

+270V 10A Isolated Power Controller
53293-004
PRELIMINARY DESIGN – SUBJECT TO CHANGE



Features:

- 270V DC System compliant SPST, normally open
- Active inductive load snubbing
- Bias and I²C Isolated from Switch
- Programmable steady state and instant trip
- Operation temperature of -40°C to +85°C
- Open frame / PC Board design with optional dust cover
- I²C reporting of Status, Switch voltage, Output Current and control board temperature
- Low on resistance Power MOSFET output
- 280 grams max

DESCRIPTION:

This Isolated DC Power Controller is a low mass open construction DC power controller intended for applications within an enclosure.

An I²C interface communication allows user defined operation conditions of programmable I²t overload and fault values, On/Off control and returns data of operating conditions Switch Voltage, Switch current, Status, I²t overload and fault and board temperature.

MOSFET output switching provides soft start and low On voltage drop for cool operation.

An isolated bias supply of 18 to 32V powers all functions.

The Power Controller combines the functionality of a relay and circuit breaker. Output current is monitored for over-current to an I²t trip curve. A load current beyond the programmed I²t trip value is terminated upon detection. Overload or fault currents above the instant trip programmed value is terminated instantly. The output remains blocked until the unit is turned off. Setting CONTROL Off resets a Tripped condition.



ABSOLUTE MAXIMUM RATINGS

T_C = 25°C unless otherwise noted

Load Voltage (Actively Clamped above 450V) ¹	650 VDC
Load Current ²	user programmable / Self Protected to 10A (Steady State), 100A (Instant)
Bias supply voltage, V _{DD}	-0.6 to 32 VDC
Operating temperature	-40°C to +85°C Base
Storage temperature	-55°C to +125°C

THERMAL CHARACTERISTICS (Output switches)

Thermal Resistance (θ _{JC}).....	0.3 °C/W
Junction Temperature ³	150 °C

Notes:

¹ Active clamping prevents transient or steady state voltages from exceeding 450V. Operation above this region may thermally
² The (circuit breaker) I²t / Instant Trip functions terminate overload and short circuit currents.
³ Power MOSFET maximum junction temperatures under transient and fault conditions.
⁴ Reverse polarity is not blocked by the SSPC possibly causing permanent damage to the SSPC and external circuits.

ELECTRICAL CHARACTERISTICS: $T_C = 25^\circ\text{C}$ unless specified.

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Input Characteristics					
Bias Supply Range, V_{DD}		18	28	32	VDC
Bias Current			70	90	mA
Output characteristics					
Maximum Output Voltage				425	VDC
Output Current I^2t Threshold	Programmable	0		10	ADC
Output Current I^2t Resolution				4096	Steps
Output Over-Current Threshold	Instant Trip - Programmable	0		100	ADC
Output Over-Current Resolution				4096	Steps
On-State Voltage Drop ($V_{DS(ON)}$)	10A at 25°C			0.5	VDC
On-state Resistance ($R_{DS(ON)}$)	10A at 25°C			0.025	Ohms
Snubbing (External Load Inductance) ²	Active Clamp protection			35	μH
Peak Snubbing current ³	Non repetitive			150	A
Output Load Capacitance	Note 7			300	μF
Dynamic Characteristics					
Output Capacitance			30,000		pF
Input to Output Capacitance			250		pF
Steady state recovery time ⁴	90% of programmed value		10		Sec
Instant trip settling time ⁴	90% of programmed value		1		Sec
Restart after fault ⁵		1			Sec
Switching Characteristics					
Turn-On Delay Time ⁶	Note 5		10	25	mS
Turn-On Rise Time	Figure 1		1.0	3.0	mS
Turn-Off Fall Time	Figure 1		1.0	3.0	mS
Status Output Specification					
Trip Reset Time	Remove overload & Cycle input	50			mS
Data Communications					
I^2C (Voltage Compliance)	Externally supplied	3.0V		5.5V	
Module Addressing	4 bits / switch programmable				
Measurement Resolution / Accuracy					
Switch Voltage Resolution	LSB		67.512		mV
Switch Voltage Accuracy	F.S. = 276.65V		$\pm 5\%$ F.S.		
Output Current Resolution	LSB		25.0		mA
Output Current Accuracy	F.S. = 102.4A		$\pm 5\%$ F.S.		
Temperature Resolution	LSB		0.04915		$^\circ\text{C}$
Temperature Accuracy	F.S. = $150.3^\circ\text{C} - 67.8468^\circ\text{C}$ Offset		2.0°C		
General Specifications					
Mass				250	gram

NOTES:

- Minimum command "Off" or "On" time is 100 mSec
- Additional external snubbing may be required for shorted while on.
- Application specific – external peak current suppression needed beyond 150A.
- Fully I^2t protected. Allow 100 Sec between overload or shorted load restarts for full current startup.
- Allow 10 Sec from Current Trip to restart to allow thermal conduction away from the output MOSFETs.
- Latency of I^2C command ON to hardware activation.
- Capacitor charge terminated beyond programmed Instant trip current. $I = V^2/C/t$ when I = Instant Trip, V = Bus Voltage, C = load capacitance and t = T-ON (1msec typical).

Module Features

Is a μ Processor based system communicating in I²C reporting operating conditions of device temperature, Bus / switch current, switch status and Switch voltage. All control circuits and the μ Processor are powered from the Bias Input and must be present for any control or monitoring function.

A design feature ensures power up in the “off” fault condition. After the application of Bias, the control must be programmed to a “0” off state to reset the fault latch then to “1” for the first switch activation. Switch turn on time is optimized to power up capacitive loads and switching power dissipation. Switch-turn off and fault shutdown times are optimized for load inductance energy control and device dissipation. The I²t is programmable to 10A in 4096 steps. Instant trip is programmable to 100A in 4096 steps. Slow Blow fuse characteristics apply when the instant trip is above the I²t value. Fast Blow characteristics apply when instant trip is set below the I²t value. Output restoration requires the control to be cycled low then back on.

Turn ON into a shorted load is terminated at the instant trip program current within the Turn-On time. Shorted while ON peak inductive spike current is internally protected to 150A peak. Additional clamping and snubbing protection may be required.

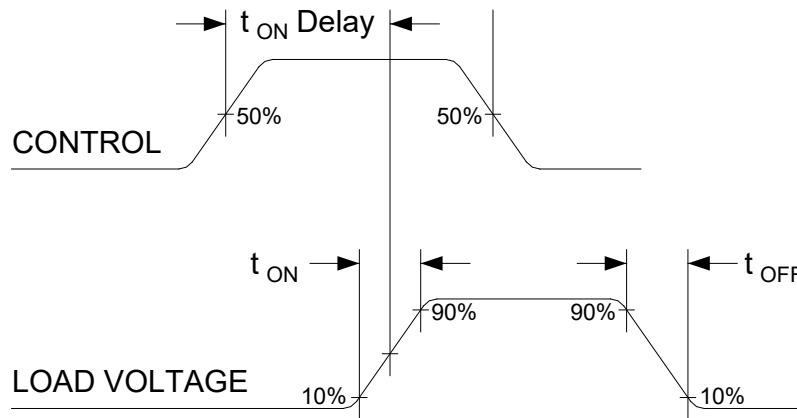


Figure 1 Switching Characteristics

Turn on into Short Sequence

Short while on Sequence

Control	0	1	1	0	1	1	1	1	0	1
I out	Off	Off	Off	Off	On	On	Off	Off	Off	On
Switch Status	0	0	0	0	Open “1”	Open “1”	0	0	0	Open “1”
Shorted Output	Shorted	Shorted	X	Off	Off	Off	On	X	X	Off

Truth Table – Short circuit and Status

Notes:

1. Unit Powers up in the OFF condition with application of Primary power.
2. An OFF Control to ON Control transition is required to first turn the Unit On.
3. Bias Power is required for condition reporting (Voltage, current, temperature or Status).
4. A loss of V_{DD} will return the output state to OFF.

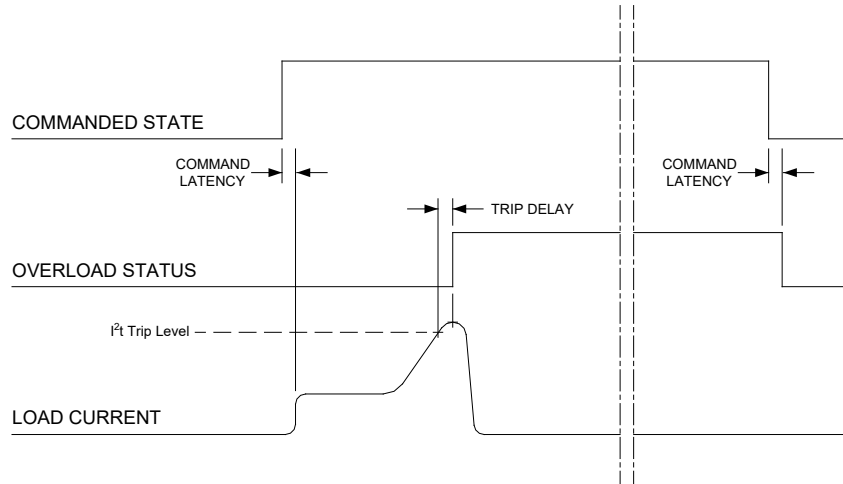


Figure 2 I²C Trip Waveforms

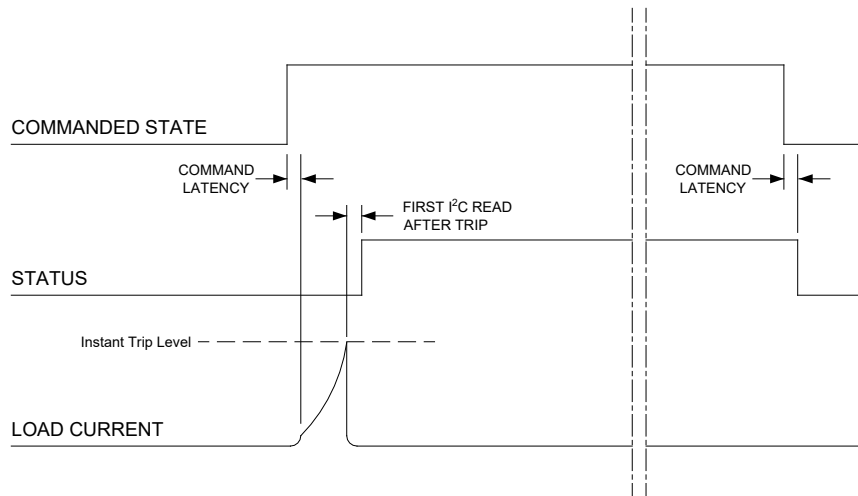


Figure 3 Instant Trip Waveforms

Notes:

5. Unit Powers up in the OFF condition with application of Primary power.
6. Bias Power is required for condition reporting (Voltage, current, temperature or Status).
7. A loss of V_{DD} will return the output state to OFF.

I²C Data Protocol

Write commands will be either 2 bytes or 3 bytes in length. This includes the address byte.

If the write is 2 bytes in length, it is an SSPC output state command. A value of zero (0) will be output off, and a value of one (1) will turn the output on.

If the write is 3 bytes in length, it is a SSPC setup command. The first data byte will be Steady State Current, with values of 1 to 10 allowed, giving trip currents of 1 Amp to 10 Amps. The second data byte will be Instant Trip Current, with allowed values of 1 to 100, giving instant trip currents of 1 Amp to 100 Amps. When either Steady State Current or Instant Trip Current values are changed, there is a 0.1 second RC time constant. Allow enough time for the new values to settle.

Read command is able to return 12 bytes of data.

Byte #: Data

1. Status Bit (0 = OK, 1 = Fault Current Trip)
2. Commanded Output State (0 or 1)
3. Steady State Current value (1 to 10 decimal, 1 to 0x0a hexadecimal)
4. Instant Trip Current value (1 to 100 decimal, 1 to 0x64 hexadecimal)
5. Packed BCD upper 2 digits of Voltage across Switch (00 to 0x40)
6. Packed BCD lower 2 digits of Voltage across Switch with implied decimal point (00 to 0x99)
7. Packed BCD upper 2 digits of sensed current
8. Packed BCD lower 2 digits of sensed current with implied decimal point
9. Packed BCD upper 2 digits of sensed temperature
10. Packed BCD lower 2 digits of sensed temperature with implied decimal point
11. Software Version Number
12. Reserved
13. Hardware Version (ASCII)

Returned Packed Voltages will be 0000 to 4095 (00,00 to 40,95), from an input Voltage of 0 to 4.096 Volts seen by the microcontroller. Scaling will need to be done by the host computer.

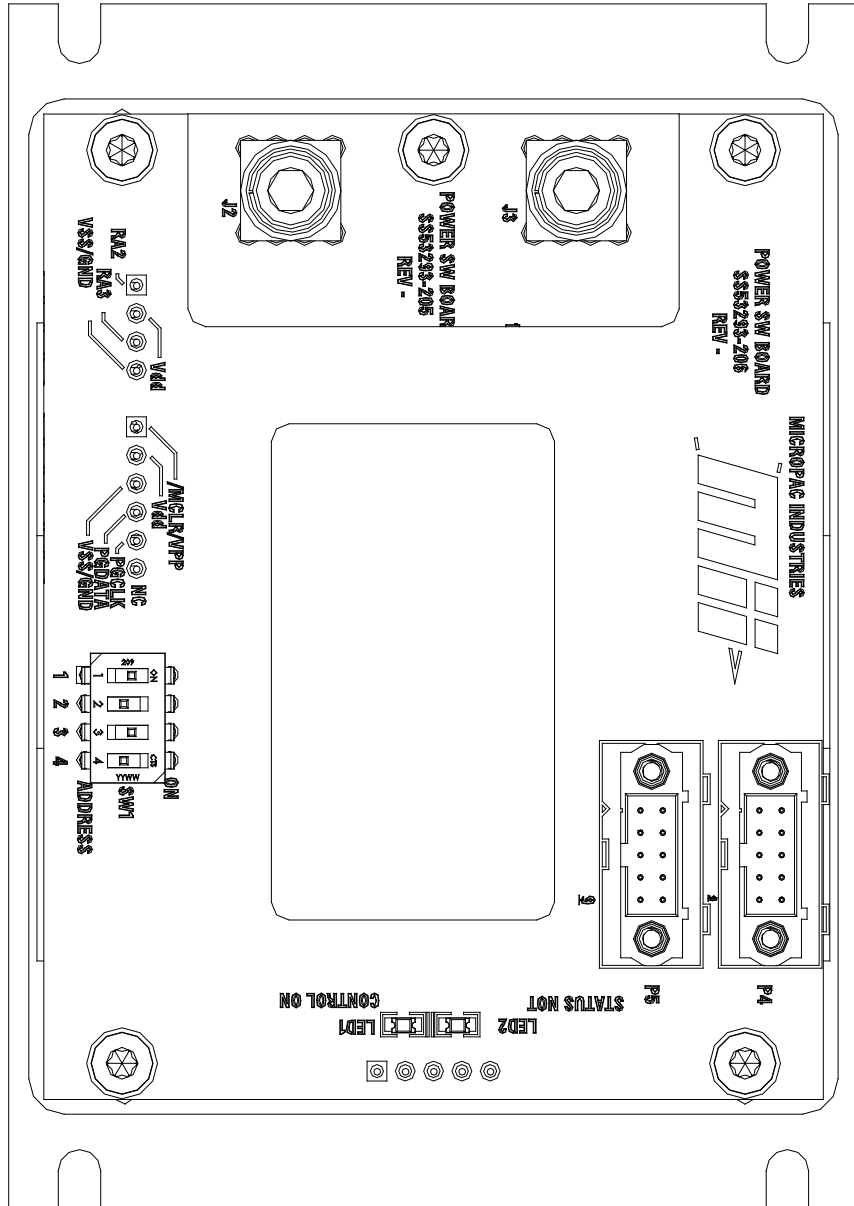
Full Scale current for the current is 102.4 Amps, which gives a bit resolution of 0.025 mA per bit.

Full Scale Voltage is 276.65 Volts, which gives a bit resolution of 0.067512 Volts per bit.

Temperature resolution is 0.04915146 Degrees C per bit, with an offset of -67.8468 Degrees.

Table 1

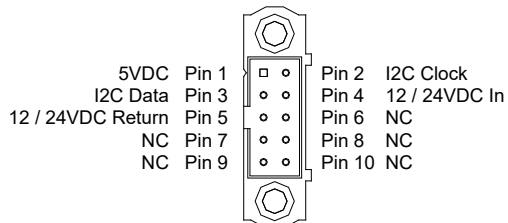
SW1	HEX ADDRESS
0 0 0 0	NOT ALLOWED
0 0 0 1	11
0 0 1 0	12
0 0 1 1	13
0 1 0 0	14
0 1 0 1	15
0 1 1 0	16
0 1 1 1	17
1 0 0 0	18
1 0 0 1	19
1 0 1 0	1A
1 0 1 1	1B
1 1 0 0	1C
1 1 0 1	1D
1 1 1 0	1E
1 1 1 1	1F



NOTE: 12 / 24VDC Return is not connected at the Power Controller to prevent ground loops at system level. This point must be connected external to the Power Controller for correct operation

Output Connections:
 Connector J2 Most Negative
 Connector J3 Most Positive

Hardware Connections:
 J2 and J3 uses M4 x 0.7mm threaded bolts
 MAX Torque for hardware is 5 in-lbs



- P4 / P5 Part Number : M80-5001042
- P4 / P5 Mating Connector : M80-4601005 [22 AWG]
- P4 / P5 Mating Connector Contacts : M80-0110005 [22 AWG]
- M80-4611005 [24 to 28 AWG]
- M80-0130005 [24 to 28 AWG]

Figure 4 Pin Assignment

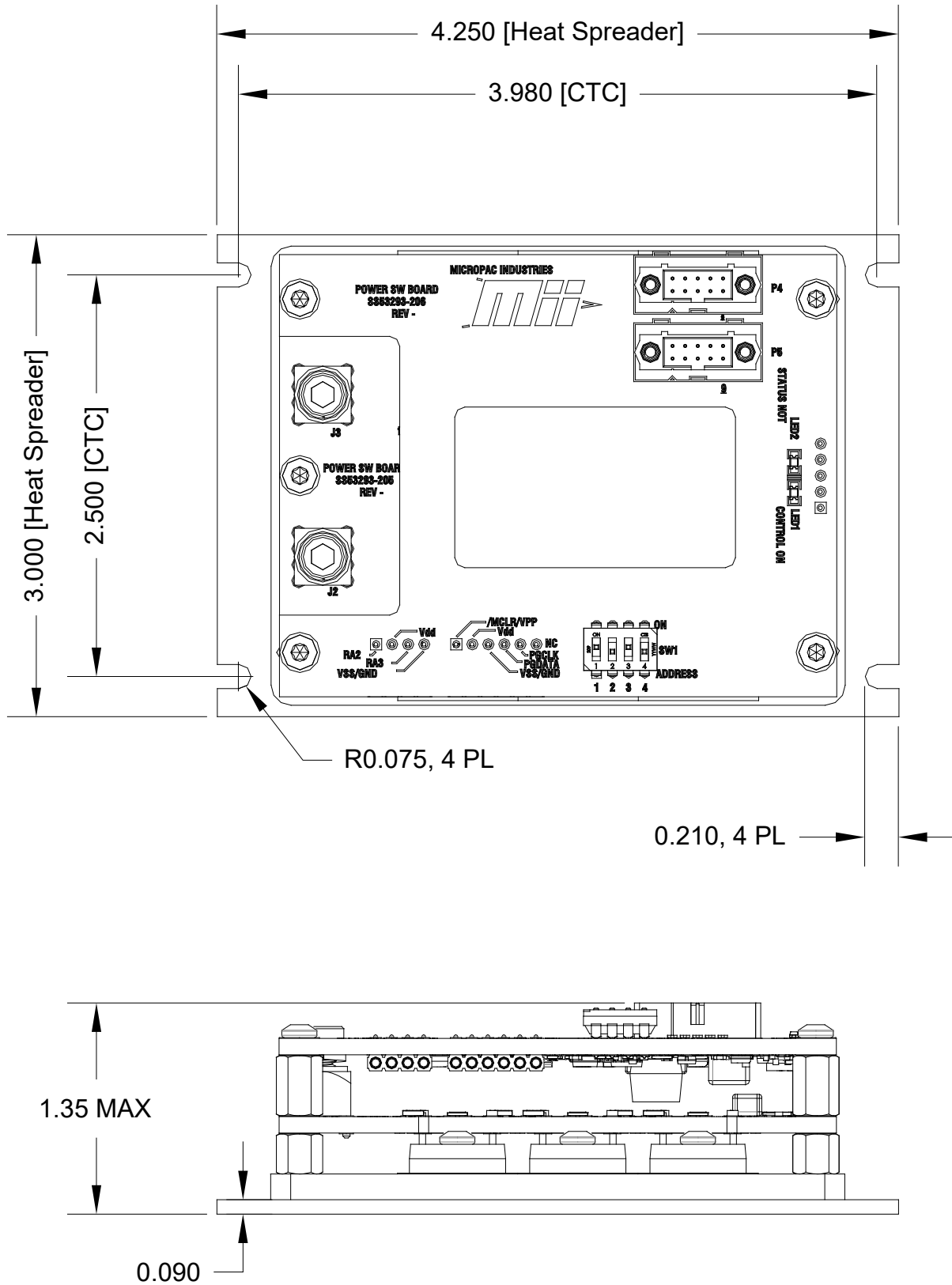


Figure 5 Package Dimensions

Product Status:

This document contains information on a product under development. Micropac reserves the right to change this product.