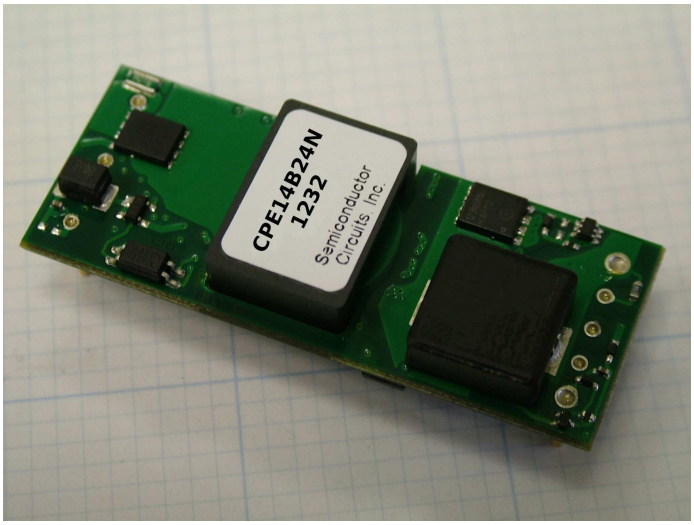
Technical Datasheet CPE14B24

Features



- Wide input voltage range: 18 – 36 Vin
- Output: 12 V at 14 A, 168W max.
- No minimum load required
- ROHS Directive 2002/95/EC Compliant
- Low height - 0.500" (12.7mm) max.
- Basic Insulation
- Withstands 50 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 [25.6 g]
- On-board input differential LC-filter
- Meets UL94, V-0 flammability rating
- UL/CSA60950-1 recognized, TUV certified per IEC/EN60950-1, 2nd edition (pending)
- Designed to meet Class B conducted emissions per FCC and EN55022 when used with external filter (see EMC Compliance section below.)

Description

The CPE14B24 "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 18 to 36 VDC, and provides a tightly regulated output voltage with an output current rating of 14 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 CPE14B24 allows operation over a wide ambient temperature range (full rated power @ 40°C & 200LFM (1m/s) airflow @ 24Vin.)

ELECTRICAL SPECIFICATIONS

18–24Vin, 12V/14Aout

Conditions: T_A = 25 °C, Airflow = 300 LFM, Vin = 24 VDC, Cin = 100 µF, unless otherwise specified.

Input Characteristics					
Parameter	**Conditions**	**Min**	**Typ**	**Max**	**Unit**
Operating Input Voltage Range		18	24	36	VDC
Input Under-Voltage Lock-out Turn-on Threshold Turn-off Threshold		 17.2 15.8	 17.6 16.2	 18 16.6	VDC
Input Voltage Transient	100ms			50	VDC
Maximum Input Current	V_{IN} = 18VDC; I_{out} = 14A			10.5	A
Input Standby Current	Converter Disabled		2	5	mA
Input No-Load Current	Converter Enabled		165	250	mA
Short Circuit Input Current			30		mA_{RMS}
Input Reflected Ripple Current	5Hz to 50MHz		25	40	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	11.82	12.00	12.18	VDC
Output Current		0		14	A
Output Current Limit Inception		14.5	15.5	18	A
Peak Short-Circuit Current	10mΩ Short			24	A
RMS Short-Circuit Current	10mΩ Short		2.25	3.0	A_{RMS}
External Load Capacitance				4700	uF
Output Ripple and Noise	20 MHz bandwidth		65	120	mV_{PK-PK}
Output Regulation Line: Load: Overall Output Regulation:	 Over line, load & temp.	 11.76	 ±5 ±5 	 ±12 ±12 12.24	 mV mV V

ELECTRICAL SPECIFICATIONS (continued) 18–36Vin, 12V/14Aout

Conditions: T_A = 25 °C, Airflow = 300 LFM, Vin = 24 VDC, Cin = 100 µF, unless otherwise specified.

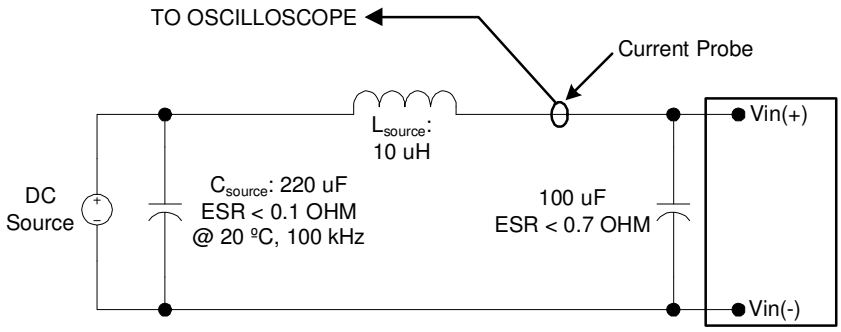
Efficiency					
Parameter	Conditions	Min	Typ	Max	Unit
100% Load		92.8	93.5		%
50% Load		92.5	93.5		%
Dynamic Response					
Parameter	Conditions	Min	Typ	Max	Unit
Load Change 50%-75% or 25% to 50% of Iout Max, di/dt = 0.1 A/µs			120	200	mV
Settling Time to 1% of Vout	Co = 1 µF ceramic + 10 µF tantalum		50		µs
Load Change 50%-75% or 25% to 50% of Iout Max, di/dt = 0.2 A/µs	Co = 1 µF ceramic + 4700 µF electrolytic		50	100	mV
Settling Time to 0.1% of Vout			100		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	2,216,014			Hours
	FITs (failures in 10^9 hours)	451			/10^9 Hours

ELECTRICAL SPECIFICATIONS (continued) 18–36Vin, 12V/14Aout

Conditions: Ta = 25 °C, Airflow = 300 LFM, Vin = 24 VDC, Cin=100 µF, unless otherwise specified.

Absolute Maximum Ratings					
Parameter	**Conditions**	**Min**	**Typ**	**Max**	**Unit**
Input Voltage	Continuous Operation	0		36	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		400	500	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

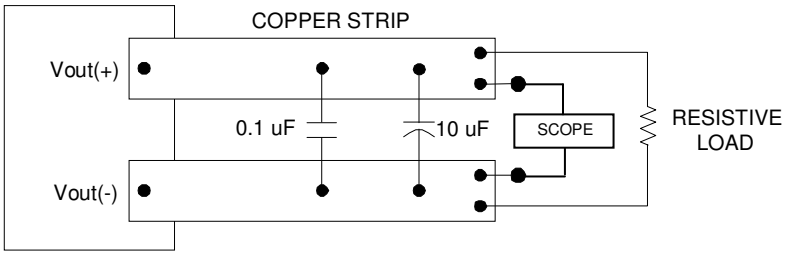
INPUT REFLECTED RIPPLE TEST SETUP:



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:



Note: 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:

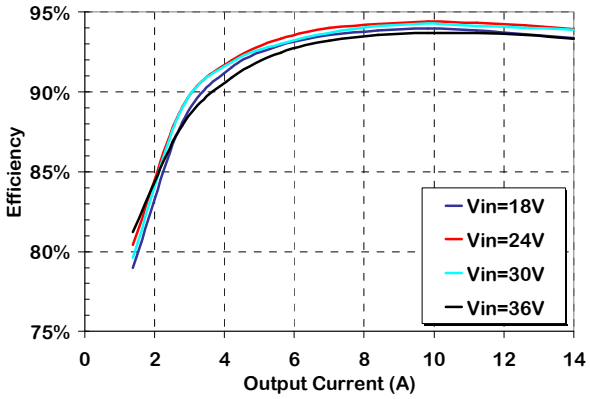


Figure 3. Efficiency vs Output Current, 300lfm airflow, 25℃ ambient.

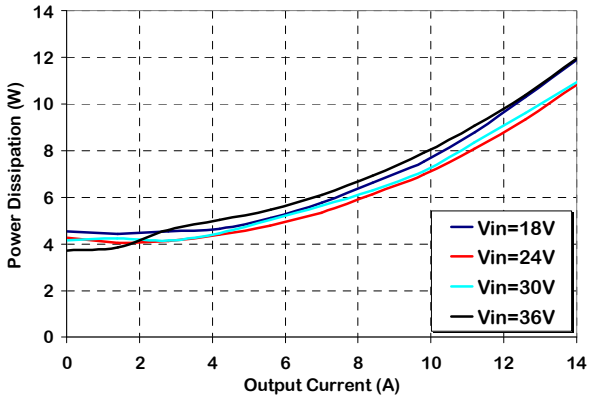


Figure 4. Power Dissipation vs. Load Current, 300lfm airflow, 25℃ ambient.

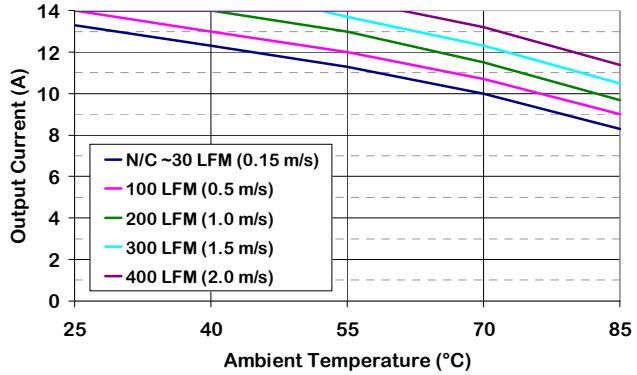


Figure 5. Output Current Derating vs Ambient Temperature & Airflow (converter mounted vertically with air flowing from pin 3 to pin 1, Vin = 24 V.)

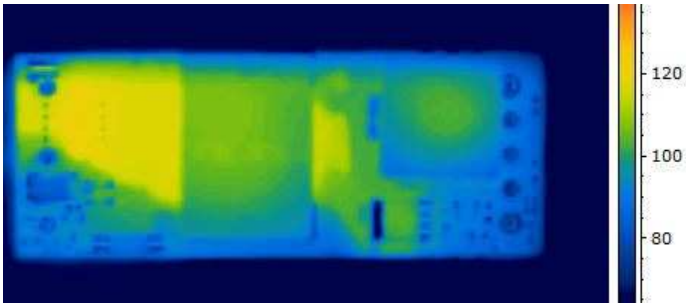


Figure 6. Thermal Image of CPE14B24 (14A output, 40C Ambient, 200lfm airflow Vin = 24V, airflow from pin 3 to pin 1, T_{max} = 123℃)

CHARACTERISTIC WAVEFORMS:

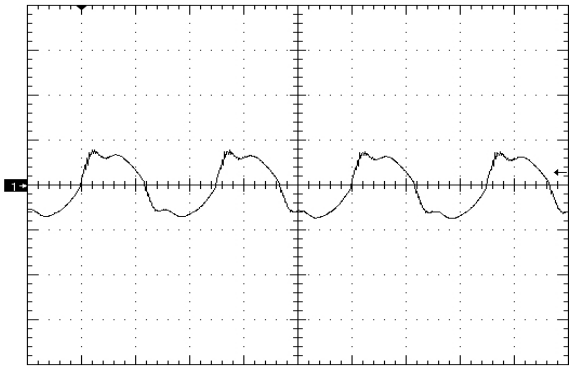


Figure 7. Output Voltage Ripple (50mV/div), time scale – 1uS/div. Vin=Vin_nom, full resistive

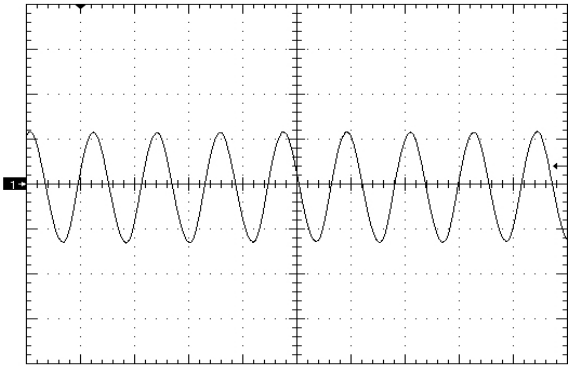


Figure 8. Input Reflected Ripple Current (10mA/div) time scale - 2uS/div. Vin=Vin_nom, full resistive

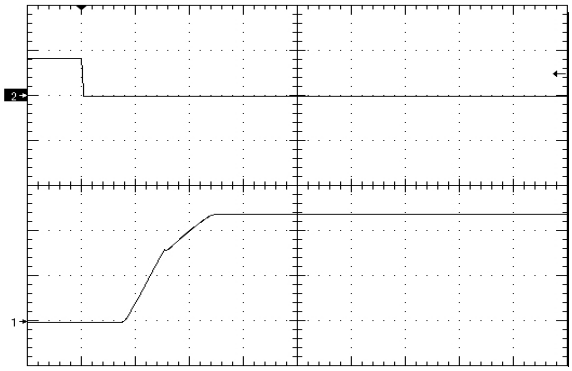


Figure 9. Startup Waveform via Enable Pin (5V/div), time scale 10mS/div. Vin=Vin_nom, full resistive load + 4700uF (negative enable.)

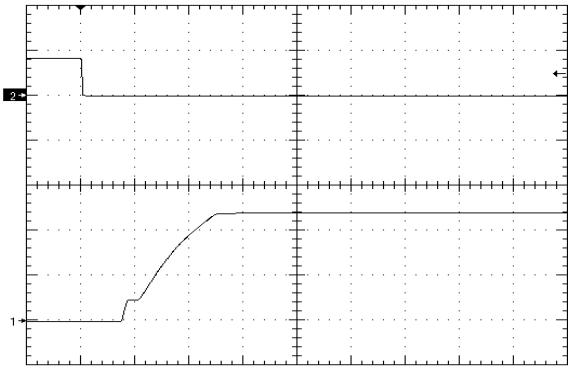


Figure 10. Startup Waveform via Enable Pin (5V/div), time scale 10mS/div. Vin=Vin_nom, No Load (negative enable.)

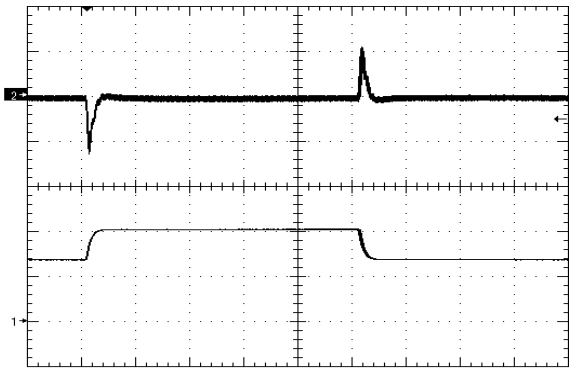


Figure 11. Load Transient Response (100mV/div), di/dt=0.1A/uS, 50% - 75% - 50% of full load, time scale: 200uS/div.

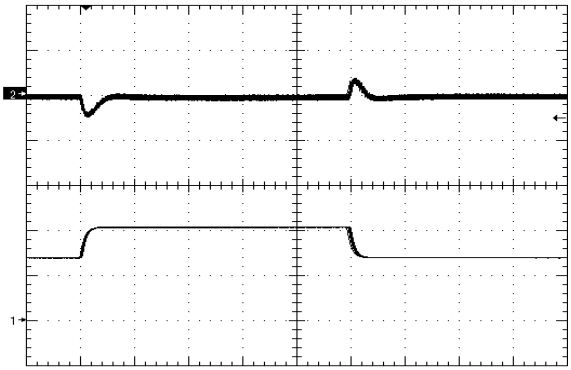


Figure 12. Load Transient Response (100mV/div), di/dt=0.15A/uS, 50% - 75% - 50% of full load, 4700uF electrolytic across output, time scale: 200uS/div.

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.

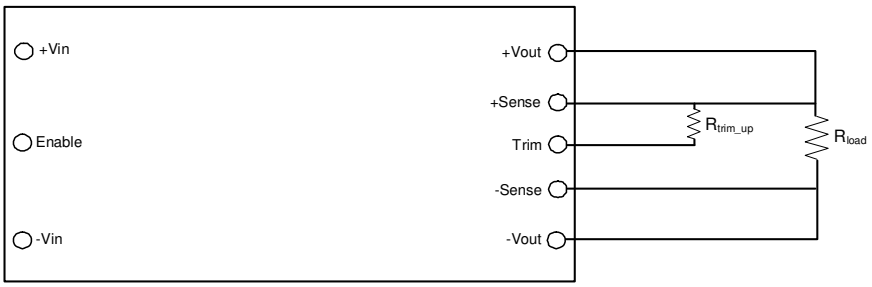


Figure 13. Trim UP circuit configuration

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.

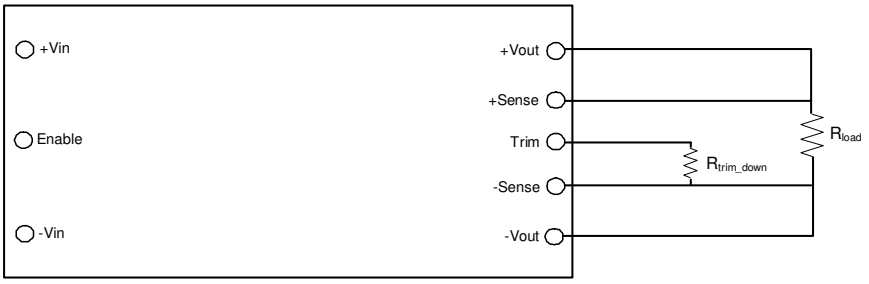


Figure 14. Trim DOWN circuit configuration

EMC COMPLIANCE:

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

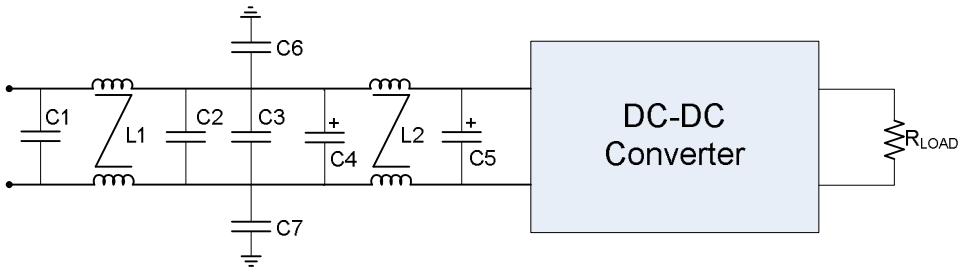


Figure 15. EMI Filter

L1, L2 =	**0.66 mH Common Mode Inductor**
C1, C2, C3 =	**2.2uF ceramic**
C4, C5 =	**100uF electrolytic**
C6, C7 =	**10nF (@2kV if output is ref. to gnd.)**

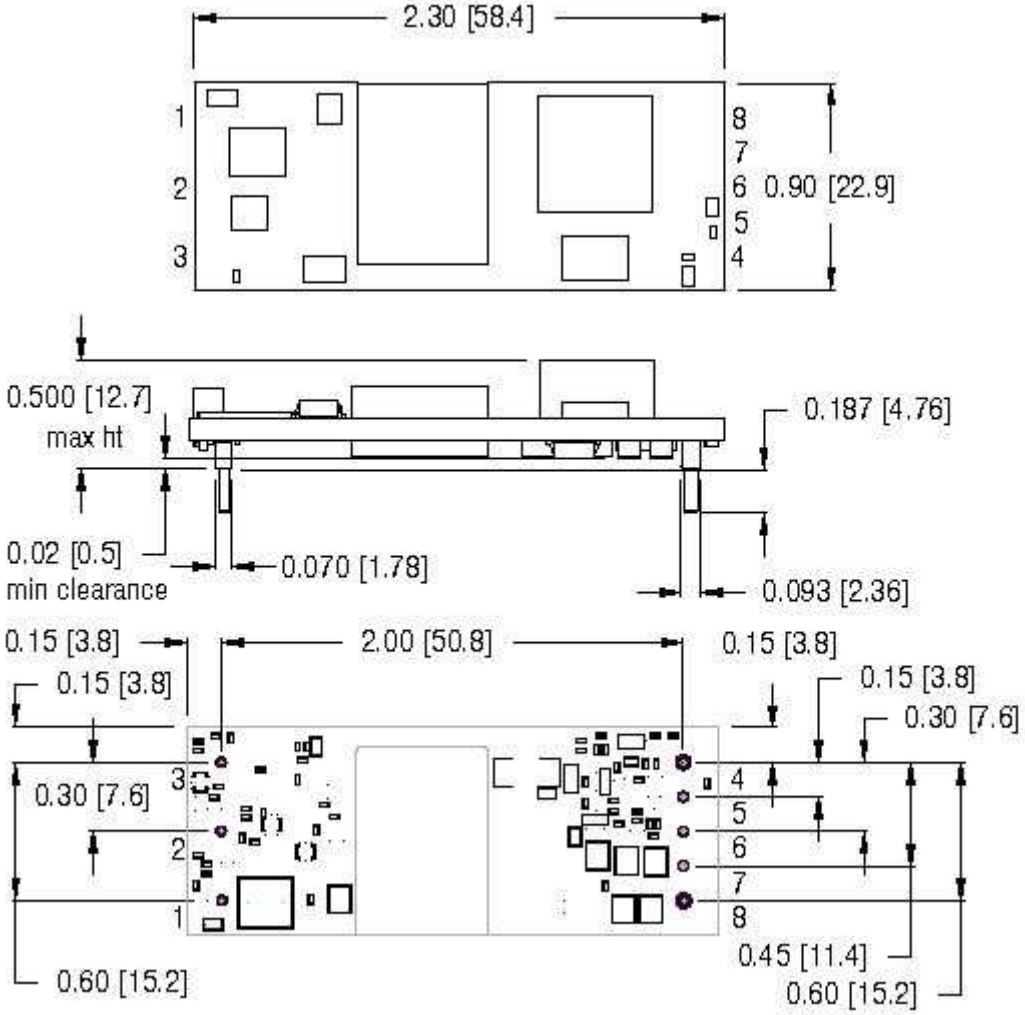
TBD

Figure 16. CPE14B24N Conducted Emissions using above specified input filter.
Vin = 24V, 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: 25.6 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	14	B	24	N or P	- XX
"Cool Power Eighth"	14A	12V	18 – 36V	N = Negative P = Positive	TBD

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