Cool Power Technologies

Sixteenth-Brick Isolated DC/DC Converter

Features

- Industry-standard pinout
- Wide input voltage range: 36 – 75Vin
- Output: 3.3 V at 12 A, 40W max.
- No minimum load required
- Low height - 0.374" (9.5mm) max.
- Basic Insulation
- Withstands 100 V input transients
- Fixed-frequency operation
- Industry standard 1/16th 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: 0.45 oz [12.8 g]
- On-board input differential LC-filter
- Meets UL94, V-0 flammability rating
- UL/CSA60950-1 recognized, TUV certified per IEC/EN60950-1 (pending)
- Designed to meet Class B conducted emissions per FCC and EN55022 when used with external filter (see EMC Compliance page.)

Description

The CPT12F48 "Cool Power Technologies" DC-DC converter is an open frame sixteenth-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 12 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/short circuit protection, output voltage trim, remote sense and overtemperature shutdown with hysteresis. The high efficiency of the CPT12F48 allows operation over a wide ambient temperature range with minimal derating (full rated power @ 80°C & 100LFM (1.0 m/s) airflow @ 48Vin.)

ELECTRICAL SPECIFICATIONS 36–75Vin, 3.3V/12Aout

Conditions: T_A = 25 °C, 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 31	 35 32.5	 36 34	VDC
Input Voltage Transient	100ms			100	VDC
Maximum Input Current	V_{IN} = 36VDC; I_{out} = 12A			1.3	A
Input Standby Current	Converter Disabled		2	5	mA
Input No-Load Current	Converter Enabled		50	65	mA
Input Reflected Ripple Current	5Hz to 50MHz		5	15	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	3.25	3.3	3.35	VDC
Output Current		0		12	A
Output Current Limit Inception		14	18	22	A
Peak Short-Circuit Current	10mΩ Short, Vin=36-75V			30	A
RMS Short-Circuit Current	10mΩ Short, Vin=36-75V		2.8	3.6	A_{RMS}
External Load Capacitance	Low ESR			10000	uF
Output Ripple and Noise	1 uF Ceramic + 10uF Tantalum See Fig 2 for setup		30	60	mV_{PK-PK}
Output Regulation Line: Load: Overall Output Regulation:	 Over line, load & temp.	 3.2	 ±1 ±1 	 ±5 ±5 3.4	 mV mV V

ELECTRICAL SPECIFICATIONS (continued) 36–75Vin, 3.3V/12Aout

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

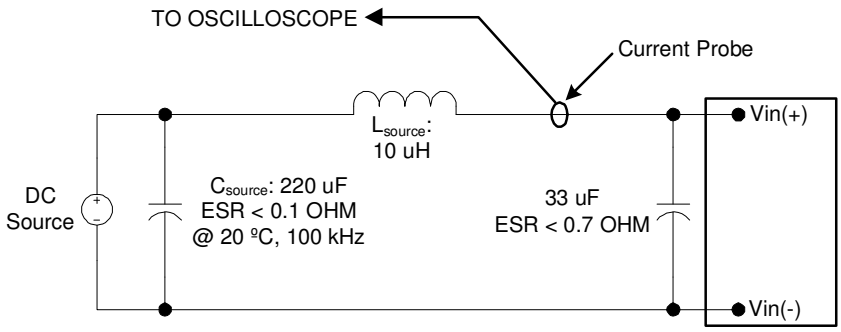
Efficiency					
Parameter	Conditions	Min	Typ	Max	Unit
Full Load	Vin = 48V	88.5	89.5		%
50% Load	Vin = 48V	86	87.5		%
Dynamic Response					
Parameter	Conditions	Min	Typ	Max	Unit
Load Change 50% - 75% or 25% to 50% of Iout Max, di/dt = 0.1 A/µs			100	150	mV
Settling Time to 1% of Vout	Co = 1 µF ceramic + 10 µF tantalum		50		µs
Load Change 50%-75% or 25% to 50% of Iout Max, di/dt = 0.1 A/µs	Co = 1 µF ceramic + 2000 µF Oscon		30	50	mV
Settling Time to 1% of Vout			100		µs
Isolation Specifications					
Isolation Capacitance			1000		pF
Isolation Resistance		10			MΩ
Isolation Voltage – Input to Output				2250	V_{DC}

ELECTRICAL SPECIFICATIONS (continued) 36–75Vin, 3.3V/12Aout

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			480		kHz
Output Voltage Trim Range		-20		+10	%
Remote Sense Compensation				+10	%
Output Over-voltage Protection	Non-latching	118	124	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		-	400	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

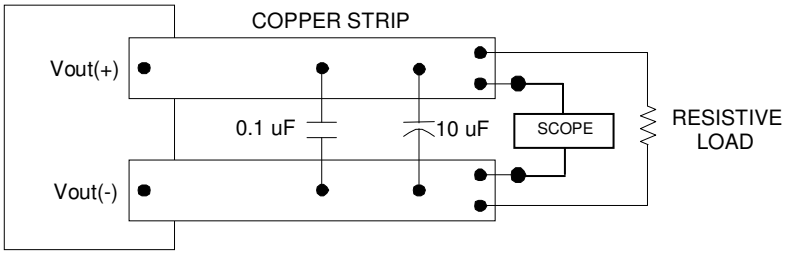
INPUT REFLECTED RIPPLE TEST SETUP:



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:



Use a 0.1μF X7R ceramic capacitor and a 10μF @ 25V 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:

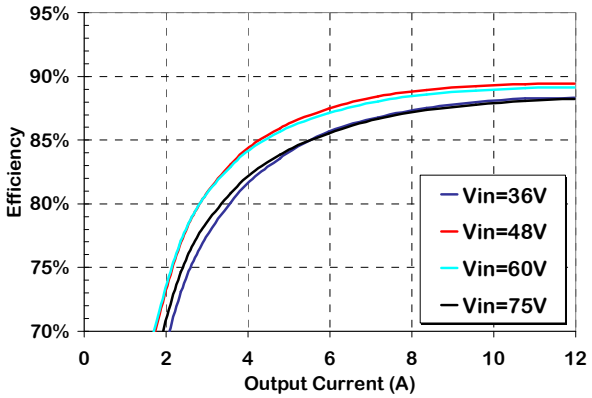


Figure 4. Efficiency vs Output Current, 300lfm airflow, 25°C ambient.

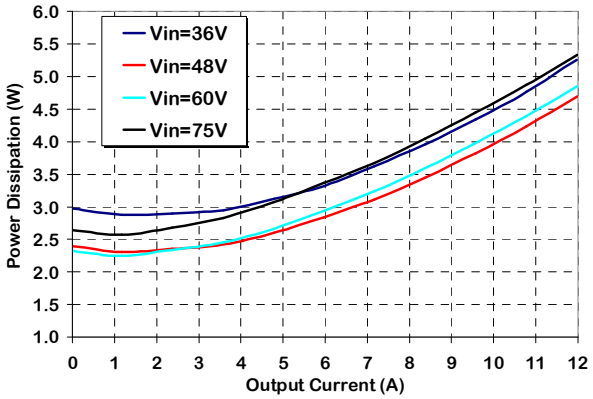


Figure 5. Power Dissipation vs. Load Current, 300lfm airflow, 25°C ambient.

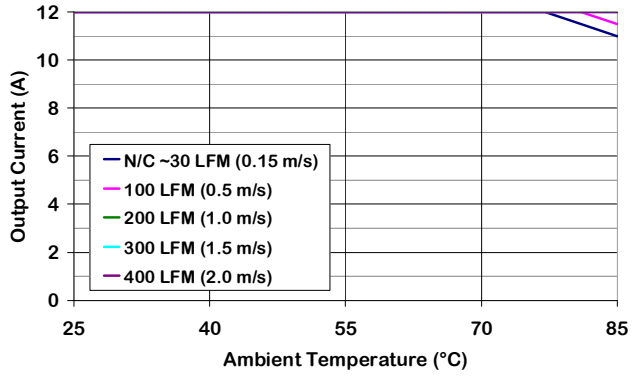


Figure 6. Output Current Derating vs Ambient Temperature & Airflow (converter mounted vertically with air flowing from pin 3 to pin 1, Vin = 48 V.)

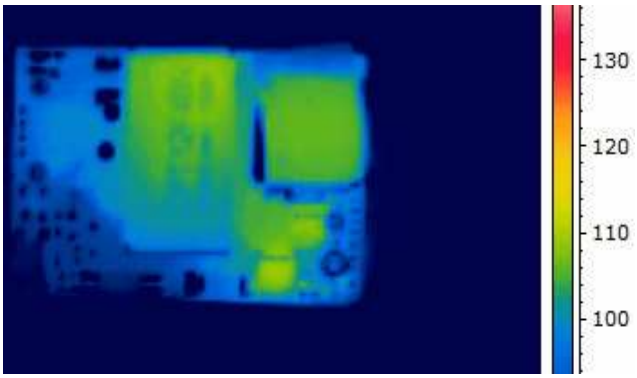


Figure 7. Thermal Image of CPT12F48 (12A output, 70C Ambient, 200lfm airflow, Vin = 48V, airflow from pin 3 to pin 1, T_{max} = 109°C)

CHARACTERISTIC WAVEFORMS:

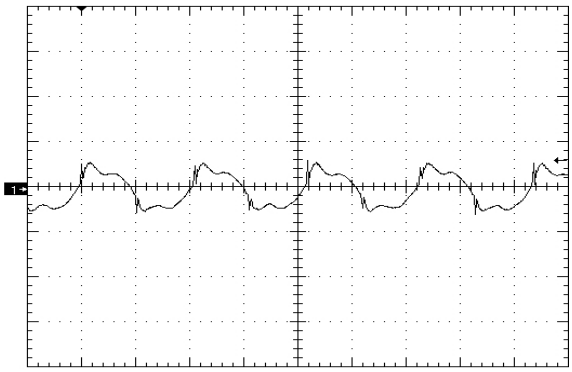


Figure 8. Output Voltage Ripple (20mV/div), time scale – 1uS/div. Vin=Vin_nom, full load Cout=1uF ceramic + 10uF Tantalum (see Fig 2)

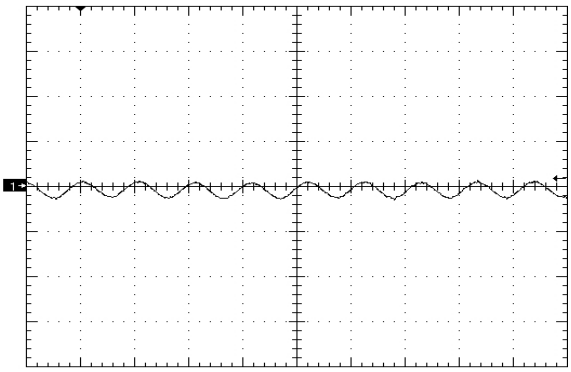


Figure 9. Input Reflected Ripple Current (5mA/div) time scale - 2uS/div. Vin=Vin_nom, full load

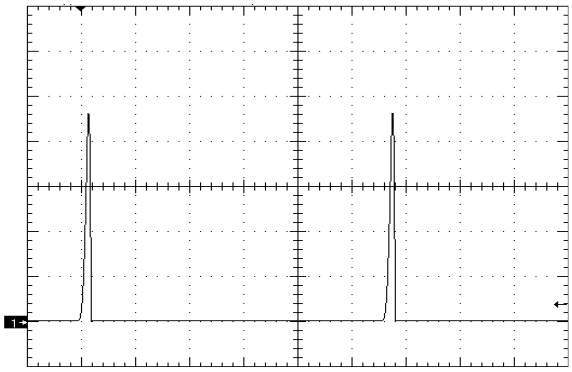


Figure 10. Output Short Circuit Current (5A/div), time scale – 20mS/div. Vin=Vin_nom, 10mOhm Short

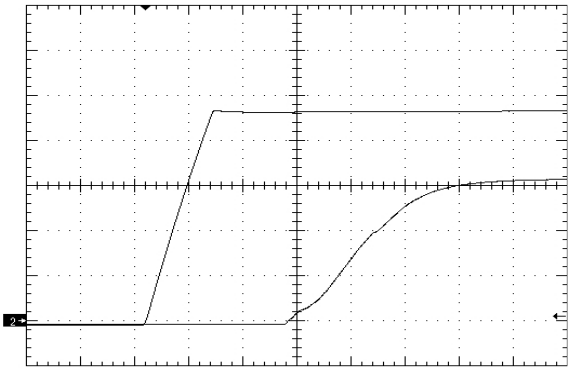


Figure 11. Startup Waveform (1V/div) via Vin, time scale 4mS/div. Vin=Vin_nom, full resistive load + 10000uF.

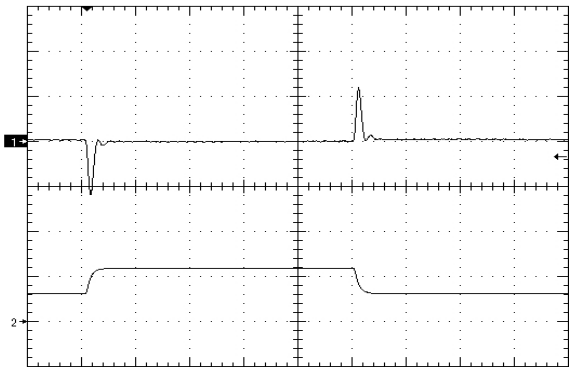


Figure 12. Load Transient Response (100mV/div), di/dt=0.1A/uS, 25% - 50% - 25% of full load, Cout=0 time scale: 200uS/div. Ch2 = 5A/div

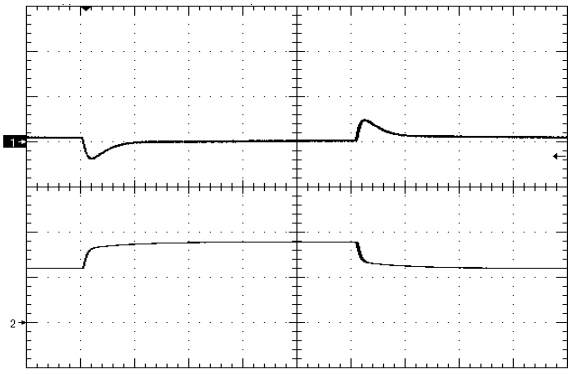


Figure 13. Load Transient Response (50mV/div), di/dt=0.1A/uS, 50% - 75% - 50% of full load, 2000uF low ESR Oscon across output, time scale: 200uS/div.

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.

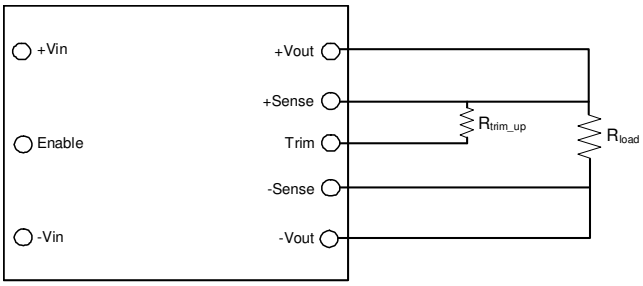


Figure 14. Trim UP circuit configuration

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.

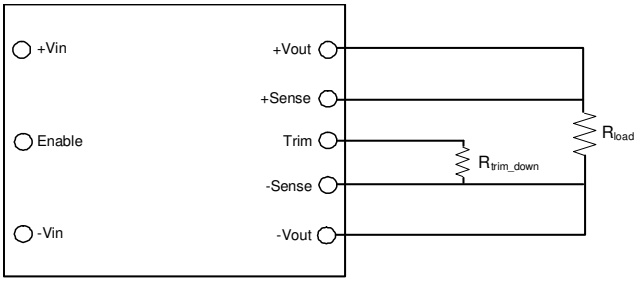


Figure 15. Trim DOWN circuit configuration

EMC COMPLIANCE:

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

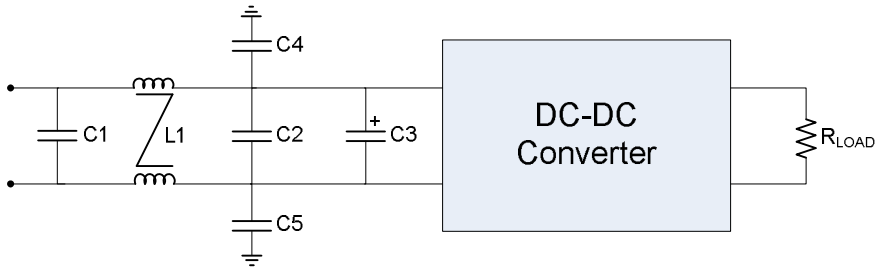


Figure 16. EMI Filter

L1 =	**1.32 mH Common Mode Inductor (Pulse P0420)**
C1,C2 =	**2.2uF ceramic**
C3 =	**100uF electrolytic**
C4,C5 =	**10nF (@2kV if output is ref. to earth gnd.)**

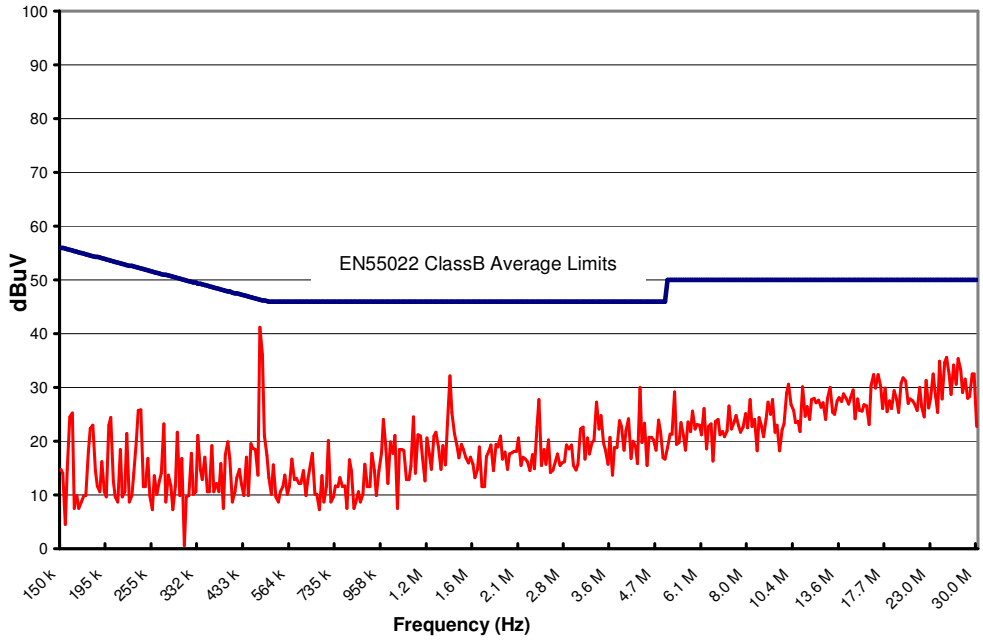
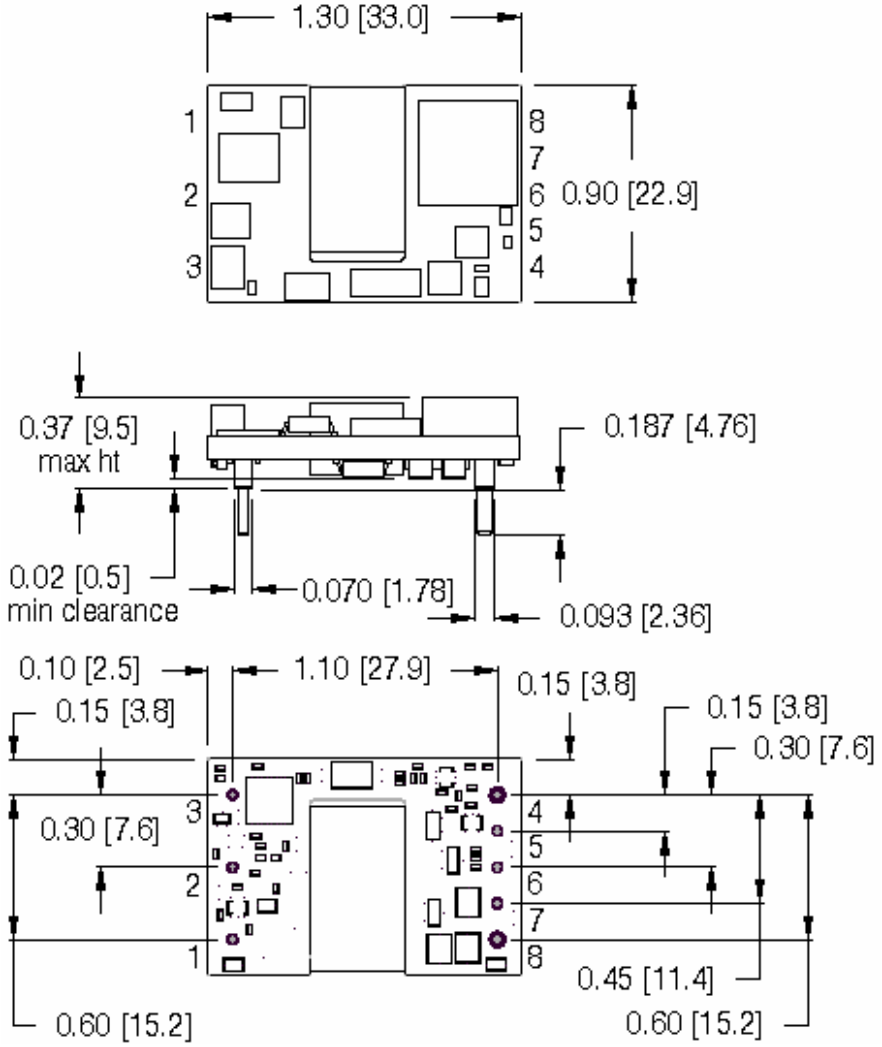


Figure 17. CPT12F48N Conducted Emissions using above specified input filter.
Vin = 48V, Full Resistive Load

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: 12.8 g (0.45 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
CPT	12	F	48	N or P	- XX
"Cool Power Technologies"	12A	3V3	36 – 75V	N = Negative P = Positive	TBD

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