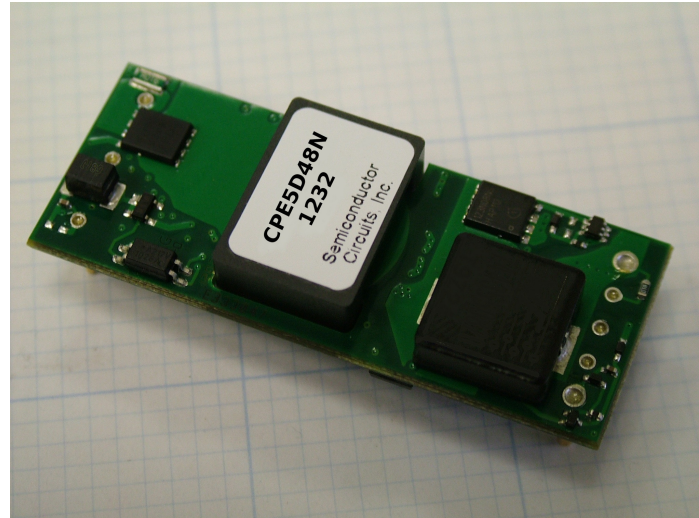## Features

- Wide input voltage range: 36 – 75Vin
- Output: 24 V at 5 A, 120W max.
- ROHS Directive 2002/95/EC Compliant
- No minimum load required
- Low height - 0.500" (12.7mm) max.
- Basic Insulation
- Withstands 100 V input transients
- Fixed-frequency operation
- Industry standard 1/8th brick footprint
- Fully protection (OTP, OCP, OVP, UVLO – auto-restart)
- Remote ON/OFF - positive or negative enable logic options
- Remote sense
- Output voltage trim range: +10%/-20% (industry-standard trim equations)
- Weight: 0.9 oz [25.5 g]
- On-board input differential LC-filter
- Meets UL94, V-0 flammability rating
- Designed to meet UL/CSA60950-1, TUV per IEC/EN60950-1, 2nd edition
- Designed to meet Class B conducted emissions per FCC and EN55022 when used with external filter (see EMC Compliance section below.)

Description

The CPE5D48 "Cool Power Technologies" DC-DC converter is an open frame eighth-brick DC-DC converter that conforms to industry standard specifications. The converter operates over an input voltage range of 36 to 75 VDC, and provides a tightly regulated output voltage with an output current rating of 5 A. The output is fully isolated from the input and the converter meets Basic Insulation requirements. The standard feature set includes remote On/Off (positive or negative enable), input undervoltage lockout, output overvoltage protection, overcurrent and short circuit protections, output voltage trim, remote sense and overtemperature shutdown with hysteresis. The high efficiency of the CPE5D48 allows operation over a wide ambient temperature range with minimal derating (full rated power @ 70°C & 200LFM (1m/s) airflow @ 48Vin.)

ELECTRICAL SPECIFICATIONS 36–75Vin, 24V/5Aout

Conditions: T_A = 25 ºC, Airflow = 300 LFM, Vin = 48 VDC, Cin = 33 µF, unless otherwise specified.

Input Characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Operating Input Voltage Range		36	48	75	VDC
Input Under-Voltage Lock-out 　Turn-on Threshold 　Turn-off Threshold		 34.2 32.4	 35.0 33.2	 35.9 34.1	VDC
Input Voltage Transient	100ms			100	VDC
Maximum Input Current	V_{IN} = 36VDC; I_{OUT} = 5A			3.6	A
Input Standby Current	Converter Disabled		2	5	mA
Input No-Load Current	Converter Enabled		85	120	mA
Short Circuit Input Current			20		mA_{RMS}
Input Reflected Ripple Current	5Hz to 50MHz		10	20	mA_{PK-PK}
Input Voltage Ripple Rejection	120Hz		50		dB
Inrush Current	All	-	-	0.05	A^2/s

Output Characteristics

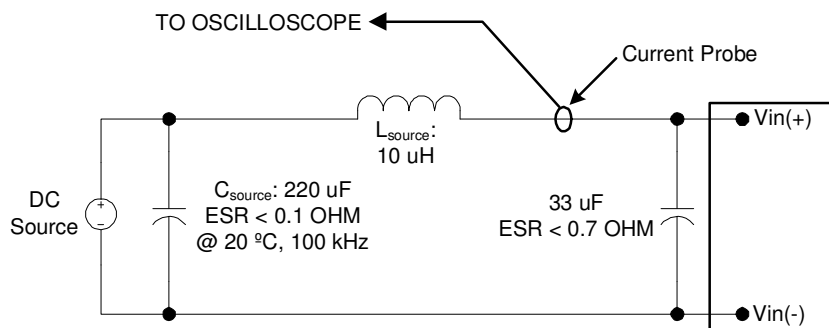| Parameter	Conditions	Min	Typ	Max	Unit
Output Voltage Set point	Sense pins connected to output pins	23.64	24.00	24.36	VDC
Output Current		0		5	A
Output Current Limit Inception		5.5	6.5	9	A
Peak Short-Circuit Current	10mΩ Short			12	A
RMS Short-Circuit Current	10mΩ Short			1.0	A_{RMS}
External Load Capacitance				1000	uF
Output Ripple and Noise	20 MHz bandwidth		80	130	mV_{PK-PK}
Output Regulation 　Line: 　Load: 　Overall Output Regulation:	 Over line, load & temp.	 23.52	 ±10 ±10 	 ±24 ±24 24.48	 mV mV V

ELECTRICAL SPECIFICATIONS (continued)   36–75Vin, 24V/5Aout

Conditions: T_A = 25 ºC, Airflow = 300 LFM, Vin = 48 VDC, Cin = 33 µF, unless otherwise specified.

Efficiency

Parameter	Conditions	Min	Typ	Max	Unit
100% Load		93	93.5		%
50% Load		90.5	91.5		%

Dynamic Response

Parameter	Conditions	Min	Typ	Max	Unit
Load Change 50%-75% or 25% to 50% of Iout Max, di/dt = 0.1 A/µs	Co = 1 µF ceramic + 10 µF tantalum		120	200	mV
Settling Time to 1% of Vout			50		µs
Load Change 25% of Iout Max, di/dt = 0.1 A/µs	Co = 1 µF ceramic + 440 µF electrolytic		60	100	mV
Settling Time to 1% of Vout			50		µs

Isolation Specifications

Parameter	Conditions	Min	Typ	Max	Unit
Isolation Capacitance			1000		pF
Isolation Resistance		10			MΩ

Reliability

Per Telcordia SR-332, Issue 2: Method I, Case 3 (I_O=80% of I_O_max, T_A=40°C, airflow = 200 lfm, 90% confidence	MTFB	2,248,774			Hours
	FITs (failures in 10^9 hours)	445			/10^9 Hours

ELECTRICAL SPECIFICATIONS (continued)   36–75Vin, 24V/5Aout

Conditions: Ta = 25 °C, Airflow = 300 LFM, Vin = 48 VDC, Cin=33 µF, unless otherwise specified.

Absolute Maximum Ratings

Parameter	Conditions	Min	Typ	Max	Unit
Input Voltage	Continuous Operation	0		75	VDC
Operating Ambient Temperature		-40		85	°C
Storage Temperature		-55		125	°C

Feature Characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Switching Frequency			410		kHz
Output Voltage Trim Range		-20		+10	%
Remote Sense Compensation				+10	%
Output Over-voltage Protection	Non-latching	115	120	130	%
Over-temperature Protection	Avg. PCB temp, non-latching		125		°C
Peak Backdrive Output Current during startup into prebiased output	Sinking current from external voltage source equal to V_{OUT} – 0.6V and connected to the output via 1Ω resistor. C_{OUT}=220µF, Aluminum		N/A		mA
Backdrive Output Current in OFF state	Converter disabled		0	5	mA
Enable to Output Turn-ON Time	V_{OUT} = 0.9*V_{OUT_NOM}		20		ms

Output Enable ON/OFF
  Negative Enable
    Converter ON
    Converter OFF
  Positive Enable
    Converter ON
    Converter OFF
		
		-0.5
		2.4
		
		2.4
		-0.5
				
				0.8
				20
				
				20
				0.8
					
					VDC
					VDC
					
					VDC
					VDC

Output Voltage Overshoot @ Startup			0	2	%Vo
Auto-Restart Period	(all protection features)		100		ms

INPUT REFLECTED RIPPLE TEST SETUP:

TO OSCILLOSCOPE

Current Probe

L_{source}: 10 uH

DC Source

C_{source}: 220 uF
ESR < 0.1 OHM
@ 20 ºC, 100 kHz

33 uF
ESR < 0.7 OHM

Vin(+)

Vin(-)

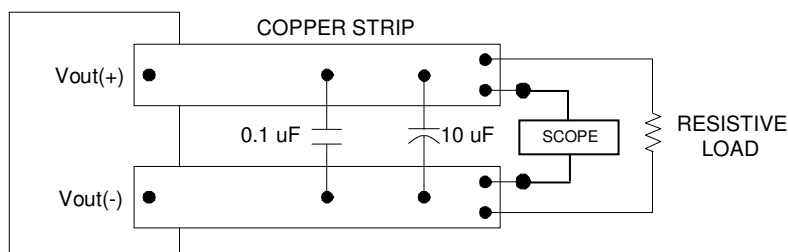**Note: Measure input reflected-ripple current with a simulated source inductance (Ltest) of 10 uH. Capacitor C$_S$ offsets possible source impedance.**

Figure 1. Input Reflected-ripple Current Test Setup.

OUTPUT RIPPLE TEST SETUP:

COPPER STRIP

Vout(+)

0.1 uF

10 uF

SCOPE

RESISTIVE LOAD

Vout(-)

Note: Use a 0.1μF X7R ceramic capacitor and a 10μF @ 35V tantalum capacitor. Scope measurement should be made using a BNC socket. Position the load 3 in. [76mm] from module.

Figure 2. Peak-to-Peak Output Noise Measurement Test Setup.

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CHARACTERISTIC CURVES:

Figure 3. Efficiency vs Output Current, 300lfm airflow, 25°C ambient.

Figure 4. Power Dissipation vs. Load Current, 300lfm airflow, 25°C ambient.

Figure 5. Output Current Derating vs Ambient Temperature & Airflow (converter mounted vertically with air flowing from pin 3 to pin 1, Vin = 48 V.)
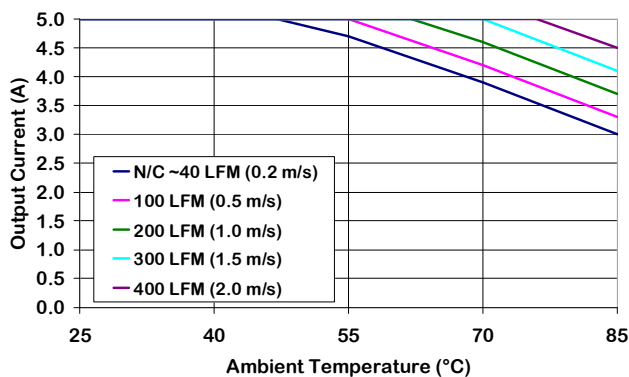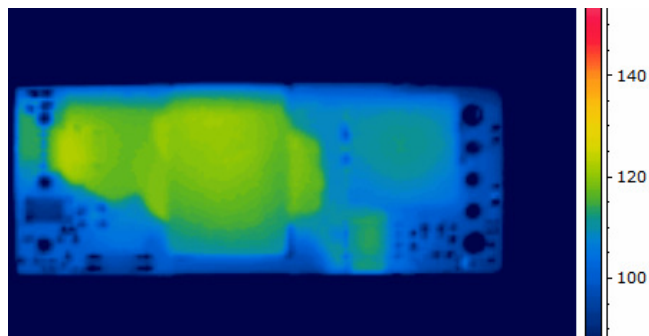

Figure 6. Output Current Derating vs Ambient Temperature & Airflow (converter mounted vertically with air flowing from pin 1 to pin 3, Vin = 48 V.)

Figure 7. Output Current Derating vs Ambient Temperature & Airflow (converter mounted vertically with air flowing from Vin to Vout, Vin = 48 V.)

Figure 8. Thermal Image of CPE5D48 (5A output, 70C Ambient, 200lfm airflow, Vin = 48V, airflow from pin 3 to pin 1, T_{max} = 123°C)

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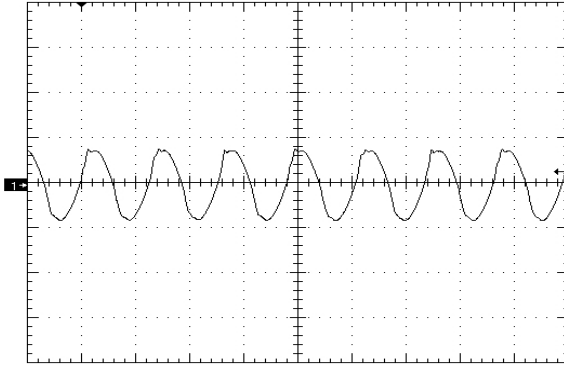
CHARACTERISTIC WAVEFORMS:

Figure 9. Output Voltage Ripple (50mV/div), time scale – 2uS/div. Vin=Vin_nom, full resistive
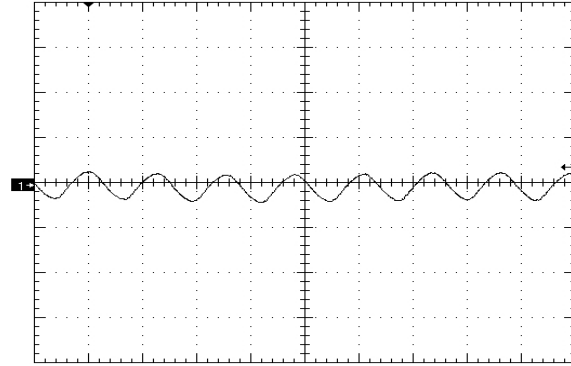

Figure 10. Input Reflected Ripple Current (10mA/div) time scale - 2uS/div. Vin=Vin_nom, full resistive
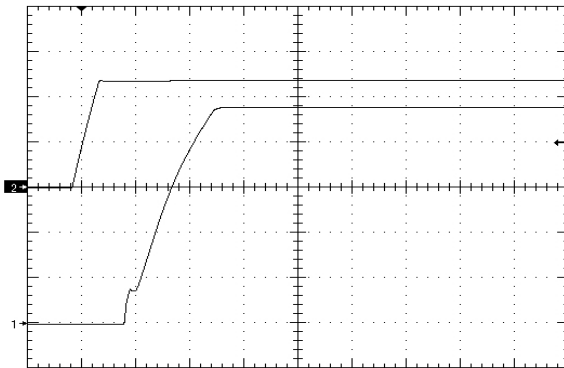

Figure 11. Startup Waveform via Line Voltage (5V/div), time scale 10mS/div. Vin=Vin_nom, no load (negative enable.)
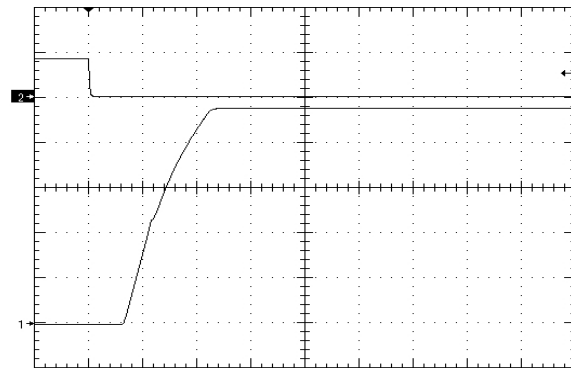

Figure 12. Startup Waveform via Enable Pin (5V/div), time scale 10mS/div. Vin=Vin_nom, full resistive load + 1000uF (negative enable.)
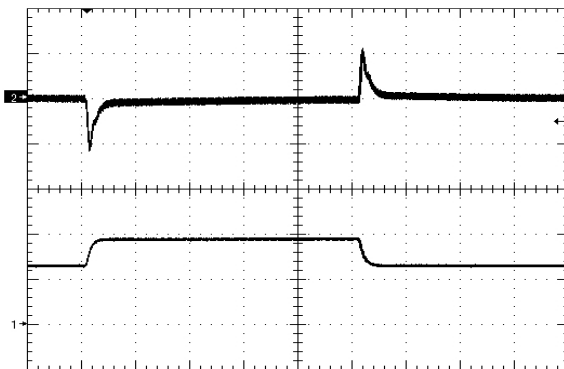

Figure 13. Load Transient Response (100mV/div), di/dt=0.1A/uS, 50% - 75% - 50% of full load, time scale: 200uS/div.
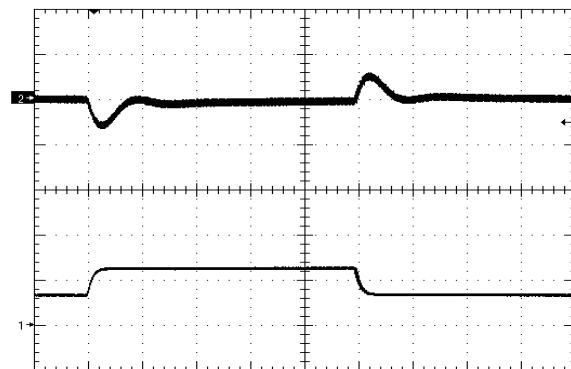

Figure 14. Load Transient Response (100mV/div), di/dt=0.1A/uS, 25% - 50% - 25% of full load, 440uF electrolytic across output, time scale: 200uS/div.

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OUTPUT VOLTAGE TRIM

Output voltage adjustment is accomplished by connecting an external resistor between the Trim Pin and either the +Vout (or +Sense) or –Vout (or –Sense) Pins.

<u>**TRIM UP EQUATION**</u>:

$$\mathrm{Rtrim\_up} = \left[\frac{5.1 \times \mathrm{Vo\_nom} \times (100 + \Delta\%)}{1.225 \times \Delta\%} - \frac{510}{\Delta\%} - 10.2 \right] \times k\Omega$$

Where **Rtrim_up** is the resistance value in k-ohms and Δ% is the percent change in the output voltage.
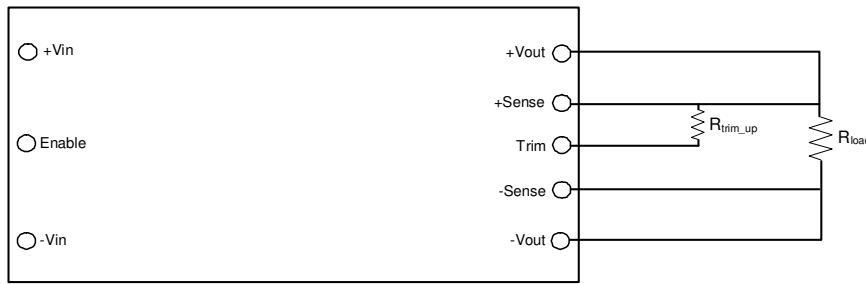

Figure 15. Trim UP circuit configuration

<u>**TRIM-DOWN EQUATION**</u>:

$$\mathrm{Rtrim\_down} = \left(\frac{510}{\Delta\%} - 10.2 \right) \times k\Omega$$

Where **Rtrim_down** is the resistance value in k ohms and Δ% is the percent change in the output voltage.
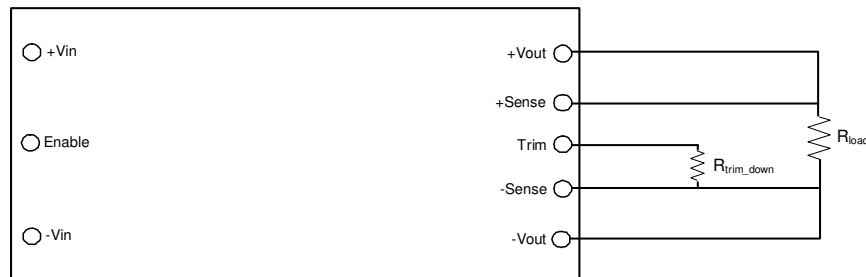

Figure 16. Trim DOWN circuit configuration

EMC COMPLIANCE:

To meet Class B compliance for EN55022 (CISPR 22) or FCC part 15 sub part j, the following input filter is required:
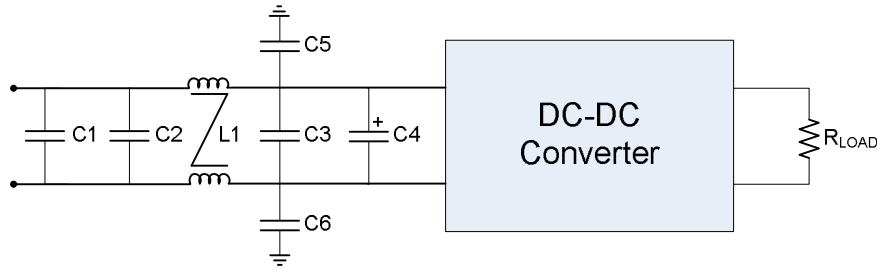

Figure 17. EMI Filter

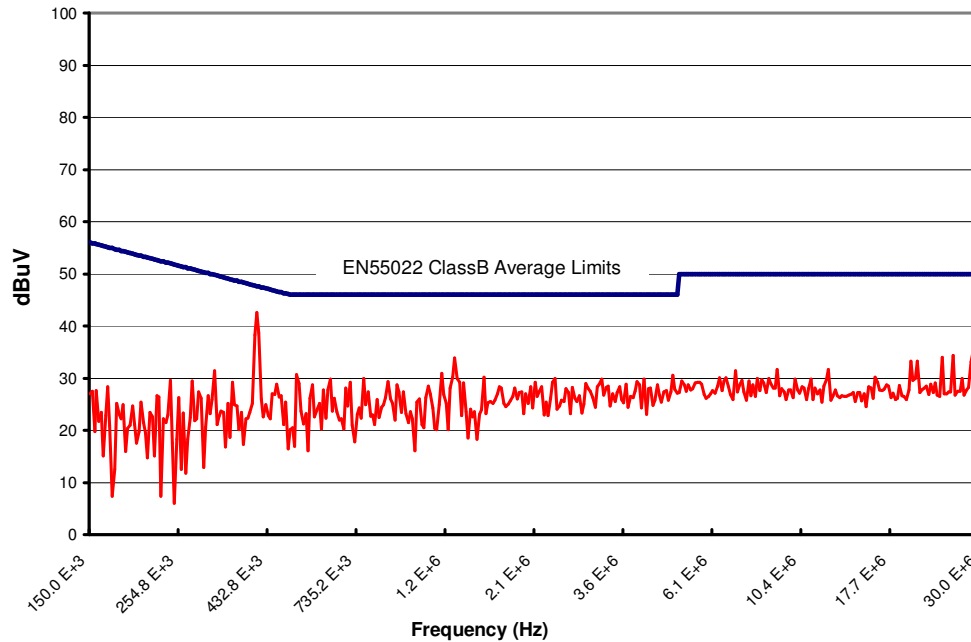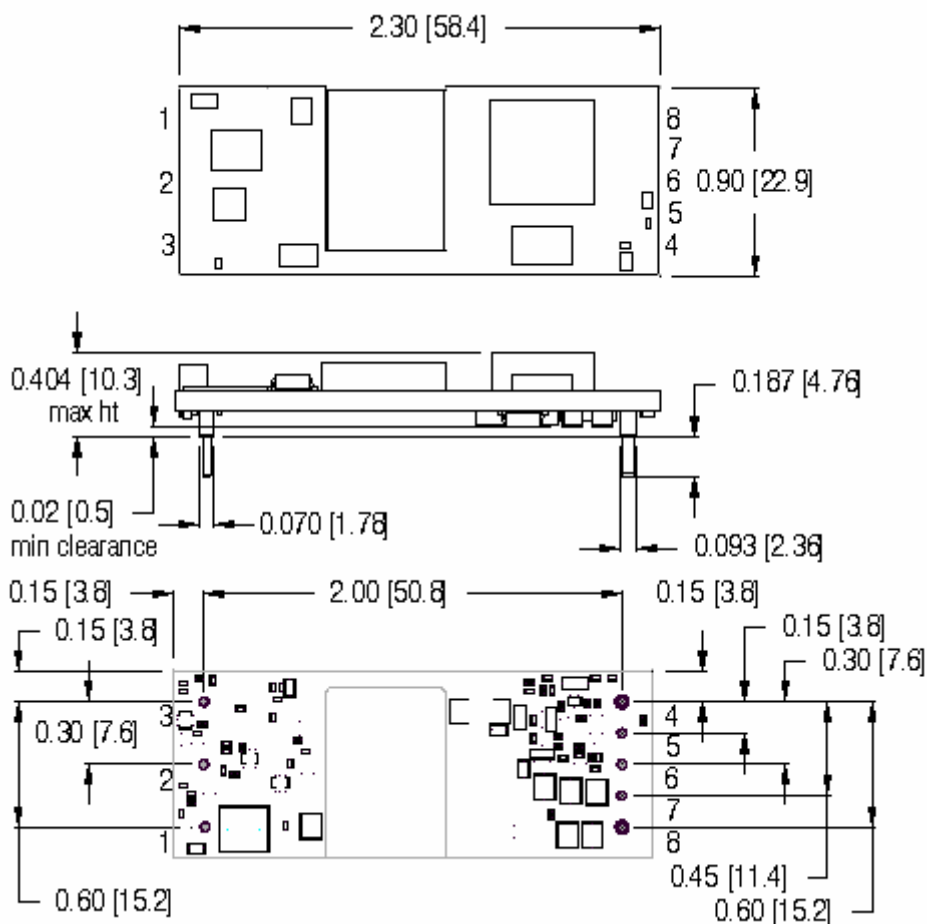| L1 =	1.32 mH Common Mode Inductor
C1, C2, C3 =	2.2uF ceramic
C4 =	100uF electrolytic
C5, C6 =	10nF (@2kV if output is ref. to gnd.)

Figure 18. CPE5D48 Conducted Emissions using above specified input filter.
Vin = 48V, Full Resistive Load

MODULE PIN ASSIGNMENT

PIN #	DESIGNATION	NOTES
1	V_{IN} (+)	1) All dimensions in inches [mm]
2	On/Off	Tolerances: .xx ± 0.02 [.x ± .5]
3	V_{IN} (-)	.xxx ± 0.010 [.xx ± .25]
4	V_{OUT} (-)	2) Input, on/off control and sense/trim pins are Ø 0.040" [1.02] with Ø 0.070" [1.77] standoff shoulders.
5	Sense (-)	3) Output pins are Ø 1.57 mm (0.062") with Ø 0.093" [2.36] shoulders (note, shoulder sits .008" above mounting surface)
6	Trim	4) All pins are gold plated with nickel under plating.
7	Sense (+)	5) Weight: 25.5 g (0.9 oz.)
8	V_{OUT} (+)	6) Workmanship: Meet or exceeds IPC-A-610 Class II

MECHANICAL OUTLINE

Ordering Information:

Product Identifier	Output Current	Output Voltage	Input Voltage	Enable logic option	Additional features
CPE	5	D	48	N or P	- XX
"Cool Power Eighth"	5A	24V	36 – 75V	N = Negative P = Positive	TBD

Rev 1.0, 14-Nov-12