Solid State Relays

SRP1–CC...E

Low EMI Noise Solid-State Relay

Description

The SRP1-CC...E series is a family of low-noise solid-state relays (SSRs) specifically optimized to reduce electromagnetic emissions (RFI), making them ideal for use in electrically noise-sensitive applications. Designed to meet EN 50081-1 standards for electromagnetic compatibility in residential, commercial, and light industrial environments, these relays ensure reliable switching while minimizing interference.

With built-in EMC suppression and high-quality components, the SRP1-CC...E relays are a solid choice for ensuring uninterrupted operation in safety-critical and comfort-sensitive systems.

- EMC-optimized design to reduce radiated and conducted emissions
- Compliant with EN 50081-1 for residential and light industrial EMC requirements
- Suitable for safety-critical environments like medical devices and fuel systems
- Enhances equipment performance in household appliances and information technology systems

Features & Benefits

FEATURES	BENEFITS
EMC-Optimized Circuit Design	Minimizes electromagnetic emissions (RFI), helping prevent disruption in nearby sensitive electronics.
Integrated EMC Suppression Components	Reduces conducted and radiated noise at the source, eliminating the need for external filters.
Clean, Interference-Free Switching	Prevents interference spikes during operation, protecting surrounding equipment and ensuring stable performance.

Applications

- Medical equipment
- Fueling systems and vehicle power control
- Household appliances
- IT equipment and consumer electronics
- Commercial systems requiring reduced EMC emission
- Electrical box disconnect applications in regulated environments

Ordering Information

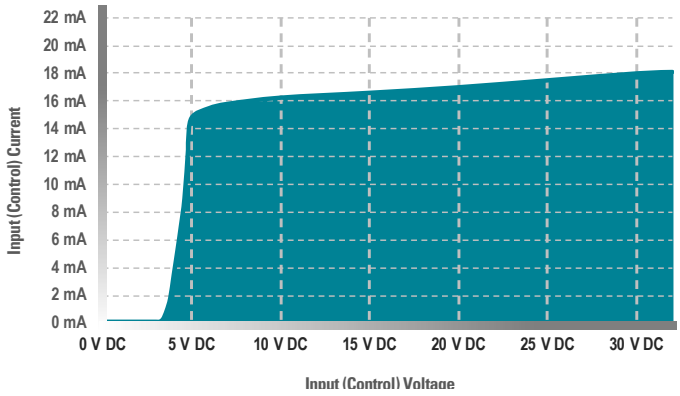
FOR HEATING CONTROL						
CATALOG #	OUTPUT MAX CURRENT	OUTPUT VOLTAGE	OUTPUT SWITCHING STYLE	OUTPUT OVERVOLTAGE PROTECTION	INPUT VOLTAGE RANGE	COMPLIANCE
SRP1-CCDZL-025TC-E	25A	240 V AC	Zero Cross	TVS[3]	6-32 V DC	cЯUus, CE, VDE
SRP1-CCDZM-050TC-E	50A	480 V AC	Zero Cross	TVS[3]	6-32 V DC	cЯUus, CE, VDE

Input/Control Specifications[1]

GENERAL DATA						
SYMBOL	PARAMETER	CONDITION	RANGE	VALUE FOR 25A VERSION	VALUE FOR 50A VERSION	UNIT
Uc	Input (Control) Voltage	-	Maximum	32	32	V DC
			Nominal	5 – 12 – 24	5 – 12 – 24	V DC
			Minimum	6	6	V DC
Urv	Reverse Voltage	-	Maximum	-32	-32	V DC
Uc on	Turn-On Voltage (Pick-up/Engage/Activation Voltage)	-	Minimum	4	4	V DC
Uc off	Turn-Off Voltage (Drop Out/Release/Deactivation Voltage)	-	Nominal	3	3	V DC
Ic	Input (Control) Current	-	Maximum	20	20	mA
			Minimum	16	16	mA
-	Input Impedance	-	Nominal	Current Regulated	Current Regulated	-
Ton	Turn-On Time	At nominal input voltage and f=50Hz	Maximum	20	20	ms
Toff	Turn-Off Time	At nominal input voltage and f=50Hz	Maximum	20	20	ms

Input Current vs Input Voltage Graphs (for power supply selection)
To ensure the Solid-State Relay (SSR) operates efficiently and reliably, it is essential to understand the relationship between input voltage and input current. The following input current graphs provide detailed information on the current consumption of our SSRs across the specified input voltage range (6-32 VDC). This data is crucial for selecting an appropriate power supply and ensuring the relay functions within its safe operating limits. Proper understanding of current consumption is vital for the optimal performance of your application.

6-32 VDC



Output/Load Specifications[1]

GENERAL DATA

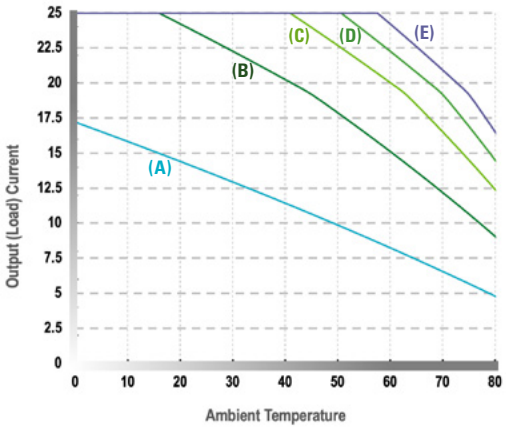
SYMBOL	PARAMETER	CONDITION	RANGE	VALUE FOR 25A VERSIONS	VALUE FOR 50A VERSIONS	UNIT
-	Output Configuration	-	-	SPST-NO	SPST-NO	-
f	Operating Frequency	-	Minimum	40	40	Hz
			Nominal	50 / 60	50 / 60	
			Maximum	70	70	
Ue	Operating Voltage	47-63Hz	Minimum	260	480	Vrms
			Nominal	120 - 240	400 - 460 - 480	
			Maximum	40	50	
Uclamp	Clamping Voltage (TVS Overvoltage Protection Self-trigger)	-	Maximum	450	800	Vpk
			Minimum			Vpk
Usync	Zero Cross Level (Zero Voltage Turn-on)	-	Maximum	40	50	V
Ua	Latching Voltage	At Ue Nominal	Minimum	2	2	V
V	On-State Voltage Drop	At Rated Current	Maximum	0.9 + 0.012 x Ie	0.9 + 0.012 x Ie	Vrms
Vto	Threshold Voltage (Power Loss Calculations only)	Tvj = 150 °C	Maximum	0.9	0.9	V
rt	On state dynamic resistance (Power Loss Calculations only)	Tvj = 150 °C	Maximum	12.0	12.0	mΩ
Up	Transient Over-Voltage[2] (Peak/Blocking/Non-Repetitive Voltage)	-	Maximum	600	1,200	Vpk
Itsm	Transient Over-Current (Surge/Overload/Non-Repetitive Current)	"Max 1 Cycle Tp = 10ms"	Minimum	320	700	Apk
			Nominal	380	750	
Ilk	Leakage Current (Off-State)	At Rated Voltage	Maximum	3	3	mArms
dv/dt	Critical dV/dt (Off-State)	At Maximum Rated Voltage	Minimum	500	500	V/µsec
di/dt	Non-repetitive di/dt	-	Maximum	50	50	A/µsec
I^2t	I^2t Value for Fusing	½ Cycle at 50/60Hz (Tvj=45 °C)	Minimum	510	2,450	A^2 sec
			Nominal	720	2,800	
Pf	Minimum Power Factor	At Maximum Load	Minimum	0.8	0.8	-
Pd	Power Dissipation	At Rated Current	Maximum	0.81 x Ie + 0.012 x Ie^2	0.81 x Ie + 0.012 x Ie^2	W
Rthj/c	Thermal Resistance Junction to Case (Rjc)	-	Maximum	0.70	0.45	°C/W

The maximum continuous current value given in this datasheet is only for resistive loads (specifically AC-1 type), which are mainly used for heating control.

SYMBOL	PARAMETER	CONDITION	RANGE	VALUE FOR 25A VERSIONS	VALUE FOR 50A VERSIONS	UNIT
Ie (AC-51)	Load Current (Continuous) – Heating Elements (AC-1)	At 40 °C	Maximum[3]	25	50	Arms
			Minimum	0.1	0.1	Arms

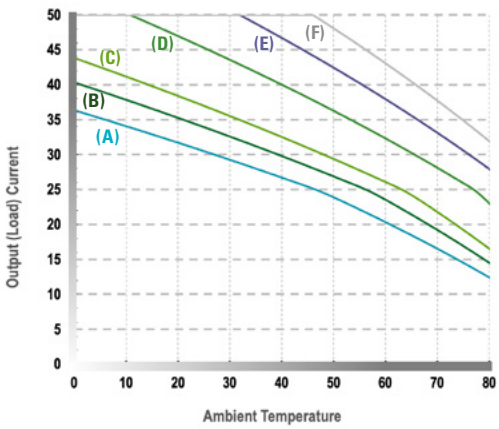
Thermal Derating Curves (for heatsink selection)
To operate the Solid-State Relay (SSR) at its specified ratings, the use of a heatsink is mandatory. The following thermal derating curves illustrate the maximum load current that our SSRs can manage under varying ambient temperatures and heatsink sizes.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

25A VERSION



(A) 6 °C/W: Heatsink (C) 2.1 °C/W: Heatsink (E) 1,5 °C/W: Heatsink
(B) 3°C/W: Heatsink (D) 1.75 °C/W: Heatsink

50A VERSION



(A) 2.1 °C/W: Heatsink (C) 1.5 °C/W: Heatsink (E) 0.7 °C/W: Heatsink
(B) 1.75 °C/W: Heatsink (D) 1.0 °C/W: Heatsink (F) 0.5 °C/W: Heatsink

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.

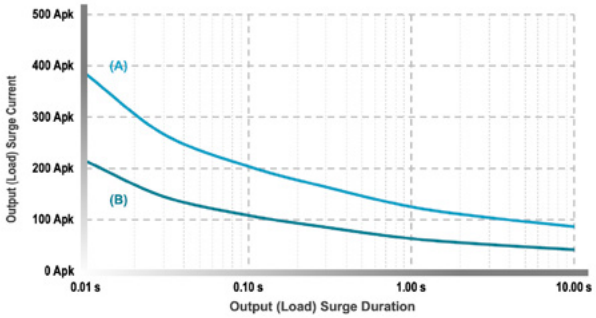
So, when selecting an SSR, consider using one with a capacity approximately 1.4 times that of the heater or operating the SSR at only 75%-80% of its maximum capacity. The following table provides guidance for choosing the right SSR for a specific heater load.

NOMINAL SSR CURRENT RATING	MAXIMUM RECOMMENDED HEATER CURRENT	HEATER POWER AT 120 VAC	HEATER POWER AT 240 VAC	HEATER POWER AT 400 VAC	HEATER POWER AT 480 VAC	HEATER POWER AT 600 VAC
25 A	20 A	2.4 KW	4.8 KW	8.0 KW	9.6 KW	12.0 KW
50 A	40 A	4.8 KW	9.6 KW	16.0 KW	19.2 KW	24.0 KW

Output Surge Current Withstand Graphs (for transient protection)
To ensure the Solid-State Relay (SSR) can handle sudden increases in current without damage, it is essential to understand its surge current capacity. The following surge current graphs illustrate the maximum surge current that our SSRs can withstand over various durations. This information is crucial for selecting an SSR that can endure transient overcurrent events, ensuring the reliability and safety of your electrical system. Proper understanding of surge current capacity helps in preventing equipment failure and maintaining optimal performance in your application.

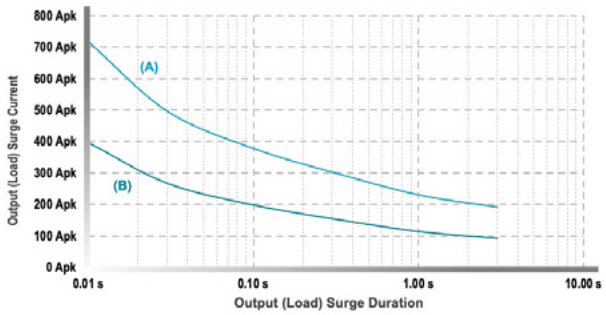
The graphs include a Single Pulse Surge Current curve used to define the protection offered by fuses, helping in the selection of appropriate protective devices. Additionally, is important to ensure that the Repetitive Surge Current curve is not exceeded during normal operation, as frequent overload currents can decrease the life expectancy of the SSR. Therefore, caution is advised to maintain the longevity and reliability of the SSR.

25A VERSION



(A) Single Pulse Surge: Initial SSR internal temperature at **25°C** (cooler state from minimal or no operation).
(B) Repetitive Surges: Initial SSR internal temperature **90°C** (warmer state from continuous operation).

50A VERSION



(A) Single Pulse Surge: Initial SSR internal temperature at **25°C** (cooler state from minimal or no operation).
(B) Repetitive Surges: Initial SSR internal temperature **121°C** (warmer state from continuous operation).

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 to Output (50/60 HZ)	Nominal	4,000	Vrms
		Input/Output to Ground (50/60 HZ)	Nominal	4,000	
Ri	Insulation Resistance	@ 500 V DC	Minimum	1	GΩ
-	Coupling Capacitance	Input / Output	Maximum	8	pF
Uimp	Impulse Withstand Voltage	-	Nominal	4,000	Vrms
-	Short Circuit Current Rating (SCCR)	-	-	5	kA
-	Endurance according to American Standard UL508		Typical	6,000	Cycles
-	MTTFd (Mean Time to Dangerous Failure) (Calculated in accordance with the guidelines for safety-related parts of control systems, as specified by the international standard ISO 13849-1)	-	-	52	Years
-	MTBF[8] (Mean Time Between Failures) (Calculated in accordance with the Military Handbook Guidelines for Reliability Prediction of Electronic Equipment, as specified by the US Department of Defense Standard MIL-HDBK-217)	@ 40°C ambient	-	32	Years
		@ 60°C ambient	-	21	

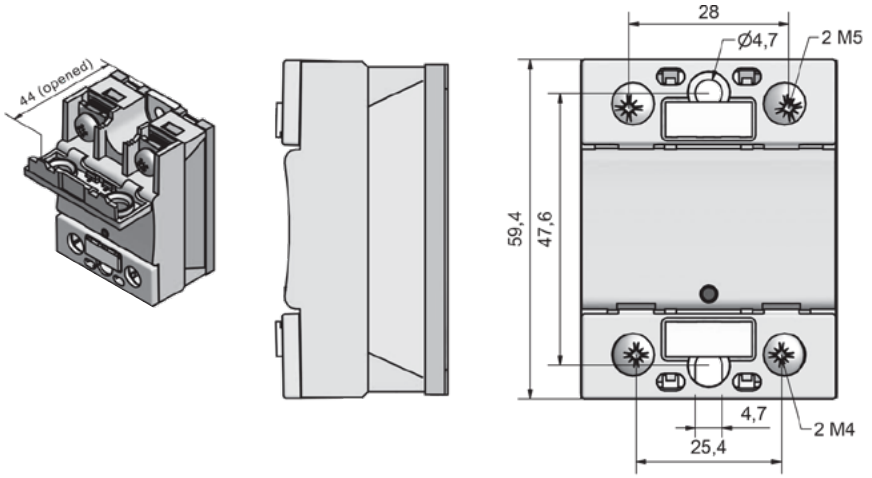
ENVIRONMENTAL DATA

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	30, 40, 50	g
-	Ambient Temperature - Operating (Working)[5]	No icing, no condensation	Maximum	100 (212)	°C (°F)
			Minimum	-40 (-40)*	°C (°F)
-	Ambient Temperature - Storage	No icing, no condensation	Maximum	125 (257)	°C (°F)
			Minimum	-40 (-40)*	°C (°F)
HR	Relative Ambient Humidity (Per international standard *IEC/EN 60068-2-78*)	Non-condensing @ 40 °C	Nominal	40 to 85	%
-	Pollution Degree	Non-conductive pollution with condensation possibilities	Nominal	2	

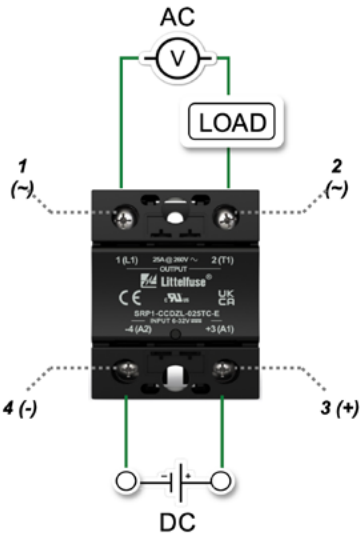
MECHANICAL DATA

SYMBOL	PARAMETER	CONDITION	RANGE	VALUE	UNIT
-	Product Weight	-	Typical	65 (0.14)	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*)			IP20	
-	Screw Torque Range	Input (Control) Terminals	Minimum	1.2 (11)	Nm (in-lb)
			Maximum	2.0 (18)	
		Output (Load) Terminals	Minimum	2 (18)	Nm (in-lb)
			Maximum	3 (26)	
		SSR Mounting	Minimum	1.2 (11)	Nm (in-lb)
			Maximum	1.8 (16)	
-	Screw Thread Size	Input Terminals	-	M4 x 0.7	-
		Output Terminals	-	M5 x 0.8	-
		SSR Mounting	-	M4 x 12mm or #8-32 Pan Head	-

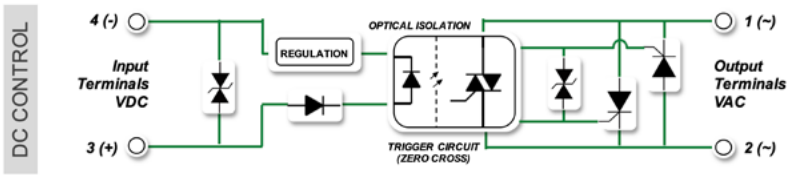
Product Dimensions (Milimeters)



Wiring Diagram



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:

- Fuse Selection: The I^2t value (energy withstand capability) of the fuse should be less than half of the I^2t 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 ЯUs No. E183688	cЯUus	North American certificate of compliance with the Safety requirements for Industrial Control Equipment	**UL508** American Standard of Safety for Industrial Control Equipment. **CAN/CSA C22.2 No.14-18** 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** EU Directive of Safety for Low Voltage Gear Equipment. In accordance with the Low Voltage Gear Testing Guidelines of the International Standard IEC 60947-4-3 **EMC Directive 2014/30/EU** EU Directive of Electromagnetic Compatibility. In accordance with the Low Voltage Gear Testing Guidelines of the International Standard IEC 60947-4-3 **RoHS Directive 2015/863/EU** EU Directive of Hazardous Substances Restriction. 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
UK CA	UKCA	Conformity with the UK product safety regulations	**SI 1101** UK Regulations of Safety for Electrical Equipment. In accordance with the Low Voltage Gear Testing Guidelines of the International Standard IEC 60947-4-3 **SI 1091** EU Directive of Electromagnetic Compatibility. In accordance with the Low Voltage Gear Testing Guidelines of the International Standard IEC 60947-4-3 **SI 3032** EU Directive of Hazardous Substances Restriction. 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: 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 -Contact Discharge: 6 kV -Air Discharge: 8 kV
IEC	Radiated RF	Immunity to Radiated Radio Frequency	International Standard IEC 61000-4-3	-Level 3: 10 V/m (80MHz-2GHz) -Level 2 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: -Line to line: 1 kV -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 -40% for 10/12 cycles, Performance Criteria A -70% for 25/30 cycles, Performance Criteria A -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

The SRP1-CC...E series is specifically designed to minimize electromagnetic emissions, making it suitable for use in residential, commercial, and light industrial environments. Thanks to its EMC-optimized design, these relays typically do not require additional external filtering to meet EN 50081-1 standards. However, for best results, ensure that the overall system installation continues to follow good EMC practices aligned with the application requirements.

Environmental Compliance[4]

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
WEEE	WEEE	Conformity with the Waste Electrical and Electronic Equipment regulation to ensure proper disposal and recycling of e-waste	Regulation 2002/96/EC

Notes:
1. All parameters at 25 °C unless otherwise specified.
2. CE declared up to 480 V.
3. TVS protected output will self-trigger between 900-1200 Vpk.
4. 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.
5. AC input option minimum operating temperature is -40 (-40).

Accessories

IMAGE	CATALOG #	TYPE	DESCRIPTION
	SADH-C1N600	DIN Rail Adapter	Allows SSR to be mounted on a 35 mm DIN type rail. It has a 6ºC/W Thermal Resistance
	C103PM	DIN Rail	35 mm aluminum DIN rail available in a 36 in. (91.4 cm) length.
	SADH-NN210	Heatsink	2.1ºC/W Thermal Resistance
	SADH-NN175	Heatsink	1.75ºC/W Thermal Resistance
	SADH-NN120	Heatsink	1.2ºC/W Thermal Resistance
	SADH-NN100	Heatsink	1.0ºC/W Thermal Resistance
	SADH-NN050	Heatsink	0.5ºC/W Thermal Resistance
	SADH-ND030	Heatsink	0.3ºC/W Thermal Resistance, 24 VDC
	SADH-NA030	Heatsink	0.3ºC/W Thermal Resistance, 230 VAC
	SANT-C1NM40	Mounting Screws	Screw Kit for heatsink mounting
	SANP-C1N030	Thermal Interface	Thermal Pad (Usable for 1 relay)
	SANG-CNN090	Thermal Interface	Heat Sink Thermal Paste 20 ml (Usable for 60+ relays)
	P0200-20	Thermal Interface	Heat Sink Compound 100 grams (Usable for 50+ relays)
	P0200-19	Thermal Interface	Heat Sink Compound 2 grams (Usable for 1 relay)

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.