

***AEH25B48X-XCXL Isolated DC/DC Converter Module
Industry Standard 1/2 Brick – 36-75V Input, 12V / 25A Output***

The AEH25B48N-6CL is a second-generation 12V half brick capable of delivering 25A output current or 300W maximum output power. It comes with industry standard brick features like: On/Off Enable pin, Differential Remote Sense pins, Output Trim pin; Input UVLO, OCP, OVP, OTP and operates from an input line voltage of 36 – 75 Vdc.



Special Features

- High efficiency
- -40°C to 100°C baseplate operating temp
- Enable On/Off
- Low output ripple and noise
- High capacitive load limit
- Remote sense compensation
- Regulation to zero load
- Fixed frequency switching (200KHz)
- EU Directive 2002/95/EC compliant for RoHS

Environmental Specifications

- Operating temperature:
-40°C to +85°C (Ambient)
- Storage temperature: -40°C to +125C
- DMTBF: > 2.5 MHrs

Electrical Parameters

Input

Input range	36-75 VDC
Input Surge	100V / 100ms
Efficiency	94% (typ)

Control

Enable	Positive & Negative Logic options
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Output

Regulation (Line, Load, Temp)	<2%
Ripple and Noise	150mV p-p
Output Voltage Adjust Range	±10% of nominal output
Transient Response	180mV typ output deviation 50% to 75% load transient 1A/10µs Slew rate 300 µs recovery

Over Voltage

Protection	115% nominal
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Safety

- UL, cUL 60950 Recognized
- EN 60950 through TUV-PS



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}
Input Cap:	220uF

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 Ambient Temperature	All	T _C	-40	-	85	°C
	T Suffix		0		55	
Storage Temperature	All	T _{STG}	-55	-	125	°C
Operating Humidity	All	-	-	-	85	%
I/O Isolation	All	-	-	-	1500	Vdc
Output Power	All	P _{O,max}	-	-	300	W

INPUT SPECIFICATIONS

Parameter	Device	Symbol	Min	Typ	Max	Unit
Operating Input Voltage	All	V _{IN}	36	48	75	V _{DC}
Undervoltage Lockout						
Turn-on Point	All	-	34.0	34.8	35.5	V
Turn-off Point	All	-	32.5	33.5	34.5	V
Maximum Input Current ¹ (V _{IN} = 0 to V _{IN,max} ; I _O = I _{O,max})	All	I _{IN,max}	-	-	11.0	A
Input Reflected-ripple Current ² (5Hz to 20MHz; 12uH source impedance; T _A = 25 °C)	All	I _I	-	-	15	mA _{PK-PK}
No Load Input Power (V _{IN} = V _{IN,nom} T _A = 25 °C)	All	-	-	-	7.5	W



ELECTRICAL SPECIFICATIONS (continued)

OUTPUT SPECIFICATIONS

Parameter	Device	Symbol	Min	Typ	Max	Unit
Output Voltage Setpoint ($V_{IN} = V_{IN,min}$ to $V_{IN,max}$ at $I_O = I_{O,max}$; $T_A = 25^\circ C$)	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 (-40 °C to 100°C)	All	-	-	-	1.0	%Vo
Output Ripple and Noise ³ (5 Hz to 20 MHz) $V_{IN} = 36V, 48V$ $V_{IN} = 75V$	All	-	-	120	150	mV _{PK-PK}
				-	250	mV _{PK-PK}
External Load Capacitance	All T suffix	- -	- -	- -	10,000 see note 8	μF
Rated Output Current	All	I_o	0	-	25	A
Output Current-limit Inception ⁴ (Latching)	All	I_o	26	-	32	A
Efficiency ⁵ ($V_I = V_{IN,nom}$; $I_{O,max}$; $T_A = 25^\circ C$)	All	-	92	92.7	-	%
Switching Frequency	All	-	160	185	210	KHz
Output Rise Time ($I_O = I_{O,max}$; Enable to Vo within 1%)	All	-	25	40	60	msec
Output Voltage Overshoot ($I_O = I_{O,max}$; $T_A = 25^\circ C$)	All	-	-	0	4	%Vo
Dynamic Response ⁶ : ($\Delta I_O / \Delta t = 1A/10\mu s$; $V_I = V_{IN,nom}$; $T_A = 25^\circ C$)						
Load Change from $I_O = 50\%$ to 75% of $I_{O,max}$: Peak Deviation Settling Time (to $V_{O,SET}$ Tolerance)	All	-	-	180	260	mV
		-	-	300	500	μsec
Load Change from $I_O = 50\%$ to 25% of $I_{O,max}$: Peak Deviation Settling Time (to $V_{O,SET}$ Tolerance)	All	-	-	180	260	mV
		-	-	300	500	μsec
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 @ Logic Hi Module Output voltage @ Logic Low	AEH		-	-	0.2	V



ELECTRICAL SPECIFICATIONS (continued)

OUTPUT SPECIFICATIONS

Parameter	Device	Symbol	Min	Typ	Max	Unit
Output Voltage Adjustment Range ⁷	All	-	90	-	110	%V _o
Output Overvoltage Clamp ⁴ (Latching)	All	V _{O,CLAMP}	13.35	13.60	14.00	V

- Note:
1. The power module is not internally fused. An input line fuse (e.g. 15A , 250V fast blow) is recommended.
 2. Refer to Figure 1 for the input reflected ripple current test setup.
 3. Refer to Figure 2 for the output ripple test setup.
 4. OCP and OVP protection modes are latching.
 5. Refer to Figure 5 for the efficiency curves.
 6. Refer to the output transient characteristics on Figures 10. For 100% to 0% step load deviation – a min of 660uF capacitor on the output is required to prevent the module into going OVP.
 7. 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.
 8. “T” suffix is a custom module tuned to operate with around 5,760 uF of output capacitance (15pcs OSCON 16SVP330M caps and 3pcs OSCON 16SP270M connected in parallel).

SAFETY AGENCY / MATERIAL RATING / ISOLATION

	Device					
Safety Approval	All	UL/cUL 60950-1 First Edition EN 60950 through TUV				
Material Flammability Rating	All	UL94V-0				
Parameter	Device	Symbol	Min	Typical	Max	Unit
Input to Output Capacitance	All		-	2700	-	pF
Input to output Resistance	All		-	10	-	MOhms
Input to Output Insulation Type	All		-	Basic	-	-

ELECTRICAL SPECIFICATIONS (continued)

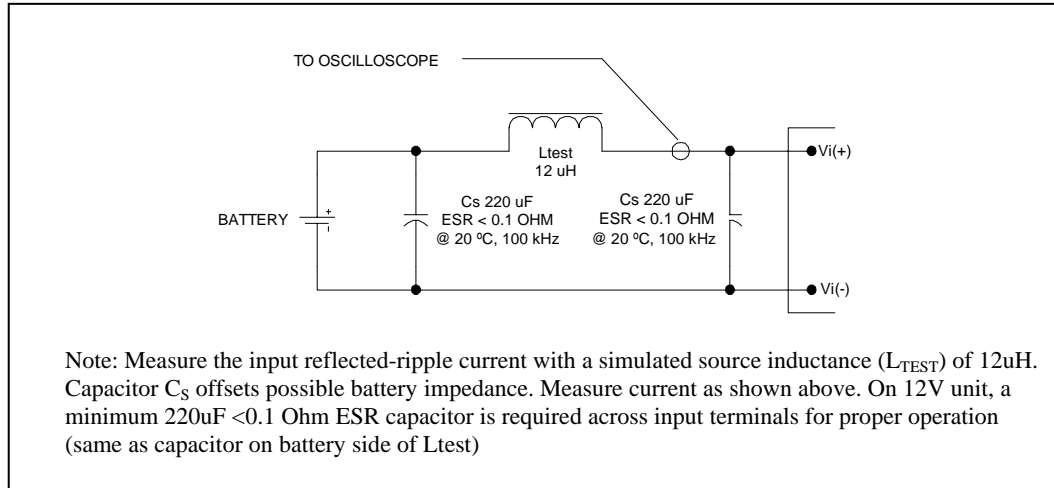


Figure 1. Input Reflected -Ripple Test Setup.

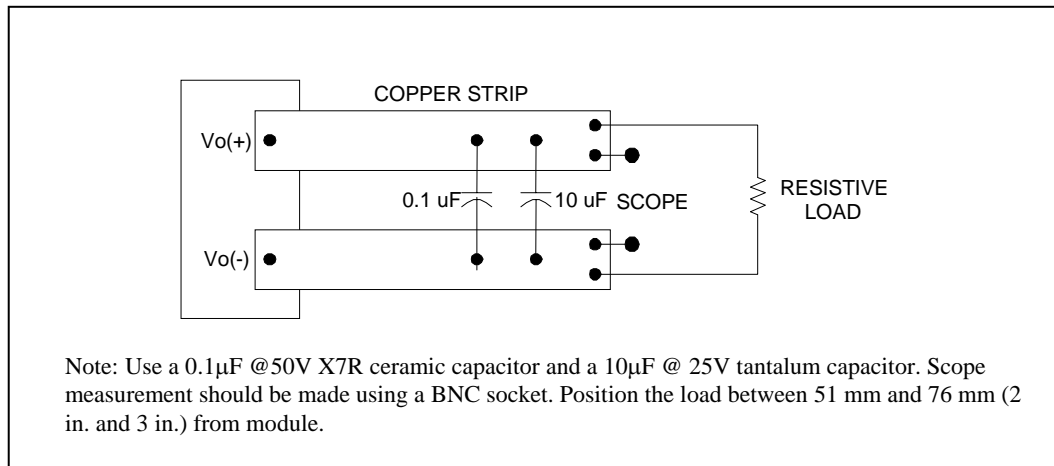


Figure 2. Peak to Peak Output Noise and Ripple Test Measurement Setup.

BASIC OPERATION AND FEATURES

AEH 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% V_{out} . 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 as default protection mode, 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 off as default protection mode 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 AEH25 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 (105°C to 120°C 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)

$$\text{Radj_up} = \left(\frac{V_o(100 + \Delta\%)}{1.225\Delta\%} - \frac{100}{\Delta\%} - 2 \right) \cdot \text{k}\Omega$$

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

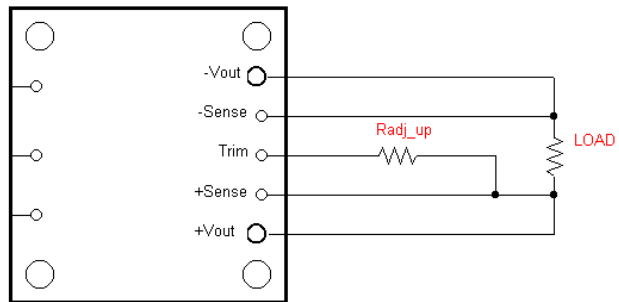


Figure 3. Radj_up Setup to increase Output Voltage.

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)

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

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

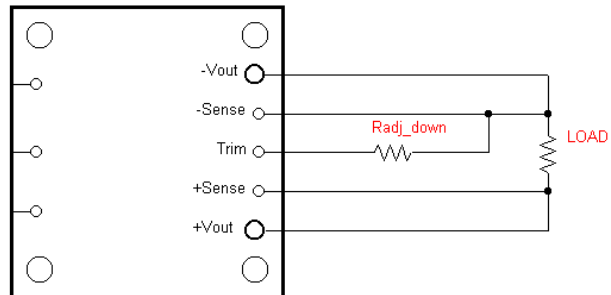


Figure 4. Radj_down Setup to decrease Output Voltage.

PERFORMANCE CURVES

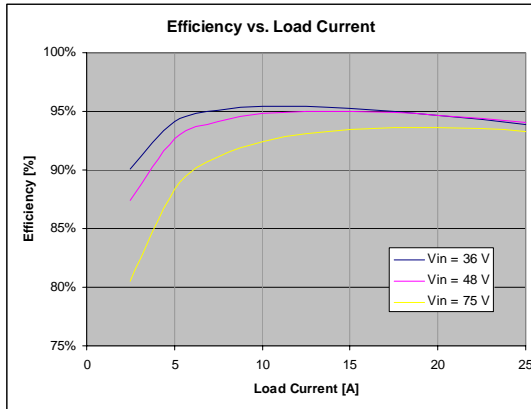


Figure 5: Efficiency curves at $T_A = 25\text{ }^\circ\text{C}$.

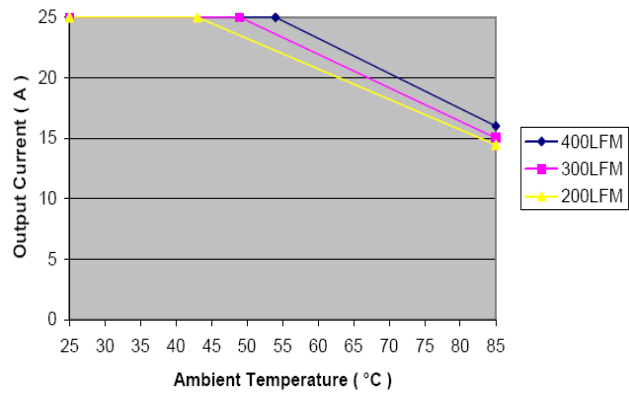


Figure 6: Derating Curve with Forced Air ($V_{IN} = 48\text{ Vdc}$)

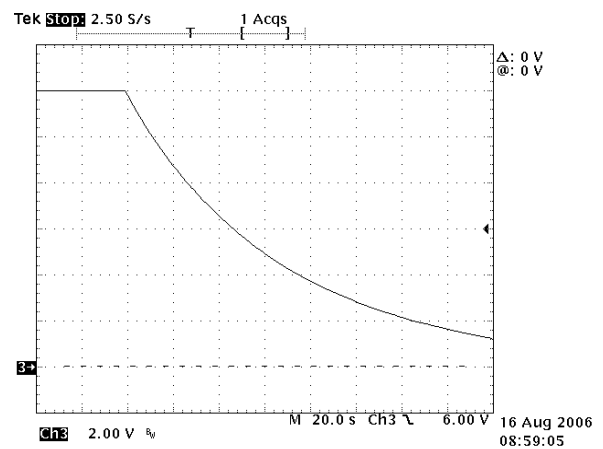
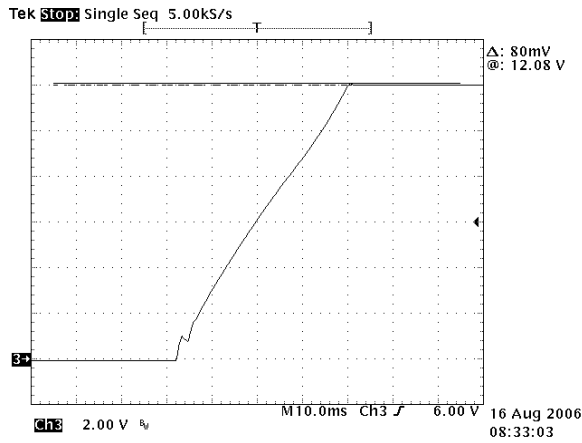


Figure 7: Output start-up characteristic at $V_{IN} = 48\text{ Vdc}$; $C_O = 10,000\text{ }\mu\text{F}$; $I_O = I_{O,min}$ Figure 8: Output Turn-off at $V_{IN} = 48\text{ Vdc}$; $C_O = 10,000\text{ }\mu\text{F}$; $I_O = I_{O,min}$

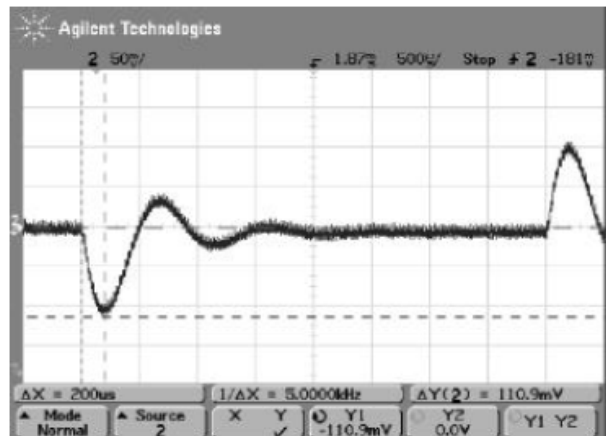
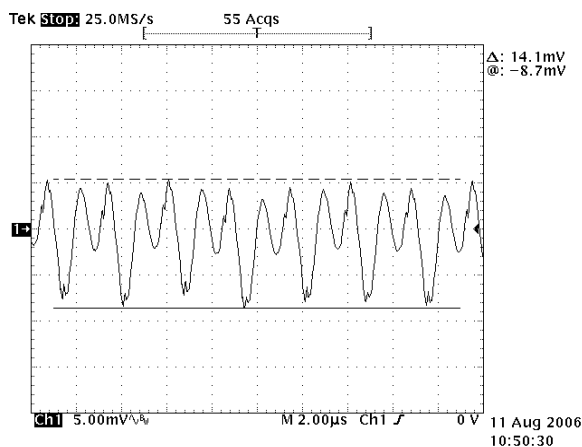


Figure 9: Output Ripple at $V_{IN} = 48\text{ Vdc}$; $I_O = I_{O,max}$

Figure 10: Output transient performance at 50% to 75% step load, $V_{IN} = 48\text{ Vdc}$.

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 11). 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.

Also shown is a sketch of a PCB layout used to achieve Class B conducted noise levels (See Figure 12). It is important to avoid extending the ground plane or any other conductors under the inductors (particularly L2) because capacitive coupling to that track or plane can effectively bypass the inductor and degrade high frequency performance of the filter.

PARTS LIST

CIRCUIT CODE	DESCRIPTION
L1, L2	Pulse Engineering P0353 / 590uH
C1, C3, C4, C5, C6, C11, C12	0.01uF / 2000V
C2, C7, C9	100uF / 100V Aluminum
C13, C14	470pF / 100V Ceramic
C8, C10	2.2uF / 100V Film

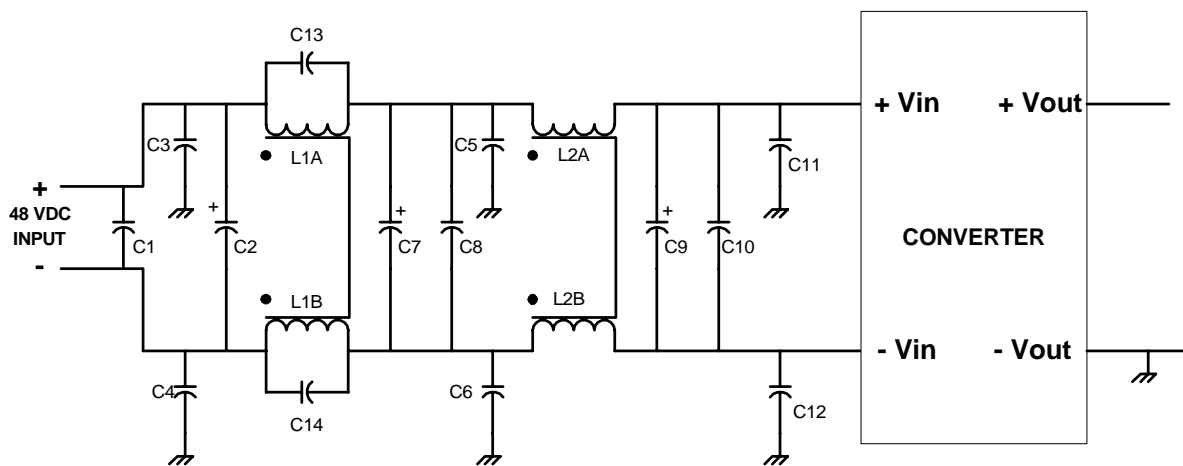


Figure 11: Class B Filter Circuit

INPUT FILTER FOR FCC CLASS B CONDUCTED NOISE (continued)

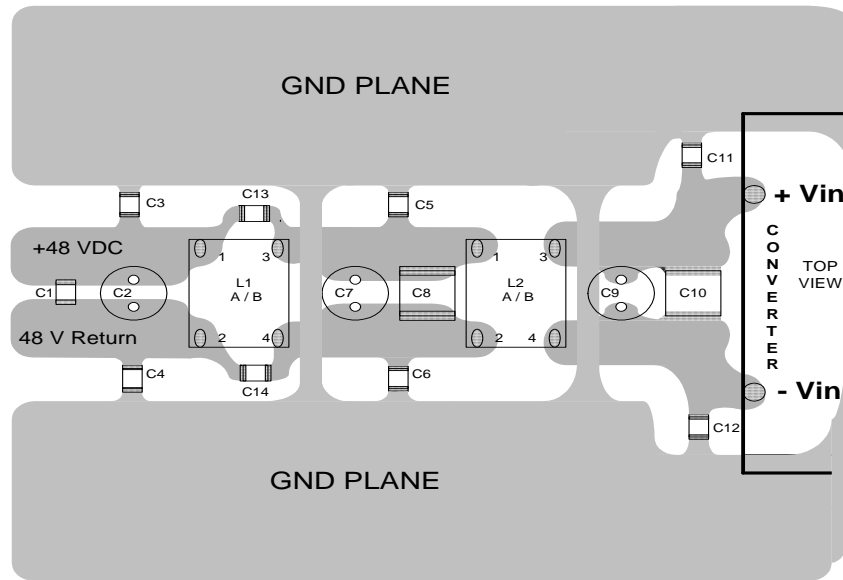


Figure 12: Recommended PCB Layout for Class B Filter

MECHANICAL SPECIFICATIONS

Parameter	Device	Symbol	Min	Typ	Max	Unit
Dimension	All	L	-	2.40 [60.96]	-	in [mm]
	All	W	-	2.30 [58.42]	-	in [mm]
	All	H	-	0.50 [12.70]	-	in [mm]
Weight	All		-	90 [3.18]	-	g [oz]

Note: (1) Nominal diameter for Pins 5 & 9 = 0.08", remaining pins at 0.04" diameter.
 (2) Recommended Torque setting for baseplate mounting holes is between 6 to 8 kg.cm.

MECHANICAL OUTLINE DRAWING

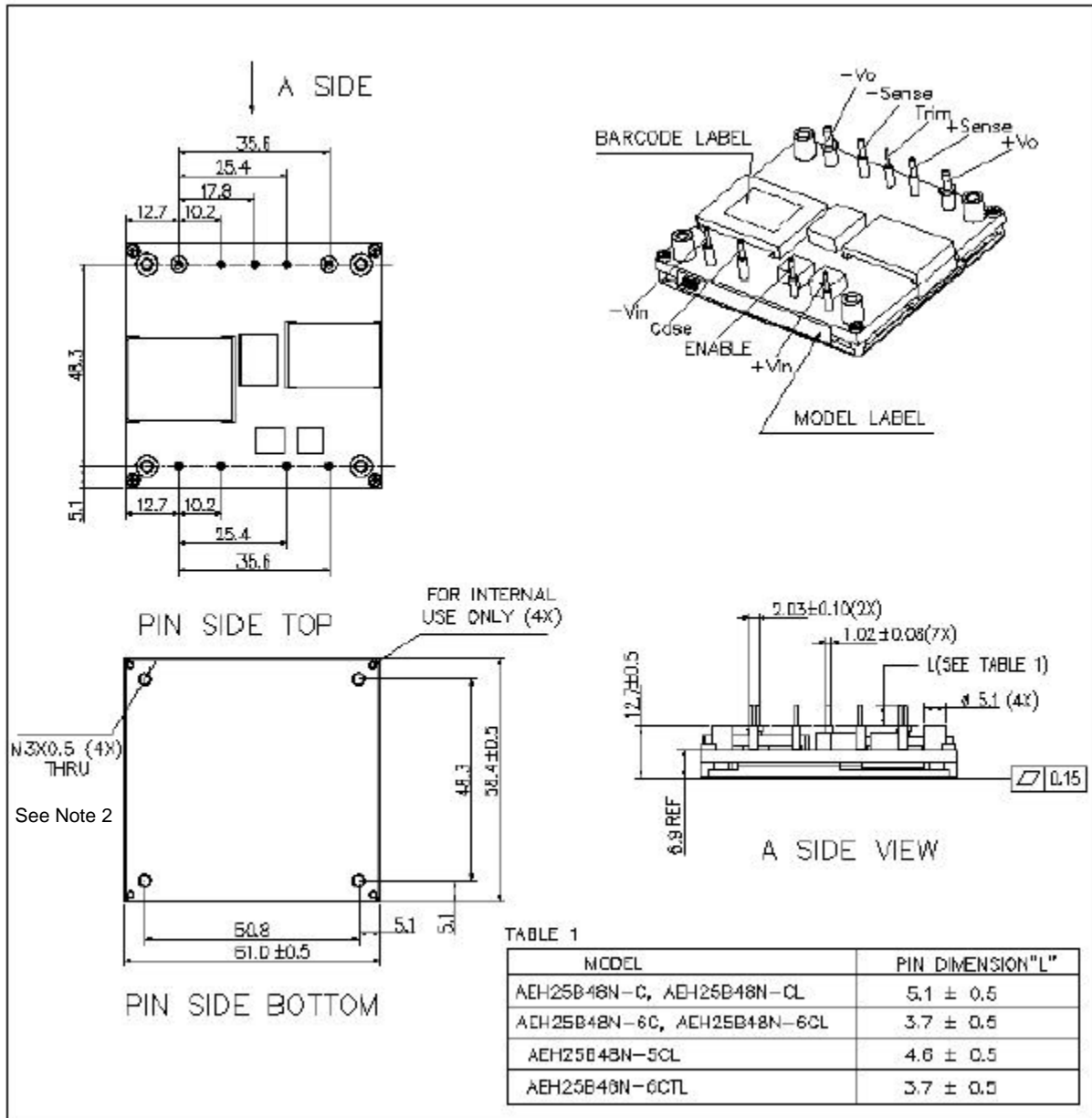


Figure 13. AEH - baseplate outline drawing.



TABLE 1. PART NUMBER CODING SCHEME FOR ORDERING

	ENABLE LOGIC	-	PIN LENGTH	GENERATION	SPECIAL	RoHS
	W	-	X	y	Z	L
AEH25B48	N = Negative logic	-	5 = 4.6mm nom 6 = 3.7mm nom Blank = 5mm nom (default)	C = second gen. product Blank = First gen. product	T = Tuned part for custom application	L = for RoHS 6

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