AEH/ALH80 Single Output Baseplate/Open-Frame DC-DC Converter Module
Industry Standard ½ Brick: 36V-75V Input / 80A Output Current

The AEH/ALH80 series is part of Astec's next generation single output, high-density industry standard half bricks. It operates from a 36V to 75V DC Bus and comes in three different Isolated Logic Output voltages (ILO) well suited for DPA applications. It's designed to handle 80A maximum output current for 1.8V, 1.5V and 1.2V at high levels of efficiency. It provides tight regulation and exhibits clean and monotonic output start up characteristics. The AEH/ALH80 comes with industry standard features such as Input UVLO, OCP, OVP, OTP, output Trim, differential output Sense pins. It comes either with baseplate or open frame construction, with double pair or single pair (option) output pins.

Special Features

- **Industry Standard ½ Brick Footprint**
- **Positive and Negative Enable Options**
- **Regulation to Zero Load**
- **High Capacitive Load Start-up**
- **Fixed Switching Frequency at 400kHz**
- **Output Trim**
- **Input Under-Voltage Lockout**
- **Low profile / open-frame**
- **Double pair or single pair output pins option**

Environmental Specifications

- **-40ºC to 85ºC Operating Temperature**
- **-40ºC to 125ºC Storage Temperature**
- **MTBF > 1 million hours**

Electrical Parameters

Input

Input Range	**36-75 VDC**
Input Surge	**100V / 100ms**
Efficiency	**1.8V @ 87.0%**
	1.5V @ 85.5%
	1.2V @ 83.0%

Control

Enable	**TTL compatible**

(Positive and Negative Enable Options)

Output

Load Current	**80A max**
Line/Load Regulation	**< 1% V_O**
Ripple and Noise	**50mV_{PK-PK} (Typ)**
Output Voltage Adjust Range	**±10% V_O**
Transient Response	**<5% V_O deviation (Typ)**
	50% to 75% Load Change
	250msec settling time (Typ)
Remote Sense	**+10%V_O**
Over Current Protection	**120% $I_{O,MAX}$**

Safety

UL + cUL 60950, Recognized
EN60950 through TUV-PS
CB Test Report

AEH/ALH80 Series

MODEL NAME	CONSTRUCTION	V_{OUT} / I_{OUT}
AEH80Y48	**Baseplate adapted**	**1.8V / 80A**
AEH80M48	**Baseplate adapted**	**1.5V / 80A**
AEH80K48	**Baseplate adapted**	**1.2V / 80A**
ALH80Y48	**Open Frame; Low Profile**	**1.8V / 80A**
ALH80M48	**Open Frame; Low Profile**	**1.5V / 80A**
ALH80K48	**Open Frame; Low Profile**	**1.2V / 80A**

OPTIONS:	SUFFIX
Negative Enable:	"N"
Positive Enable (Default):	No suffix
Single Pair Output Pins:	“-3”
Redundant Output Pins (Default):	No suffix

Electrical Specifications

STANDARD TEST CONDITION on a single module unless otherwise specified.

T_A		25°C (Ambient Air)
Airflow		Refer to Figures 21 to 24
$+V_{IN}$	PIN 1	Return pin for $+V_{IN}$
Enable	PIN 2	Dependent on model series
$-V_{IN}$	PIN 3	48V ± 2V
$-V_{OUT}$	PIN 4	Connected to Load
-Sense	PIN 5	Connected to $+V_{OUT}$
Trim	PIN 6	Open
+Sense	PIN 7	Connected to $-V_{OUT}$
+Vout	PIN 8	Connected to Load (return)

ABSOLUTE MAXIMUM RATINGS

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

Parameter	Device	Symbol	Min	Typ	Max	Unit
Input Voltage[1]						
Continuous	All	V_{IN}	0	-	75	Vdc
Transient (100ms)	All	$V_{IN, trans}$	0	-	100	Vdc
Isolation Voltage						
Input to Output	All		-	-	1500	Vdc
Input to Case	AEH				1500	Vdc
Output to Case					1500	Vdc
Operating Ambient Temperature	ALH	T_A	-40	-	+85	ºC
	AEH	T_C	-40	-	100	
Storage Temperature	All	T_{STG}	-55	-	125	ºC
Operating Humidity	All	-	-	-	85	%
Maximum Enable Voltage	All				25	Vdc
Max Output Power	Y (1.8V)	P_O	-	-	144	W
	M (1.5V)	P_O	-	-	120	W
	K (1.2V)	P_O	-	-	96	W

Electrical Specifications (*continued)*

INPUT SPECIFICATION

Parameter	Device	Symbol	Min	Typ	Max	Unit
Operating Input Voltage	All	V_{IN}	36	48	75	V_{DC}
Input Under-Voltage Lock-out T_ON Threshold T_OFF Threshold	All		 34.0 32.5	 34.8 33.5	 35.5 34.5	 Vdc
Maximum Input Current[1] Conditions: $V_{IN} = V_{IN,min}$ $I_O = I_{O,max}$; $T_A = 25$ ºC	Y (1.8V) M (1.5V) K (1.2V)	$I_{IN,max}$	- - -	- - -	5.2 4.4 3.6	A
Max P_{DISS} @ $I_O = 0A$ ($V_{IN} = V_{IN,NOM}$)	All		-	-	5	W
Input Reflected Ripple Current[2] Conditions: $P_O = P_{O,max}$; $T_A = 25$ ºC BW: 5Hz to 20MHz	All	I_{I1}/ I_{I2}	-	-	15	mA_{PK-PK}

Note: 1. An input line fuse is recommended for use (e.g. Littlefuse type 3AB 314, 8A/250V or equivalent).
2. External input capacitance required. See Input Ripple Current test measurement setup on Fig 1.

OUTPUT SPECIFICATIONS

Parameter	Device	Symbol	Min	Typ	Max	Unit
Output Voltage Set point $V_{IN} = V_{IN, min}$ to $V_{IN, max}$; $I_O = I_{O,Max}$	1V8 (Y) 1V5 (M) 1V2 (K)	$V_{O,SET}$	1.770 1.475 1.180	1.800 1.500 1.200	1.830 1.525 1.220	Vdc Vdc Vdc
Output Regulation Line: $V_{IN} = V_{IN, Min}$ to $V_{IN, Max}$ Load: $I_O = I_{O, Min}$ to $I_{O, Max}$ Temperature: Ta = -40 ºC to +85ºC	 All 1V8 (Y) All 1V2 (K) All		 - - - - -	 0.3 0.1 0.1 0.3 -	 0.6 0.4 0.4 0.7 1.0	 %Vo
Ripple and Noise[3] Peak-to-Peak: (5Hz to 20MHz)	 All	 -	 -	 50	 100	 mVp-p
Output Current[4]	All	I_O	0	-	80	A
External Load Capacitance Capacitor ESR	All	-	- 4	- -	50,000 -	µF mΩ
Output Current-limit Inception $V_{OUT} = 90\%$ $V_{O,SET}$[5]	All	I_O	83	-	100	A
Over Voltage Protection Range[6]	1V8 (Y) 1V5 (M) 1V2 (K)		2.20 1.80 1.44	2.40 1.90 1.50	2.90 2.50 2.10	V
Over Temperature Range[7] (AVG PCB TEMPERATURE)	All		110	-	120	°C
Efficiency $V_{IN} = V_{IN-NOM}$; $I_O = I_{O,MAX}$ T_A=25°C	1V8 (Y) 1V5 (M) 1V2 (K)	η η η	86.0 84.5 82.0	87.0 85.5 83.0	- - -	% % %

Electrical Specifications (*continued*)

OUTPUT SPECIFICATIONS

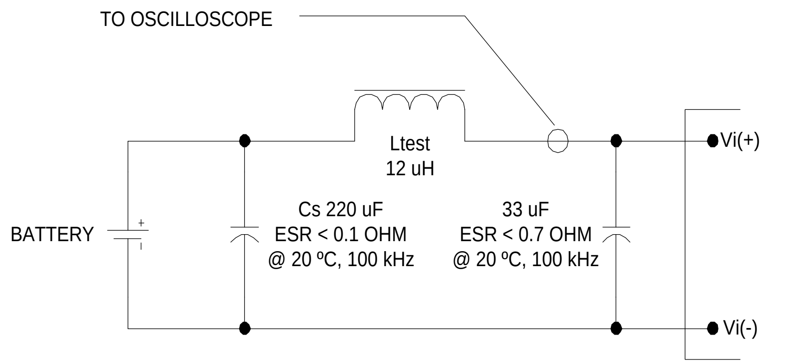
Parameter	Device	Symbol	Min	Typ	Max	Unit
Turn-On Response Time $I_O = I_{O,MAX}$, V_O within 1%	All	-	-	4	10	ms
Switching Frequency	All	-	360	400	440	KHz
Dynamic Response: $\Delta I_O/\Delta t$=0.1A / uS C_O = 0uF		-	-	0.1	-	A/µs
Load Change from I_O = 50% to 75% of $I_{O, Max}$:	All	-	-	-	200	mV
Peak Deviation Settling Time to $V_{O, SET}$ tolerance		-	-	-	500	µs
Load Change from I_O = 50% to 25% of $I_{O, Max}$:	All	-	-	-	200	mV
Peak Deviation Settling Time to $V_{O, SET}$ tolerance		-	-	-	500	µs
Output Overshoot at T-on / T-off Passive Resistive Full Load	All	-	-	0	4	%Vo
Output Enable ON/OFF						
Negative Enable ("N" suffix) Enable Pin voltage for Module ON	N suffix	-	-0.7	-	1.2	V
Module OFF		-	2.95	-	10.0	V
Positive Enable (No suffix) Enable Pin voltage for Module ON	No suffix	-	2.95	-	10.0	V
Module OFF		-	-0.7	-	1.2	
Output Voltage Remote Sensing[8,10]	All	-	-	-	10	$\%V_O$
Output Voltage Trim Range[9,10]	All		90		110	$\%V_O$

Note:
3. See Figure 2 for Ripple and Noise test measurement setup. Output ripple may exceed max limits at high line condition.
4. Appropriate Thermal Derating applies. See Figures 17 to 22 for the Thermal Derating Curves
5. In an event of an over current condition - the converter will be latched off. Restart is possible either by cycling the input voltage or toggling the Enable signal for 100ms. Consult factory for Auto restart option.
6. The OVP mode is latching. The converter will be latched off once the sensed voltage across the output pins exceeds the threshold limits. Restart is possible by either cycling the input voltage or toggling the Enable signal for 100ms. For testing purposes, output current should be derated so as not to exceed maximum output power.
7. Output of the module will be terminated once the operating temp reaches the OTP range. Normal operation resumes once the temperature falls below the OTP range.
8. The sense pins can be used to compensate for any voltage drops (per indicated max limits) that may occur along the connection between the output pins to the load. Pin 9 (+Sense) and Pin 7 (-Sense) should be connected to Pin 10/11 (+Vout) and Pin 5/6 (Return) respectively at the point where regulation is desired.
9. Refer to Equation (1) and (2) and Figures 3 and 4 for the Output Trim Adjust configuration.
10. The combination of remote sense and Trim adjust cannot exceed 110% of $V_{O, NOM}$.

Electrical Specifications (*continued)*

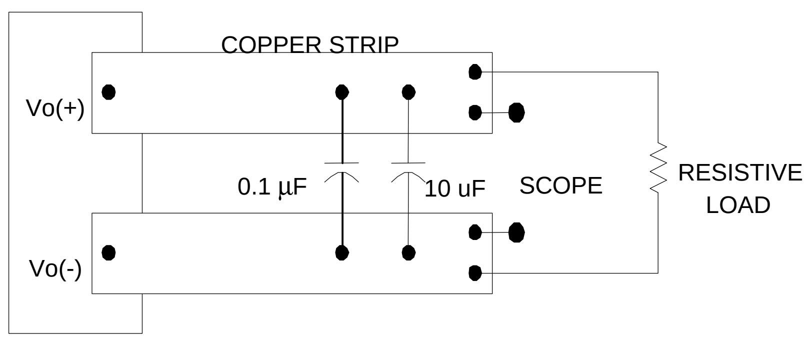
SAFETY APPROVAL
The AEH80/ALH80 series have been certified through:

- UL + cUL 60950, Third Edition - Recognized (PENDING)
- EN 60950 through TUV-PS (PENDING)
- Meets Basic Insulation



Note: Measure the input reflected ripple current with a simulated source inductance (Ltest) of 12uH. Capacitor Cs offsets possible battery/ source impedance. Measure current as shown above.

Figure 1. Input Reflected Ripple Current Measurement Setup.



Note: Use a 0.1µF 50V X7R ceramic capacitor and a 10µF 25V tantalum cap. Scope measurement should be made using a BNC probe socket positioned about 76mm (3 in.) away from the module's output terminals. The ext. capacitors should be placed between the BNC socket and the module's output terminals, with a minimum distance of 51mm (2in.) from the latter.

Figure 2. Peak to Peak Output Noise Measurement Setup.

Basic Operation and Features

INPUT UNDER VOLTAGE LOCKOUT

To prevent any instability to the converter, which may affect the end system, the AEH/ALH80 series have been designed to turn-on once V_{IN} is in the voltage range of 34-35.5 VDC. Likewise, it has also been programmed to turn-off when V_{IN} drops down to 32.5-34.5 VDC.

OUTPUT VOLTAGE ADJUST/TRIM

The converter comes with a TRIM pin (PIN 8), which is used to adjust the output by as much as 90% to 110% of its set point. This is achieved by connecting an external resistor as described below.

To **INCREASE** the output, external R_{adj_up} resistor should be connected between TRIM PIN (Pin8) and +SENSE PIN (Pin 7). Please refer to Equation (1) for the required external resistance and output adjust relationship.

1.8V / 1.5V

Equation (1a):

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

1.2V

Equation (1b):

$$Radj\_up = \left(\frac{5.1 \cdot Vo(100 + \Delta\%)}{0.6 \cdot \Delta\%} - \frac{510}{\Delta\%} - 6.1 \right) \cdot k\Omega$$

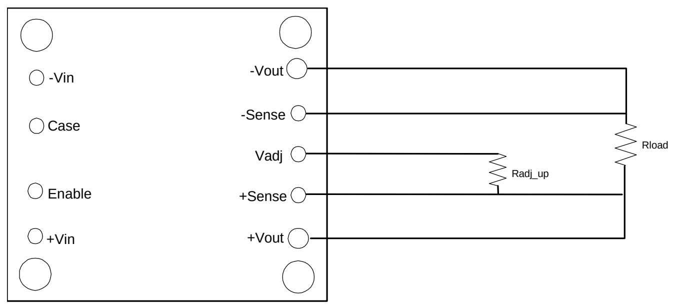


Figure 3. External resistor configuration to increase the output.

To **DECREASE** the output, external R_{adj_down} resistor should be connected between TRIM PIN (Pin 8) and -SENSE PIN (Pin 9). Please refer to Equation (2) for the required external resistance and output adjust relationship.

1.8V / 1.5V

Equation (2a)

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

1.2V

Equation (2b):

$$Radj\_down = \left(\frac{510}{\Delta\%} - 6.1 \right) \cdot k\Omega$$

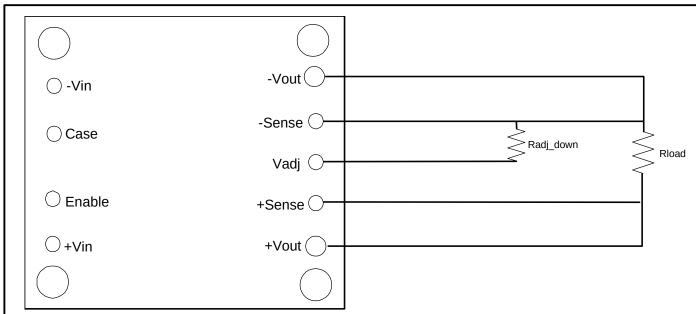


Figure 4. External resistor configuration to decrease the output.

Where: Radj = resistance in kohms
? % = percent change in the output

Basic Operation and Features *(continued)*

OUTPUT ENABLE

The AEH/ALH80 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. Please refer to Table 2 for the Part Numbering Scheme.

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.

OUTPUT OVER VOLTAGE PROTECTION (OVP)

The Over Voltage Protection circuit comes in latching mode. The converter is latched off if the output voltage exceeds the OVP threshold limits. The OVP latch is reset either by cycling the input voltage or toggling the Enable signal for 100ms.

OVER CURRENT PROTECTION (OCP)

The Over Current Protection circuit comes in latching mode. The converter is latched off if the load current on the output reaches the OCP threshold limit. The OCP latch can be reset either by cycling the input voltage or toggling the Enable signal for 100ms. Consult factory for Auto-restart option.

OVER TEMPERATURE PROTECTION (OTP)

The Over Temperature Protection circuit will shutdown the converter once the average PCB temperature reaches the OTP range. 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 to less than 110°C.

Performance Curves

1.8V SERIES

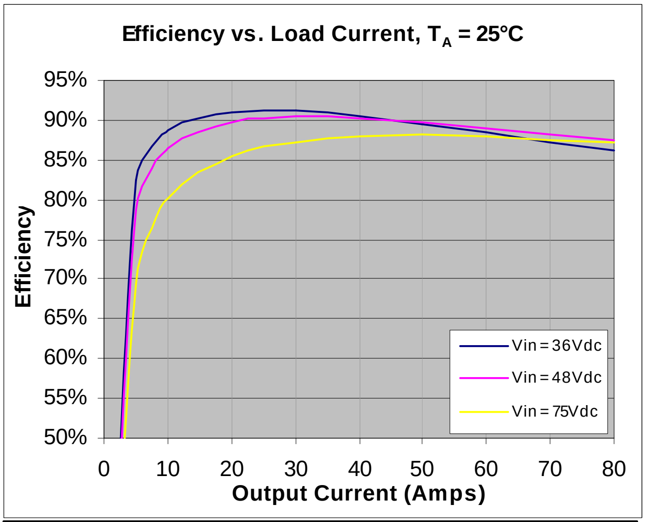


Figure 5. Efficiency vs. Load Current Curves at T_A=25°C for different input voltages with 300 LFM airflow directed from Pins 4 to 1.

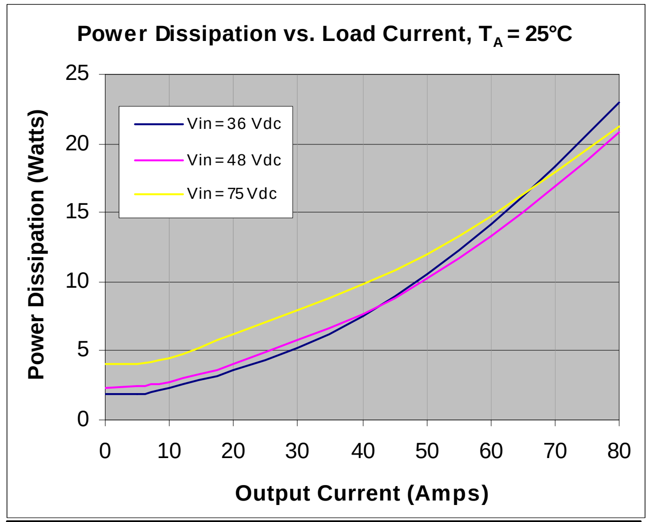


Figure 6. Power Dissipation vs. Load Current Curves at T_A=25°C for different input voltages with 300 LFM airflow directed from Pins 4 to 1.

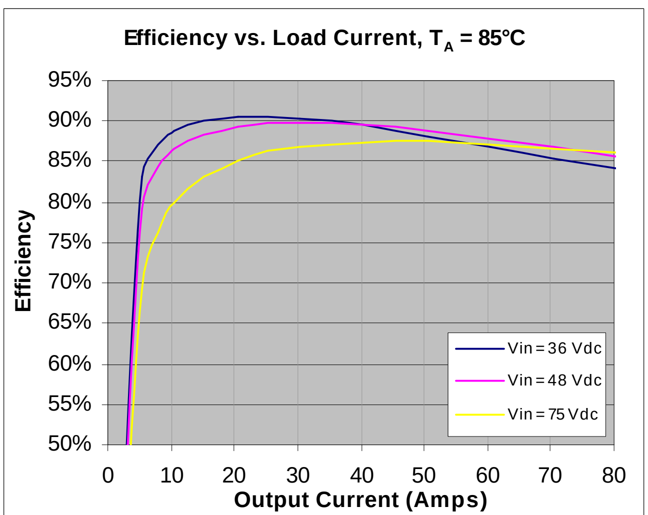


Figure 7. Efficiency vs. Load Current Curves at T_A=85°C for different input voltages with 300 LFM airflow directed from Pins 4 to 1.

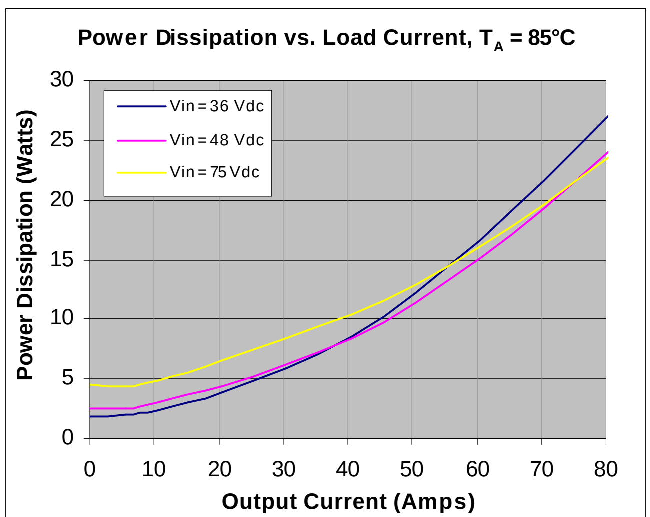


Figure 8. Power Dissipation vs. Load Current at T_A=85°C for different input voltages with 300LFM airflow directed from Pins 4 to 1.

Performance Curves *(continued)*

1.5V SERIES

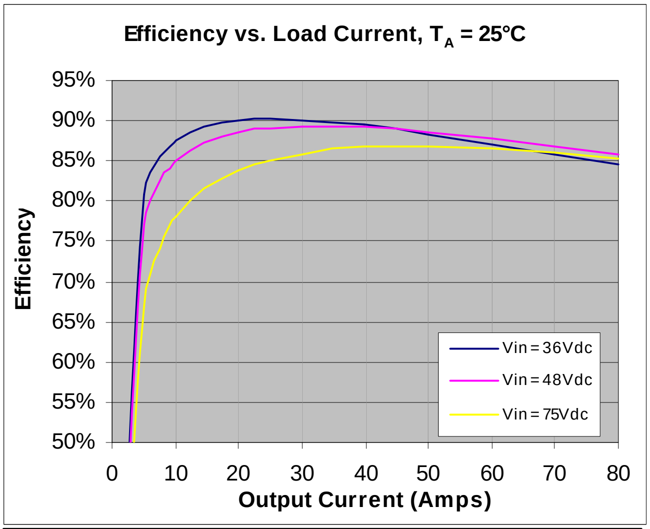


Figure 9. Efficiency vs. Load Current Curves at T_A=25°C for different input voltages with 300 LFM airflow directed from Pins 4 to 1.

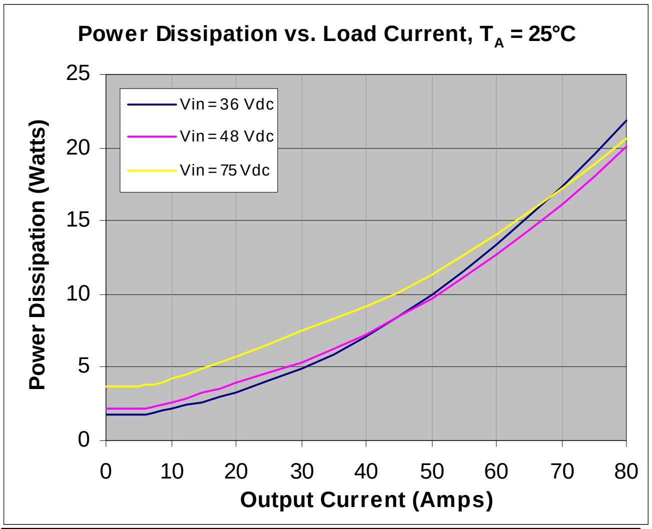


Figure 10. Power Dissipation vs. Load Current at T_A=25°C for different input voltages with 300 LFM airflow directed from Pins 4 to 1.

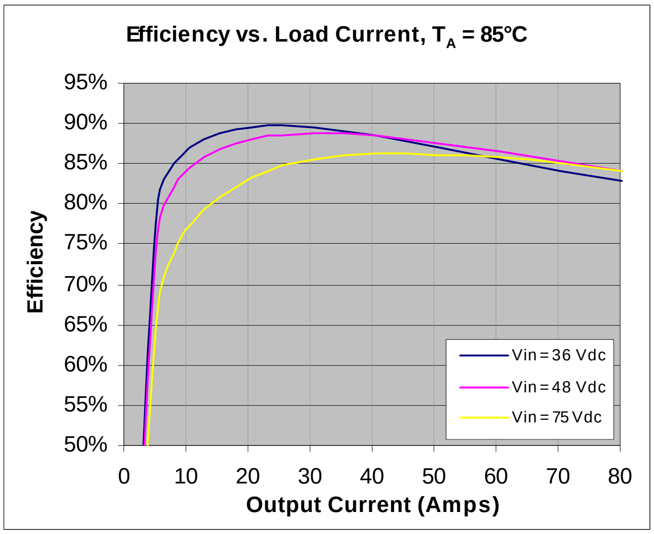


Figure 11. Efficiency vs. Load Current Curves at T_A=85°C for different input voltages with 300 LFM airflow directed from Pins 4 to 1.

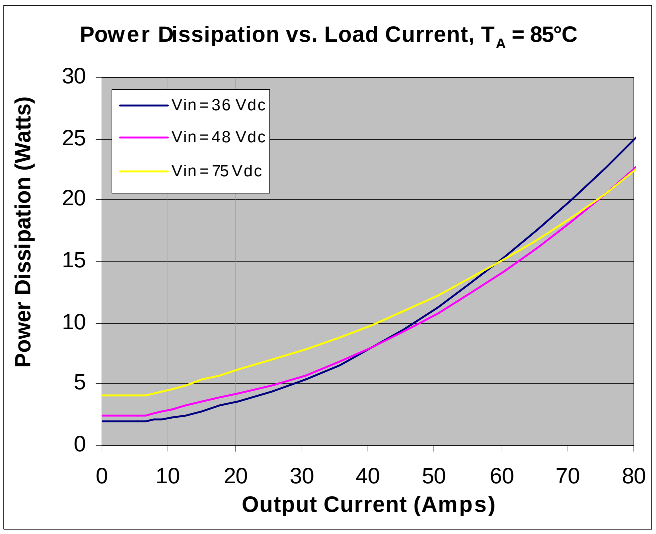


Figure 12. Power Dissipation vs. Load Current at T_A=85°C for different input voltages with 300 LFM airflow directed from Pins 4 to 1.

Performance Curves *(continued)*

1.2V SERIES

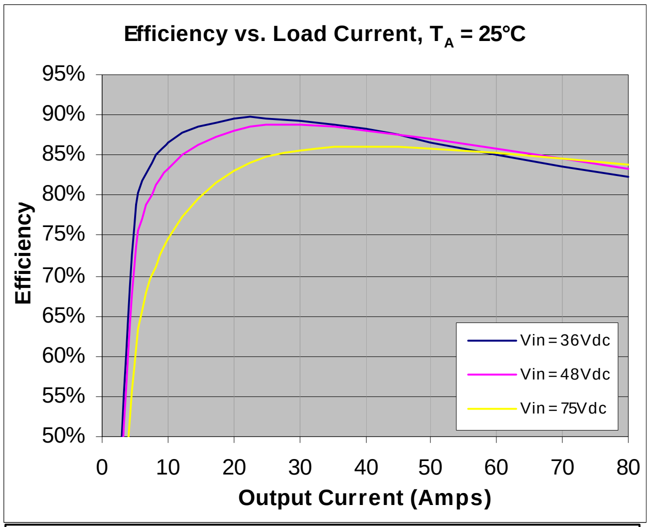


Figure 13. Efficiency vs. Load Current Curves at T_A=25°C for different input voltages with 300 LFM airflow directed from Pins 4 to 1.

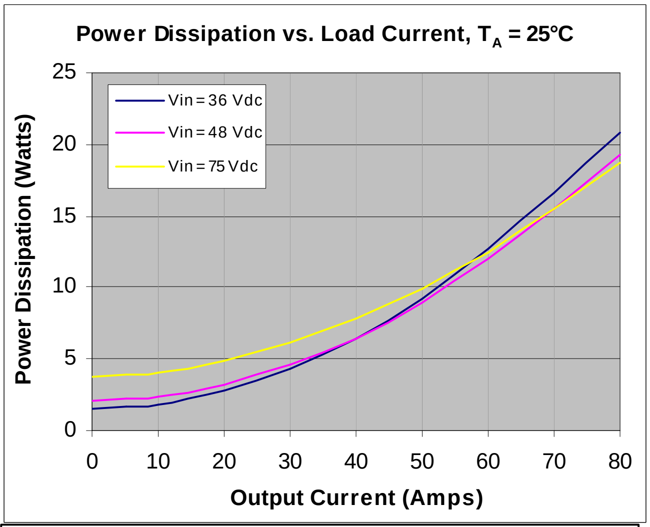


Figure 14. Power Dissipation vs. Load Current at T_A=25°C for different input voltages with 300 LFM airflow directed from Pins 4 to 1.

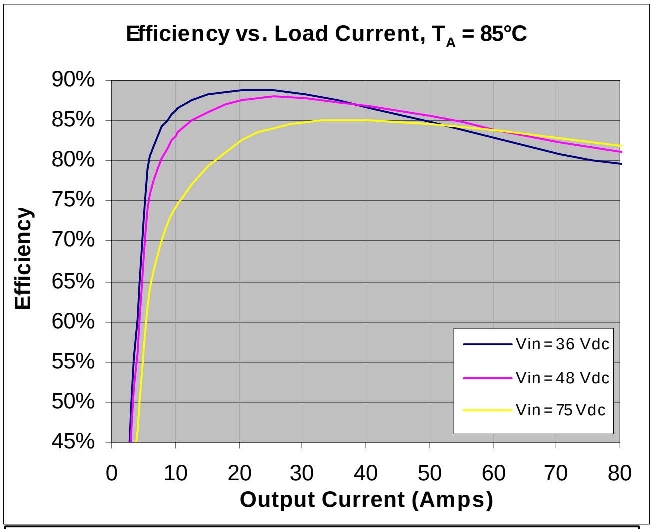


Figure 15. Efficiency vs. Load Current Curves at T_A=85°C for different input voltages with 300 LFM airflow directed from Pins 4 to 1.

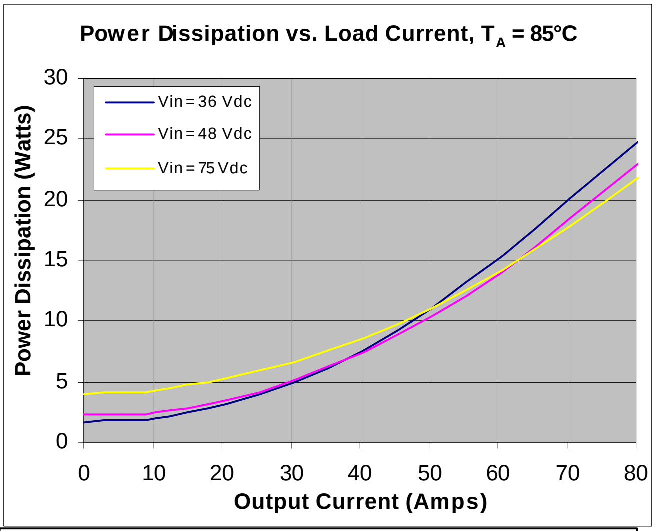


Figure 16. Power Dissipation vs. Load Current at T_A=85°C for different input voltages with 300 LFM airflow directed from Pins 4 to 1.

Performance Curves *(continued)*

CURRENT VS. TEMPERATURE CURVES

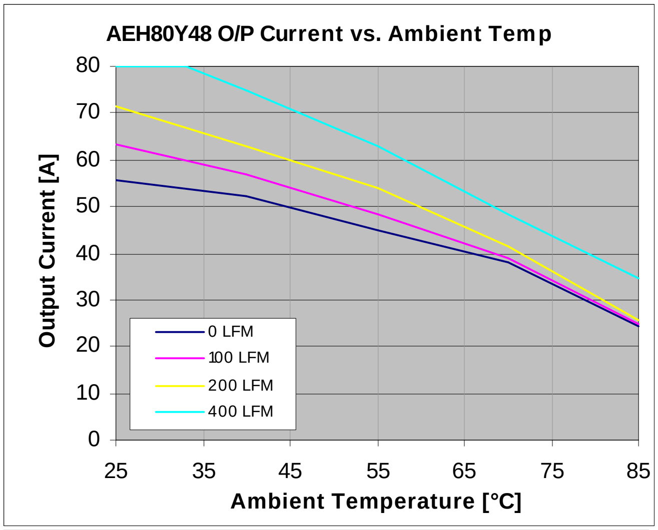


Figure 17. 1.8V Output Derating Curves (100ºC Baseplate) at various airflow conditions directed across PIN 4 to 1 with the module mounted vertically.

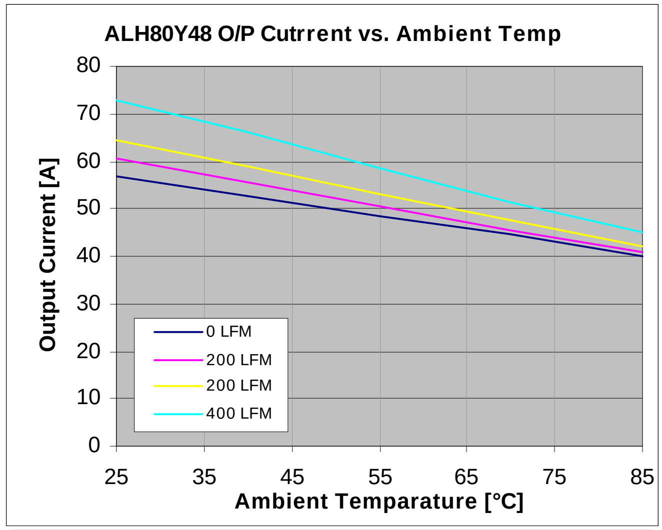


Figure 18. 1.8V Output Derating Curves (125ºC Junction) at various airflow conditions directed across PIN 4 to 1 with the module mounted vertically.

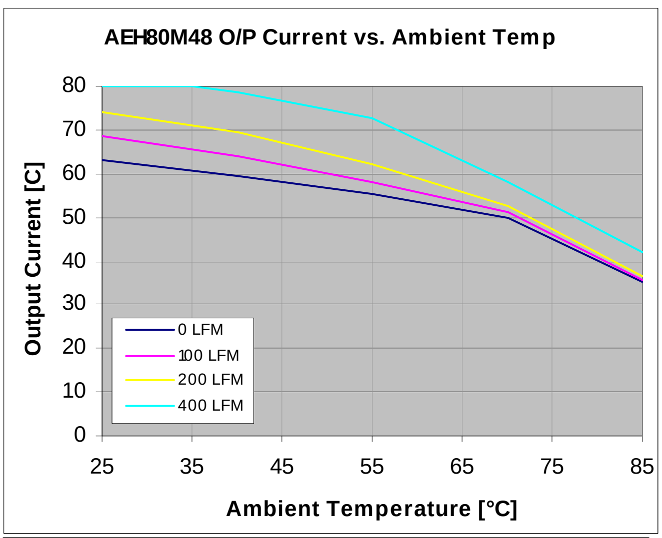


Figure 19. 1.5V Output Derating Curves (100ºC Baseplate) at various airflow conditions directed across PIN 4 to 1 with the module mounted vertically.

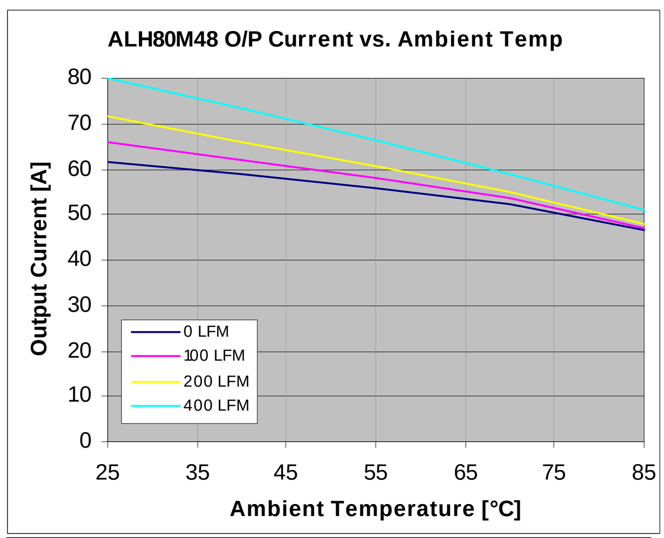


Figure 20. 1.5V Output Derating Curves (125ºC Junction) at various airflow conditions directed across PIN 4 to 1 with the module mounted vertically.

Performance Curves *(continued)*

CURRENT VS. TEMPERATURE CURVES

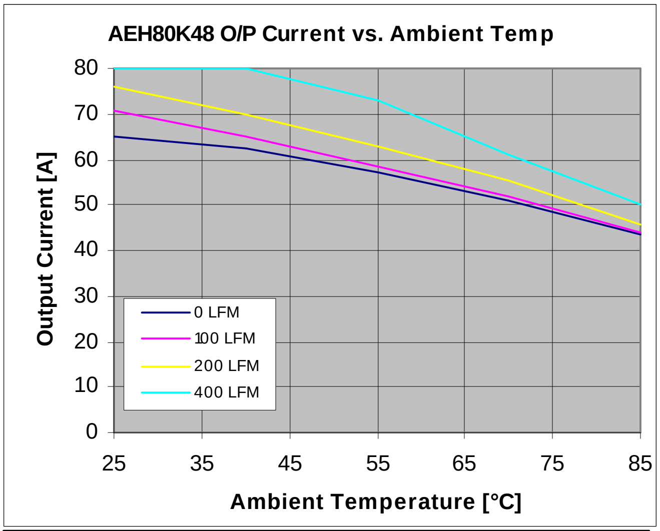


Figure 21. 1.2V Output Derating Curves (100ºC Baseplate) at various airflow conditions directed across PIN 4 to 1 with the module mounted vertically.

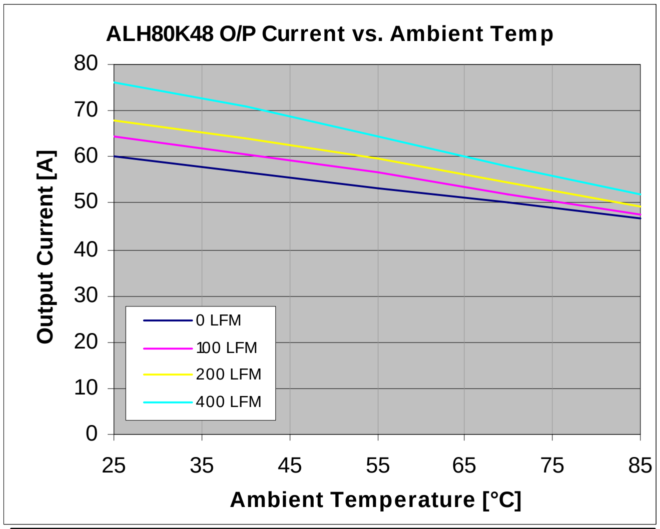


Figure 22. 1.2V Output Derating Curves (125ºC Junction) at various airflow conditions directed across PIN 4 to 1 with the module mounted vertically.

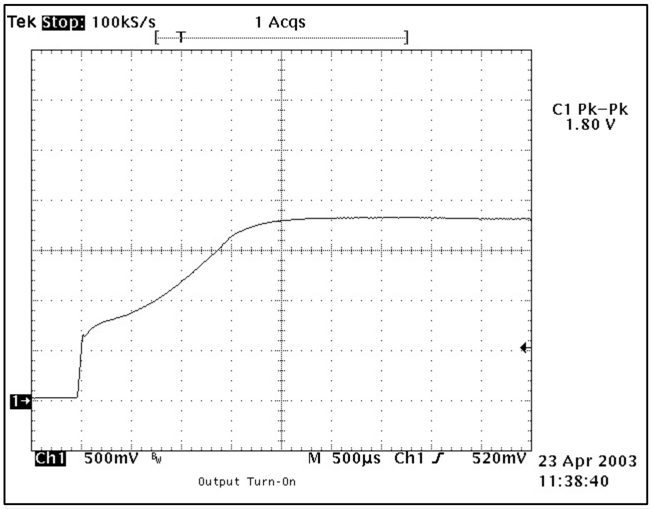


Figure 23. 1.8V Start-up characteristic at V_{IN} = 48Vdc, full load condition at T_A = 25ºC.

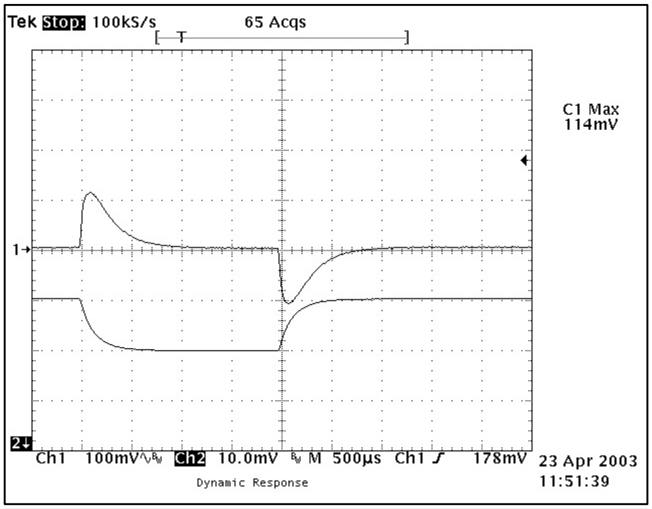


Figure 24. 1.8V transient load response for a 25% $I_{O,MAX}$ (40-60-40A) load change at V_{IN} = 48Vdc, T_A = 25ºC.

Performance Curves *(continued)*

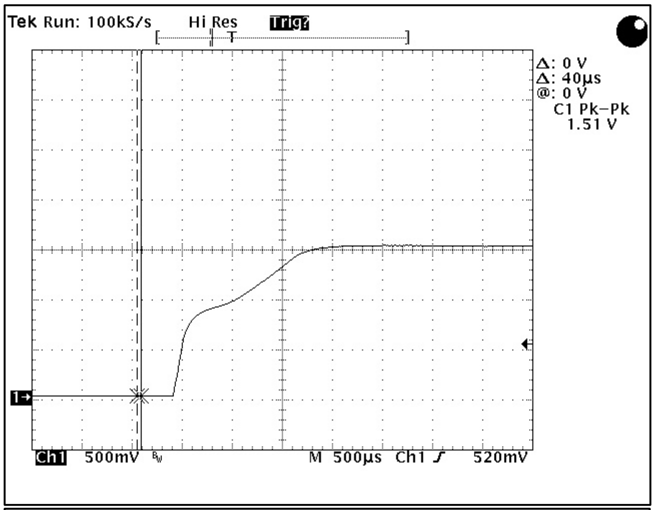


Figure 25. 1.5V Start-up characteristic at V_{IN} = 48Vdc, full load condition at T_A = 25ºC.

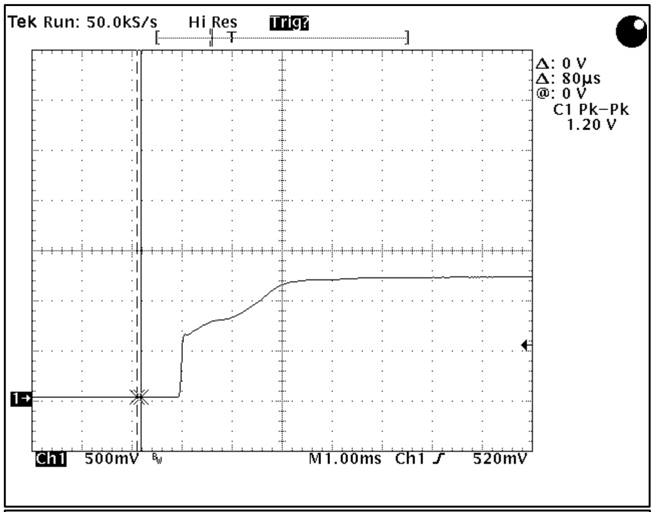


Figure 27. 1.2V Start-up characteristic at V_{IN} = 48Vdc, full load condition at T_A = 25ºC.

Mechanical Specifications

Parameter	Device	Symbol	Min	Typ	Max	Unit
Dimension	All	L	-	2.40 [60.9]	-	in [mm]
		W	-	2.30 [58.4]	-	in [mm]
	AEH	H	-	0.50 [12.7]	-	in [mm]
	ALH	H	-	0.42 [10.6]		in [mm]
Weight	AEH		-	130 [4.6]	-	g [oz]
	ALH		-	110 [3.9]	-	g [oz]

PIN ASSIGNMENT			
1	$+V_{IN}$	**7**	-SENSE
2	Enable (On/Off)	**8**	TRIM
3	Case	**9**	+SENSE
4	$-V_{IN}$	**10**	$+V_O$ [Optional Pin]
5	-Vo	**11**	+Vo
6	-Vo [Optional Pin]		

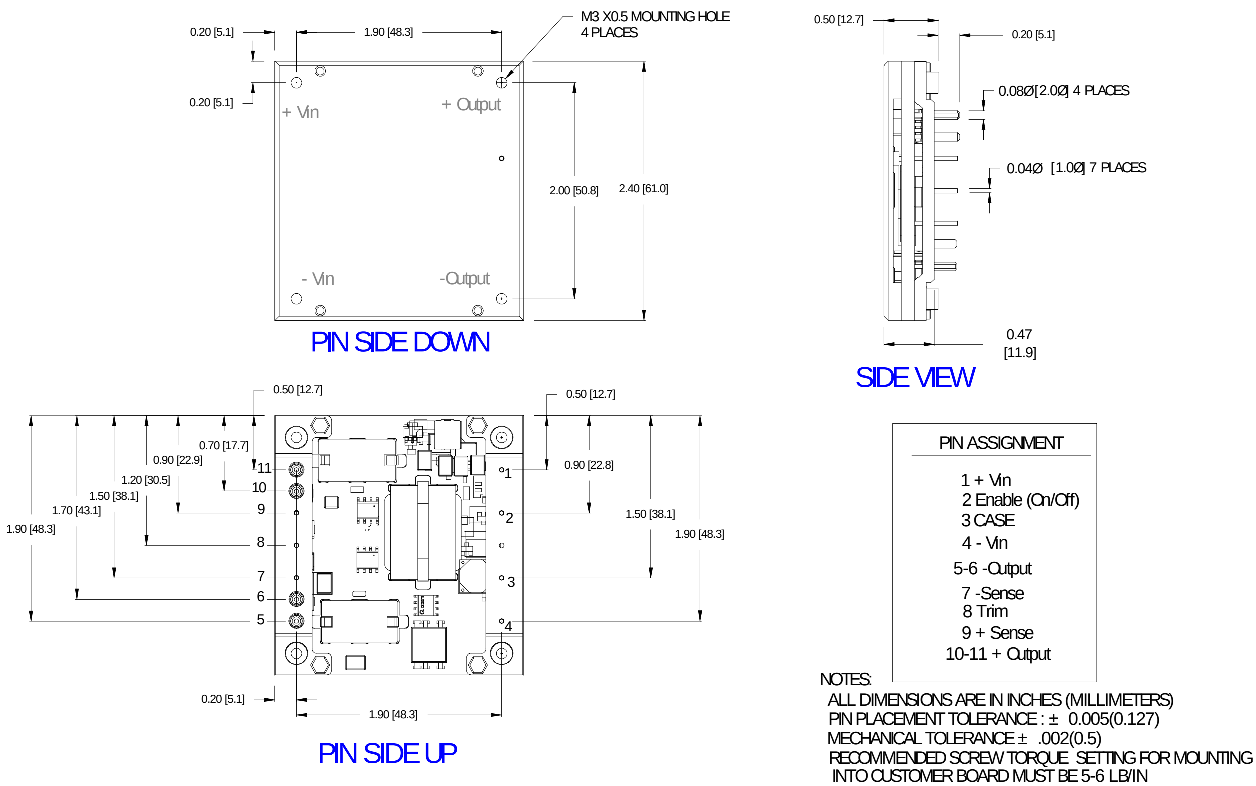


Figure 25. AEH80 Series (Baseplate) Mechanical Outline Drawing.

Mechanical Specifications *(continued)*

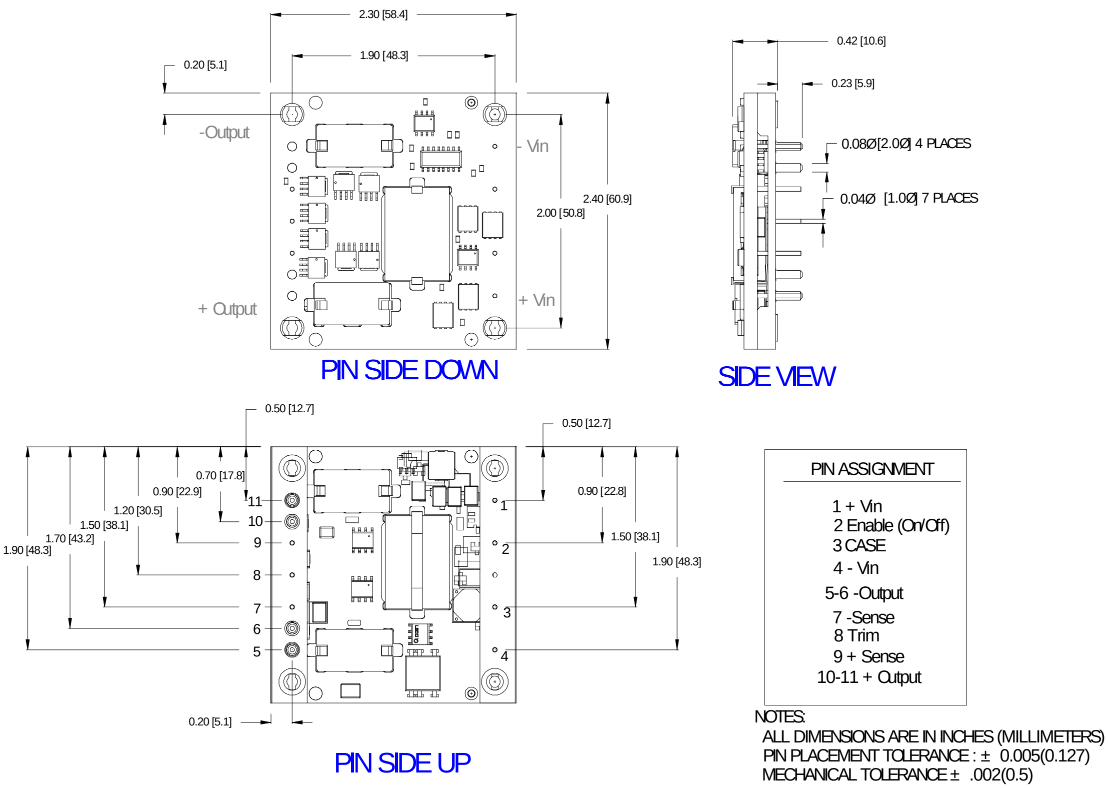


Figure 26. ALH80 Series (Open Frame) Mechanical Outline Drawing.

SOLDERING CONSIDERATIONS

The AEH/ALH80 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.

Mechanical Specifications *(continued)*

PART NUMBERING SCHEME FOR ORDERING

	OUTPUT VOLTAGE	V_{IN}	ENABLE LOGIC	OUTPUT PIN OPTION
AwH80	**x**	**48**	**y**	**z**
E = Baseplate **L** = Open Frame	**Y** = 1.8V **M** = 1.5V **K** = 1.2V		**N** = Negative Enable "Blank" = Positive Enable (Default)	"**-3**" = Single pair of output pins (delete Pins 6 and 10) "Blank" = 4 output pins (Pins 5, 6, 10, 11 present)

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