SOLID STATE POWER CONTROLLER SSPC1

USER'S MANUAL

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Contents

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The engineers of "Electrum AV" have a broad experience in development, production and application of power force devices and smart drivers for force devices and they have already realized a great number of individual decisions. If you need force modules and drivers that are not available with, as well as products with differences from the standard devices in specifications and construction, address to our managers and specialists, who will offer you the best decision of your goal.

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1 DESCRIPTION AND FUNCTIONS

Solid state power controller (hereinafter - module or SSPC1) designed to switch DC load current, for load protecting and current overload protecting of switching transistor (by criterion I^2t), for temperature protection and protection against inductive kicks in load circuit. The module includes control circuit and power circuit with galvanic decoupling from supply and control circuits.

SSPC1 will provide the following functions and capabilities:

- load current switching;
- load current control by criterion I^2t with load current protection;
- status signal delivery when exceeding load current permissible value;
- overheating protection of switching transistor;
- status signal delivery when controlled transistor overheating;
- collector-emitter overvoltage protection of controlled transistor (drain-source);
- status signal delivery by criterion $I \geq 0.1Inom$

2 MODULE TYPES

The SSPC1 is produced with different types of power assemblies (to different voltages and currents). The SSPC1 are produced to currents 50, 60, 75, 90, 120, 150, 180, 240, 320 A and at 60, 100, 200, 400, 600 or 1200 V of power elements (module modification with relevant current/voltage nominal is chosen in accordance with section 4). In module name the maximum permissible average value of long-term current is specified.

Maximum voltage, denoted in module name, will indicate maximum permissible collector-emitter voltage (drain-source) used in power transistor modules. Therewith the maximum switch voltage is lower than it is specified in the name (ref. to section 4)

The SSPC1 are produced with two control options: modules with forward and inverse control inputs and modules with forward control input and reset input.

The SSPC1 are produced at three diverse supply voltage of built-in DC/DC-converter– 15, 24, 32 V, and two classes of overload characteristic I^2t.

Figure 2.1 shows the SSPC1 decoding

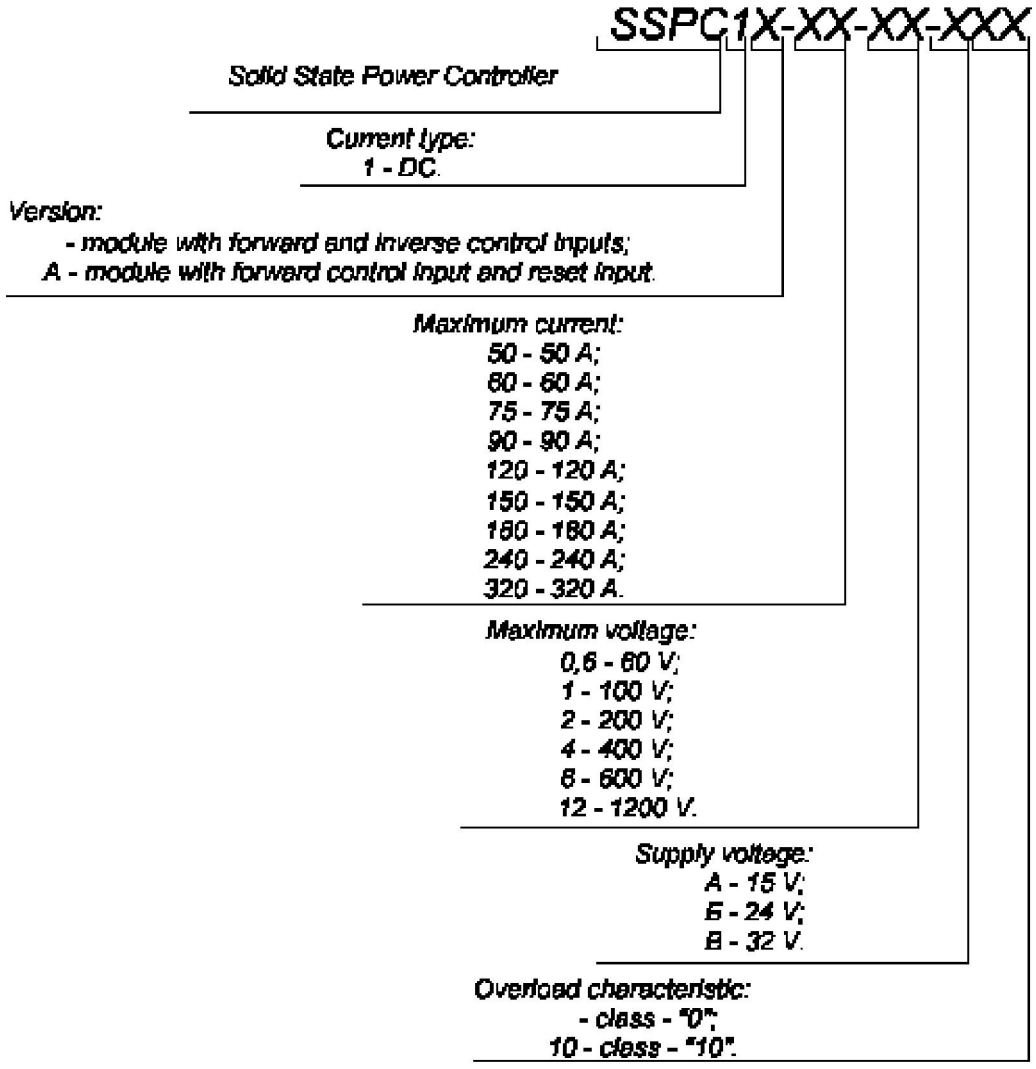


Figure 2.1 – Module name decoding

For instance, SSPC1 -120-12-A – solid state power controller SSPC1 with forward and inverse control inputs, with maximum switching current 120A, with maximum voltage of power elements 1200V, with supply voltage 15V, overload characteristic class «0».

3 GENERAL MODULE DESCRIPTIONS

The SSPC1 is an assembly of control circuit with power part including power switch transistors (MOSFET – for devices of 0,6, 1, 2, 4 class, IGBT for devices of 6 and 12 voltage class), current-measuring shunt and thermistor that are located on the radiator through insulating base.

Structure circuits of SSPC1 are given at Figures 3.1 and 3.2.

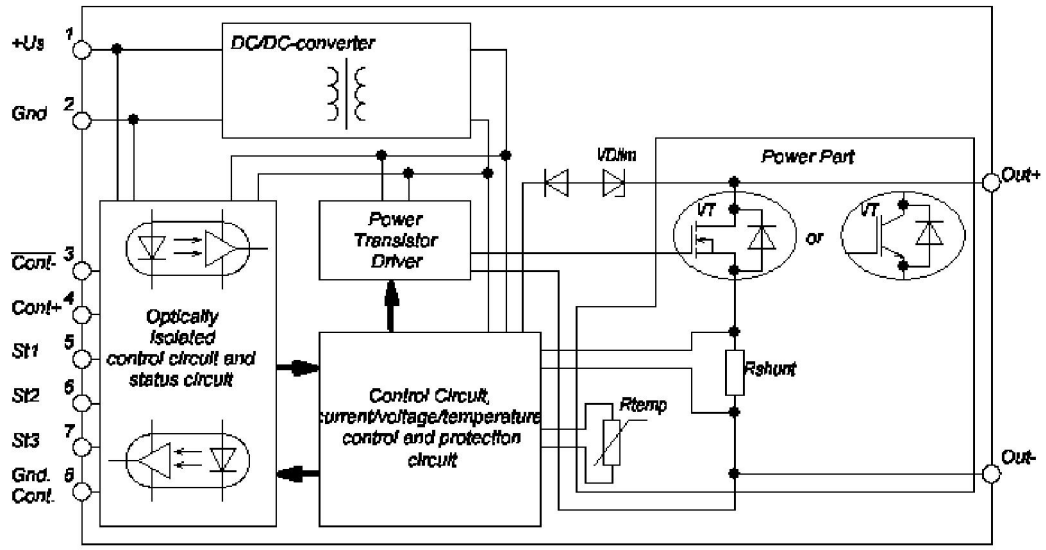


Figure 3.1 – Structure circuit SSPC1-XX-XX-XXX

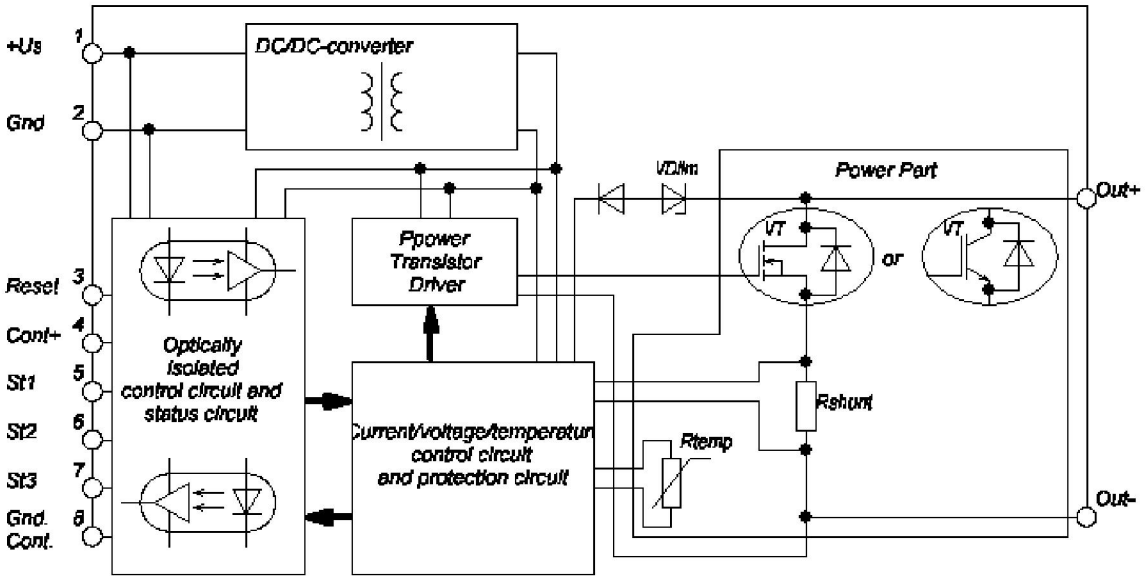


Figure 3.2 – Structure circuit SSPC1A-XX-XX-XXX

Input supply contacts of built-in DC/DC converter, connection contacts of control signals and reset signals, connection contacts of status signals are push terminal series 385, power output contacts – thread piece under screw or bolt (ref. to overall drawings). Output function is shown in Table 3.1.

Table 3.1 – Outputs' function

Contact #	Symbol	Function
1	+Us	Positive output of built-in DC/DC converter
2	Gnd	Negative output of built-in DC/DC converter
3	$\overline{\text{Cont-}}$	Optically isolated inverse control input for module series SSPC1-XX-XX-XXX.
	Reset	Optically isolated input of external reset when current exceeding or short-circuit emergency for modules series SSPC1A-XX-XX-XXX.
4	Cont+	Optically isolated forward control input.
5	St1	Optically isolated status signal (open collector) by criterion $I \geq 0.1I_{nom}$.
6	St2	Optically isolated status signal (open collector) of load current exceeding or load short-circuit.
7	St3	Optically isolated status signal (open collector) of radiator's power transistor overload.
8	Gnd. cont.	Ground output for control signal, reset signal and status signal.
	Out+	Power collector (drain) output for load connection.
	Out-	Power emitter (source) output for load connection.

4 BASIC CHARACTERISTICS

Basic electric characteristics and maximum-permissible electric characteristics of modules SSPC1-XX-XX-XXX at 25 ^{0}C are given in Tables 4.1 and 4.2.

Table 4.1 – Basic and maximum-permissible electric characteristics of control circuits

Name	Unit	Rate			Note
		min	type	max	
Supply characteristics					
Supply voltage, Us	V	13.5	15	18	SSPC1X-XX-XX-A
		22	24	27	SSPC1X-XX-XX-Б
		30	32	36	SSPC1X-XX-XX-B
Current consumption, Ic	mA	80	120	150	SSPC1X-XX-XX-A
		50	80	100	SSPC1X-XX-XX-Б
		50	80	100	SSPC1X-XX-XX-B
Control signal characteristic					
«Low logic level»input signal, $U_{cont.off}$	V	-0.5		10	
«High logic level»input signal, $U_{cont.on}$	V	13.5		36	
Control inputs' current, Icont	mA			1	«Cont+», «Cont-», «Reset»
Status signal characteristics					
Maximum voltage of status signal output, Uout. ST	V			30	Open collector
Maximum current of status signal output, Iout. ST	mA			10	
Module function characteristics					
Delay time on/off of switching element, ton/off	µs			5	
Maximum switching frequency, f_{max}	kHz			30	
On current ST1			≥0.1Inom		
On current ST2			≥1.1Inom		
Protection operation delay time by I ≥ 1.5Inom, t1	ms			4	SSPC 1X-XX-XX-X
	s			40	SSPC 1X-XX-XX-X10
Protection operation delay time by I ≥ 3Inom, t2	ms			1.5	SSPC 1X-XX-XX-X
	s			15	SSPC 1X-XX-XX-X10
Protection operation delay time by I ≥ 4Inom, t3	µs			10	
Overheating protection operation temperature, Toff	ºC		90	100	
Overheating protection lock release temperature, Ton	ºC	60		70	
Delay time of status signal connection ST1, ton/off St1	µs			5	I = 0.5Inom
Delay time of status signal connection ST2, ton/off St2	µs			5	I = 3Inom
Delay time of status signal connection ST3, ton/off St3	µs			5	
Isolation voltage between control circuits, power circuits and radiator, U_{isol}	V			1000	SSPC 1X-XX-0,6-XXX SSPC 1X-XX-1-XXX
				2000	SSPC 1X-XX-2-XXX SSPC 1X-XX-4-XXX
				4000	SSPC 1X-XX-6-XXX SSPC 1X-XX-12-XXX
Critical speed of output voltage change, dU/dt	kV/ µs			20	

Table 4.2 – Basic and maximum-permissible electric characteristics of control circuits for modules of 0,6 class (SSPC1X-XX-0,6-X)

Name	Unit	Rate			Note
		min	type	max	
Breakdown voltage of switching element, U_{break}	V			60	
Maximum DC switch voltage, U_{com}	V			24	
Active protection limitation voltage, U_{lim}	V			48	
Switching element leakage current, Iout.l.	μA			100	U_{out} =60 V
Rated switching current, Inom	A			50	SSPC1X-50-0,6-X
				60	SSPC 1X-60-0,6-X
				75	SSPC 1X-75-0,6-X
				90	SSPC 1X-90-0,6-X
				120	SSPC 1X-120-0,6-X
				150	SSPC 1X-150-0,6-X
				180	SSPC 1X-180-0,6-X
				240	SSPC 1X-240-0,6-X
				320	SSPC 1X-320-0,6-X
Maximum pulse current $I_{pul.max}$ at t_{pul}=10 ms	A			150	SSPC 1X-50-0,6-X
				180	SSPC 1X-60-0,6-X
				215	SSPC 1X-75-0,6-X
				270	SSPC 1X-90-0,6-X
				360	SSPC 1X-120-0,6-X
				450	SSPC 1X-150-0,6-X
				540	SSPC 1X-180-0,6-X
				720	SSPC 1X-240-0,6-X
				960	SSPC 1X-320-0,6-X
Output residual on-state resistance, R_{res}	mΩ			12.33	SSPC 1X-50-0,6-X
				3.33	SSPC 1X-60-0,6-X
				3.33	SSPC 1X-75-0,6-X
				6.33	SSPC 1X-90-0,6-X
				1.67	SSPC 1X-120-0,6-X
				1.67	SSPC 1X-150-0,6-X
				3.17	SSPC 1X-180-0,6-X
				2.5	SSPC 1X-240-0,6-X
				1.8	SSPC 1X-320-0,6-X
Thermal junction-radiator resistance, Rth j-r	ºC/W			1.07	SSPC 1X-50-0,6-X
				0.82	SSPC 1X-60-0,6-X
				0.82	SSPC 1X-75-0,6-X
				0.695	SSPC 1X-90-0,6-X
				0.57	SSPC 1X-120-0,6-X
				0.57	SSPC 1X-150-0,6-X
				0.507	SSPC 1X-180-0,6-X
				0.47	SSPC 1X-240-0,6-X
				0.427	SSPC 1X-320-0,6-X

Table 4.3 – Basic and maximum-permissible electric characteristics of control circuits for modules of 1-st class (SSPC1X-XX-1-X)

Name	Unit	Rate			Note
		min	typ.	max	
Breakdown voltage of switching element, U_{break}	V			100	
Maximum DC switch voltage, U_{com}	V			48	
Active protection limitation voltage, Ulimit	V			78	
Switching element leakage current, Iout.l.	μA			100	U_{out} =100 V
Rated switching current, Inom	A			50	SSPC 1X-50-1-X
				60	SSPC 1X-60-1-X
				75	SSPC 1X-75-1-X
				90	SSPC 1X-90-1-X
				120	SSPC 1X-120-1-X
				150	SSPC 1X-150-1-X
				180	SSPC 1X-180-1-X
				240	SSPC 1X-240-1-X
				320	SSPC 1X-320-1-X
Maximum pulse current $I_{pul.max}$ at t_{pul}=10 ms	A			150	SSPC 1X-50-1-X
				180	SSPC 1X-60-1-X
				215	SSPC 1X-75-1-X
				270	SSPC 1X-90-1-X
				360	SSPC 1X-120-1-X
				450	SSPC 1X-150-1-X
				540	SSPC 1X-180-1-X
				720	SSPC X-240-1-X
				960	SSPC 1X-320-1-X
Output residual on-state resistance, R_{res}	mΩ			18.33	SSPC 1X-50-1-X
				18.33	SSPC 1X-60-1-X
				7.33	SSPC 1X-75-1-X
				7.33	SSPC 1X-90-1-X
				7.17	SSPC 1X-120-1-X
				14.17	SSPC 1X-150-1-X
				6.17	SSPC 1X-180-1-X
				4.6	SSPC 1X-240-1-X
				3	SSPC 1X-320-1-X
Thermal junction-radiator resistance, $R_{th\ j\text{-}r}$	ºC/W			0.795	SSPC 1X-50-1-X
				0.795	SSPC 1X-60-1-X
				0.77	SSPC 1X-75-1-X
				0.77	SSPC 1X-90-1-X
				0.57	SSPC 1X-120-1-X
				0.576	SSPC 1X-150-1-X
				0.478	SSPC 1X-180-1-X
				0.439	SSPC 1X-240-1-X
				0.414	SSPC 1X-320-1-X

Table 4.4 – Basic and maximum-permissible electric characteristics of control circuits for modules of 2-nd class (SSPC1X-XX-2-X)

Name	Unit.	Rate			Note
		min	type	max	
Breakdown voltage of switching element, U_{break}	V			200	
Maximum DC switch voltage, U_{com}	V			100	
Active protection limitation voltage, U_{lim}	V			150	
Switching element leakage current, Iout.l.	μA			100	Uout =200 V
Rated switching current, Inom	A			50	SSPC 1X-50-2-X
				60	SSPC 1X-60-2-X
				75	SSPC 1X-75-2-X
				90	SSPC 1X-90-2-X
				120	SSPC 1X-120-2-X
				150	SSPC 1X-150-2-X
				180	SSPC 1X-180-2-X
				240	SSPC 1X-240-2-X
				320	SSPC 1X-320-2-X
Maximum pulse current $I_{pul.max}$ at t_{pul}=10 ms	A			150	SSPC 1X-50-2-X
				180	SSPC 1X-60-2-X
				215	SSPC 1X-75-2-X
				270	SSPC 1X-90-2-X
				360	SSPC 1X-120-2-X
				450	SSPC 1X-150-2-X
				540	SSPC 1X-180-2-X
				720	SSPC 1X-240-2-X
				960	SSPC 1X-320-2-X
Output residual on-state resistance, R_{res}	mΩ			23.33	SSPC 1X-50-2-X
				23.33	SSPC 1X-60-2-X
				11.33	SSPC 1X-75-2-X
				18.33	SSPC 1X-90-2-X
				11.67	SSPC 1X-120-2-X
				11.17	SSPC 1X-150-2-X
				7.87	SSPC 1X-180-2-X
				5.9	SSPC 1X-240-2-X
				2.9	SSPC 1X-320-2-X
Thermal junction-radiator resistance, $R_{th\ j\text{-}r}$	ºC/W			0.36	SSPC 1X-50-2-X
				0.356	SSPC 1X-60-2-X
				0.545	SSPC 1X-75-2-X
				0.476	SSPC 1X-90-2-X
				0.226	SSPC 1X-120-2-X
				0.476	SSPC 1X-150-2-X
				0.183	SSPC 1X-180-2-X
				0.161	SSPC 1X-240-2-X
				0.106	SSPC 1X-320-2-X

Table 4.5 – Basic and maximum-permissible electric characteristics of control circuits for modules of 4-th class (SSPC1X-XX-4-X)

Name	Unit	Rate			Note
		min	type	max	
Breakdown voltage of switching element, U_{break}	V			400	
Maximum DC switch voltage, Ucom	V			180	
Active protection limitation voltage, Ulimit	V			350	
Switching element leakage current, Iout.l.	μA			100	Uout=400 V
Rated switching current, Inom	A			50	SSPC 1X-50-4-X
				60	SSPC 1X-60-4-X
				75	SSPC 1X-75-4-X
				90	SSPC 1X-90-4-X
				120	SSPC 1X-120-4-X
Maximum pulse current $I_{pul.max}$ at t_{pul}=10 ms	A			150	SSPC 1X-50-4-X
				180	SSPC 1X-60-4-X
				215	SSPC 1X-75-4-X
				270	SSPC 1X-90-4-X
				360	SSPC 1X-120-4-X
Output residual on-state resistance, R_{res}	mΩ			62.33	SSPC 1X-50-4-X
				45.33	SSPC 1X-60-4-X
				34.33	SSPC 1X-75-4-X
				27.33	SSPC 1X-90-4-X
				23.17	SSPC 1X-120-4-X
Thermal junction-radiator resistance, $R_{th\ j\text{-}r}$	ºC/W			0.431	SSPC 1X-50-4-X
				0.176	SSPC 1X-60-4-X
				0.156	SSPC 1X-75-4-X
				0.144	SSPC 1X-90-4-X
				0.136	SSPC 1X-120-4-X

Table 4.6 – Basic and maximum-permissible electric characteristics of control circuits for modules of 6-th class (SSPC1X-XX-6-X)

Name	Unit	Rate			note
		min	type	max	
Breakdown voltage of switching element, U_{break}	V			600	
Maximum DC switch voltage, Ucom	V			280	
Active protection limitation voltage, Ulimit	V			450	
Switching element leakage current, Iout.l.	μA			100	Uout =600 V
Rated switching current, Inom	A			50	SSPC1X-50-6-X
				60	SSPC 1X-60-6-X
				75	SSPC 1X-75-6-X
				90	SSPC 1X-90-6-X
				120	SSPC 1X-120-6-X
				150	SSPC 1X-150-6-X
				180	SSPC 1X-180-6-X
				240	SSPC 1X-240-6-X
				320	SSPC 1X-320-6-X
Maximum pulse current $I_{pul.max}$ at t_{pul}=10 ms	A			150	SSPC1X-50-6-X
				180	SSPC 1X-60-6-X
				215	SSPC 1X-75-6-X
				270	SSPC 1X-90-6-X
				360	SSPC 1X-120-6-X
				450	SSPC 1X-150-6-X
				540	SSPC 1X-180-6-X
				720	SSPC 1X-240-6-X
				960	SSPC 1X-320-6-X
Output residual resistance, R_{res}	V		2.5	3	
Thermal junction-radiator resistance, $R_{th\ j\text{-}r}$	ºC/W			0.550	SSPC1X-50-6-X
				0.430	SSPC 1X-60-6-X
				0.360	SSPC 1X-75-6-X
				0.270	SSPC 1X-90-6-X
				0.196	SSPC 1X-120-6-X
				0.185	SSPC 1X-150-6-X
				0.154	SSPC 1X-180-6-X
				0.115	SSPC 1X-240-6-X
				0.092	SSPC 1X-320-6-X

Table 4.7 – Basic and maximum-permissible electric characteristics of control circuits for modules of 12-th class (SSPC1X-XX-12-X)

Name	Unit	Rate			Note
		min	type	max	
Breakdown voltage of switching element, U_{break}	V			1200	
Maximum DC switch voltage, Ucom	V			540	
Active protection limitation voltage, Ulimit	V			800	
Switching element leakage current, Iout.l.	μA			100	Uout =1200 V
Rated switching current, I_{nom}	A			50	SSPC1X-50-12-X
				60	SSPC 1X-60-12-X
				75	SSPC 1X-75-12-X
				90	SSPC 1X-90-12-X
				120	SSPC 1X-120-12-X
				150	SSPC 1X-150-12-X
				180	SSPC 1X-180-12-X
				240	SSPC 1X-240-12-X
				320	SSPC 1X-320-12-X
Maximum pulse current $I_{pul.max}$ at t_{pul}=10 ms	A			150	SSPC1X-50-12-X
				180	SSPC 1X-60-12-X
				215	SSPC 1X-75-12-X
				270	SSPC 1X-90-12-X
				360	SSPC 1X-120-12-X
				450	SSPC 1X-150-12-X
				540	SSPC 1X-180-12-X
				720	SSPC 1X-240-12-X
				960	SSPC 1X-320-12-X
Output residual resistance, R_{res}	V		3	3.5	
Thermal junction-radiator resistance, $R_{th\ j\text{-}r}$	ºC/W			0.550	SSPC1X-50-12-X
				0.430	SSPC 1X-60-12-X
				0.360	SSPC 1X-75-12-X
				0.270	SSPC 1X-90-12-X
				0.196	SSPC 1X-120-12-X
				0.185	SSPC 1X-150-12-X
				0.154	SSPC 1X-180-12-X
				0.115	SSPC 1X-240-12-X
				0.092	SSPC 1X-320-12-X

Table 4.8 – Basic and maximum-permissible electric characteristics of control circuits for modules of 0,6-class (SSPC1X-XX-0,6-X10)

Name	Unit	Rate			Note
		min	type	max	
Breakdown voltage of switching element, U_{break}	V			60	
Maximum DC switch voltage, Ucom	V			24	
Active protection limitation voltage, Ulimit	V			48	
Switching element leakage current, Iout.l.	μA			100	Uout =60 V
Rated switching current, Inom	A			50	SSPC1X-50-0,6-X10
				60	SSPC1X-60-0,6-X10
				75	SSPC1X-75-0,6-X10
				90	SSPC1X-90-0,6-X10
				120	SSPC1X-120-0,6-X10
				150	SSPC1X-150-0,6-X10
				180	SSPC1X-180-0,6-X10
				240	SSPC1X-240-0,6-X10
				320	SSPC1X-320-0,6-X10
Maximum pulse current $I_{pul.max}$ at t_{pul}=10 ms	A			500	SSPC1X-50-0,6-X10
				600	SSPC1X-60-0,6-X10
				750	SSPC1X-75-0,6-X10
				900	SSPC1X-90-0,6-X10
				1200	SSPC1X-120-0,6-X10
				1500	SSPC1X-150-0,6-X10
				1800	SSPC1X-180-0,6-X10
				2400	SSPC1X-240-0,6-X10
				3200	SSPC1X-320-0,6-X10
Output residual on-state resistance, R_{res}	mΩ			2	SSPC1X-50-0,6-X10
				3.4	SSPC1X-60-0,6-X10
				1.08	SSPC1X-75-0,6-X10
				0.93	SSPC1X-90-0,6-X10
				0.8	SSPC1X-120-0,6-X10
				0.6	SSPC1X-150-0,6-X10
				0.5	SSPC1X-180-0,6-X10
				0.55	SSPC1X-240-0,6-X10
				0.4	SSPC1X-320-0,6-X10
Thermal junction-radiator resistance, $R_{th\ j\text{-}r}$	ºC/W			0.3	SSPC1X-50-0,6-X10
				0.3	SSPC1X-60-0,6-X10
				0.23	SSPC1X-75-0,6-X10
				0.18	SSPC1X-90-0,6-X10
				0.13	SSPC1X-120-0,6-X10
				0.15	SSPC1X-150-0,6-X10
				0.09	SSPC1X-180-0,6-X10
				0.16	SSPC1X-240-0,6-X10
				0.12	SSPC1X-320-0,6-X10

Table 4.9 – Basic and maximum-permissible electric characteristics of control circuits for modules of 1-st class (SSPC1X-XX-1-X10)

Name	Unit	Rate			Note
		min	type	max	
Breakdown voltage of switching element, U_{break}	V			100	
Maximum DC switch voltage, Ucom	V			48	
Active protection limitation voltage, Ulimit	V			78	
Switching element leakage current, Iout.l.	μA			100	Uout=100 V
Rated switching current, Inom	A			50	SSPC1X-50-1-X10
				60	SSPC 1X-60-1-X10
				75	SSPC 1X-75-1-X10
				90	SSPC 1X-90-1-X10
				120	SSPC 1X-120-1-X10
				150	SSPC 1X-150-1-X10
				180	SSPC 1X-180-1-X10
				240	SSPC 1X-240-1-X10
				320	SSPC 1X-320-1-X10
Maximum pulse current $I_{pul.max}$ at t_{pul}=10 ms	A			500	SSPC1X-50-1-X10
				600	SSPC 1X-60-1-X10
				750	SSPC 1X-75-1-X10
				900	SSPC 1X-90-1-X10
				1200	SSPC 1X-120-1-X10
				1500	SSPC 1X-150-1-X10
				1800	SSPC 1X-180-1-X10
				2400	SSPC 1X-240-1-X10
				3200	SSPC 1X-320-1-X10
Output residual on-state resistance, R_{res}	mΩ			5.6	SSPC1X-50-1-X10
				4.9	SSPC 1X-60-1-X10
				2.7	SSPC 1X-75-1-X10
				2.4	SSPC 1X-90-1-X10
				1.8	SSPC 1X-120-1-X10
				1.4	SSPC 1X-150-1-X10
				1.1	SSPC 1X-180-1-X10
				0.65	SSPC 1X-240-1-X10
				0.6	SSPC 1X-320-1-X10
Thermal junction-radiator resistance, $R_{th\ j\text{-}r}$	ºC/W			0.3	SSPC1X-50-1-X10
				0.25	SSPC 1X-60-1-X10
				0.3	SSPC 1X-75-1-X10
				0.22	SSPC 1X-90-1-X10
				0.18	SSPC 1X-120-1-X10
				0.15	SSPC 1X-150-1-X10
				0.12	SSPC 1X-180-1-X10
				0.12	SSPC 1X-240-1-X10
				0.1	SSPC 1X-320-1-X10

Table 4.10 – Basic and maximum-permissible electric characteristics of control circuits for modules of 2-nd class (SSPC1X-XX-2-X10)

Name	Unit	Rate			Note
		min	type	max	
Breakdown voltage of switching element, U_{break}	V			200	
Maximum DC switch voltage, Ucom	V			100	
Active protection limitation voltage, Ulimit	V			150	
Switching element leakage current, Iout.l.	μA			100	Uout =200 V
Rated switching current, I_{nom}	A			50	SSPC1X-50-2-X10
				60	SSPC1X-60-2-X
				75	SSPC1X-75-2-X
				90	SSPC1X-90-2-X
				120	SSPC1X-120-2-X
Maximum pulse current $I_{pul.max}$ at t_{pul}=10 ms	A			500	SSPC1X-50-2-X
				600	SSPC1X-60-2-X
				750	SSPC1X-75-2-X
				900	SSPC1X-90-2-X
				1200	SSPC1X-120-2-X
Output residual on-state resistance, R_{res}	mΩ			9	SSPC1X-50-2-X
				7	SSPC1X-60-2-X
				3.5	SSPC1X-75-2-X
				3.2	SSPC1X-90-2-X
				2	SSPC1X-120-2-X
Thermal junction-radiator resistance, $R_{th\ j\text{-}r}$	ºC/W			0.25	SSPC1X-50-2-X
				0.18	SSPC1X-60-2-X
				0.15	SSPC1X-75-2-X
				0.13	SSPC1X-90-2-X
				0.1	SSPC1X-120-2-X

Table 4.11 – Basic and maximum-permissible electric characteristics of control circuits for modules of 6-th class (SSPC1X-XX-6-X10)

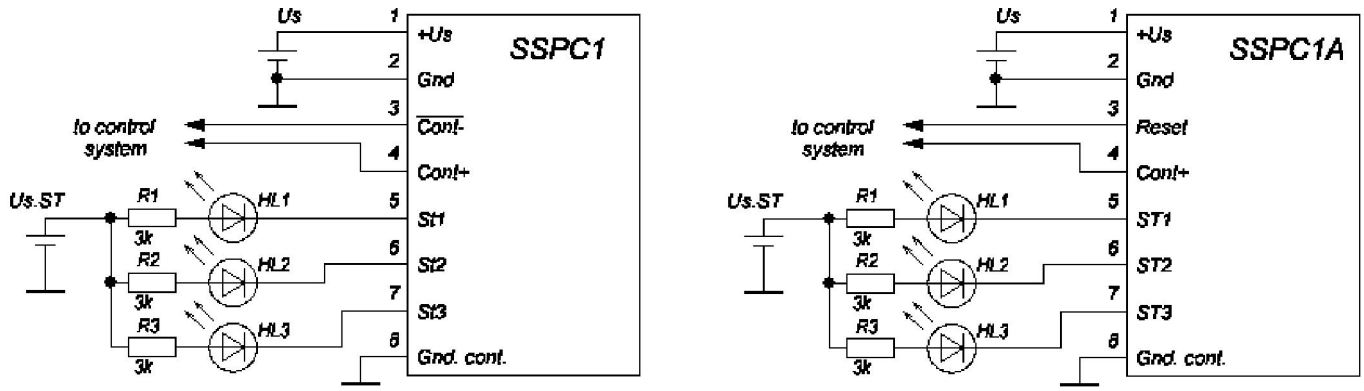
Name	Unit	Rate			Note
		min	type	max	
Breakdown voltage of switching element, U_{break}	V			600	
Maximum DC switch voltage, Ucom	V			280	
Active protection limitation voltage, Ulimit	V			450	
Switching element leakage current, Iout.l.	μA			100	Uout =600 V
Rated switching current, I_{nom}	A			50	SSPC1X-50-6-X10
				60	SSPC1X-60-6-X10
				75	SSPC1X-75-6-X10
				90	SSPC1X-90-6-X10
Maximum pulse current $I_{pul.max}$ at t_{pul}=10 ms	A			500	SSPC1X-50-6-X10
				600	SSPC1X-60-6-X10
				750	SSPC1X-75-6-X10
				900	SSPC1X-90-6-X10
Output residual resistance, R_{res}	V			2.9	SSPC1X-50-6-X10
				2.91	SSPC1X-60-6-X10
				2.9	SSPC1X-75-6-X10
				2.9	SSPC1X-90-6-X10
Thermal junction-radiator resistance, $R_{th\ j\text{-}r}$	ºC/W			0.14	SSPC1X-50-6-X10
				0.12	SSPC1X-60-6-X10
				0.1	SSPC1X-75-6-X10
				0.09	SSPC1X-90-6-X10

Table 4.12 – Basic and maximum-permissible electric characteristics of control circuits for modules of 12-th class (SSPC1X-XX-12-X10)

Name	Unit	Rate			Note
		min	type	max	
Breakdown voltage of switching element, U_{break}	V			1200	
Maximum DC switch voltage, Ucom	V			540	
Active protection limitation voltage, Ulimit	V			800	
Switching element leakage current, Iout.l.	μA			100	Uout =1200 V
Rated switching current, I_{nom}	A			50	SSPC1X-50-12-X10
				60	SSPC1X-60-12-X10
				75	SSPC1X-75-12-X10
				90	SSPC1X-90-12-X10
Maximum pulse current $I_{pul.max}$ at t_{pul}=10 ms	A			500	SSPC1X-50-12-X10
				600	SSPC1X-60-12-X10
				750	SSPC1X-75-12-X10
				900	SSPC1X-90-12-X10
Output residual resistance, R_{res}	V			3.75	SSPC1X-50-12-X10
				3.76	SSPC1X-60-12-X10
				3.73	SSPC1X-75-12-X10
				3.73	SSPC1X-90-12-X10
Thermal junction-radiator resistance, $R_{th\ j\text{-}r}$	ºC/W			0.1	SSPC1X-50-12-X10
				0.1	SSPC1X-60-12-X10
				0.09	SSPC1X-75-12-X10
				0.08	SSPC1X-90-12-X10

5 MODULE CONTROL

We recommend the following connection circuits (ref. to Figure 5.1).



a) SSPC1-XX-XX-XXX b) SSPC1A-XX-XX-XXX

Figure 5.1 — Connection scheme of control circuits

If the noises of "controlled" ground and supply source ground are not critical when module connection then it is allowed to combine the output «Gnd» and «Gnd.cont», within the module these grounds are not combined.

The status signals of SSPC can be used both for signaling forming by means of LEDs and for status signal forming for its further processing by control circuit to realize the control algorithm.

Module functioning series SSPC1-XX-XX-XXX

Functioning diagram of module series SSPC1-XX-XX-XXX is shown at Figure 5.2. When delivering of logic unit state to input «Cont+», and logic zero state to input «Cont-», in accordance with the Table of module states (ref. to Table 5.1), power voltage switch will be allowed and in load circuit the current flows.

If the current value is more than 0.1Inom then the optically isolated status signal St1 will be switched on.

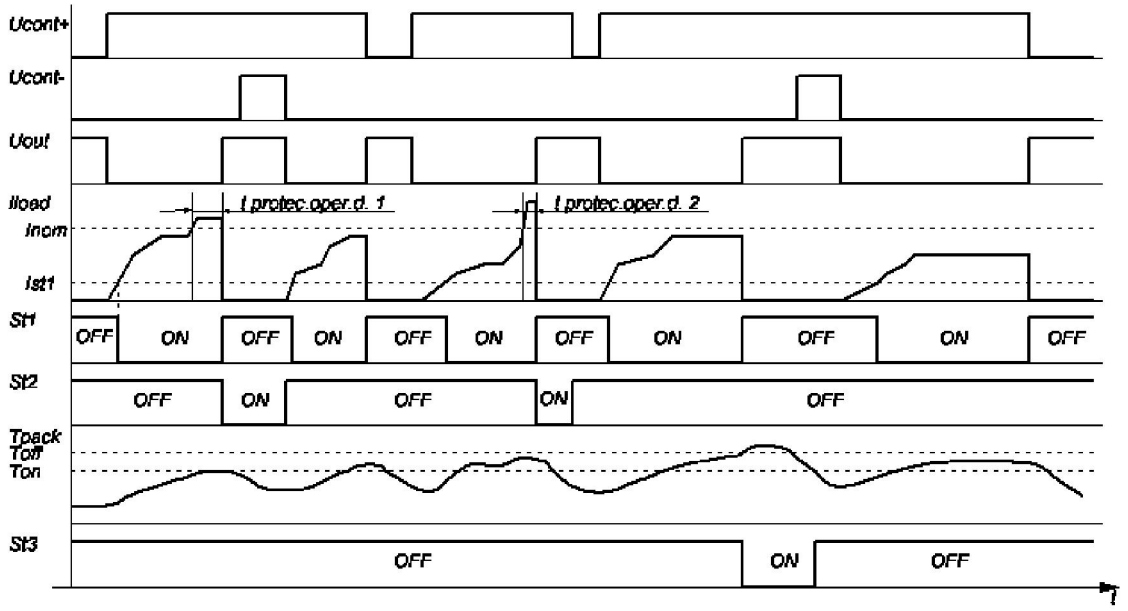


Figure5.2 — SSPC1 functioning diagram

If current value is more than 1.1Inom then overload or SC protection with protection operation delay $t_{protect.oper.d}$ will operate, the value of which depends on the overload value in accordance with overload characteristic that is shown at Figures 5.4 and 5.5 (for similar modification).

At the expiration of time t $_{protect.oper.d}$ the power transistors will be disconnected, and optically isolated status signal St2 will be switched on.

Table 5.1 — Status table SSPC1-XX-XX-XXX

«Cont+»	«Cont-»	«St1»	«St2»	«St3»	Status
«0»	«0»	«1»	«1»	«1»	«On»
«0»	«1»	«1»	«1»	«1»	«Off»
«1»	«1»	«1»	«1»	«1»	«Off»
«1»	«0»	«1»	«1»	«1»	«On», load current is lower than 0.1Inom
«1»	«0»	«0»	«1»	«1»	«On», load current is more than 0.1Inom
«1»	«0»	«1»	«0»	«1»	«Off», overload or load SC
«1»	«0»→«1»→«0»	«1»	«0»	«1»	«Internal Reset», rerun after current emergency
«1»→«0»→«1»	«0»	«1»	«0»	«1»	«Internal Reset», rerun after current emergency
«1»	«0»	«1»	«1»	«0»	«Off», overheating of power element
«1»	«0»→«1»→«0»	«1»	«1»	«0»	«Off», overheating of power element
«1»→«0»→«1»	«0»	«1»	«1»	«0»	«Off», overheating of power element

To remove emergency mode of SC or overload and to rerun the module it is necessary to reset the signal «Cont+» or «Cont-», if current exceeds or SC was not eliminated, then the current protection will operate repeatedly until the reason of protection operation is removed.

If radiator temperature is more than overheating protection operation temperature Toff equal to 90...100ºC then power transistors will be disconnected and the optically isolated status signal St3 will be switched on. Current switch will be allowed if the radiator temperature will be lower than the temperature of overheating protection lock release Ton equal to 60...70ºC. Control signal reset «Cont+» or «Cont-» will not lead to overheating lock release prior to radiator temperature will be reduced to value which is lower than Ton.

SSPC1A-XX-XX-XXX functioning

Functioning diagram of module series SSPC1A-XX-XX-XXX is shown at Figure 5.3. When delivering of logic unit state to input «Cont+» and logic zero state to input «Cont-», in accordance with table of module states (ref. to Table 5.2), power voltage switch will be allowed and in load circuit the current flows.
If the current value is more than 0.1Inom then the optically isolated status signal St1 will be switched on.

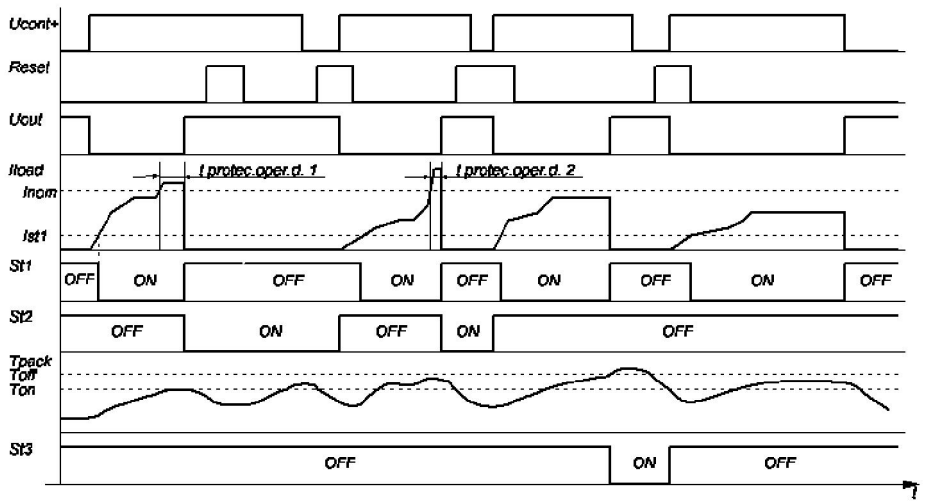


Figure5.3 — SSPC1A functioning diagram

If current value is more than 1.1Inom then overload or SC protection with protection operation delay $t_{protect.oper.d}$ will operate, value of which depends on overload value in accordance with overload characteristic that is shown at Figures 5.4, 5.5. (for similar modification)

At the expiring of time $t_{protect.oper.d}$ the power transistors will be disconnected, and optically isolated status signal St2 will be switched on.

Table 5.2— Status table SSPC1A-XX-XX-XXX

«Cont+»	«Reset»	«St1»	«St2»	«St3»	Status
«0»	«0»	«1»	«1»	«1»	«Off»
«0»	«1»	«1»	«1»	«1»	«Off»
«1»	«0»	«1»	«1»	«1»	«On», load current is lower than 0.1Inom
«1»	«0»	«0»	«1»	«1»	«On», load current is more than 0.1Inom
«1»	«0»	«1»	«0»	«1»	«Off», overload or load SC
«1»→«0»→«1»	«0»	«1»	«0»	«1»	«Off», overload or load SC
«1»	«0»	«1»	«1»	«0»	«Off», overheating of power element
«1»	«1»	«1»	«1»	«1»	«On», load current is lower than 0.1Inom
«1»	«1»	«0»	«1»	«1»	«On», load current is more than 0.1Inom
«1»	«1»	«1»	«0»	«1»	«Off», overload or load SC
«1»→«0»→«1»	«1»	«1»	«0»	«1»	«External Reset», rerun after current emergency
«1»	«1»	«1»	«1»	«0»	«Off», overheating of power element
«1»→«0»→«1»	«1»	«1»	«1»	«0»	«Off», overheating of power element

To remove emergency mode of SC or overload and to rerun the module it is necessary to set the logic unit status on input «Reset» and to rerun the module on the input «Cont+». If current exceeds or SC was not eliminated, then the current protection will operate repeatedly until the reason of protection operation is removed.

If radiator temperature is more than overheating protection operation temperature Toff equal to 90...100ºC then power transistors will be disconnected and the optically isolated status signal St3 will be switched on. Current switch will be allowed if the radiator temperature will be lower than the temperature of overheating protection lock release Ton equal to 60...70ºC. Control signal reset «Cont+» or «Cont-» will not lead to overheating lock release prior to radiator temperature will be reduced to value which is lower than Ton.

Overall characteristics of SSPC1 are given at Figures 5.4 and 5.5.

Protection functioning occurs strictly in compliance with overall characteristic: module protection will not operate if the module status is “Always closed”, overload or SC protection will operate if module status is “Always open”.

Figure 5.6 gives the several diagrams explaining current protection operation. Every of these figures combine the several protection operation diagrams depending on current overload level.

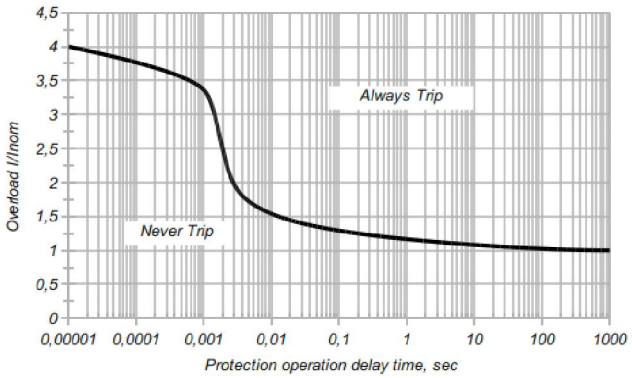


Figure 5.4 —SSPC1X-XX-XX-X overall characteristic

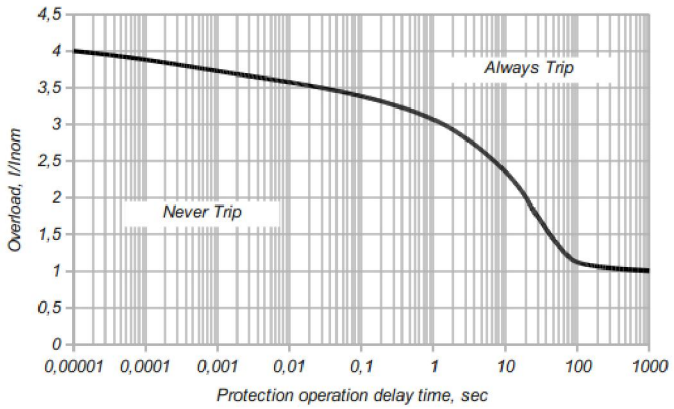
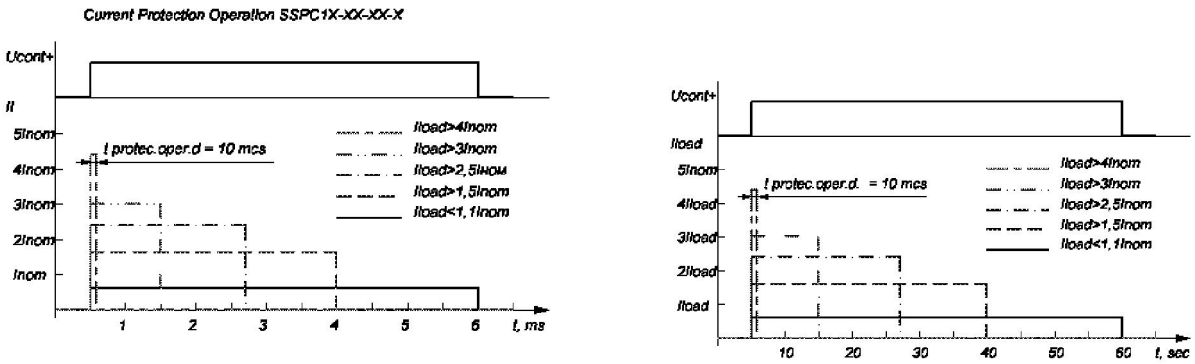


Figure 5.5 —SSPCT1X-XX-XX-X10 overall characteristic



a) SSPC1X-XX-XX-X b) SSPC1X-XX-XX-X10

Figure 5.6 — Current protection operation diagram.

6 POWER OUTPUTS

We recommend the following power circuit connection schemes (Figure 6.1).

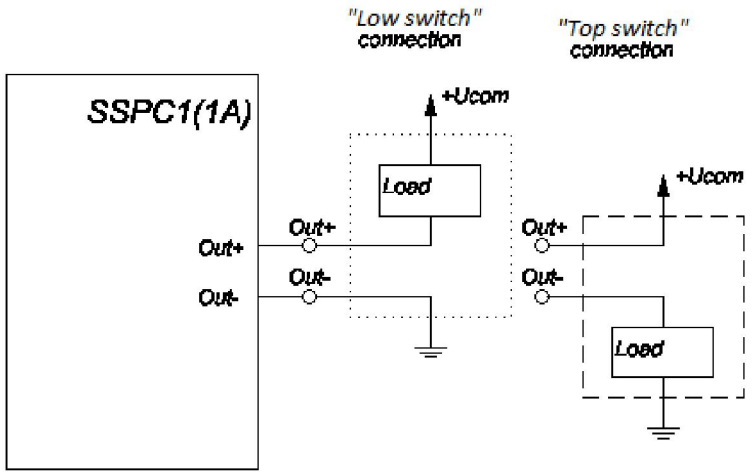


Figure 6.1 — Power circuit connection

The SSPC 1 power part is designed in such a way that to withstand overload over the permissible range of overload characteristic shown at Figures 5.5 and 5.6 for relevant overload characteristic class, without power transistors failure that prevents thereby overheating and module failure as well as does not tolerate long-term load current leaking that can damage load or its component parts.

The SSPC1 provides active voltage limitation protection that is realized by means of load shunting, by means of power switch.

The diagram of active voltage limitation operation is shown at Figure 6.2. Switch overvoltage arises as a rule when it is disconnected as module load has inductive component. When drain (collector) voltage of power switch relative to source (emitter) value reaches to U_{lim} then power transistor of SSPC1 will open that prevent drain voltage exceeds of power transistor up to U_{break} exceeding of which can lead to power part breakdown.

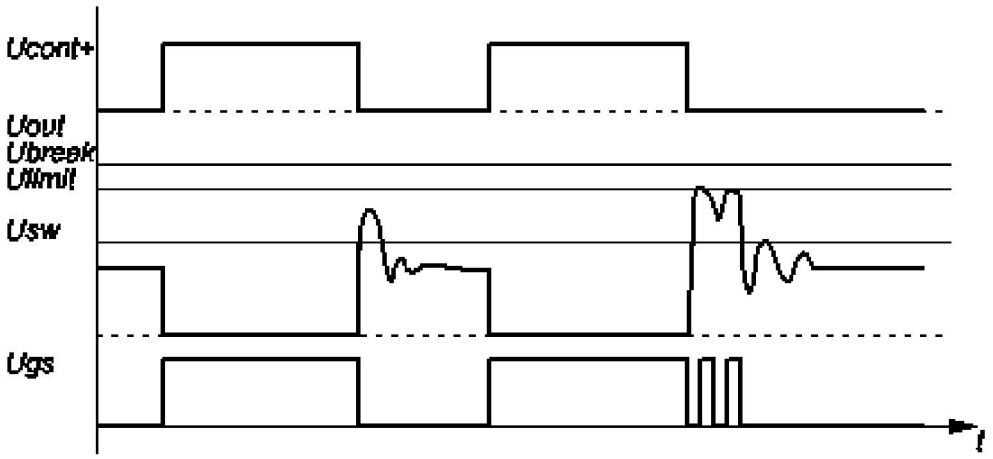


Figure 6.2 — Functioning of active voltage limitation protection

7 SERVICE INSTRUCTIONS

Connection to module

Power circuit is mounted to the module by means of thread contacts. The standard size of fasts is shown in Table 7.1. Screws (bolts) should be tightened with torque (5±0.5) Hm, with obligatory mounting of fast and spring washers that are supplied with the module.

Table 7.1 – Standard size of fasts

Module	Switching current, average	Fasts
SSPC1X-50-XX-X	50 A	Screw M6
SSPC1X-60-XX-X	60 A	
SSPC1X-75-XX-X	75 A	
SSPC1X-90-XX-X	90 A	
SSPC1X-120-XX-X	120 A	
SSPC1X-150-XX-X	150 A	
SSPC1X-180-XX-X	180 A	Bolt M8
SSPC1X-240-XX-X	240 A	
SSPC1X-320-XX-X	320 A	Bolt M10
SSPC1X-50-XX-X10	100 A	Bolt M6
SSPC1X-60-XX-X10	120 A	
SSPC1X-75-XX-X10	150 A	
SSPC1X-90-XX-X10	180 A	Bolt M8
SSPC1X-120-XX-X10	240 A	
SSPC1X-150-XX-X10	300 A	Bolt M10
SSPC1X-180-XX-X10	360 A	
SSPC1X-240-XX-X10	480 A	2xBolt M8
SSPC1X-320-XX-X10	640 A	2xBolt M10

The power wires should be connected through the connectors, with corrosion-inhibiting covering, cleaned of extraneous accretions. After screws (bolts) tightening the connection should be painted. The screws (bolts) should be tightened again in 8 days and in 6 weeks after commencement of operation. Afterwards the tightening should be controlled at least 1 time in a half year.

The mounting of output contacts, error contacts and supply connection of built-in DC/DC converter is carried out by means of the crimping terminal block of series 385.

When mounting and servicing you must assume measures of module protection against static electricity impact; when mounting the personnel must use the grounding bracelets and grounded low-voltage soldering irons with transformer supply.

Module installation

The module is mounted in the equipment to the cooler (chassis, installations magnet frame, metal plates, etc.) in any orientation by the instrumentality of screws M5 or M6 with torque (5±0.5) Nm, with obligatory installation of flat and spring washers. In plants the module should be located in order to protect it against additional heat from neighboring elements. The planes of cooler ribs should be oriented in the direction of air flow.

The contact area of the cooler should have roughness not more than 2.5 μm and flatness tolerance– not more than 30 μm. Cooler surface should not have any rough edges, honeycombs. No extraneous particles should be between the module and cooler. To improve the heat balance module installation to mounting area or cooler should be carried out by instrumentality of heat conducting pastes.

On mounting you should provide uniform pressure of module housing to cooler. For this purpose you should tighten all screws uniform in 2 – 4 motions in turn: first, located on one diagonal, then on the other one. Disassembling the module the screw tightening should be done the reverse order.

Not earlier than in 3 hours after mounting the screws should be rotated to the end, keeping the prescribed torque, because the part of heat conducting paste under pressure will outflow and the fastening can fail.

You can install the several modules without additional insolating spacer to one cooler, on condition that voltage between outputs of different modules will not exceed the minimum value of isolation breakdown voltage of each of them or when the cooler is grounded.

Below there is the corresponding Table 7.2 of the SSPC1, loss power table and table of necessary cooler without additional blow-off.

Table 7.2 – Necessary cooler dimensions for SSPC1 of diverse types. T = 25 °C

Module	Loss power at max load, max, W	Cooler type	
		C153	C271
SSPC1X-50-0,6-X	30.825	C153-110	C271-50
SSPC 1X-60-0,6-X	11.99	C153-110	C271-50
SSPC 1X-75-0,6-X	18.73	C153-110	C271-50
SSPC 1X-90-0,6-X	51.27	C153-110	C271-110
SSPC 1X-120-0,6-X	24.05	C153-110	C271-50
SSPC 1X-150-0,6-X	37.58	C153-110	C271-50
SSPC 1X-180-0,6-X	102.71	C153-110	C271-110
SSPC 1X-240-0,6-X	144	C153-110	C271-150
SSPC 1X-320-0,6-X	184.32	C153-150	C271-250
SSPC 1X-50-0,6-X10	15	C153-110	C271-50
SSPC 1X-60-0,6-X10	36.72	C153-110	C271-50
SSPC 1X-75-0,6-X10	18.23	C153-110	C271-50
SSPC 1X-90-0,6-X10	22.6	C153-110	C271-50
SSPC 1X-120-0,6-X10	34.56	C153-110	C271-50
SSPC 1X-150-0,6-X10	40.5	C153-110	C271-50
SSPC 1X-180-0,6-X10	48.6	C153-110	C153-110
SSPC 1X-240-0,6-X10	95.04	C153-110	C153-110
SSPC 1X-320-0,6-X10	122.88	C153-110	C271-150
SSPC 1X-50-1-X	45.825	C153-110	C271-50
SSPC 1X-60-1-X	65.99	C153-110	C271-110
SSPC 1X-75-1-X	41.23	C153-110	C271-50
SSPC 1X-90-1-X	59.37	C153-110	C271-110
SSPC 1X-120-1-X	103.25	C153-110	C271-110
SSPC 1X-150-1-X	318.83	C153-250	C271-300
SSPC 1X-180-1-X	199.91	C153-150	C271-250
SSPC 1X-240-1-X	264.96	C153-250	C271-300
SSPC 1X-320-1-X	307.2	C153-250	C271-300
SSPC 1X-50-1-X10	42	C153-110	C271-50
SSPC 1X-60-1-X10	52.92	C153-110	C271-50
SSPC 1X-75-1-X10	45.56	C153-110	C271-50
SSPC 1X-90-1-X10	58.32	C153-110	C271-110
SSPC 1X-120-1-X10	77.76	C153-110	C271-110
SSPC 1X-150-1-X10	94.5	C153-110	C271-110
SSPC 1X-180-1-X10	106.92	C153-110	C271-150
SSPC 1X-240-1-X10	112.32	C153-110	C271-150
SSPC 1X-320-1-X10	184.32	C153-150	C271-250
SSPC 1X-50-2-X	58.325	C153-110	C271-110
SSPC 1X-60-2-X	83.99	C153-110	C271-110
SSPC 1X-75-2-X	63.73	C153-110	C271-110
SSPC 1X-90-2-X	148.47	C153-150	C271-250
SSPC 1X-120-2-X	168.05	C153-150	C271-250
SSPC 1X-150-2-X	251.33	C153-250	C271-250
SSPC 1X-180-2-X	254.99	C153-250	C271-250
SSPC 1X-240-2-X	339.84	C153-250	C271-500
SSPC 1X-320-2-X	296.96	C153-250	C271-300
SSPC 1X-50-2-X10	67.5	C153-110	C271-110
SSPC 1X-60-2-X10	75.6	C153-110	C271-110
SSPC 1X-75-2-X10	59.06	C153-110	C271-110
SSPC 1X-90-2-X10	77.76	C153-110	C271-110

Continuation of Table 7.2

Module	Loss power at max load, max, W	Cooler type	
SSPC 1X-120-2-X10	86.4	C153-110	C271-110
SSPC 1X-50-4-X	155.83	C153-150	C271-250
SSPC 1X-60-4-X	163.19	C153-150	C271-250
SSPC 1X-75-4-X	193.11	C153-150	C271-250
SSPC 1X-90-4-X	221.37	C153-250	C271-250
SSPC 1X-120-4-X	333.65	C153-250	C271-500
SSPC 1X-50-6-X	150	C153-150	C271-250
SSPC 1X-60-6-X	180	C153-150	C271-250
SSPC 1X-75-6-X	225	C153-250	C271-250
SSPC 1X-90-6-X	270	C153-250	C271-300
SSPC 1X-120-6-X	360	C153-300	C271-500
SSPC 1X-150-6-X	450	C153-400	C271-500
SSPC 1X-180-6-X	540	C153-400	C271-500
SSPC 1X-240-6-X	720	C153-500	-
SSPC 1X-320-6-X	960	C153-800	-
SSPC 1X-50-6-X10	435	C153-400	C271-500
SSPC 1X-60-6-X10	523.8	C153-400	C271-500
SSPC 1X-75-6-X10	652.5	C153-500	-
SSPC 1X-90-6-X10	783	C153-500	-
SSPC 1X-50-12-X	175	C153-150	C271-250
SSPC 1X-60-12-X	210	C153-250	C271-250
SSPC 1X-75-12-X	262.5	C153-250	C271-250
SSPC 1X-90-12-X	315	C153-250	C271-300
SSPC 1X-120-12-X	420	C153-300	C271-500
SSPC 1X-150-12-X	525	C153-400	C271-500
SSPC 1X-180-12-X	630	C153-500	-
SSPC 1X-240-12-X	840	C153-800	-
SSPC 1X-320-12-X	1120	C153-1000	-
SSPC 1X-50-12-X10	562.5	C153-400	-
SSPC 1X-60-12-X10	676.8	C153-500	-
SSPC 1X-75-12-X10	839.25	C153-800	-
SSPC 1X-90-12-X10	1007.1	C153-1000	-

The smaller dimensions are allowed if the module operates at a load that is lower than the maximum or if force cooling is provided for.

Service requirements

The module should only be used in conditions of exposure to mechanical loads in accordance with Table 7.3.

Table 7.3 – Mechanical loads

Exposure factor	Exposure factor value
Sinusoidal vibration: - acceleration, m/s2 (g); - frequency, Hz	 100 (10) 1 - 500
Mechanical shock of repeated action : - peak impact acceleration , m/s2 (g); - duration of impact acceleration, ms	 400 (40) 0.1 – 2.0
Linear acceleration, m/s2 (g)	5000 (500)

The module should be used in conditions of exposure to climatic loads in accordance with Table 7.4.

Table 7.4 – Climatic loads

Climatic factor	Climatic factor value
Low temperature of environment: - operating, °C; - absolute, °C	 - 40 - 45
High temperature of environment: - operating, °C; - absolute, °C	 + 85 + 100
Relative humidity at temperature 35 °C non-condensing %, max	98

Safety Requirements

1. Operation with the module should be carried out only by qualified personnel.
2. Do not touch the power outputs if the supply voltage is fed.
3. Do not connect or disconnect wires and connectors while on the power circuit is energized.
4. Connect the oscilloscope probe only after removal of the power voltage and discharge of filter capacity.
5. Do not disassemble or modify the module. If it is necessary, please contact to the manufacturer.
6. If the radiator is not grounded, do not touch it, if the module is filed by force feeding.
7. Do not touch the radiator or discharge resistance, because its temperature can be very high.
8. Do not spray the module with water and other liquids.

8 RELIABILITY SPECIFICATIONS

Reliability probability of the module for 25000 hours must be at least 0.95.

Gamma-percent life must be no less than 50000 hours by $\gamma = 90$ %.

Gamma-percent service life of the modules, subject to cumulative operating time is no more than gamma-percent life, no less than10 years, when $\gamma = 90$ %.

Gamma-percent storage-ability time of the modules, when $\gamma = 90$ % and storing – 10 years.

9 OVERALL AND CONNECTING DIMENSIONS

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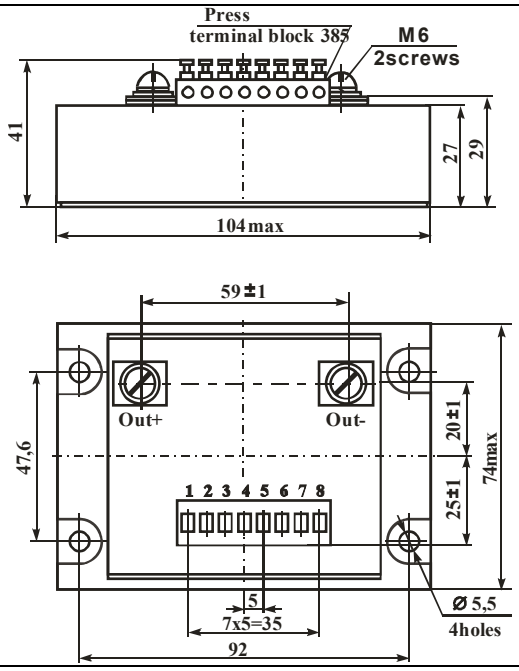
<td> 
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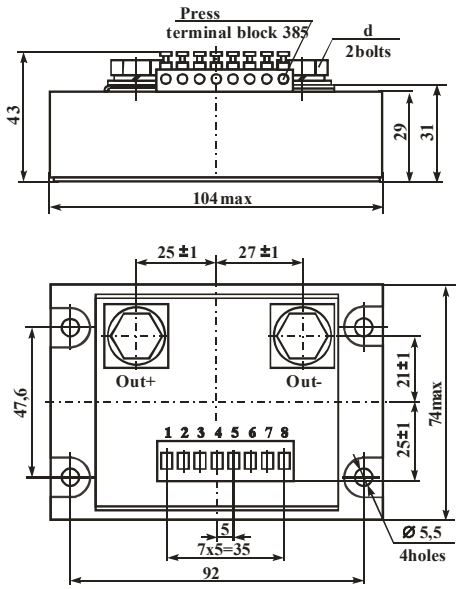
<td> 
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<tr>
<td>50, 60, 75, 120, 150 A</td>
<td>d – M8, for 180, 240 A
d – M10, for 320 A</td>
</tr>
<tr>
<td colspan="2">Figure 9.1 – Overall and connecting dimensions</td>
</tr>
</table>

Precious metals are not contained.

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