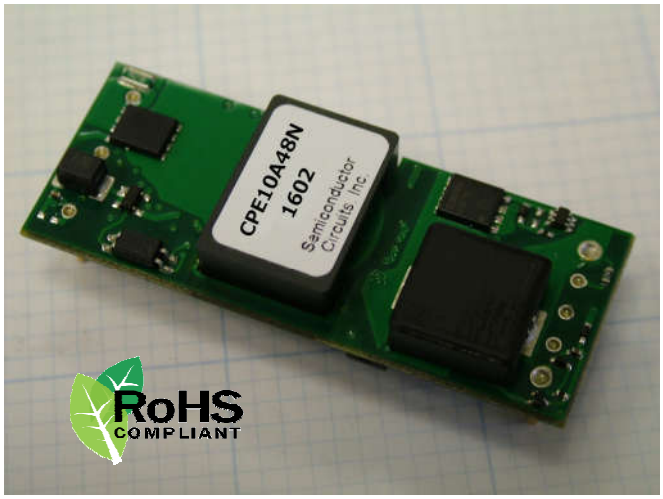
Cool Power Technologies

Eighth-Brick Isolated DC/DC Converter

Features



- Wide input voltage range: 36 – 75Vin
- Output: 5 V at 10 A, 50W max.
- High efficiency – 90% @ FL
- ROHS II Directive 2011/65/EU Compliant
- No minimum load required
- Low height - 0.404" (10.3mm) max.
- Basic Insulation w/2250VDC I/O isolation
- 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]
- Compliant to REACH (EC) No 1907/2006
- On-board input differential LC-filter
- Meets UL94, V-0 flammability rating
- Complies with 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 CPE10A48 "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 10 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 CPE10A48 allows operation over a wide ambient temperature range with minimal derating (see Characteristic Curves section.)

ELECTRICAL SPECIFICATIONS 36–75Vin, 5V/10Aout

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} = 10A			1.6	A
Input Standby Current	Converter Disabled		2	5	mA
Input No-Load Current	Converter Enabled		50		mA
Short Circuit Input Current			30		mA_{RMS}
Input Reflected Ripple Current	5Hz to 50MHz		10	20	mA_{PK-PK}
Input Voltage Ripple Rejection	120Hz		50		dB
Inrush Current	All	-	-	0.1	A^2/s

Output Characteristics					
Parameter	**Conditions**	**Min**	**Typ**	**Max**	**Unit**
Output Voltage Set point	Sense pins connected to output pins	4.925	5.00	5.075	VDC
Output Current		0		10	A
Output Current Limit Inception		10.5	12.5	15	A
Peak Short-Circuit Current	10mΩ Short			25	A
RMS Short-Circuit Current	10mΩ Short		1.6	2.5	A_{RMS}
External Load Capacitance				4700	uF
Output Ripple and Noise	20 MHz bandwidth		40	80	mV_{PK-PK}
Output Regulation Line: Load: Overall Output Regulation:	 Over line, load & temp.	 4.90	 ±1 ±1 	 ±3 ±3 5.10	 mV mV V

ELECTRICAL SPECIFICATIONS (continued) 36–75Vin, 5V/10Aout

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		89.5	90.3		%
50% Load		86	88		%
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			80	300	mV
Settling Time to 1% of Vout	Co = 1 µF ceramic + 10 µF tantalum		50		µs
Load Change 25%-75% of Iout Max, di/dt = 1.0 A/µs	Co = 1 µF ceramic + 220 µF electrolytic		200	400	mV
Settling Time to 1% of Vout			200		µs
Isolation Specifications					
Isolation Capacitance			1000		pF
Isolation Resistance		10			MΩ
Isolation Voltage – Input to Output				2250	V_{DC}
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	3,823,983			Hours
	FITs (failures in 10^9 hours)	262			/10^9 Hours

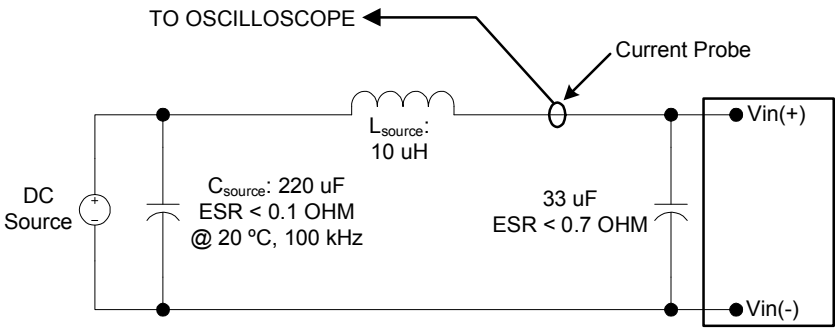
ELECTRICAL SPECIFICATIONS (continued) 36–75Vin, 5V/10Aout

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 Temperature	T_{ref}, see Cooling Considerations section	-40		123	°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		500		mA
Backdrive Output Current in OFF state	Converter disabled		0	5	mA
Power On to Output Turn-ON Time	$V_{OUT} = 0.9*V_{OUT\_NOM}$		20		mS
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 Enable Pin Current Source/Sink	Voltages WRT –Vin. Converter has internal pull-up voltage of approx 5V.	 -0.5 2.4 2.4 -0.5	 0.25	 0.8 20 20 0.8 1	 VDC VDC VDC VDC mA
Output Voltage Overshoot @ Startup			0	2	%Vo
Auto-Restart Period	(OVP, OCP)		100		ms

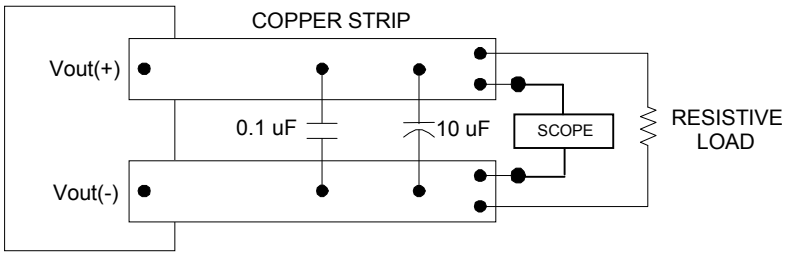
INPUT REFLECTED RIPPLE TEST SETUP:



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:



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.

CHARACTERISTIC CURVES:

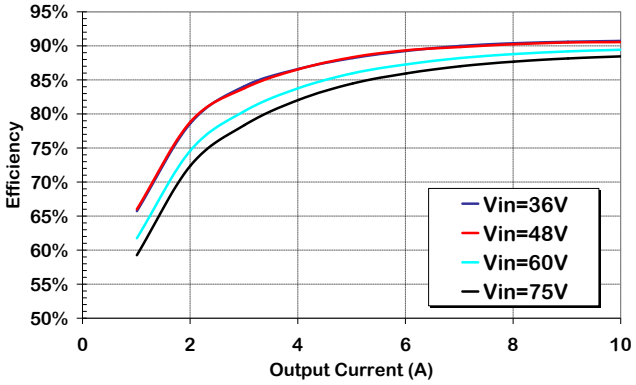


Figure 3. Efficiency vs Output Current, 300lfm airflow, 25°C ambient.

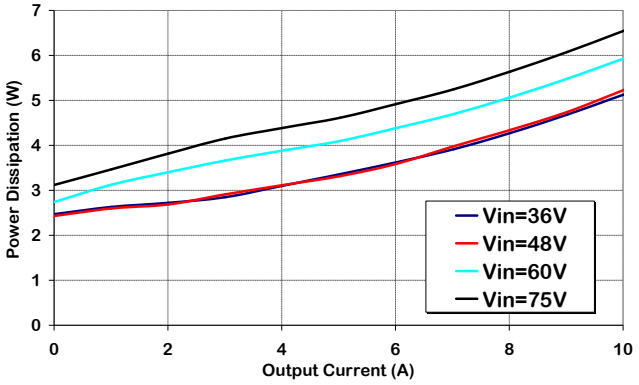


Figure 4. Power Dissipation vs. Load Current, 300lfm airflow, 25°C ambient.

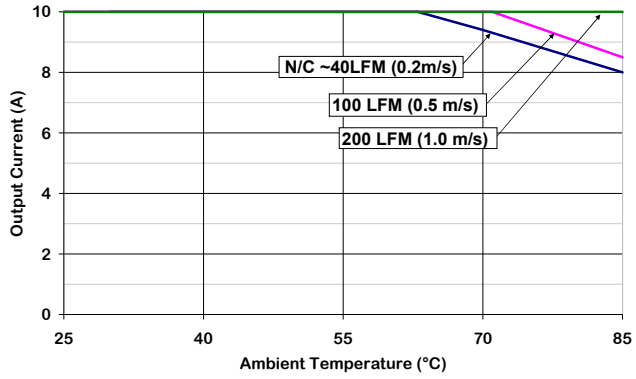


Figure 5. Output Current Derating vs Ambient Temperature & Airflow (converter mounted vertically with air flowing from pin 3 to pin 1, Vin = 48 V.)

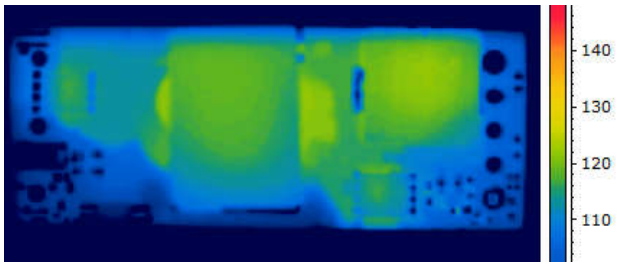


Figure 6. Thermal Image of CPE10A48 (10A output, 70C Ambient, 100lfm airflow, Vin = 48V, airflow from pin 3 to pin 1, T_{max} = 119°C)

CHARACTERISTIC WAVEFORMS:

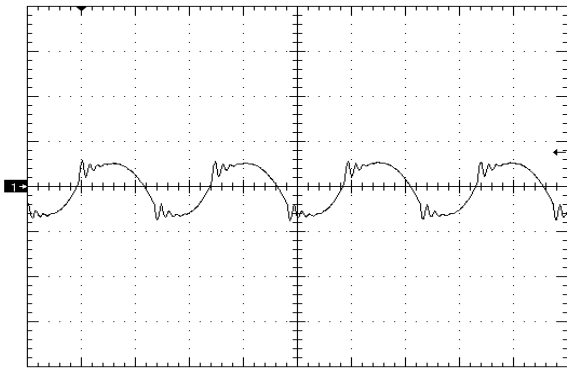


Figure 7. Output Voltage Ripple (20mV/div), time scale – 1uS/div. Vin=Vin_nom, full resistive

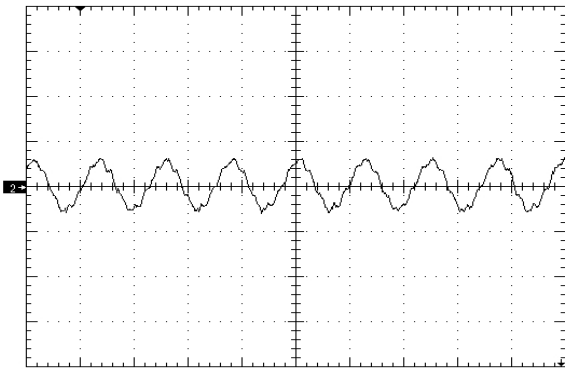


Figure 8. Input Reflected Ripple Current (10mA/div) time scale - 2uS/div. Vin=Vin_nom, full resistive

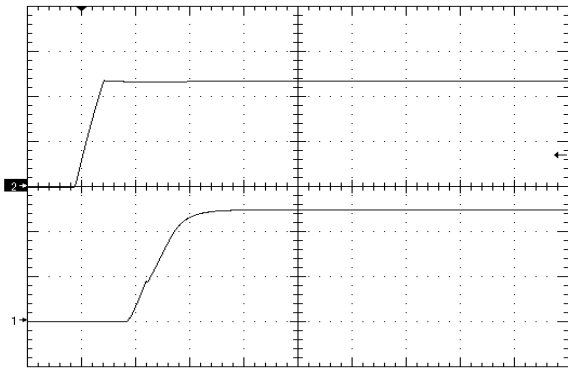


Figure 9. Startup Waveform via Line Voltage, time scale 10mS/div. Vin=Vin_nom, full resistive load

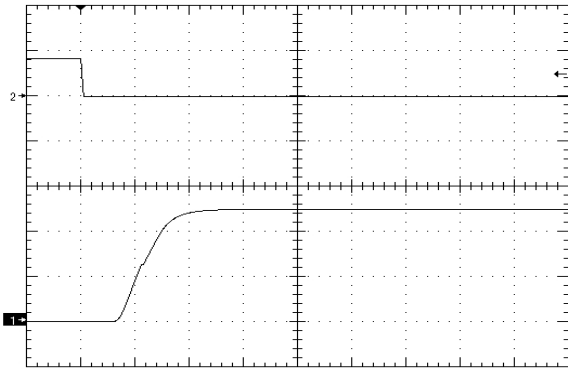


Figure 10. Startup Waveform via Enable Pin, time scale 10mS/div. Vin=Vin_nom, Full Load + 2200uF

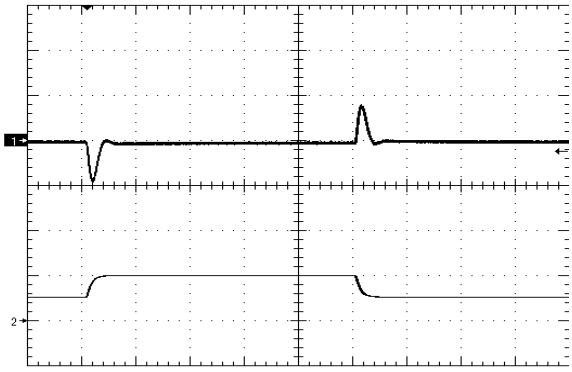


Figure 11. Load Transient Response (100mV/div), di/dt=0.1A/uS, 50% - 25% - 50% of full load, time scale: 200uS/div. Ch2 = 5A/div

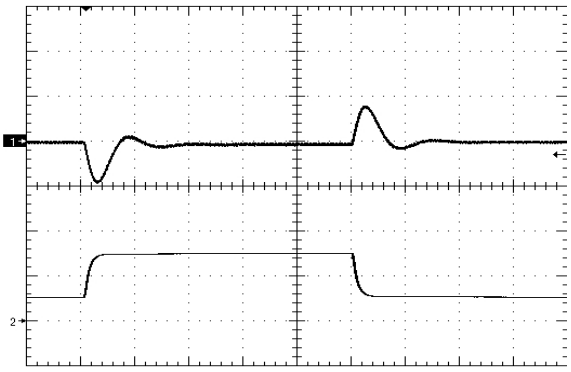


Figure 12. Load Transient Response (100mV/div), di/dt=0.2A/uS, 25% - 75% of full load + 1000uF Oscon low ESR, time scale: 200uS/div. Ch2 = 5A/div

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.

TRIM UP EQUATION:

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

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

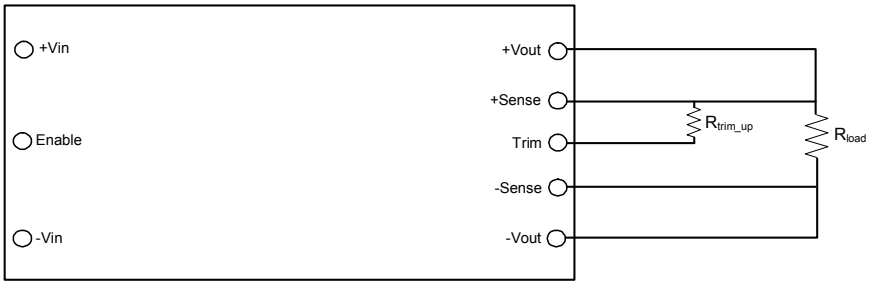


Figure 15. Trim UP circuit configuration

TRIM-DOWN EQUATION:

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

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

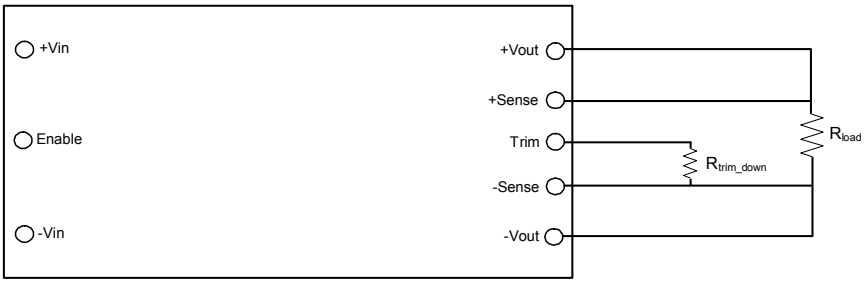


Figure 16. Trim DOWN circuit configuration

EMC COMPLIANCE:

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

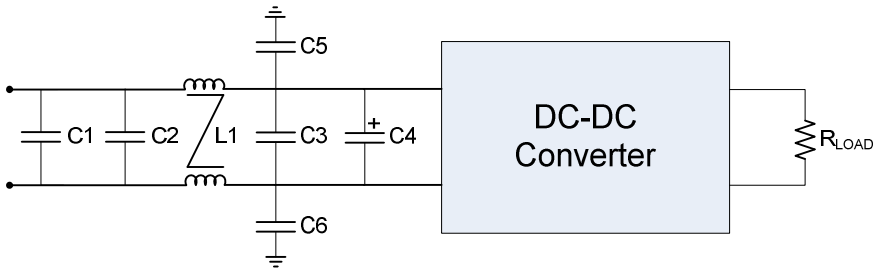


Figure 17. EMI Filter

L1 =	**1.32 mH Common Mode Inductor (P0420)**
C1, C2, C3 =	**2.2uF ceramic**
C4 =	**220uF electrolytic**
C5, C6 =	**10nF (@2kV if output is ref. to gnd.)**

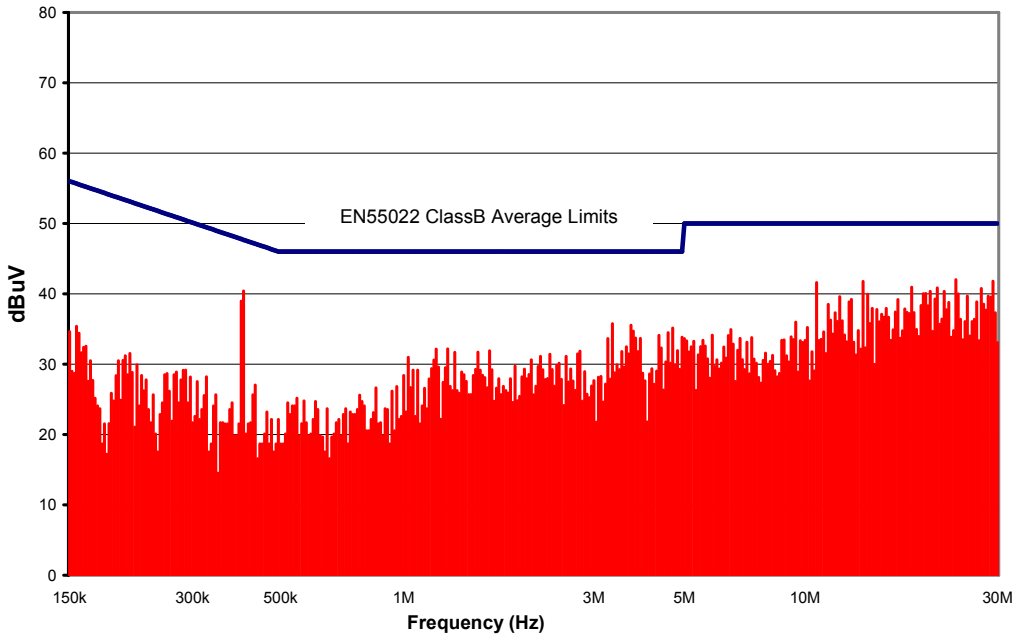
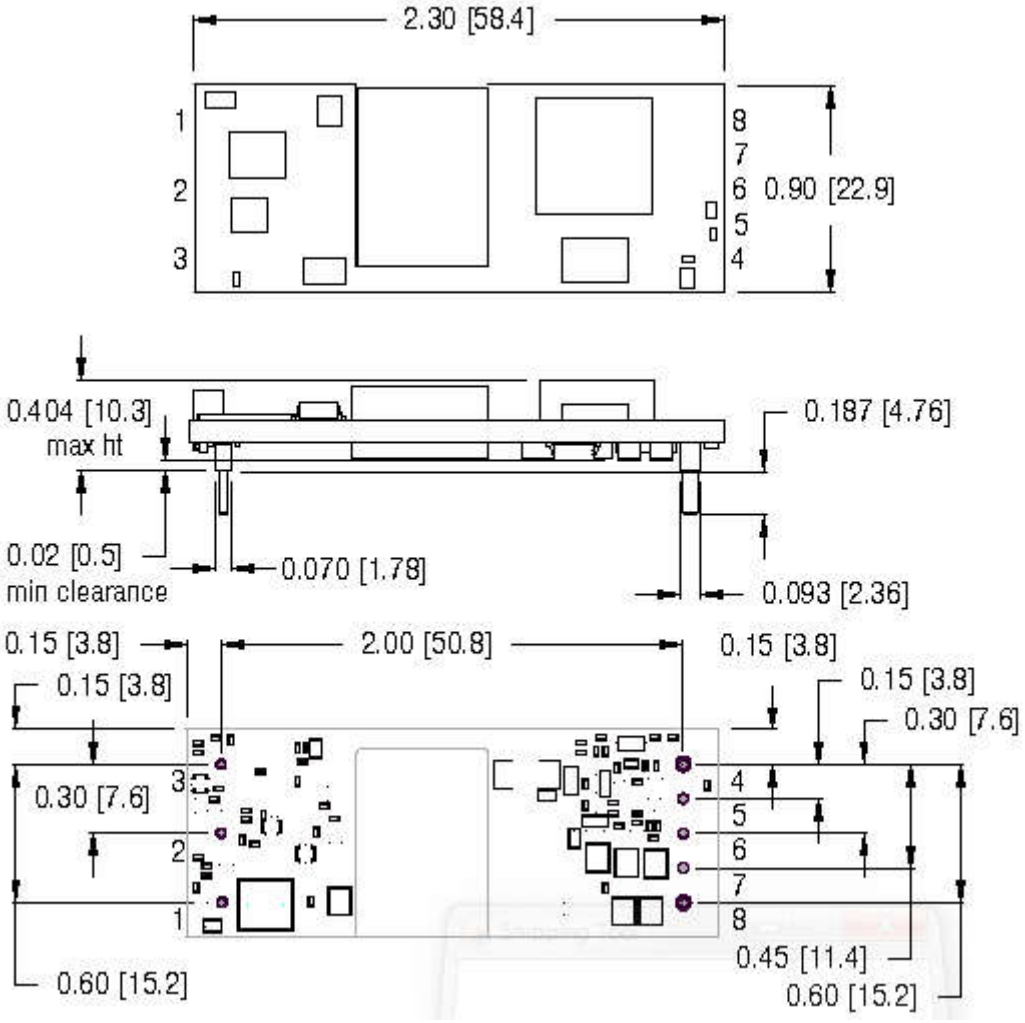


Figure 18. CPE10A48 Conducted Emissions using above specified input filter.
Vin = 48V, Full Resistive Load

MODULE PIN ASSIGNMENT

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

MECHANICAL OUTLINE



Ordering Information:					
Product Identifier	**Output Current**	**Output Voltage**	**Input Voltage**	**Enable logic option**	**Additional features**
CPE	10	A	48	N or P	- XX
"Cool Power Eighth"	10A	5V	36 – 75V	N = Negative P = Positive	TBD

Rev 1.0, 20-July-16