SOLID STATE POWER CONTROLLER MODULE

SSPC-270V-2,5A

AREA Solid State Power Controller (SSPC) Modules combine the functions of a circuit breaker, including load monitor and I²t protection, in a small and cost effective plug-in package, without any internal mechanical part that can wear out.

Using last generation power MOSFET switches, these solid state modules offer very low “ON” resistance, low drop out, very high “OFF” resistance and low power dissipation, assuring constant load current sensing with no significative derating over the full operative temperature range.

The SSPC Modules use two standard TTL-CMOS I/O signals to perform the solid state switch control and state indication. A logic high on the “ON/OFF” input (pin 6) will turn on the power switch and a logic low will turn it off. The switch actual state is reported on “STATUS” open drain output (pin 4) where a logic low level can be available when the power switch is turned off. Both signals, as well as any internal control circuit, are referred to +5Vdc bias supply side (pin 5) and are electrically insulated from the high voltage output power side.

If the SSPC Module is put in on state, as in a circuit breaker, it will carry continuous current up to a defined level without tripping. If the current value increase over the trip level, the SSPC Module automatically turns off the output switch, disconnecting the load and putting the “STATUS” output signal at a low impedance state.
Again, like a circuit breaker, the SSPC Modules can handle short duration overloads without tripping. The I²t curve defines how the time to trip is inversely proportional to the square of the current value. This means that little overloads may be of large time duration while bigger overloads must have a smaller time duration to avoid tripping occurrence.

In presence of short-circuit conditions, the SSPC assure a tripping delay time less than 20uS over the full operative temperature range and it remains at off state until a new ON/OFF command is sent to it.

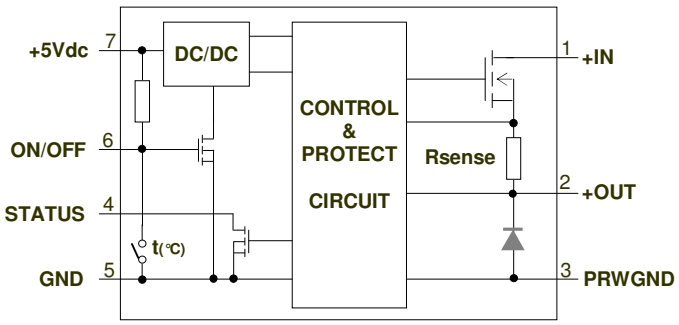
AREA SSPC Modules can drive either resistive, inductive or capacitive loads with no significant limitations with respect to equivalent mechanical breakers. A capacitive drive capability between 80uF@270Vdc or 1500uF@48Vdc, depending from rated working voltage, is assured over the full operative temperature range.

To prevent any possible load damage due to SSPC abnormal working condition, the Module is also provided by internal inrush current limitation, as well as temperature sensor and bias under voltage sensing protection circuits. In case that the case temperature goes over 95°C or the bias voltage goes below 4,6Vdc, the SSPC power switch is automatically turned off, disconnecting the load and putting the “STATUS” output signal at a low impedance state.

Application

Designed to satisfy Military Market requirements, AREA SSPC Modules can be used in many hi-rel DC applications such as: fuel injection, avionics, pump control, land and sea vehicles as well as rail train markets.

Internal Block Diagram



Typical Connection Scheme

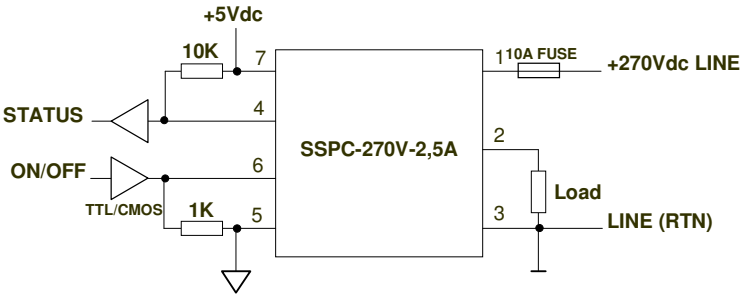


Figure 1.a – Normal OFF Control Connection

The SSPC is always in OFF State in no driving current condition at ON/OFF control signal.
A logic High level at ON/OFF control signal will turn on the load.
A logic Low level at ON/OFF control signal will turn off the load.

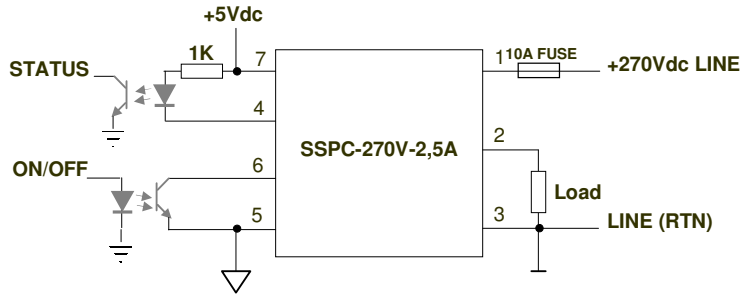
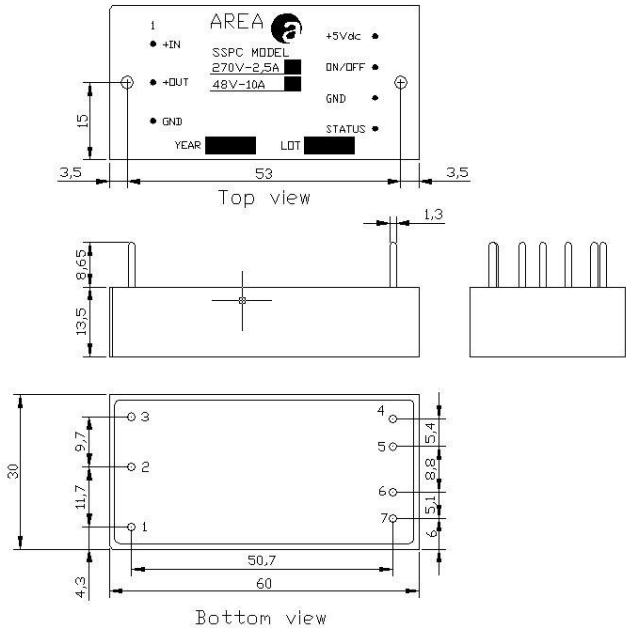


Figure 1.b – Normal ON Control Connection

The SSPC is always in ON State in no driving current condition at ON/OFF control signal.
A logic High level at ON/OFF control signal will turn off the load.

Mechanical Dimension (Unit: mm Tolerance: ± 0,1mm for all dimensions)



Weight 60 gr.

Pin Assignment :

pin 1	+IN	Line input
pin 2	*OUT	Load output
pin 3	PWRGND	Line return
pin 4	STATUS	Control output
pin 5	GND	Bias return
pin 6	ON/OFF	Control input
pin 7	+5Vdc	Bias

Ordering Information

P/N	SSPC Model
9001009-A	270V-2,5A
9001009-B	48V-10A

Absolute Maximum Ratings

Maximum Line Input Voltage	: 500 Vdc (continuous)
Maximum Load Output Voltage Rating (*)1	: 500 Vdc (continuous)
Never Trip Current Limit	: 2,5 A (continuous)
Short Circuit Peak Output Current	: 15 A / 15uS
Maximum Capacitive Load Drive Capability	: 80uF @ 270 Vdc
Maximum Inductive Line Drive Capability	: 150uH @ 270 Vdc
Maximum Bias Voltage	: 5,5 Vdc
Maximum Control Input Signal Voltage Rating (*)2	: 12 Vdc (continuous)
Maximum Control Output Signal Voltage Rating (*)3	: 30 Vdc (continuous)
Maximum Control Output Signal Drive Current	: 1 A @ 10 Vdc
Ambient Operating Temperature range	: -40° C to +85° C
Case Maximum Operative Temperature	: +95° C
MTBF (estimate MIL-STD-217-F)	: 0,9Mhrs at 25° C Full load

Notes :
(*)1 maximum voltage allowed on +OUT (pin2) with respect to PWRGND (pin3)
(*)2 maximum voltage allowed on ON/OFF input (pin6) with respect to GND (pin5)
(*)3 maximum voltage allowed on STATUS output (pin4) with respect to GND (pin5)

Electrical Characteristics (over all -40°C /+85°C operating temperature range unless otherwise specified)

Line Input Voltage Range	: 15 – 300 Vdc
Nominal Load Current	: 2,4 A +/-0,1
Nominal Trip Current Limit	: 2,5 A +/-0,1
Turn ON resistance	: < 0,26 ohm @ 25° C
Turn OFF resistance	: > 150 Megaohm
Drop out	: < 650mV @ 25° C
Leakage current	: < 200 uA @ 270 Vdc
Bias Voltage	: 5 Vdc +/- 10%
Maximum Bias Current	: < 80 mA
Case-to-Ambient Thermal Resistance	: < 7 °C/W

Control Signals Electrical Characteristics (over all -40°C /+85°C operating temperature range unless otherwise specified)

ON/OFF Input	- threshold voltage	: > 1,2 Vdc to turn ON < 0,7 Vdc to turn OFF
	- sink current	: < 1 mA
STATUS Output	- resistance	: > 20 Mega ohm at ON state < 0,4 ohm at OFF state

Timing Characteristics (over all -40°C /+85°C operating temperature range unless otherwise specified)

Turn ON Delay Time (*)4	: < 200 uS
Load Current Rise Time Slew Rate (*)5	: < 7 uS/A
Turn OFF Delay Time (*)4	: < 200 uS
Load Current Fall Time Slew Rate	: < 2 uS/A
Short Circuit Detection Time (*)6	: < 20 uS during ON state < 70 uS at Turn ON Command
Short Circuit Peak Current	: < 15 A during ON state < 8 A at Turn ON Command
STATUS Output Delay Time	: < 50 uS
Overload Detection Time	: see tripping curves
Tripping Characteristic	: see tripping curves

Notes :
(*)4 from ON/OFF input command signal high to LOAD output nominal current
(*)5 measured with an external 100 ohm resistive load between pin2 and pin3
(*)6 measured with an external 0 ohm resistive load between pin2 and pin3

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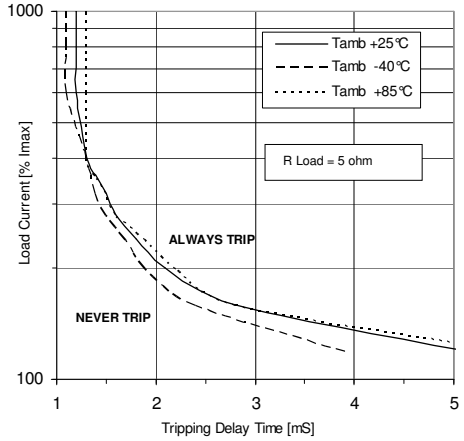
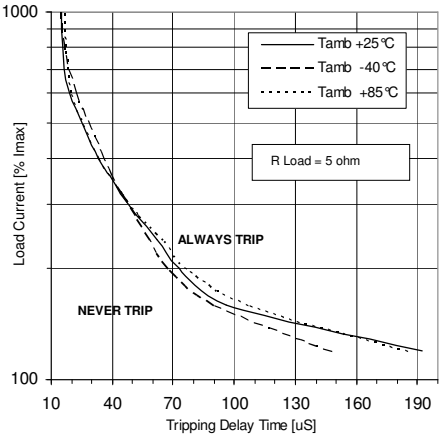
Tripping Curves

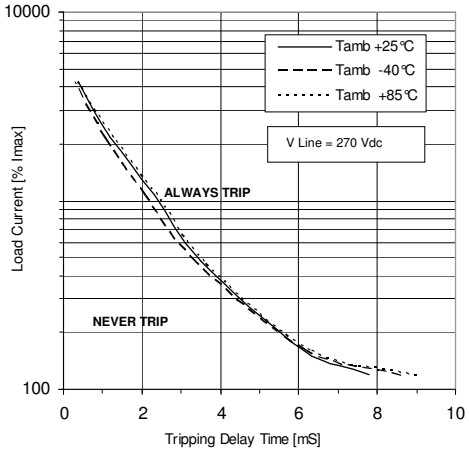
TRIPPING CURVE @ TURN ON



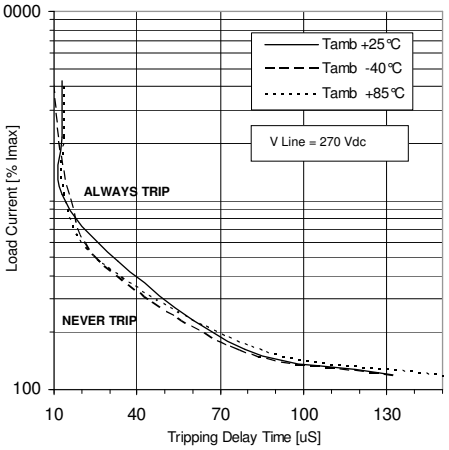
TRIPPING CURVE @ ON STATE



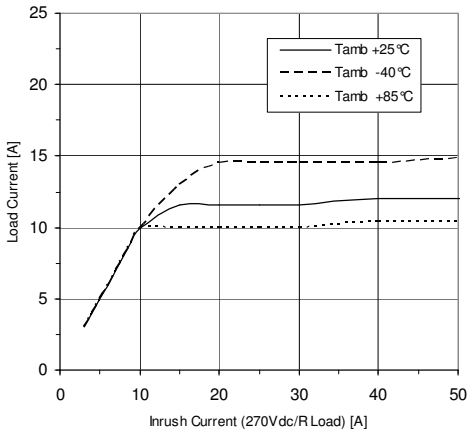
TRIPPING CURVE @ TURN ON



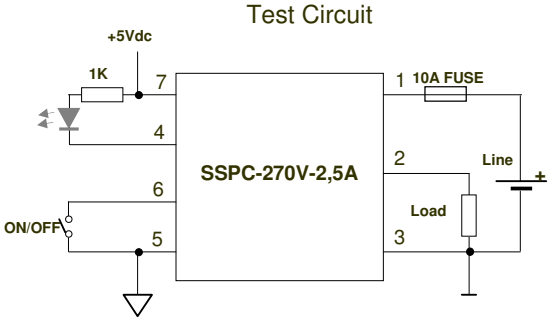
TRIPPING CURVE @ ON STATE



OVERLOAD INRUSH CURRENT LIMITATION



Test Circuit



Test Method

Curves 1 – 2	Line	0 / 270 Vdc	Load	5 ohm
Curves 3 – 4	Line	270 Vdc	Load	0 – 100 ohm

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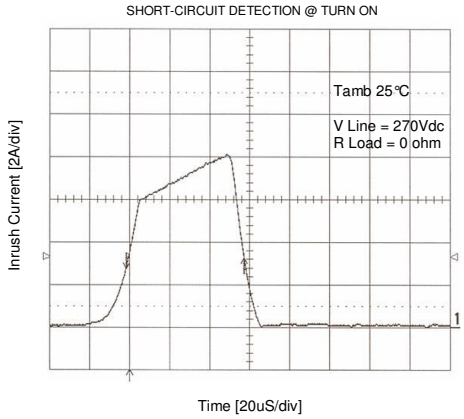
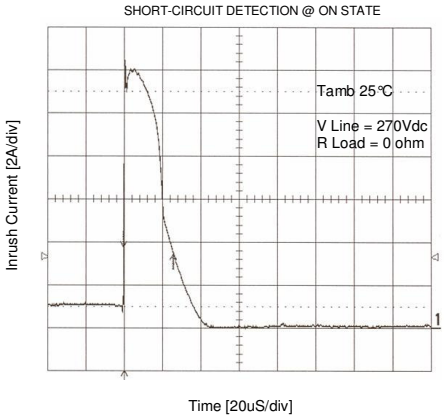
Short-circuit Detection





Application Notes

Board Layout
During board layout must be take in account that any current-carrying power tracks could produce unwanted magnetic coupling when turn normal load on and off. As the magnetic coupling is current dependent, in presence of overload or short-circuit, the above mentioned phenomena could be significantly higher than with normal loads. To prevent as much as possible any oscillation on the low power side control signals, AREA SSPC provides a short-circuit inrush current internally limited at 12 Amps nominal value. Good lay-out practices regarding the high current tracks routing, that must be placed as far as possible from control signal tracks, have always be token in consideration to prevent these kind of troubles.

Capacitive load driving
AREA SSPC can turn on into a nominal pure capacitive load of 80uF@270V or 1500uF@48V without tripping. When the SSPC is already in on state, and an heavy uncharged capacitive load is applied, i.e. through a manual switch, it could trip the power switch also for capacitance lower than 80uF. In case of high capacitive load is recommended to verify that the load charging current doesn't intersect the SSPC I^2t curves to prevent unwanted tripping. Capacitive overload can't produce any permanent damage on SSPC device.

Inductive line driving
AREA SSPC are equipped with internal free-wheel power diode, between LOAD and PWRGND, to provide, at switch off or at tripping occurrences, an easy discharge path for the energy stored in a inductive wiring. This diode prevents any unwanted negative voltage transient between LOAD and LINE pins, that could exceed the absolute ratings of 500Vdc, increasing the device reliability. In case of inductive line or long wire driving, the use of an external rated transient suppressor, between LINE and PWRGND pins, is recommended to prevent any possible problem. Inductive overload could produce permanent damage on SSPC device.

Device paralleling
Due to many technical reasons, SSPC devices employ doesn't allow direct parallel connection to increase load current performance. The manufacturer recommend to avoid as much as possible these kind of usage.

Heatsink
AREA SSPC are equipped with internal 95 °C over temperature detection circuit that automatically turn off the power switch when the case temperature exceeds this limit. The maximum ambient temperature that doesn't require heat sink is given as : 95°C – (7[°C/W] x (0,26 [ohm] x I Load² [Amp])).
Operative ambient temperature that exceed this limit requires external carrier and forced heat sink. The external carrier can be locked on the device case using two M3 screws.

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