<td>1</td>
<td>**Fan (230 VAC Power Supply Requirement)</td>
</tr>
<tr>
<td>2</td>
<td>**Fan (120 VAC Power Supply Requirement)</td>
</tr>
</tbody>
</table>

**Notes:**
- \(^1\) Available only on models ≥ 50 Amps
- Some models may accept 24 VDC or 24 VAC. See optional Alarm Wiring details in manual.
- * Available only for models with 6-32 VDC input control signal
- ** Fan requires customer supplied voltage.

The following Chromalox Temperature Controllers offer a suitable 24VDC power supply for the alarm option:
- 40 Series: 6040 / 8040 / 4040
- 50 Series: 6050 / 4050
- 60 Series: 6060
- 80 Series: 4080 / 4081 / 4082

**Limited Warranty:**
Please refer to the Chromalox limited warranty applicable to this product at http://www.chromalox.com/customer-service/policies/termsofsale.aspx.