SHCDC

DC Switching Solid State Relays

Description

The **SHCDC** is a DC output Industrial Solid-State Relay ideal for applications where fast switching response times are critical. It is well-suited for applications requiring a high number of switching cycles, as its lifetime is not affected by frequent switching. It can be mounted on a panel or heatsink and is controlled by a DC voltage ranging from 4 to 32 V and includes an LED status output to indicate the presence of control voltage on the SSR.

Applications

- DC heaters
- Solenoid valves
- Test equipment
- Battery Charging Stations
- DC Motor Control
- Lighting Control
- Telecommunications
- Industrial Automation

Main Features

- Low power dissipation output MOSFET
- 100 ADC maximum output current up to 60 VDC
- 50 ADC maximum output current up to 200 VDC
- 10 ADC maximum output current up to 500 VDC
- Switching frequency up to 1000 Hz
- 4-32 VDC control voltage range
- LED for control presence indication
- Clip-on IP 20 protection cover
- Self-lifting terminals
- Housing free of moulding mass
- 3750 Vrms isolation between input and output
- Fast response times to switch ON and OFF

Part Numbering System

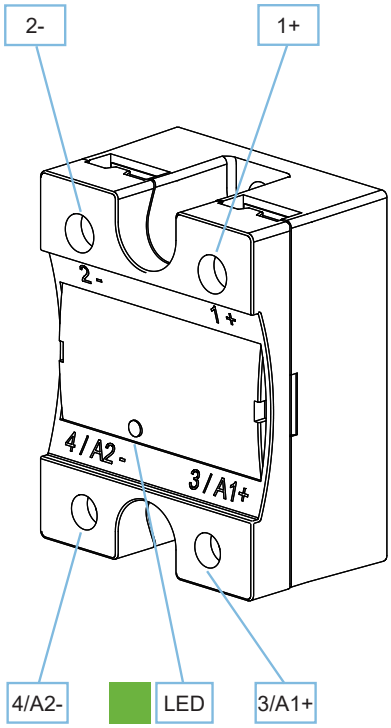
Code	Option	Description	Notes
SHC-DC-		Product Series	
-	06	Operational Voltage Range: 1-60 VDC	
	20	Operational Voltage Range: 1-200 VDC	
	50	Operational Voltage Range: 1-500 VDC	
DC	-	Control voltage: 4-32 VDC	*4.5-32VDC for SHC20DC.. models
-	10	10A Rated Load Current	
	20	20A Rated Load Current	
	50	50A Rated Load Current	
	100	100A Rated Load Current	

Example: **SHC** **06** **DC** **100**

- **SHC** — Series
- **06** — Operational Voltage Range
- **DC** — Control Voltage
- **100** — Rated Load Current

Structure

Element	Component	Function
1+	Power connection	Load connection or positive supply connection
2-	Power connection	Load connection or ground supply connection
3/A1+	Control connection	Control supply signal
4/A2-	Control connection	Ground connection for control
LED	Control indication	Indicates presence of control voltage



Dimensions

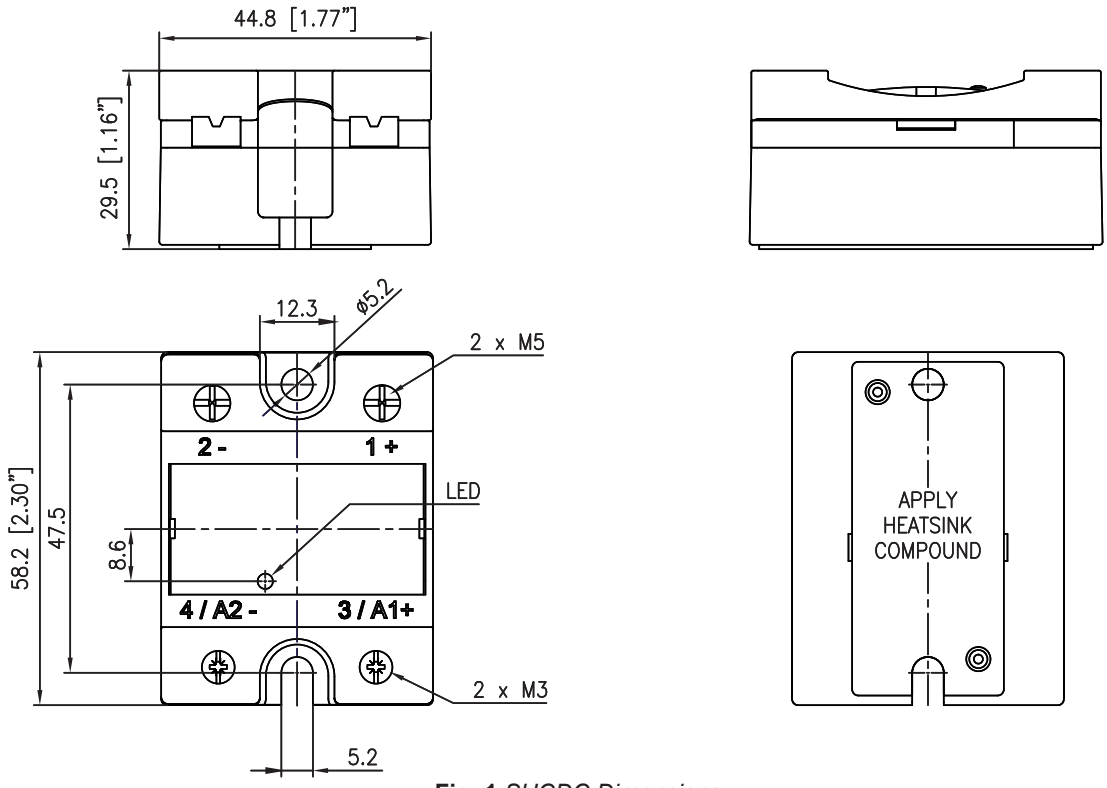


Fig. 1 *SHCDC Dimensions*

Dimensions in mm unless otherwise noted

General Specifications

Housing material	Noryl, black
Mounting	Panel mount
Touch protection	IP20
Isolation	Input and output to case: 3750 Vrms Input to output: 3750 Vrms
Weight	approx. 83 g
LED indication	Continuously ON green LED when control input is applied

Specifications are at a surrounding temperature of 25°C unless otherwise specified.

Input Specifications

	SHC06DC..	**SHC20DC.. SHC50DC..**
Control Voltage Range	4-32 VDC	4.5-32 VDC
Pick-Up Voltage[1]	4 VDC	4.5 VDC
Drop-Out Voltage	1.2 VDC	
Maximum Reverse Voltage	32 VDC	
Maximum Switching Frequency[2]	1000 Hz	
Response Time Pickup @ V_{out} = 24 VDC, t_{on}[3]	≤100 µs	
Response Time Drop-Out, t_{off}[3]	≤100 µs	≤150 µs
Input Current @ 40°C	<16 mADC	

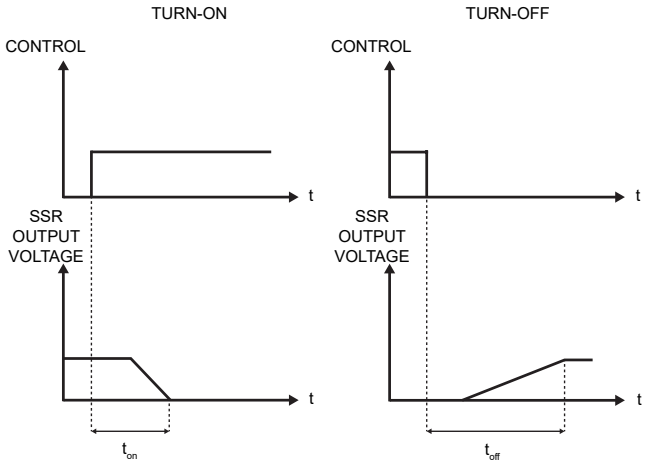


Fig. 2 *Response Time Characteristics*

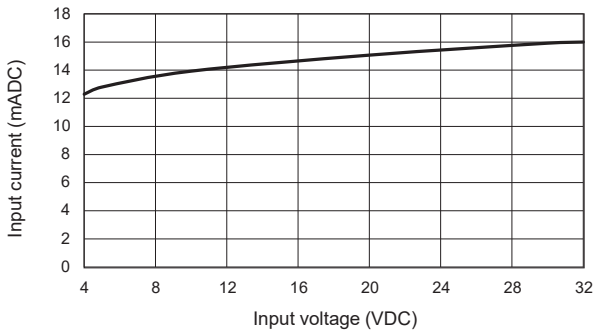


Fig. 3 *Input Voltage vs. Input Current Curve*

1: Pick-up voltage increases to 5.5 VDC at operating temperatures lower than -20°C
2: Output current has to be derated at high switching frequencies. Refer to the Current derating vs. switching frequency section
3: Response times will be longer for lower output voltages (<24 VDC)

Output Specifications

	SHC06DC	SHC20DC		SHC50DC
Max. Operational Current: DC 1 Rating	100 A	20 A	50 A	10A
Absolute Max. Output voltage	60 VDC	200 VDC		500 VDC
Operational Voltage Range, Ue	1-60 VDC	1-200 VDC	1-200 VDC (150 VDC*)	1-500 VDC
Output Protection	Integrated transil			
Leakage Current @ Rated Voltage	0.1 mADC			
Minimum Operational Current	5 mADC			
Repetitive Overload Current UL508: T_{AMB}=40˚C, t_{ON}=1 s, t_{OFF}=9 s, 50 cycles	150 A	30 A	75 A	15A

* Please refer to note found in the Connection diagrams section

Current Derating vs. Switching Frequency

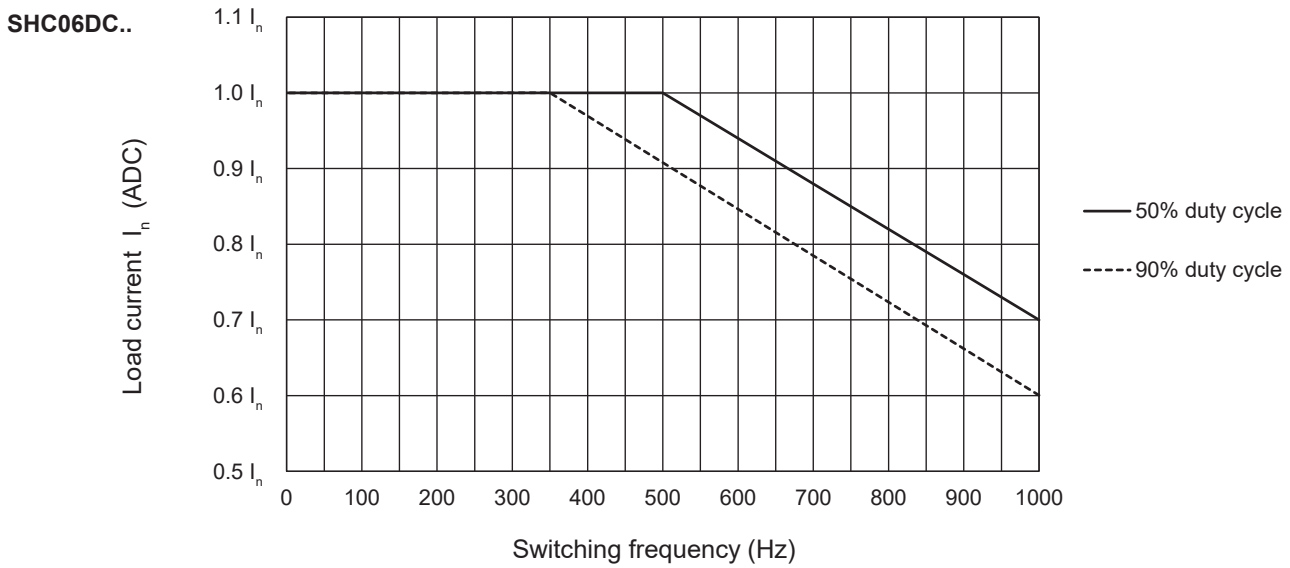


Fig. 4 *Current Derating vs. Switching Frequency*

SHC20DC..

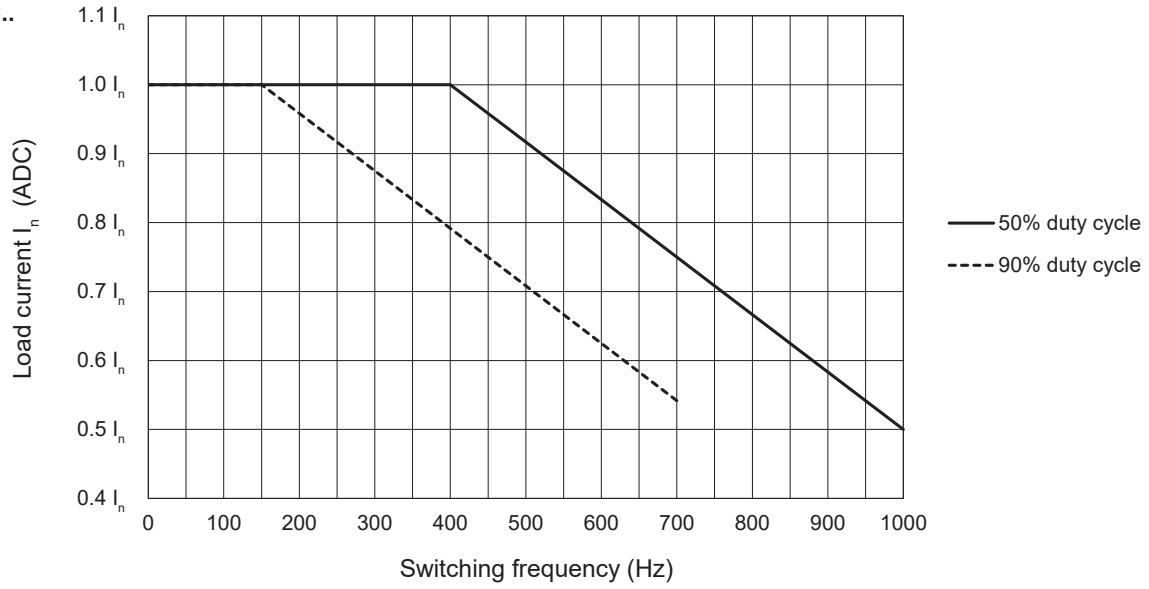


Fig. 5 *Current Derating vs. Switching Frequency*[4]

SHC50DC..

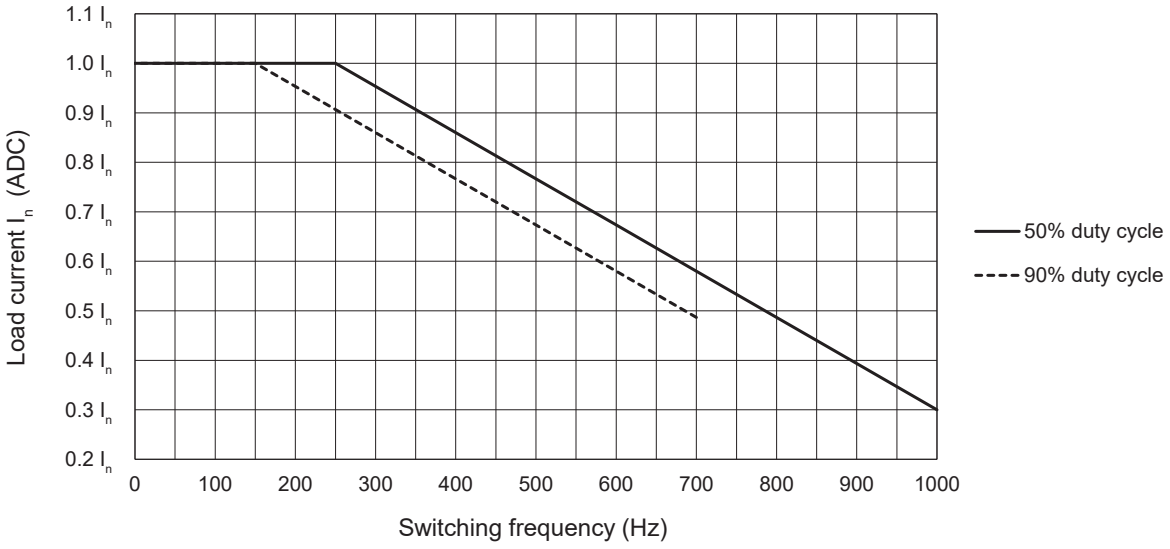


Fig. 6 *Current derating vs. switching frequency*[4]

4. At 90% duty cycle, the switching frequency for the SHC20DC.. and SHC50DC.. is limited to 700 Hz. This limitation is related to the response time drop out of 150 µs for these models. For example:
   - OFF time at a switching frequency of 800Hz with 90% duty cycle is 125 µs, that is lower than the time needed for the SSR to switch OFF (150 µs) so the SSR output would not switch OFF
   - OFF time at a switching frequency of 600Hz with 90% duty cycle is 167 µs which is greater than the time needed for the SSR to switch OFF (150 µs)

Output Power Dissipation

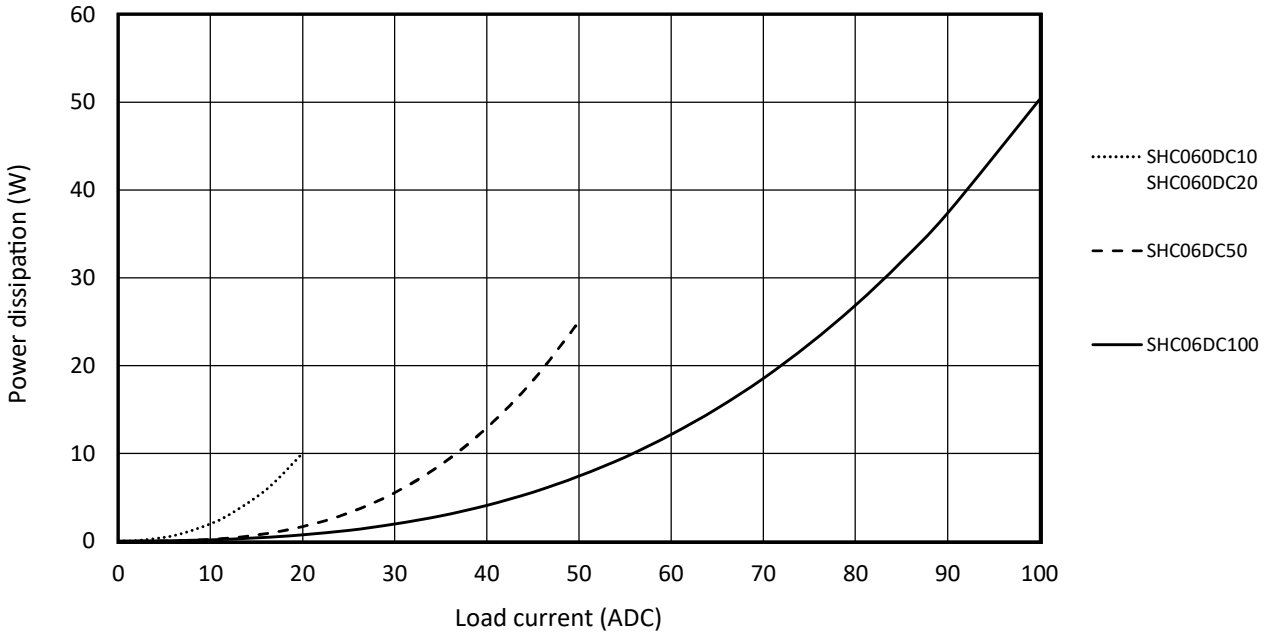


Fig. 7 *Output power dissipation graph*

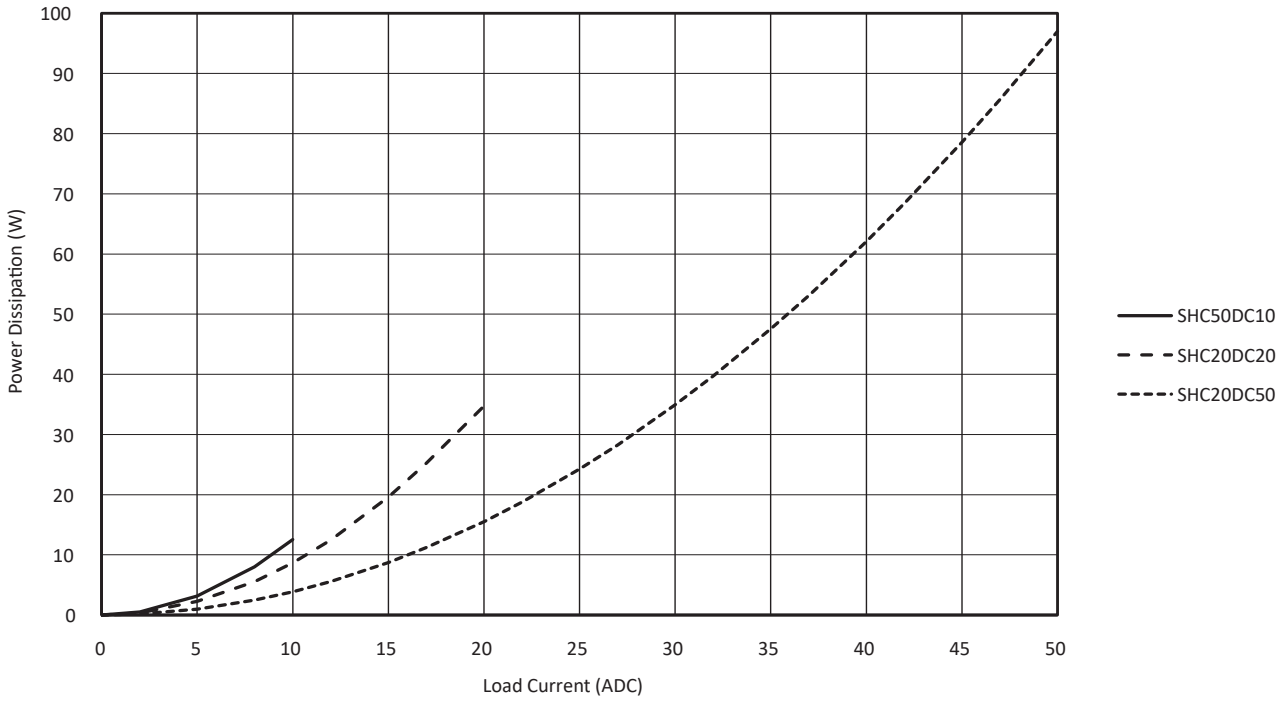


Fig. 8 *Output power dissipation graph*

Heatsink Selection

Note: The heatsink selection in tables below is valid only when a fine layer of silicon based thermal paste (with a similar thermal resistance to that specified for R_{thcs} in the Thermal data section) is utilized. The SSR will overheat if this heatsink selection is used for heatsink assemblies using a thermal interface material having a higher R_{thcs} than indicated in the Thermal data section.

Thermal resistance (°C/W) of SHC06DC100

	Surrounding Ambient Temperature (°C)						
Load current (A)	**20**	**30**	**40**	**50**	**60**	**70**	**80**
100	1.8	1.4	1.1	0.73	0.4	-	-
90	2.4	1.9	1.5	1.0	0.6	0.21	-
80	3.3	2.7	2.0	1.4	0.88	0.37	-
70	4.8	3.8	2.9	2.1	1.3	0.61	-
60	7.6	5.9	4.4	3.1	2.0	0.98	-
50	14.0	10.2	7.4	5.1	3.2	1.6	0.27
40	nh	nh	15.5	9.9	5.9	2.9	0.64
30	nh	nh	nh	nh	14.2	6.3	1.5
20	nh	nh	nh	nh	nh	nh	4.2
10	nh	nh	nh	nh	nh	nh	nh

Thermal resistance (°C/W) of SHC20DC20

	Surrounding Ambient Temperature (°C)						
Load current (A)	**20**	**30**	**40**	**50**	**60**	**70**	**80**
20	3.4	2.8	2.2	1.7	1.2	0.71	0.27
18	4.8	3.9	3.1	2.4	1.7	1.1	0.53
16	7.1	5.7	4.5	3.4	2.5	1.7	0.91
14	11.5	9.0	6.9	5.2	3.8	2.6	1.5
12	nh	16.1	11.7	8.5	6.1	4.1	2.4
10	nh	nh	nh	16.3	10.6	6.7	3.9
8	nh	nh	nh	nh	nh	13.5	7.0
6	nh	nh	nh	nh	nh	nh	17.5
4	nh	nh	nh	nh	nh	nh	nh
2	nh	nh	nh	nh	nh	nh	nh

Thermal resistance (°C/W) of SHC20DC50

	Surrounding Ambient Temperature (°C)						
Load current (A)	**20**	**30**	**40**	**50**	**60**	**70**	**80**
50	1.1	1.0	0.79	0.60	0.42	0.24	-
45	1.6	1.4	1.1	0.86	0.62	0.39	0.17
40	2.3	1.9	1.6	1.2	0.92	0.62	0.33
35	3.4	2.8	2.3	1.8	1.4	1.0	0.55
30	5.3	4.4	3.5	2.8	2.1	1.5	0.92
25	9.3	7.5	5.9	4.6	3.4	2.4	1.5
20	nh	16.5	11.9	8.7	6.2	4.2	2.5
15	nh	nh	nh	nh	15.6	9.2	5.1
10	nh	nh	nh	nh	nh	nh	17.5
5	nh	nh	nh	nh	nh	nh	nh

Note: 'nh' means no heatsink necessary. The SSR should still be tightened to a surface to ensure optimal thermal dissipation.

Thermal resistance (°C/W) of SHC06DC10, SHC06DC20

	Surrounding Ambient Temperature (°C)						
Load current (A)	**20**	**30**	**40**	**50**	**60**	**70**	**80**
20	nh	14.0	9.7	6.4	3.8	1.8	-
18	nh	nh	14.0	8.9	5.2	2.5	0.25
16	nh	nh	nh	13.3	7.5	3.5	0.51
14	nh	nh	nh	nh	11.4	5.1	0.92
12	nh	nh	nh	nh	nh	8.0	1.6
10	nh	nh	nh	nh	nh	14.3	2.7
8	nh	nh	nh	nh	nh	nh	5.0
6	nh	nh	nh	nh	nh	nh	11.5
4	nh	nh	nh	nh	nh	nh	nh
2	nh	nh	nh	nh	nh	nh	nh

Thermal resistance (°C/W) of SHC06DC50

	Surrounding Ambient Temperature (°C)						
Load current (A)	**20**	**30**	**40**	**50**	**60**	**70**	**80**
50	4.3	3.3	2.4	1.6	0.9	0.22	-
45	6.0	4.6	3.4	2.3	1.3	0.47	-
40	8.8	6.7	4.9	3.3	2.0	0.82	-
35	14.3	10.3	7.4	5.0	3.0	1.3	-
30	nh	18.7	12.3	8.0	4.7	2.2	0.18
25	nh	nh	nh	14.8	8.2	3.8	0.59
20	nh	nh	nh	nh	17.5	7.2	1.4
15	nh	nh	nh	nh	nh	18.5	3.2
10	nh	nh	nh	nh	nh	nh	10.3
5	nh	nh	nh	nh	nh	nh	nh

Note: 'nh' means no heatsink necessary. The SSR should still be tightened to a surface to ensure optimal thermal dissipation.

Thermal Data

	SHC06DC10 SHC06DC20 SHC06DC50	SHC06DC100	SHC20DC20	SHC20DC50	SHC50DC10
Max. Junction Temperature	175°C	175°C	150°C	150°C	150°C
Junction to Case Thermal Resistance, R_{thjc}	1.2°C/W	0.6°C/W	0.9°C/W	0.45°C/W	1.5°C/W
Case to Heatsink Thermal Resistance, R_{thcs} [5]	0.2°C/W	0.2°C/W	0.1°C/W	0.1°C/W	0.2°C/W

5: Thermal resistance case to heatsink values are applicable upon application of a fine layer of silicon based thermal paste from Electrolube between SSR and heatsink.

Environmental Specifications

Operating Temperature	-20°C to 80°C (-4°F to 176°F)
Storage Temperature	-40°C to +100°C (-40°F to +212°F)
Relative Humidity	95% non-condensing @ 40°C
Pollution degree	2
Installation Altitude	0-1000 m. Above 1000 m derate linearly by 1% of FLC per 100 m up to a maximum of 2000 m
Vibration Resistance	2g / axis
EU RoHS Compliant	Yes
China RoHS	

The declaration in this section is prepared in compliance with People's Republic of China Electronic Industry Standard SJ/T11364-2014: Marking for the Restricted Use of Hazardous Substances in Electronic and Electrical Products.

Part Name	**Toxic or Harardous Substances and Elements**					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
Power Unit Assembly	x	O	O	O	O	O

O: Indicates that said hazardous substance contained in homogeneous materials for this part are below the limit requirement of GB/T 26572.

X: Indicates that said hazardous substance contained in one of the homogeneous materials used for this part is above the limit requirement of GB/T 26572.

Short Circuit Protection

Part No.	**Prospective Short Circuit Current (kArms)**	**Ferraz Shawmut (Mersen)**			**Siba**		
		Max Fuse Size (A)	**Part Number**	**Voltage Rating (VDC)**	**Max Fuse Size (A)**	**Part Number**	**Voltage Rating (VDC)**
SHC06DC100	5	125	A4J125	300	125	5019006.125	440
SHC20DC20		25	HSJ25	500	25	5019006.25	660
SHC20DC50		70	HSJ70		63	5019006.63	

Compatibility and Conformance

Approvals	
Standard Compliance	LVD: EN 60947-1 EMCD: EN 61000-6-2, EN 61000-6-3 EE: EN 60947-1 EMC: EN 61000-6-2, EN 61000-6-3 cURus: UL508 Recognized (E128555), NRNT2, NRNT8 CSA: C22.2 No. 14
UL Short Circuit Current Rating	5 kArms

Electromagnetic Compatibility (EMC) - Immunity	
Electrostatic Discharge (ESD)	EN/IEC 61000-4-2 8 kV air discharge, 4 kV contact (PC2)
Radiated Radio Frequency	EN/IEC 61000-4-3 10 V/m, from 80 MHz to 1 GHz (PC1) 10 V/m, from 1 GHz to 2.7 GHz (PC1)
Electrical Fast Transient (burst)	EN/IEC 61000-4-4 Output 5 kHz, 100 kHz: 2 kV (PC2) Input 5 kHz, 100 kHz: 1 kV (PC2)
Conducted Radio Frequency	EN/IEC 61000-4-6 10 V/m, from 0.15 to 80 MHz (PC1)
Electrical Surge	EN/IEC 61000-4-5 Output, line to line: 1 kV (PC2) Output, line to earth: 1 kV (PC2) Input, line to earth: 1 kV (PC2)
Voltage Dips	EN/IEC 61000-4-11 0% for 10, 20, 5000 ms (PC2) 40% for 200 ms (PC2) 70% for 500 ms (PC2) 80% for 5000 ms (PC2)
Voltage Dips, Short Interruptions and Voltage Variations	EN/IEC 61000-4-29 0% for 1, 3, 10, 30, 100, 300, 1000 ms (PC2) 30% for 10, 30, 100, 300, 1000 ms (PC2) 40% for 10, 30, 100, 300, 1000 ms (PC2) 60% for 10, 30, 100, 300, 1000 ms (PC2) 70% for 10, 30, 100, 300, 1000 ms (PC2) 80% on min. 19.2 VDC for 10, 30, 100, 300, 1000, 3000, 10000 ms (PC2) 120% on min. 29.8 VDC for 10, 30, 100, 300, 1000, 3000, 10000 ms (PC2)

Electromagnetic compatibility (EMC) - Emissions	
Radio Interference Field Emission (Radiated)	EN/IEC 55011 Class B: from 0.15 to 30 MHz
Radio Interference Voltage Emissions (Conducted)	EN/IEC 55011 Class B: from 30 MHz to 1 GHz

Note:

Control input lines must be installed together (i.e. a 2 core cable) to maintain products' susceptability to Radio Frequency interference

- Performance Criteria 1 (PC1): No degradation of performance or loss of function is allowed when the product is operated as intended.
- Performance Criteria 2 (PC2): During the test, degradation of performance or partial loss of function is allowed. However when the test is complete the product should return operating as intended by itself.

Connection Diagrams

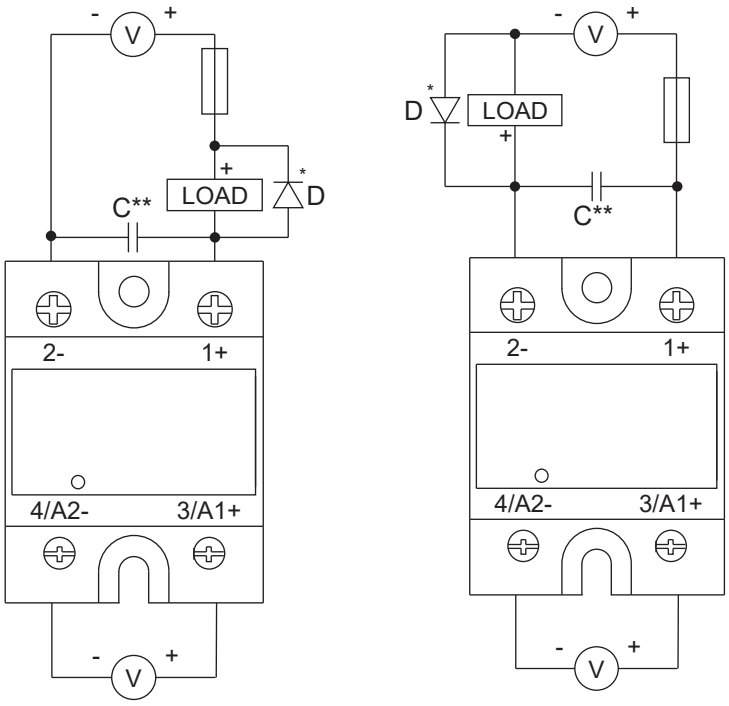


Fig. 8 *SHCDC connection diagrams*

* A suppressor diode D is required for inductive loads.

** Applicable only to SHC20DC

The wiring cables in a DC system act as an inductor and upon switching of the load, voltage transients exceeding the max. SSR voltage may result, leading to SSR damage. The SHCDC output is protected with an internal transil, however, this internal component is not intended for repetitive operation as may happen in situations with repetitive voltage transients (for example with high switching frequencies). The internal transil will fail prematurely. Hence, for the **SHC20DC** models, when used at switching frequencies >1Hz it is strongly recommended to connect capacitor C across the SSR output as shown in Fig. 8 to protect the SSR output from damages resulting from uncontrolled transients.

Capacitor C is not necessary (even at high switching frequencies) if the voltage transients can be controlled and cannot exceed the absolute maximum voltage rating of the SSR.

CAUTION!
Specifically for the **SHC20DC20**, if C is required due to high switching frequencies as explained above, the absolute maximum output voltage of the SSR shall be limited to 150 VDC.

Functional Diagrams

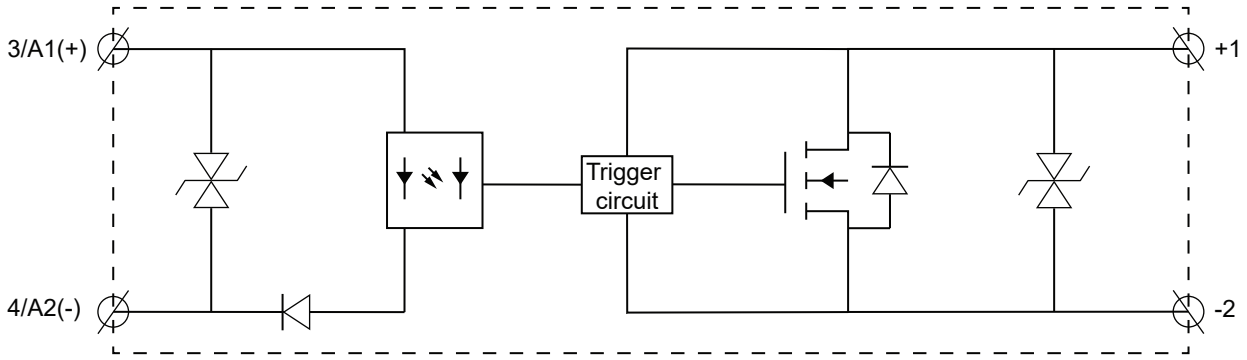


Fig. 9 *SHCDC series Functional Diagram*

Installation

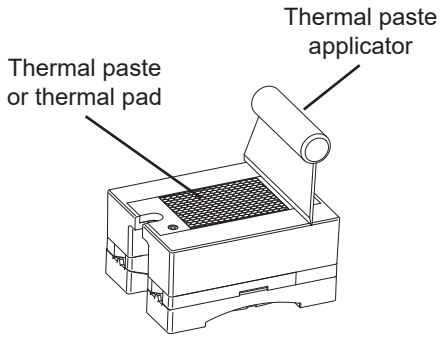


Fig. 10 A fine layer of thermally conductive silicone paste shall be evenly distributed to the base of the SSR before mounting on a heat dissipator. Alternatively a thermal pad may be used. The thermal interface material affects the thermal performance. Make sure that the heatsink is sized properly.

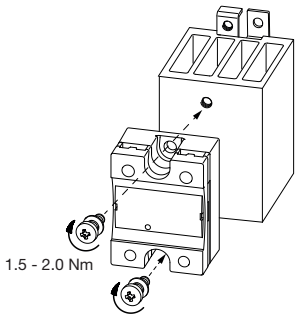


Fig. 11 Tighten screws alternately to 0.5 Nm and then continue to max. 2.0 Nm.

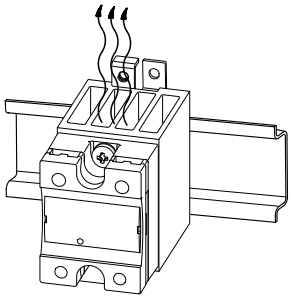
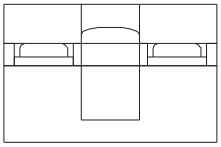
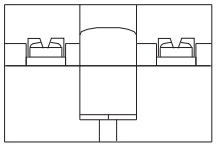
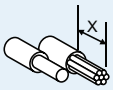


Fig. 12 Mount heatsink with fins in the vertical orientation to guarantee the best possible airflow through the heatsink.

Connection Specifications

	1+, 2-		3/A1+, 4/A2-	
				
Mounting Screws (SSR to heatsink)	M5, not provided with SSR			
Mounting Torque (SSR to heatsink)	1.5 - 2.0 Nm (13.3 - 17.7 lb-in)			
Conductors	Use 75˚C copper (Cu) conductors		Use 60/75°C copper (Cu) conductors	
Stripping Length, X	12 mm		8 mm	
Connection Type	M5 screw with captivated washer		M3 screw with captivated washer	
Rigid (Solid & Stranded) UR/CSA rated data 	1x 2.5 - 6.0 mm² 1x 14 - 10 AWG	2x 2.5 - 6.0 mm² 2x 14 - 10 AWG	1x 0.5 - 2.5 mm² 1x 18 - 12 AWG	2x 0.5 - 2.5 mm² 2x 18 - 12 AWG
Flexible with End Sleeve 	1x 1.0 - 4.0 mm² 1x 18 - 12 AWG	2x 1.0 - 2.5 mm² 2x 2.5 - 4.0 mm² 2x 18 - 14 AWG 2x 14 - 12 AWG	1x 0.5 - 2.5 mm² 1x 18 - 12 AWG	2x 0.5 - 2.5 mm² 2x 18 - 12 AWG
Flexible without End Sleeve 	1x 1.0 - 6.0 mm² 1x 18 - 10 AWG	2x 1.0 - 2.5 mm² 2x 2.5 - 6.0 mm² 2x 18 - 14 AWG 2x 14 - 10 AWG	- -	- -
Torque Specifications 	Pozidrive 2 2.4 Nm (21.2 lb-in)		Pozidrive 1 0.5 Nm (4.4 lb-in)	
Aperture for Termination Lug	12 mm		7.5 mm	

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