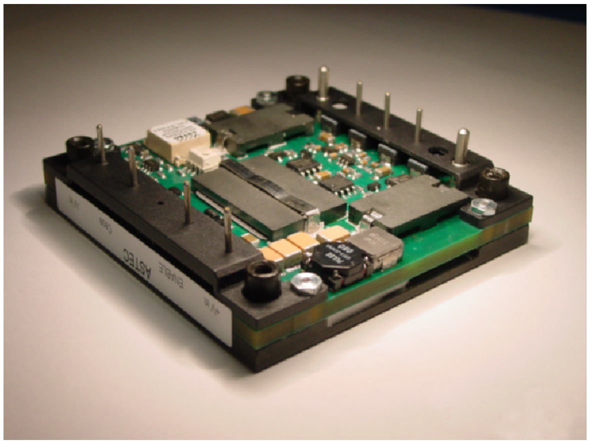
AEH30B48 Isolated DC/DC Converter Module
Industry Standard ½ Brick – 36-75V Input, 12V / 29.17A Output

The AEH30B48 is Astec's latest addition to its Ultra High Density ½ Brick family capable of delivering 350W of full power at 12V output. With efficiencies of 92.7% typical plus the standard features common to the AEH half brick series, this version is best suited not only for 12V applications but for Intermediate Bus Voltage Applications as well.



Electrical Parameters

Input

Input range	**36-75 VDC**
Input Surge	**100V / 100ms**
Efficiency	**92.7%@12V (Typ)**

Control

Enable	**TTL compatible**

(Positive & Negative enable options)

Output

Regulation (Line, Load, Temp)	**<2%**
Ripple and Noise	**120mV p-p Typ**
Remote Sense	**Up to 10%Vout**
Output Voltage Adjust Range	**±10% of nominal output**
Transient Response	**580mV typ output deviation 50% to 75% load transient < 500 µS recovery**
Over Voltage Protection	**115% nominal**

Special Features

- **High efficiency, 92.7% @ full load**
- **-40°C to 100°C baseplate operating temp**
- **Positive and Negative enable function**
- **Low output ripple and noise**
- **High capacitive load limit**
- **Remote sense compensation**
- **Regulation to zero load**
- **Fixed frequency switching**

Environmental Specifications

- **Operating temperature:**
  -40°C to +100°C (Baseplate)
- **Storage temperature: -55°C to 125°C**
- **MTBF: >1 million hours**

Safety

- **UL, cUL 60950 Recognized (Pending)**
- **EN 60950 through TUV-PS (Pending)**

Electrical Specifications

STANDARD TEST CONDITION on a single unit, unless otherwise specified.

T_A:	25°C (Ambient Air)
$+V_{IN}$:	48V ± 2%
$-V_{IN}$:	Return pin for $+V_{IN}$
Enable:	Open (Positive Enable)
$+V_{OUT}$:	Connect to Load
$-V_{OUT}$:	Connect to Load (return)
Trim (V_{ADJ}):	Open
+Sense:	Connect to $+V_{OUT}$
-Sense:	Connect to $-V_{OUT}$

ABSOLUTE MAXIMUM RATINGS

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the specs. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

Parameter	Device	Symbol	Min	Typ	Max	Unit
Input Voltage:						
Continuous:	All	V_I	0	-	75	Vdc
Transient (100ms)	All	$V_{I, trans}$	0	-	100	Vdc
Operating Temperature	AEH	T_{BP}	-40	-	100	ºC
Storage Temperature	All	T_{STG}	-55	-	125	ºC
Operating Humidity	All	-	-	-	85	%
Isolation Voltage	All	-	-	-	1500	Vdc
Input-Output	AEH	-	-	-	1500	Vdc
Input-Case	AEH	-	-	-	1500	Vdc
Output-Case						
Output Power	12V	$P_{O,max}$	-	-	350	W

Electrical Specifications *(continued)*

INPUT SPECIFICATIONS

Parameter	Device	Symbol	Min	Typ	Max	Unit
Operating Input Voltage	All	V_{IN}	36	48	75	V_{DC}
Maximum Input Current[1] (V_{IN} = 0 to $V_{IN,max}$: $I_O = I_{O,max}$)	All	$I_{IN,max}$	-	-	13	A
Input Reflected-ripple Current[2] (5Hz to 20MHz: 12uH source impedance: T_A = 25 ºC.)	All	I_I	-	-	15	mA_{PK-PK}
No Load Input Power ($V_{IN} = V_{IN,nom}$)	All	-	-	-	7.5	W

Note: 1. The power module is not internally fused. An input line fuse is recommended.
2. See Figure 1 for the Input Reflected-Ripple Current Test Setup.

OUTPUT SPECIFICATIONS

Parameter	Device	Symbol	Min	Typ	Max	Unit
Output Voltage Setpoint ($V_{IN} = V_{IN,min}$ to $V_{IN,max}$ at $I_O = I_{O,max}$; T_A = 25 ºC)	All	$V_{O,SET}$	11.80	12.00	12.20	Vdc
Output Regulation:						
Line	All	-	-	0.1	0.4	%
Load ($I_O = I_{O,min}$ to $I_{O,max}$)	All	-	-	0.1	0.4	%
Temp (AEH: -40 ºC to 100ºC)	All	-	-	-	1.0	%Vo
Output Ripple and Noise[3] (5 Hz to 20 MHz)						
V_{IN} = 36V, 48V	All	-	-	125	150	mV_{PK-PK}
V_{IN} = 75V	All	-	-	-	250	mV_{PK-PK}
External Load Capacitance	All	-	-	-	10,000	µF
Rated Output Current[4]	All	Io	0	-	29.17	A
Output Current-limit Inception (Latching)	All	Io	32	-	36.5	A
Efficiency ($V_I = V_{IN,nom}$; $I_{O,max}$; T_A = 25°C)	All	-	92	92.7	-	%
Switching Frequency	All	-	490	540	590	KHz
Turn-On Time ($I_O = I_{O,max}$; Vo within 1%)	All	-	25	40	60	msec

Electrical Specifications *(continued)*

OUTPUT SPECIFICATIONS

Parameter	Device	Symbol	Min	Typ	Max	Unit
Dynamic Response: ($\Delta I_O/\Delta t$ = 1A/10µs; $V_I = V_{IN,nom}$; T_A = 25°C)						
Load Change from I_O = 50% to 75% of $I_{O,max}$:	All	-	-	580	700	mV
Peak Deviation Settling Time (to $V_{O,SET}$ Tolerance)		-	-		500	µsec
Load Change from I_O = 50% to 25% of $I_{O,max}$:	All	-	-	580	700	mV
Peak Deviation Settling Time (to $V_{O,SET}$ Tolerance)		-	-		500	µsec
Output Voltage Overshoot ($I_O = I_{O,max}$; T_A = 25°C)	All	-	-	0	4	%Vo

FEATURE SPECIFICATIONS

Parameter	Device	Symbol	Min	Typ	Max	Unit
Enable Pin Voltage:						
Logic Low	All		-0.7	-	1.2	V
Logic High	All		2.95	-	10	V
Enable Pin Current:						
Logic Low	All		-	-	1.0	mA
Logic High ($I_{LEAKAGE}$ at 10V)	All		-	-	50	µA
Module Output Voltage (Enable – Off)	All		-	-	0.2	V
Output Voltage Adjustment Range[5]	All	-	90	-	110	%Vo
Output Over Voltage Clamp[5] (Latching)	All	$V_{O,CLAMP}$	13.35	13.60	14.00	V
Over Temperature Shutdown (Avg. Baseplate Temp)	All	T_{BP}	115	-	125	ºC
Under Voltage Lockout						
Turn-on Point	All	-	34.0	34.8	35.5	V
Turn-off Point	All	-	32.5	33.5	34.5	V

Electrical Specifications *(continued)*

FEATURE SPECIFICATIONS

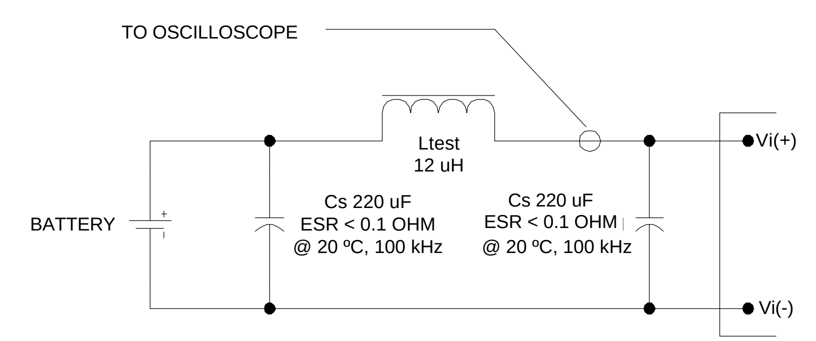
Parameter	Device	Symbol	Min	Typ	Max	Unit
Isolation Capacitance	All	-	-	2700	-	PF
Isolation Resistance	All	-	10	-	-	Mohm
Calculated MTBF ($I_O = I_{O,max}$; T_A = 25°C)	All	-	-	TBD	-	Hours

Note: 3. See Figure 2 for the Output Ripple Test Setup.
4. Appropriate output derating applies. See Figure 12.
5. For Output Voltage Adjustment setup, refer to Figures 3 and 4. For V_{IN} < 39V, the output can only be trimmed up 5% and the minimum OVP clamp is reduced to 12.75V.

SAFETY APPROVAL

The AEH30B48 series have been certified through:

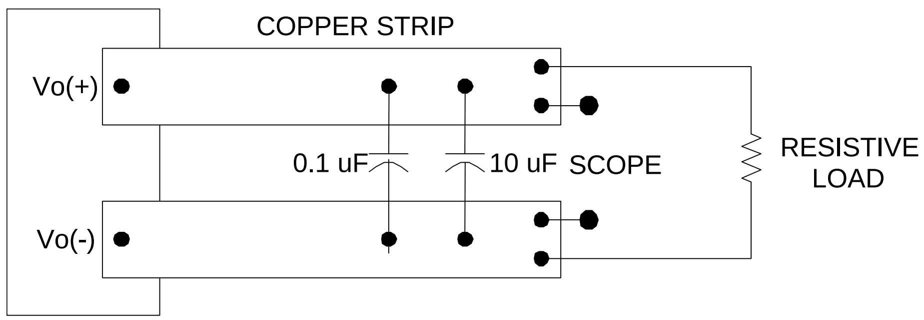
- UL, cUL 60950, Recognized – (Pending)
- EN 609050 through TUV-PS – (Pending)



Note: Measure the input reflected-ripple current with a simulated source inductance (L_{TEST}) of 12uH. Capacitor C_S offsets possible battery impedance. Measure current as shown above. On 12V unit, a minimum 220uF <0.1 Ohm ESR capacitor is required across input terminals for proper operation (same as capacitor on battery side of Ltest)

Figure 1. Input Reflected -Ripple Test Setup.

Electrical Specifications *(continued)*



Note: Use a 0.1µF @50V X7R ceramic capacitor and a 10µF @ 25V tantalum capacitor. Scope measurement should be made using a BNC socket. Position the load between 51 mm and 76 mm (2 in. and 3 in.) from module.

Figure 2. Peak to Peak Output Noise and Ripple Test Measurement Setup.

Basic Operation and Features

AEH / ALH converters were designed specifically to address applications where ultra high power density is required. These modules provide basic insulation and 1500V isolation with very high output current capability in an industry standard half size module. Operating from 36 to 75V input, they have standard features such as remote sense, trim, OVP, OCP and OTP. AEH series devices will accept industry standard heat sinks to enhance thermal performance in applications with conductive cooling.

REMOTE SENSE

Connect the + Sense and – Sense pins close to the load to allow the module to compensate for the voltage drop across conductors carrying high load current. If remote sense is not required (for example if the load is close to the module) the sense pins should be connected to the corresponding output pins. Maximum voltage drop compensation is 10% Vout. It is important to avoid introducing lumped inductance or capacitance into the remote path. Do not connect remote sense lines “beyond” any external output filter stages used with the module.

OUTPUT OVERCURRENT PROTECTION

To provide protection in an output overload or short circuit condition, the converter is equipped with current limiting circuitry and can endure fault conditions for an unlimited duration. At the point of current-limit inception, the converter latches, causing the output current to be limited both in peak and duration. The OCP latch is reset either by cycling the input voltage or toggling the Enable signal for 100ms.

OUTPUT OVERVOLTAGE PROTECTION

The output over voltage system consists of a separate control loop, independent of the primary feedback path. This control loop has a higher voltage set point than the main circuit. In a fault condition, the converter latches which ensures that the output voltage does not exceed $V_{O,CLAMP,max}$. The converter will operate back normally once the fault is removed and the input voltage is cycled or the Enable signal is toggled for 100ms.

ENABLE FUNCTION

The AEH30 series comes with an Enable pin (PIN 2), which is primarily used to turn ON/OFF the converter. Both a Positive (no part number suffix required) and a Negative (suffix “N” required) Enable Logic options are being offered.

For Positive Enable, the converter is turned on when the Enable pin is at logic HIGH or left open. The unit turns off when the Enable pin is at logic LOW or directly connected to $-V_{IN}$. On the other hand, the Negative Enable version turns unit on when the Enable pin is at logic LOW or directly connected to $-V_{IN}$. The unit turns off when the Enable pin is at Logic HIGH.

OVER TEMPERATURE PROTECTION

The Over Temperature Protection circuit will shutdown the converter once the average PCB temperature reaches the OTP range (115ºC to 125ºC baseplate). This feature prevents the unit from overheating and consequently going into thermal runaway, which may further damage the converter and the end system. Such overheating may be an effect of operation outside the given power thermal derating conditions. Restart is possible once the temperature of the sensed location drops below the OTP range.

Basic Operation and Features *(continued)*

Trim Function

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

To adjust Vo to a higher value, please refer to Figure 3. An external resistor, **Radj_up** should be connected between the Trim Pin and the +Sense Pin. From Equation (1), Radj_up resistor can be determined for the required output voltage increment.

Equation (1)

$$Radj\_up = \left(\frac{Vo(100 + \Delta\%)}{1.225\,\Delta\%} - \frac{100}{\Delta\%} - 2 \right) \cdot k\Omega$$

Where: Radj_up - in kΩ
Δ% - percent change in output voltage

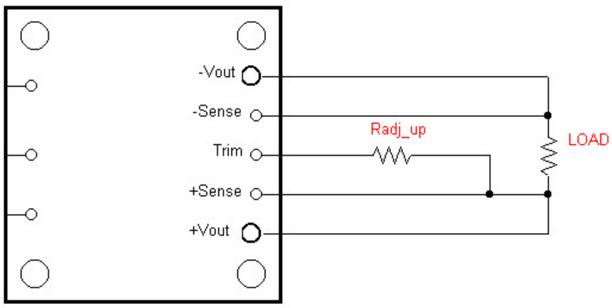


Figure 3. Radj_up Setup to increase Output Voltage.

To adjust Vo to a lower value, please refer to Figure 4. An external resistor, **Radj_down** should be connected between the Trim Pin and the -Sense Pin. From Equation (2), Radj_down resistor can be determined for the required output voltage change.

Equation (2)

$$Radj\_down = \left(\frac{100}{\Delta\%} - 2 \right) \cdot k\Omega$$

Where: Radj_down - in kΩ
Δ% - percent change in output voltage

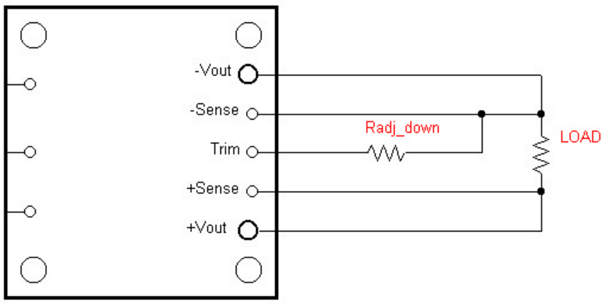


Figure 4. Radj_down Setup to decrease Output Voltage.

Performance Curves

EFFICIENCY

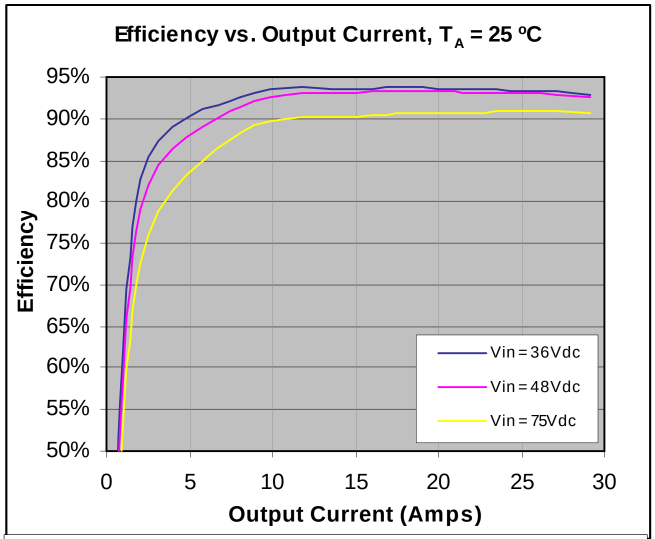


Figure 5. 12V Efficiency vs. Load Current at various input voltages, T_A = 25^o C with 300LFM.

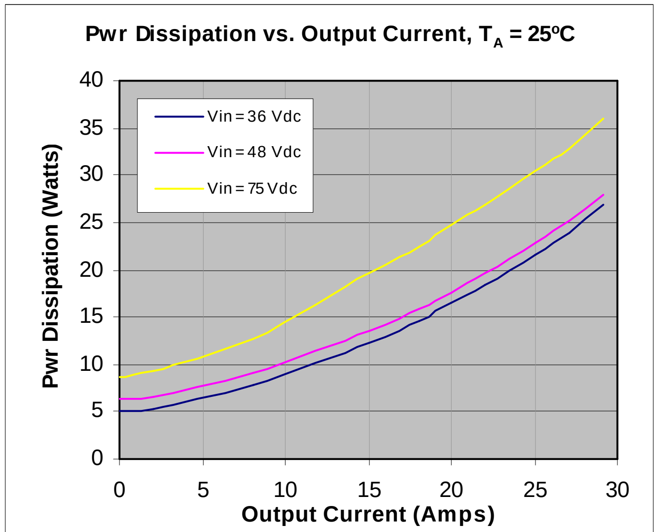


Figure 6. Power Dissipation vs. Output Load at T_A = 25 ^{o}C with 300LFM.

TRANSIENT RESPONSE

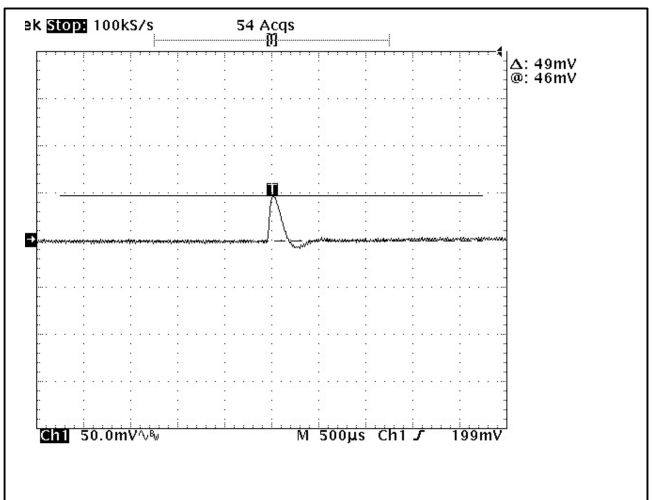


Figure 7. Transient Response at 50% to 25% Step load change, 48V_{IN}, 0.1A/µs slew rate and 2200µF output capacitive load, T_A = 25 ºC.

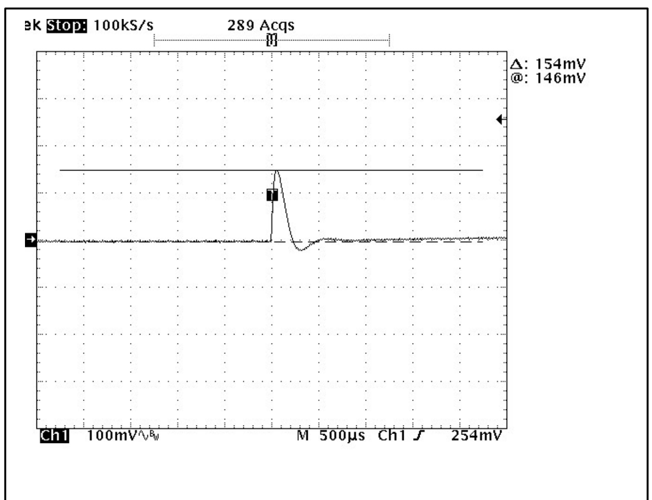


Figure 8. Transient Response at 75% to 50% Step load change, 48V_{IN}, 0.1A/µs slew rate and 2200µF output capacitive load, T_A = 25 ºC.

Performance Curves *(continued)*

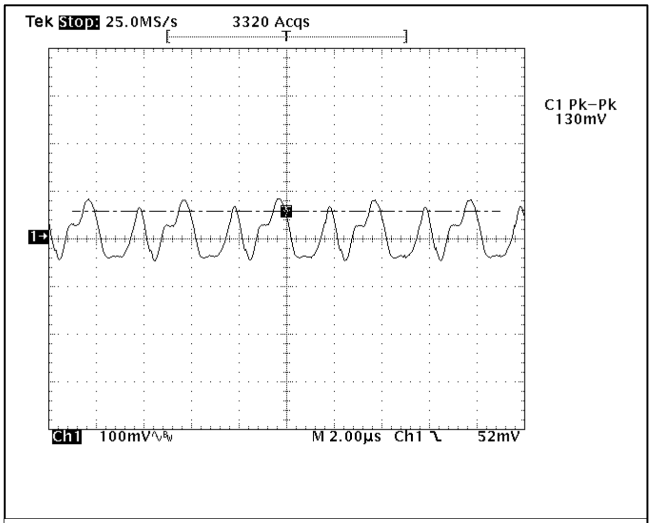


Figure 9. Typical output ripple at V_{IN} = 48Vdc, Full Load condition, T_A = 25 ºC (See figure 2 for test setup).

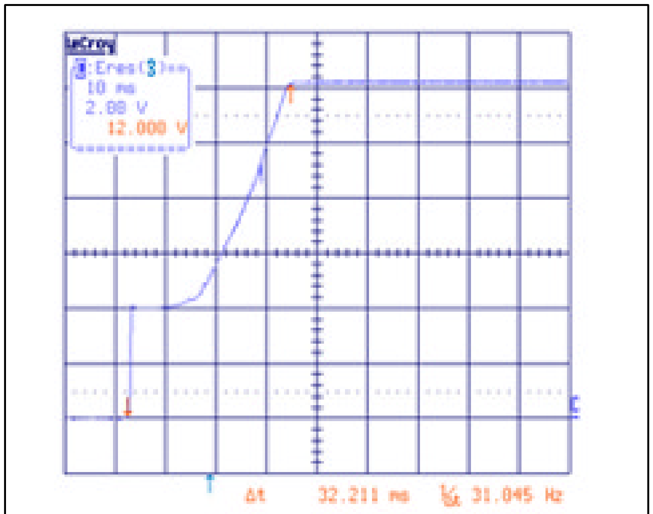


Figure 10. Typical 12V output turn-on characteristic at V_{IN} = 48Vdc, T_A = 25 ºC, Full Load, zero capacitive load.

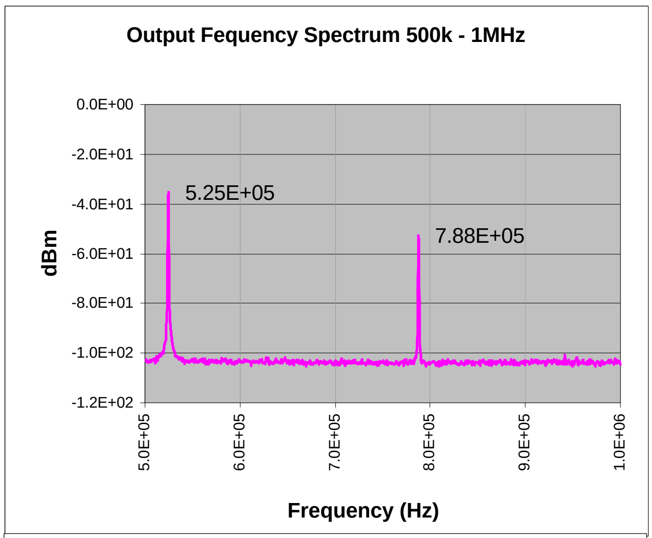


Figure 11. Output spectrum sweep at V_{IN} = 48V, I_O = 50% Load, C_{IN} = 220µF, C_{OUT} = 0, T_A = 25 ºC.

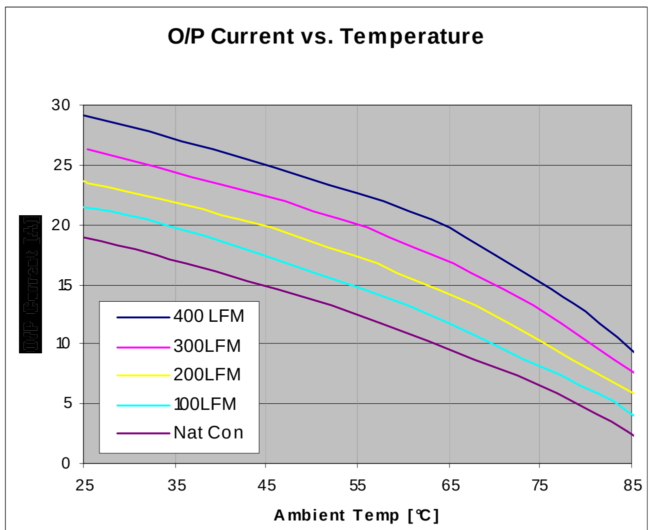


Figure 12. Output current vs. ambient temperature at V_{IN} = 48V and various airflow. Junction Temp = 120ºC.

Input Filter for FCC Class B Conducted Noise

A reference design for an input filter that can provide FCC Class B conducted noise levels is shown below (See Figure 13). Two common mode connected inductors are used in the circuit along with balanced bypass capacitors to shunt common mode currents into the ground plane. Shunting noise current back to the converter reduces the amount of energy reaching the input LISN for measurement.

The application circuit shown has an earth ground (frame ground) connected to the converter output (-) terminal. Such a configuration is common practice to accommodate safety agency requirements. Grounding an output terminal results in much higher conducted emissions as measured at the input LISN because a hard path for common mode current back to the LISN is created by the frame ground. "Floating" loads generally result in much lower measured emissions. The electrical equivalent of a floating load, for EMI measurement purposes, can be created by grounding the converter output (load) through a suitably sized inductor(s) while maintaining the necessary safety bonding.

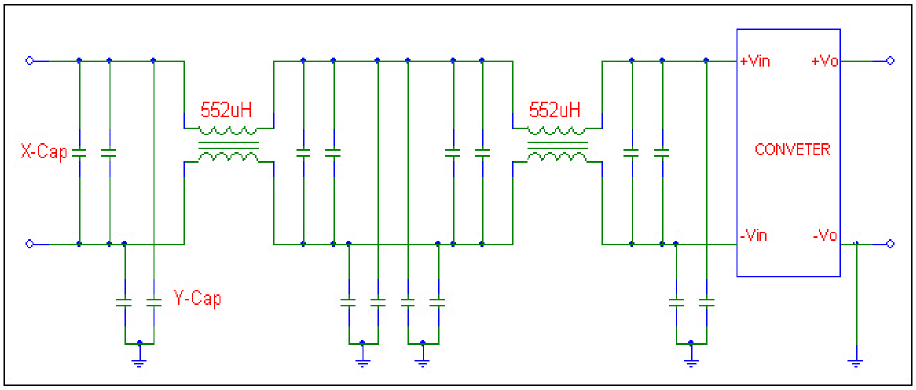


Figure 13: Class B Filter Circuit

PARTS LIST

CKT CODE	DESCRIPTION
Inductor	CTX01-15091 Cooper Electronic Technologies
X-Cap	0.47 µF X 8pcs
Y-Cap	22 nF X 8 pcs

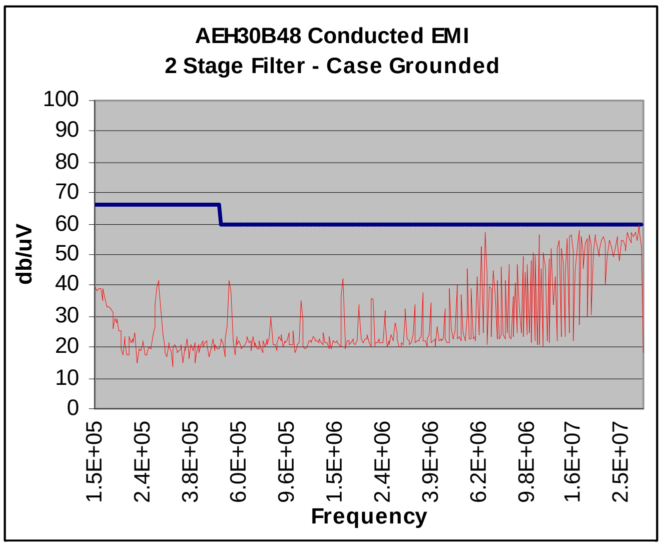


Figure 14. Conducted emission with case grounded.

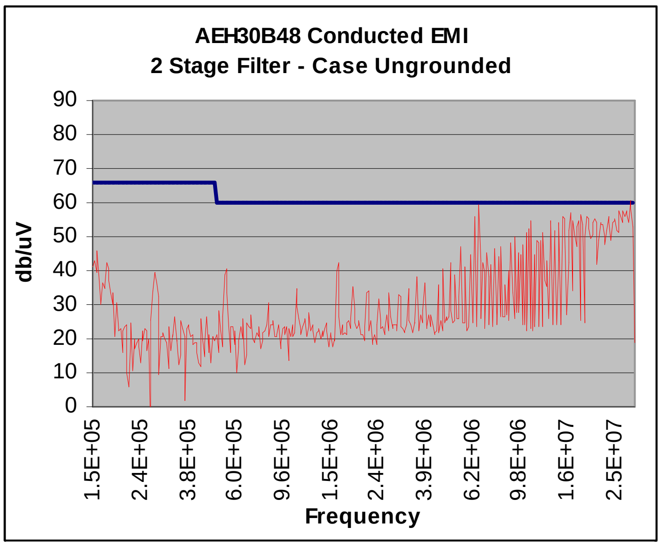


Figure 15. Conducted emission with case ungrounded.

Mechanical Specifications

Parameter	Device	Symbol	Min	Typ	Max	Unit
Dimension	AEH	L	-	2.40 [60.96]	-	in [mm]
	AEH	W	-	2.30 [58.42]	-	in [mm]
	AEH	H	-	0.50 [12.70]	-	in [mm]
Weight	AEH		-	130 [4.60]	-	g [oz]

Note: Nominal diameter for Pins 5 & 9 = 0.08", remaining pins at 0.04" diameter.

OUTLINE DRAWING

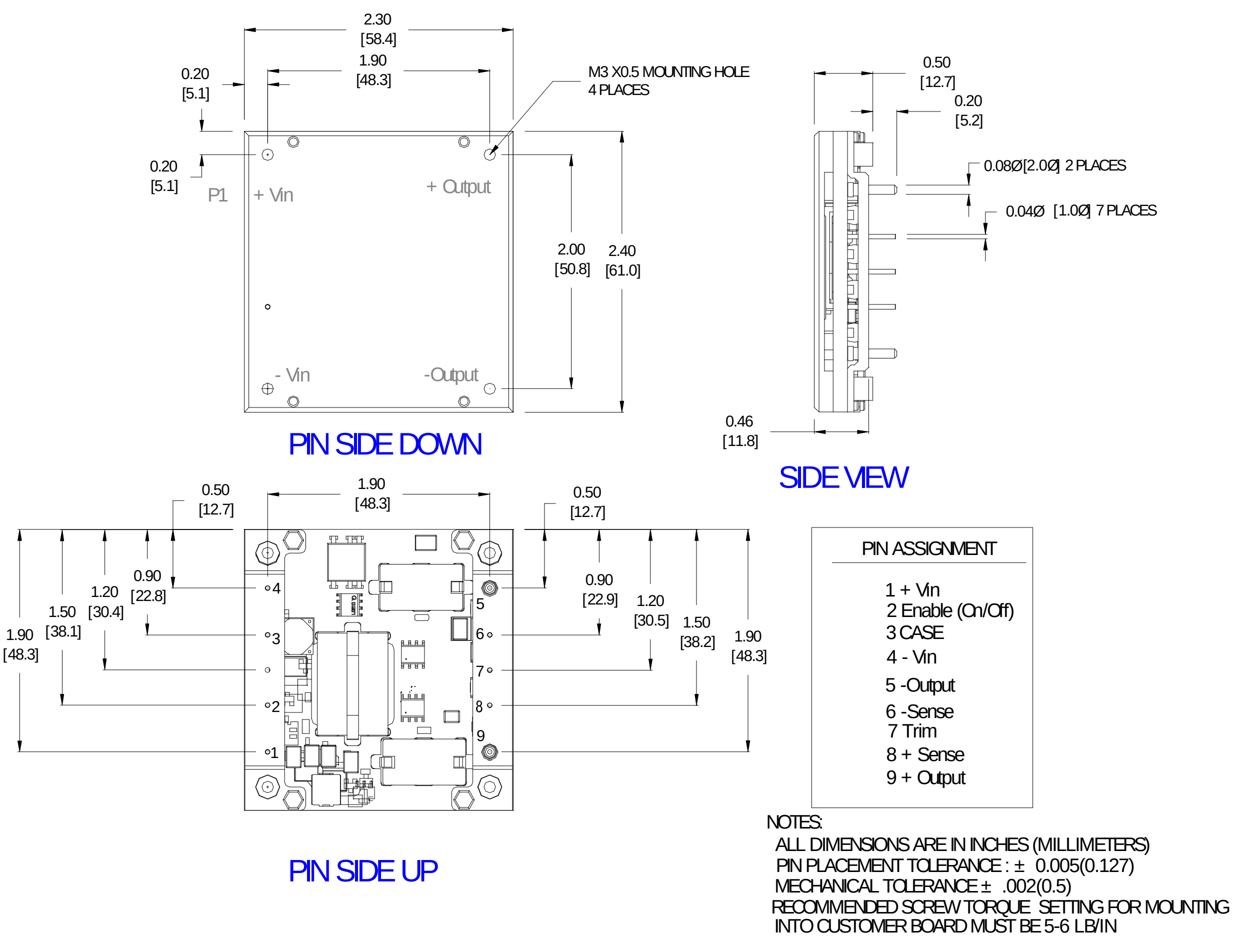


Figure 16. AEH - baseplate outline drawing.

Mechanical Specifications *(continued)*

SOLDERING CONSIDERATIONS

The AEH/ALH series converters are compatible with standard wave soldering techniques. When wave soldering, the converter pins should be preheated for 20–30 seconds at 110 °C and wave soldered at 260 °C for less than 10 seconds.

When hand soldering, the iron temperature should be maintained at 425°C and applied to the converter pins for less than 5 seconds. Longer exposure can cause internal damage to the converter. Cleaning can be performed with cleaning solvent IPA or with water.

PART NUMBER CODING SCHEME FOR ORDERING

AEH30	x	48	y	-	z

x	**Output Voltage**
	B = 12V
y	**Enable Option**
	N: Negative Enable **No Suffix**: Positive Enable
z	**Pin Length Option**
	No Suffix: 5mm nominal (default) Consult factory for other pin length options

Note: 1. For other output voltages of the same product family, please refer to the AEH60/ALH60 series.