# Solid State Relays
## SRP1–CB...F

High-Endurance Solid-State Relay


Quick-connect terminals

## Description

The SRP1-CB...F High-Endurance series of solid-state relays (SSRs) features quick-connect terminals, purpose-built for the food & beverage industry. These SSRs provide superior uptime, offering consistent and reliable performance in high-frequency applications that require frequent on/off switching.

Using the latest manufacturing techniques in Direct Bonding Technology and featuring high-end power semiconductors (Littelfuse proprietary IXYS Technology) this relay guarantees maximum quality, reliability, and longevity even under tough conditions compared to any other relay in the market.

## Features & Benefits

| FEATURES | BENEFITS |
|---|---|
| **High-Endurance Design** | Provides enhanced operational reliability and up to 2x-3x times more life endurance cycles, ensuring consistent performance even in demanding conditions |
| **Compliance with International Standards (cЯUus, CE)** | Ensures the Solid-State Relay (SSR) has undergone rigorous testing, providing enhanced safety and product quality |
| **Zero Cross Switching** | Reduces electrical noise and minimizes voltage spikes during switching, enhancing overall system stability |

## Applications

- Cooking ovens
- Hot drinks dispensers
- Coffee machines
- Commercial fryers
- Cooking suites
- Commercial toasters

## Ordering Information

**FOR HEATING CONTROL**

| CATALOG # | OUTPUT MAX CURRENT | OUTPUT VOLTAGE | OUTPUT SWITCHING STYLE | OUTPUT OVERVOLTAGE PROTECTION | INPUT VOLTAGE RANGE | COMPLIANCE |
|---|---|---|---|---|---|---|
| SRP1-CBDZL-010NF-N | 10 A | 24-240 V AC | Zero Cross | - | 4-32 V DC | cЯUus, CE |
| SRP1-CBDZL-025NF-N | 25 A | 24-240 V AC | Zero Cross | - | 4-32 V DC | cЯUus, CE |
| SRP1-CBDZH-050NF-N | 50 A* | 48-600 V AC | Zero Cross | - | 4-32 V DC | cЯUus, CE |

*With 2 quick connects installed.

## Input/Control Specifications[1]

**GENERAL DATA**

| SYMBOL | PARAMETER | RANGE | VALUE | UNIT |
|---|---|---|---|---|
| Uc | Input (Control) Voltage | Maximum | 32 | V DC |
| | | Nominal | 5 – 12 – 24 | V DC |
| | | Minimum | 4 | V DC |
| Urv | Reverse Voltage | Maximum | -32 | V DC |
| Uc on | Turn-On Voltage (Pick-up/Engage/Activation Voltage) | Minimum | 4.0 | V DC |
| Uc off | Turn-Off Voltage (Drop Out/Release/Deactivation Voltage) | Nominal | 1.0 | V DC |
| Ic | Input (Control) Current | Maximum | 12 | mA |
| | | Minimum | 7 | mA |
| - | Input Impedance | Nominal | Current Regulated | - |
| - | Turn-On Time | Maximum | ½ (20 us for instant on) | Cycle |
| - | Turn-Off Time | Maximum | ½ | Cycle |

## Output/Load Specifications[1]

**GENERAL DATA**

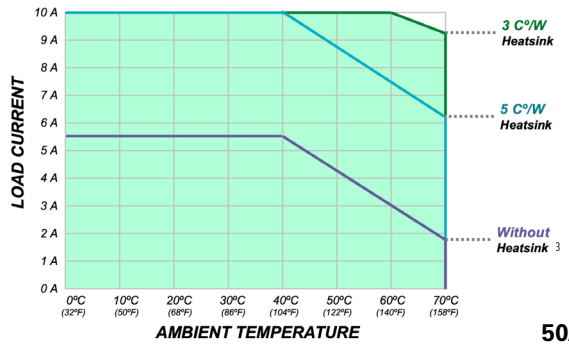
| SYMBOL | PARAMETER | CONDITION | RANGE | VALUE FOR 10A VERSIONS | VALUE FOR 25A VERSIONS | VALUE FOR 50A VERSIONS | UNIT |
|---|---|---|---|---|---|---|---|
| - | Output Configuration | - | - | SPST-NO | SPST-NO | SPST-NO | - |
| f | Operating Frequency | - | Minimum | 47 | 47 | 47 | Hz |
| | | | Nominal | 50 – 60 | 50 – 60 | 50 – 60 | |
| | | | Maximum | 63 | 63 | 63 | |
| Ue | Operating Voltage | | Minimum | 24 | 24 | 24 | Vrms |
| | | | Nominal | 120 - 240 | 120 - 240 | 120 - 240 | |
| | | | Maximum | 280 | 280 | 280 | |
| V | On-State Voltage Drop | At Rated Current | Maximum | 1.15 V | 1.15 V | 1.3 V | Vrms |
| Vto | Threshold Voltage (Power Loss Calculations only) | Tvj = 150 °C | Maximum | 0.88 | 0.88 | 0.88 | V |
| rt | On state dynamic resistance (Power Loss Calculations only) | Tvj = 150 °C | Maximum | 6.3 | 6.3 | 6.3 | mΩ |
| Up | Transient Over-Voltage (Peak/Blocking/Non-Repetitive Voltage) | - | Maximum | 1200 | 1200 | 1200 | Vpk |
| Itsm | Transient Over-Current (Surge/Overload/Non-Repetitive Current) | 1/2 Cycle At 50/60 Hz (Tvj=45 °C) | Maximum | 220/260 | 420/460 | 620/660 | Apk |

## Output/Load Specifications[1]

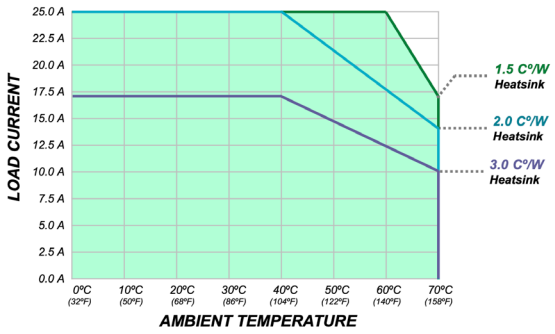
| SYMBOL | PARAMETER | CONDITION | RANGE | VALUE FOR 10A VERSIONS | VALUE FOR 25A VERSIONS | VALUE FOR 50A VERSIONS | UNIT |
|---|---|---|---|---|---|---|---|
| Ilk | Leakage Current (Off-State) | At Rated Voltage | Maximum | 1 | 1 | 1 | mArms |
| dv/dt | Critical dV/dt (Off-State) | At Maximum Rated Voltage | Minimum | 500 | 500 | 500 | V/µsec |
| I²t | I²t Value for Fusing | ½ Cycle at 50/60 Hz (Tvj=45 °C) | Minimum | 800/900 | 1200/1300 | 1800/1900 | A² sec |
| Pf | Minimum Power Factor | At Maximum Load | Minimum | 0.5 | 0.5 | 0.5 | - |
| - | Thermal Resistance Junction to Case (Rjc) | | | 1.0 | 0.8 | 0.5 | °C/W |
| Ie (AC-51) | Load Current (Continuous) – Heating Elements (AC-51) | At 40 °C | Maximum | 10 | 25 | 50 | Arms |
| | | | Minimum | 0.15 | 0.15 | 0.15 | Arms |

**Thermal Derating Curves (for heatsink selection)**
To operate the Solid-State Relay (SSR) at its specified ratings, the use of a heatsink is mandatory. The following thermal derating curves illustrate the maximum load current that our SSRs can manage under varying ambient temperatures and heatsink sizes. It is crucial to select a heatsink that is most suitable for your specific application.

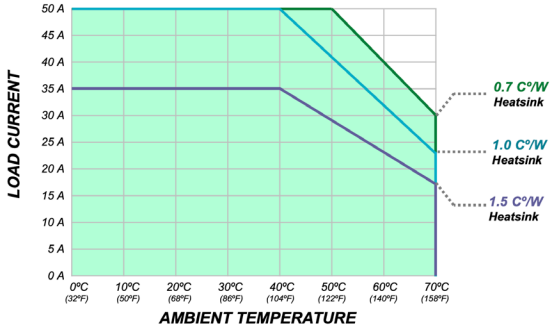
**10A VERSIONS:**




**25A VERSIONS:**




**50A VERSIONS:**




**Considerations - Switching Type**
In applications requiring precise temperature management, solid-state relays (SSRs) play a crucial role. Specifically, the Zero Cross Switching type of SSR is commonly employed to regulate heaters based on signals from a temperature controller. This technology proves particularly valuable in scenarios where high-frequency switching occurs—such as when a heater cycles on and off frequently over short intervals for extended periods.

**Considerations - Inrush Current**

It's essential to recognize that variations exist between different types of heating elements, especially in hot or cold conditions. While it is generally expected that heating elements exhibit no inrush current, in certain heating elements cold conditions can lead to an inrush current equivalent to 1.4 times the nominal current. To mitigate this, we highly recommend oversizing the current rating and ensuring an appropriately sized heatsink. Doing so improves the relay's thermal endurance and extends its operational lifespan.

So, when selecting an SSR, consider using one with a capacity approximately 1.4 times that of the heater or operating the SSR at only 75%-80% of its maximum capacity. The following table provides guidance for choosing the right SSR for a specific heater load.

| NOMINAL SSR CURRENT RATING | MAXIMUM RECOMMENDED HEATER CURRENT | HEATER POWER AT 120 VAC | HEATER POWER AT 240 VAC |
|---|---|---|---|
| 10 A | 8 A | 960 W | 1.9 KW |
| 25 A | 20 A | 2.4 KW | 4.8 KW |
| 50 A | 40 A | 4.8 KW | 9.6 KW |

## General Specifications[1]

**GENERAL DATA**

| SYMBOL | PARAMETER | CONDITION | RANGE | VALUE | UNIT |
|---|---|---|---|---|---|
| - | LED for Input (Control) Status Indicator | - | - | Continuously ON Green LED, when control input is applied | - |
| Ui | Isolation (Dielectric Strength) Input/Output/Base | 50/60 HZ | Nominal | 4 000 | Vrms |
| Ri | Insulation Resistance | @ 500 V DC | Minimum | 1 | GΩ |
| - | Coupling Capacitance | - | Maximum | 8 | pF |
| - | Endurance* according to American Standard UL508 | | Typical | 100,000 | Cycles |

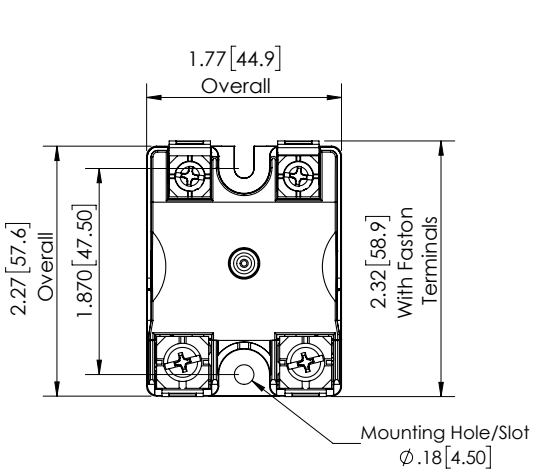
*The SRP1 series is engineered for durability, having undergone rigorous testing to ensure a minimum lifespan of 100,000 Endurance cycles, with each cycle consisting of a 1-second activation followed by a 9-second rest, at twice the rated current. This means that the relay can be expected to operate reliably for 100,000 times under these conditions, but it may have a shorter or longer lifetime depending on other factors, such as switching frequency, environmental temperature, and humidity.

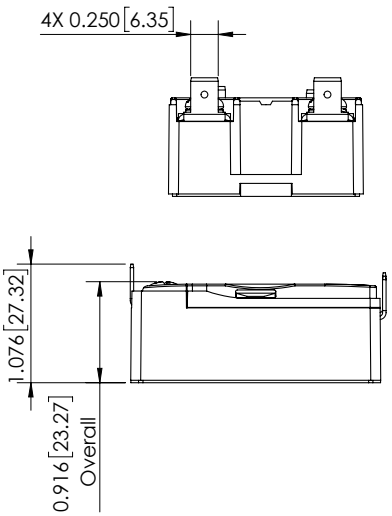
**ENVIRONMENTAL DATA**

| SYMBOL | PARAMETER | CONDITION | RANGE | VALUE | UNIT |
|---|---|---|---|---|---|
| - | Vibration (Test conducted in accordance with the Vibration Environmental Testing Guidelines of the International Standard *IEC 60068-2-6)* | 5-100Hz | Nominal | 10 | g |
| - | Shock (Test conducted in accordance with the Shock Environmental Testing Guidelines of the International Standard *IEC 60068-2-27*) | 11ms | Nominal | 50 | g |
| - | Ambient Temperature - Operating (Working) | No icing, no condensation | Maximum | 70 (158) | °C (°F) |
| | | | Minimum | -40 (-40) | °C (°F) |
| - | Ambient Temperature - Storage | No icing, no condensation | Maximum | 100 (212) | °C (°F) |
| | | | Minimum | -40 (-40) | °C (°F) |
| HR | Relative Ambient Humidity (Per international standard *IEC/EN 60068-2-78*) | Non-condensing @ 40 °C | Nominal | 93 | % |
| - | Pollution Degree | Non-conductive pollution with condensation possibilities | Nominal | 2 | |

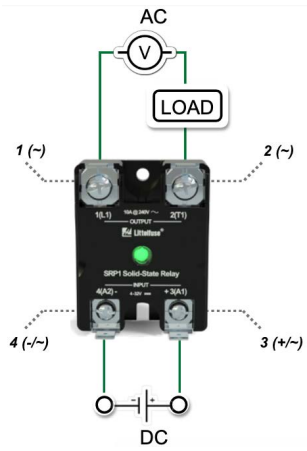
| MECHANICAL DATA | | | | | |
|---|---|---|---|---|---|
| SYMBOL | PARAMETER | CONDITION | RANGE | VALUE | UNIT |
| - | Product Weight | - | Typical | 100 (0.22) | g (lbs) |
| - | Housing Material (In accordance with the American Standard UL-94 for Safety of Flammability of Plastic Materials for Parts in Devices and Appliances) | - | - | Plastic UL 94 V-0 | - |
| - | Baseplate Material | | - | Aluminum | - |
| | Touch Protection Level (Test conducted in accordance with the IP Code of Degrees of Protection Testing Guidelines of the International Standard *IEC 60529*) | | | IP00 | |
| - | Screw Torque Range | SSR Mounting | Typical | 2-2.2 (18-20) | Nm (in-lb) |
| - | Screw Thread Size | SSR Mounting | - | M4 x 0.7 or #8-32 Pan Head | - |

## Product Dimensions

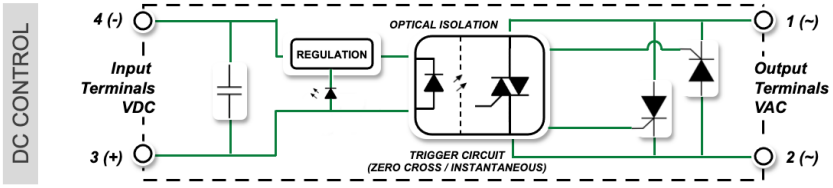



## Wiring Diagrams




## Equivalent Circuit Block Diagrams



### Short-Circuit Protection by Fuse

To safeguard solid-state relays (SSRs) against load short circuits, the use of fuses is essential, especially fast-acting ones. Here are the key considerations:

No. E183688

- Fuse Selection: The **I²t value** (energy withstand capability) of the fuse should be **less than half** of the I²t value of the relay. Standard fuses are inadequate because they cannot react swiftly enough to prevent fault currents from exceeding the maximum levels that thyristors (used in SSRs) can handle. Therefore, we strongly recommend employing **ultra-fast fuses.**
- Fuse Placement: Position the fuse in front of the SSR in the circuit. This strategic placement ensures that if the relay must unexpectedly break the earth insulation (due to overheating, case damage, or leakage with the heatsink), the fuse will protect the entire circuit from firing.
- Resource for Fuse Options: For the most suitable fuse options, consider checking the **Littelfuse website.**

## Standards Conformity & Certifications

### Product Safety Certifications

Products tested, compliant and certified to the following standards that states the requirements for electrical products to ensure they are safe for consumers to use.

| CERTIFICATION BODY MARK | CERTIFICATION BODY NAME | CERTIFICATION DESCRIPTION | STANDARDS COVERED BY THE CERTIFICATION |
|---|---|---|---|
| c US<br>No. E183688 | cRUus | North American certificate of compliance with the Safety requirements for Industrial Control Equipment | **UL508**<br>American Standard of Safety for Industrial Control Equipment.<br>**CAN/CSA C22.2 No.14-18**<br>Canadian Standard of Safety for Industrial Control Equipment. |
| CE | CE | Conformity with the European safety, health, and environmental protection requirements. | **LVD Directive 2014/35/EU**<br>EU Directive of Safety for Low Voltage Gear Equipment.<br>In accordance with the Low Voltage Gear Testing Guidelines of the International Standard IEC 60947-4-3<br>**EMC Directive 2014/30/EU**<br>EU Directive of Electromagnetic Compatibility.<br>In accordance with the Low Voltage Gear Testing Guidelines of the International Standard IEC 60947-4-3<br>**RoHS Directive 2015/863/EU**<br>EU Directive of Hazardous Substances Restriction.<br>In accordance with the Assessment of electrical and electronic products with respect to the restriction of Hazardous substances Guidelines of the International Standard IEC 63000 |

## EMC Compliance (Electro-magnetic compatibility)

### Radiated Emissions

| - | STANDARD NAME | STANDARD DESCRIPTION | STANDARD NUMBER | LEVELS |
|---|---|---|---|---|
| IEC | Radiated RF | Radio interference field emission (radiated) | International Standard CISPR 11 | Class B: 30M – 1GHz |
| IEC | Conducted RF | Radio interference voltage emissions (conducted) | International Standard CISPR 11 | Class B (with external filter): 150k – 30MHz |

### Immunity

| - | STANDARD NAME | STANDARD DESCRIPTION | STANDARD NUMBER | LEVELS |
|---|---|---|---|---|
| IEC | ESD | Immunity to Electrostatic Discharge (ESD) | International Standard IEC 61000-4-2 | Level 3<br>-Contact Discharge: 6 kV<br>-Air Discharge: 8 kV |
| IEC | Radiated RF | Immunity to Radiated Radio Frequency | International Standard IEC 61000-4-3 | -Level 3:<br>10 V/m (80MHz-2GHz)<br>-Level 2<br>3 V/m (2GHz-6GHz) |
| IEC | Burst | Immunity Electrical Fast Transients (Burst) | International Standard IEC 61000-4-4 | Level 3: 2 kV |
| IEC | Surge | Immunity to Electrical Surges | International Standard IEC 61000-4-5 | Level 3:<br>-Line to line: 1 kV<br>-Line to ground: 2 kV |
| IEC | Conducted RF | Immunity to Conducted Radio Frequency | International Standard IEC 61000-4-6 | Level 3: 10V/m (0.15 - 80 MHz) |
| IEC | Dips | Immunity to Voltage Dips | International Standard IEC 61000-4-11 | -0% for 0.5, 1 cycle, Performance Criteria A<br>-40% for 10/12 cycles, Performance Criteria A<br>-70% for 25/30 cycles, Performance Criteria A<br>-80% for 250/300 cycles, Performance Criteria A |
| IEC | Interruptions | Immunity to Voltage Interruptions | International Standard IEC 61000-4-11 | 0% for 250/300 cycles, Performance Criteria B |

## Environmental Compliance[2]

Products comply to the following environmental standard requirements for electrical products to ensure they are safe for consumers to use.

| - | STANDARD NAME | STANDARD DESCRIPTION | STANDARD NUMBER |
|---|---|---|---|
| RoHS | RoHS | Conformity with the European Restriction of Hazardous Substances in electrical and electronic products | European Directive 2015/863/EU (IEC 63000) |
| REACH | REACH | Conformity with the Registration, Evaluation, Authorization and Restriction of Chemicals regulation to ensure safe use of chemicals | European Directive 1907/2006 |

Notes:

1. All parameters at 25 °C unless otherwise specified.
2. The environmental compliance data reflects the most current information available and adheres to our rigorous standards for quality and sustainability. These specifications are valid from the product's initial release and are subject to change with ongoing improvements.
3. If no heatsink is used then the baseplate has to be exposed to free ambient air.

## Warning Information

**Caution: Material Damage, Electric Shock, and Arc Flash Hazard.** Before installing or working with this product, take the following precautions:

1. **Disconnect all power:** Ensure that all power sources are disconnected.
2. **Verify connections:** Double-check all connections.

Failure to adhere to these instructions may lead to **serious injury or damage** of equipment.