



**Technical Reference Notes**  
**AA60A-036L-050D033H Series**  
**(5V / 3V3 Dual Output Half Brick)**



**AA60A-036L-050D033H SERIES**

This specification covers the requirement for a wide input voltage range (18V to 60V) half brick - baseplate design, 60W power - dual output high efficiency DC/DC converter.

MODEL NAME	V <sub>IN</sub> nominal	V <sub>OUT</sub> / I <sub>OUT</sub>
AA60A-036L-050D033H	36V	5V, 12A / 3.3V, 15A
AA60A-036L-050D033HN	36V	5V, 12A / 3.3V, 15A
AA60A-036L-050D033H-6	36V	5V, 12A / 3.3V, 15A
AA60A-036L-050D033HN-6	36V	5V, 12A / 3.3V, 15A
AA60A-036L-050D033H-8	36V	5V, 12A / 3.3V, 15A
AA60A-036L-050D033HN-8	36V	5V, 12A / 3.3V, 15A
AA60A-036L-050D033H-6M3	36V	5V, 12A / 3.3V, 15A
AA60A-036L-050D033H-8M3	36V	5V, 12A / 3.3V, 15A
AA60A-036L-050D033H-6M4	36V	5V, 12A / 3.3V, 15A
AA60A-036L-050D033H-8M4	36V	5V, 12A / 3.3V, 15A
AA60A-036L-050D033H-6M9	36V	5V, 12A / 3.3V, 15A

OPTIONS:

	<u>SUFFIX</u>
Negative Enable:	"N"
Positive Enable:	No suffix "N"
3.7mm (nom) Pin Length:	"-6"
2.8mm (nom) Pin Length:	"-8"
0.45"H - Transverse Heatsink	M3
0.45"H - Longitudinal Heatsink	M4
Non-threaded baseplate stand-off	M9



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**Electrical Specifications**

STANDARD TEST CONDITION on a single module unless otherwise specified.

TA:		25°C (Ambient Air)
- V <sub>IN</sub> :	PIN 1	Return Pin for +VIN
Case:	PIN 2	Case Ground - OPEN
Enable:	PIN 3	Dependent on model series <sup>1</sup>
+ V <sub>IN</sub> :	PIN 4	48 VDC
+V <sub>OUT2</sub> :	PIN 5	3.3V Load
-V <sub>OUT2</sub> :	PIN 6	3.3V Load Return
Trim2:	PIN 7	3.3V Trim - Open
+V <sub>OUT1</sub> :	PIN 8	5V Load
- V <sub>OUT1</sub> :	PIN 9	5V Load Return
Trim1:	PIN 10	5V trim - Open

Note: 1. For Negative Enable series ("N" suffix), Enable pin should be connected to -Vin to allow module to turn-on. For Positive Enable series (no "N" suffix), Enable pin should be connected to + Vin.

**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:	All	V <sub>IN</sub>	0	-	60	Vdc
Continuous			0	-	100	Vdc
Transient(100ms) :		V <sub>IN,trans</sub>				
Operating Ambient Temperature		T <sub>A</sub>	-40	-	70 <sup>2</sup>	°C
Operating Baseplate Temperature		T <sub>B</sub>		-	100	°C
Storage Temperature		T <sub>STG</sub>	-55	-	125	°C
Operating Humidity		-	-	-	85	%
I/O Isolation						
Input to Output		-	1500	-	-	Vdc
Input to Case			707	-	-	Vdc
Output to Case			1500	-	-	Vdc

Note: 2. Power Derating applies



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**Electrical Specifications (continued)**

**INPUT SPECIFICATION**

Parameter	Device	Symbol	Min	Typ	Max	Unit
Operating Input Voltage After start-up with max 60W	All	$V_{IN}$	19	36	60	VDC
			18		60	VDC
Startup Voltage	All		19		20	VDC
Shutdown Voltage	All	$I_{IN,max}$	17	17.8	18	VDC
Maximum Input Current <sup>3</sup> Conditions: $V_{IN} = V_{IN,min}$ $I_O = I_{O,max}$ ; $T_A = 25\text{ }^\circ\text{C}$			-	-	6.5	A
Input Reflected Ripple Current <sup>4</sup> Conditions: $P_{O1} = P_{O2} = 30\text{W}$ ; $T_A = 25\text{ }^\circ\text{C}$	All	$I_{I1}/I_{I2}$	-	-	100	mA <sub>PK-PK</sub>
Standing Loss Condition: $V_{IN} = V_{IN,nom}$ ; $T_A = 25\text{ }^\circ\text{C}$	All	-	-	3	-	W

NOTE: 3. This power module is not internally fused. An input line is recommended.

4. See Figure 1 for Input Reflected Ripple Current Test Setup.

**OUTPUT SPECIFICATIONS**

Parameter	Device	Symbol	Min	Typ	Max	Unit
Voltage Setpoint Conditions: $V_I = V_{IN,nom}$ ; $T_A = 25\text{ }^\circ\text{C}$ ; $T_C = 50\text{ }^\circ\text{C}$ ; $V_{O1}$ : $I_{O1} = I_{O,max}$ ; $V_{O2}$ : $I_{O2} = I_{O,min}$ ;	All	$V_{O1}/V_{O2}$	4.92 / 3.25	5.0 / 3.30	5.08 / 3.35	Vdc
Load Current	All	$I_{O1}/I_{O2}$	0.5 / 0.5	-	12.0 / 15.0	A
Output Capacitive Load	All				10,000	µF
Line Regulation	All		-	0.01	1.0	%V <sub>o</sub>
Load Regulation <sup>5</sup>	All		-	0.05	1.0	%V <sub>o</sub>
Temperature Coefficient of Voltage Conditions: $T_C = -40\text{ }^\circ\text{C}$ to $100\text{ }^\circ\text{C}$ $V_{IN} = V_{IN,nom}$ ; $I_O = I_{O,max}$ ;	All		-	-	2.0	%V <sub>o</sub>



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**Electrical Specifications (continued)**

**OUTPUT SPECIFICATIONS**

Parameter	Device	Symbol	Min	Typ	Max	Unit
Output Ripple and Noise: Peak-to-Peak <sup>6</sup>	All		-	50	100	mV <sub>PK-PK</sub>
Conditions: $I_O = I_{O,max}$ ; $V_{IN} = V_{IN,nom}$ ; BW = 20 MHz; $T_A = 25\text{ }^\circ\text{C}$			-	20	40	mV <sub>RMS</sub>
Over Current Limit Inception		$I_{O1}$	16.5	-	22	A
		$I_{O2}$	18.0	-	25	A
Efficiency	5V	? <sub>1</sub>	80	83		%
Conditions: $V_{IN} = V_{IN,nom}$ ; $T_A = 25\text{ }^\circ\text{C}$ ; $T_C = 50\text{ }^\circ\text{C max}$	3.3V	? <sub>2</sub>	73	75		%
? <sub>1</sub> : $I_{O1} = I_{O1,max}$ , $I_{O2} = I_{O2,min}$						
? <sub>2</sub> : $I_{O1} = I_{O1,min}$ , $I_{O2} = I_{O2,max}$						
Dynamic Response						
Conditions: $\Delta I_O / \Delta t = 1\text{A}/10\mu\text{s}$ ; $V_{IN} = V_{IN,nom}$ ; $T_A = 25\text{ }^\circ\text{C}$ ; $T_C = 50\text{ }^\circ\text{C max}$						
Peak Voltage Deviation	3.3V	-	-	52	120	mV
Load Change: $I_O = 50\%$ to $75\% I_{O,max}$	5V	-	-	27	300	mV
Other output at min load						
Transient Settling Time						
Up to 1% of $V_O$	3.3V	-	-	40	300	$\mu\text{sec}$
	5V	-	-	-	300	msec
Turn-On Time	All	-	-	5	100	msec
Conditions: $V_{IN} = V_{IN,min}$ ; $I_{O1} = I_{O,max}$ ; $I_{O2} = I_{O,min}$ ; $T_A = 25\text{ }^\circ\text{C}$						
Output Voltage Overshoot	All	-	-	120	200	% $V_O$
Conditions: $I_O = I_{O,max}$ ; $T_A = 25\text{ }^\circ\text{C}$ ;						

NOTE: 5. Channel under test shall follow the specified conditions while the other channel is set to min load.

6. Channel under test shall be set to full load with the other channel set to  $I_{O,min}$  - See Fig 2 for the recommended ripple and noise test setup.



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**Electrical Specifications (continued)**

**FEATURE SPECIFICATION**

Parameter	Device	Symbol	Min	Typ	Max	Unit
<u>Enable Pin Voltage</u>						
Logic Low:	ALL	V <sub>ENABLE</sub>	0	-	0.7	V
Logic High:		V <sub>ENABLE</sub>	1.5	-	12.0	V
<u>Enable Pin Current</u>						
Logic Low	All	I <sub>ENABLE</sub>	-	0.4	1.0	mA
Logic High: (I <sub>LKG</sub> at V <sub>ENABLE</sub> = 5V)	All	I <sub>ENABLE</sub>	-	-	50	µA
Output Over Voltage Clamp	All	V <sub>O,CLAMP</sub>	120	-	140	%V <sub>O</sub>
Output Voltage Adjustment Range						
V <sub>O1</sub> : V <sub>IN</sub> =V <sub>IN,nom</sub> ; I <sub>O1</sub> = I <sub>O,MAX</sub> ; I <sub>O2</sub> = I <sub>O,MIN</sub>	5V	V <sub>O1</sub>	4.3	-	5.25	V
V <sub>O2</sub> : V <sub>IN</sub> =V <sub>IN,nom</sub> ; I <sub>O2</sub> = I <sub>O,MAX</sub> ; I <sub>O1</sub> = I <sub>O,MIN</sub>	3.3V	V <sub>O2</sub>	2.5	-	3.46	V

**ISOLATION SPECIFICATION**

Parameter	Device	Symbol	Min	Typ	Max	Unit
Isolation Capacitance	All	-	-	2000	-	pF
Isolation Resistance	All	-	10	-	-	MΩ

**SAFETY APPROVAL**

The AA60A-036L series have been certified through:

- ?? UL 1950, Third Edition - Recognized
- ?? CSA C22.2 No 950-95 - Recognized
- ?? EN60950 through TUV-PS

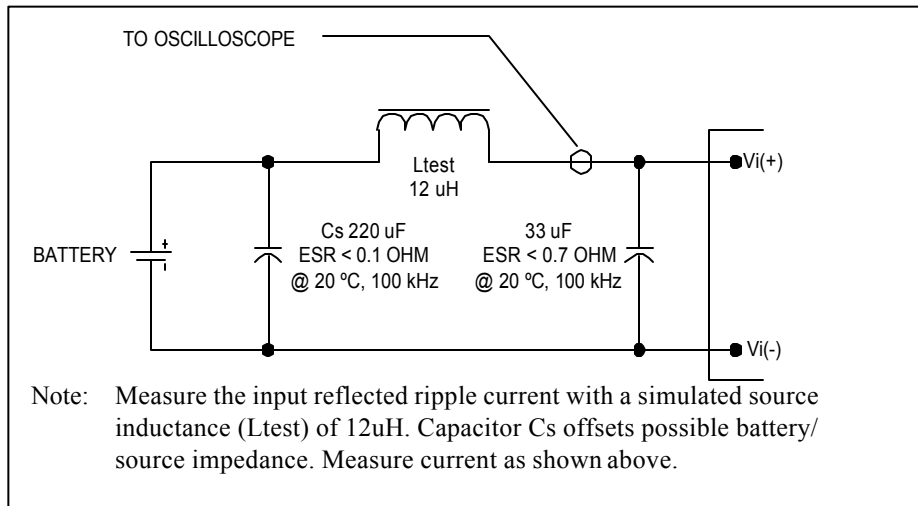


Figure 1. Input Reflected Ripple Current Measurement Setup.

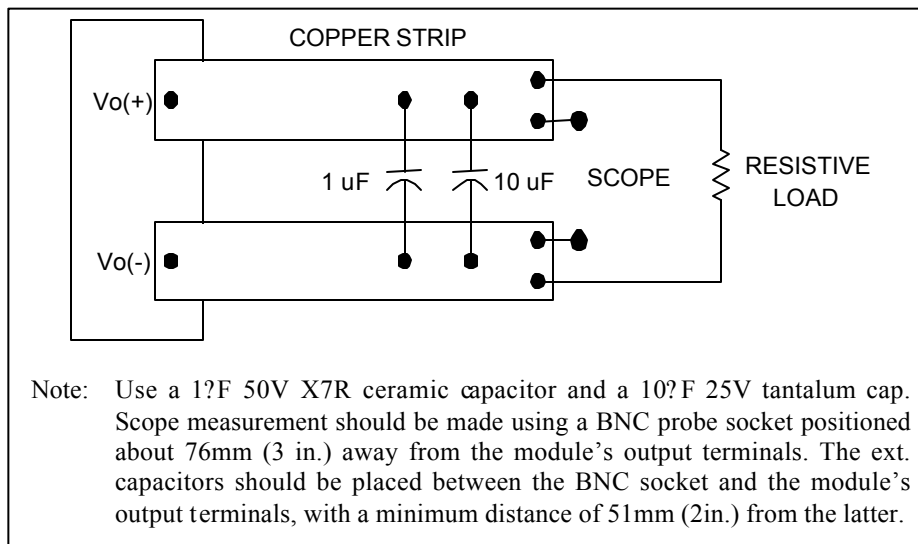


Figure 2. Peak to Peak Output Noise Measurement Setup.



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**Basic Operation and Features**

**INPUT STARTUP / SHUTDOWN VOLTAGE**

To prevent any instability to the converter that may affect and consequently damage the end system, the AA60A series have been designed to turn-on once  $V_{IN}$  is in the voltage range of 19 - 20VDC. Likewise, it has also been programmed to turn-off when  $V_{IN}$  drops down to 17 - 18VDC.

**OUTPUT VOLTAGE ADJUST/TRIM**

Each channel/ output comes with a Trim pin (Pin 10 for  $V_{O1}$  and Pin 7 for  $V_{O2}$ ). This can be used to used to adjust the outputs up and down per the given trim range in the previous section. This is achieved by connecting an external resistor as described below.

Output voltage adjustment is accomplished by connecting an external resistor between the Trim Pin and either the  $+V_O$  or  $-V_O$  Pins. With an external resistor,  $R_{TRIM}$  between the Trim Pin and  $+V_O$  Pin the output voltage increases. With  $R_{TRIM}$  connected between the Trim Pin and  $-V_O$  Pin the output voltage decreases. See Figure 3.

The following equation determines the required external resistor value to obtain an adjusted output voltage:

$$R_{TRIM} = (G - (H * V_{O,Adj})) / (V_{O,Adj} - K)$$

Where:  $V_{O,ADJ}$  = is the desired output voltage (e.g. 5.2V = 5V \* +4%)

**Trim Output Voltage UP ( $R_{TRIM}$  connect to V+)**

Model	Output	G	H	K
036H 5/3.3	5	129980.1	10220	5
036H 5/3.3	3.3	12194.5	2000	3.3

**Trim Output Voltage DOWN ( $R_{TRIM}$  connect to V-)**

Model	Output	G	H	K
036H 5/3.3	5	25578.4	10220	5
036H 5/3.3	3.3	3301.2	2000	3.3

**OUTPUT OVER VOLTAGE PROTECTION (OVP)**

The Over Voltage Protection circuit will shut down the entire converter if any of the two output voltages exceeds the OVP threshold limits. The output will remain latched until the OVP fault is removed and the input voltage is recycled



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**Basic Operation and Features (continued)**

**OUTPUT ENABLE**

The AA60A comes with an Enable pin (PIN 3), 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 option is 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. On the other hand, the Negative Enable version turns 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 CURRENT PROTECTION (OCP)**

The Over Current Protection circuit will shutdown the converter if any of the load current of either output reaches the OCP threshold limits. The unit will automatically recover once the over current condition is removed.





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**Performance Curves**

EFFICIENCY

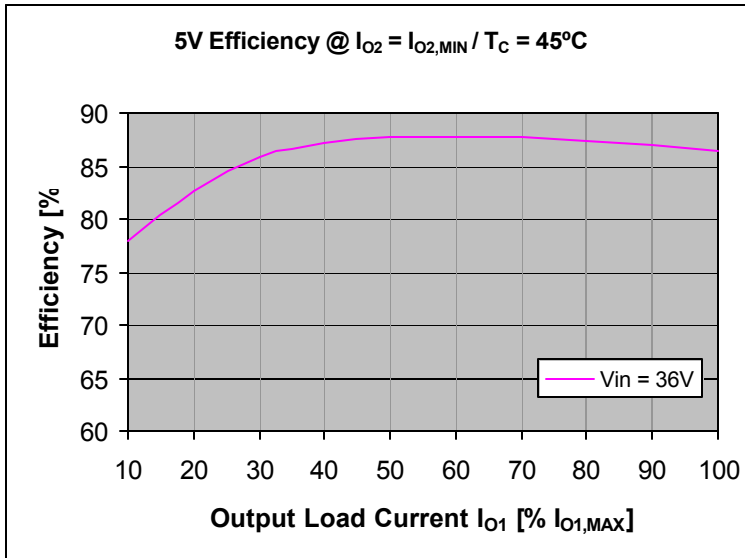


Figure 3. 5V Efficiency curve vs. Output load at 45°C case temperature, input line voltage of 36VDC nominal.

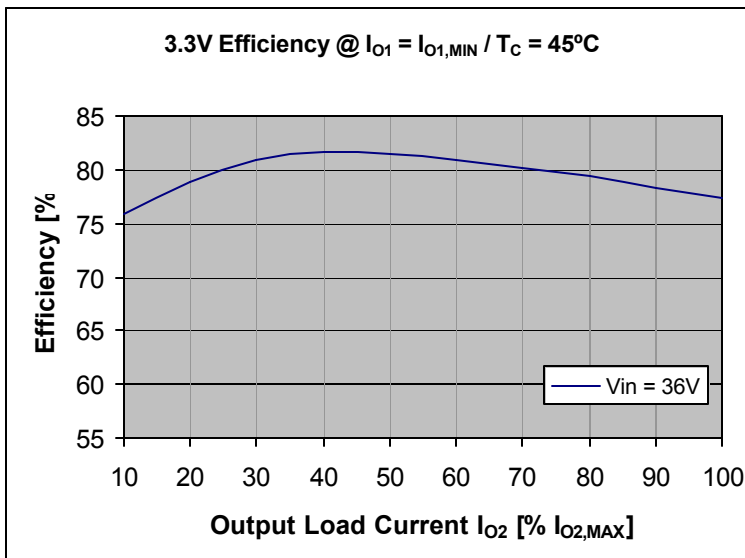


Figure 4. 3.3V Efficiency curve vs. Output load at 45°C case temperature, input line voltage of 36VDC nominal.

**Performance Curves**

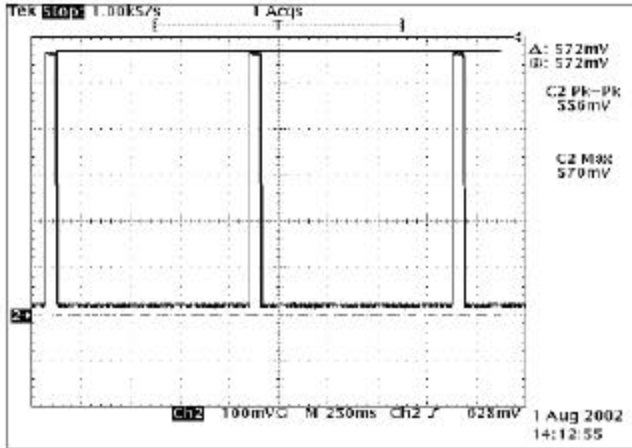


Figure 5. Typical 5V Short circuit waveform at  $T_A = 25^\circ\text{C}$ ,  $V_{IN} = 36\text{V}$  nominal.

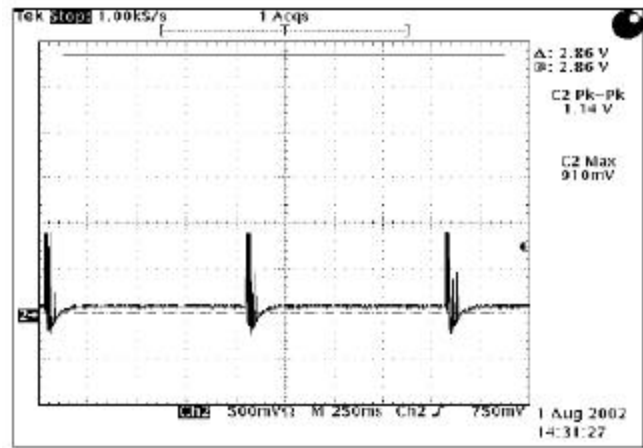


Figure 6. Typical 3.3V Short circuit waveform at  $T_A = 25^\circ\text{C}$ ,  $V_{IN} = 36\text{V}$  nominal.

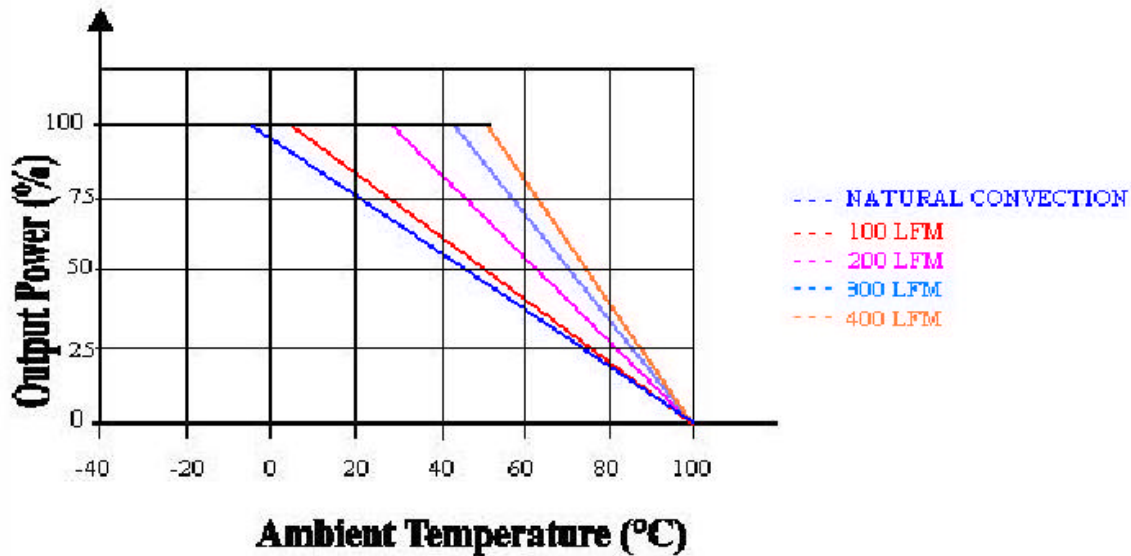


Figure 7. Power Derating at 36V nominal input voltage.



# Technical Reference Notes

## AA60A-036L-050D033H Series

### (5V / 3V3 Dual Output Half Brick)



### Mechanical Specifications

Parameter	Device	Symbol	Min	Typ	Max	Unit
Dimension	All	L	-	2.40 [61.0]	-	in [ mm ]
		W	-	2.30 [58.4]	-	in [ mm ]
		H	-	0.50 [12.07]	-	in [ mm ]
Weight			-	0.0893	0.100	kg
PIN ASSIGNMENT						
1		-V <sub>IN</sub>		6		RTN_2
2		Case		7		TRIM_2
3		Enable		8		+V <sub>OUT1</sub>
4		+V <sub>IN</sub>		9		RTN_1
5		+V <sub>OUT2</sub>		10		TRIM_1

NOTE: Pin diameter at 0.04"

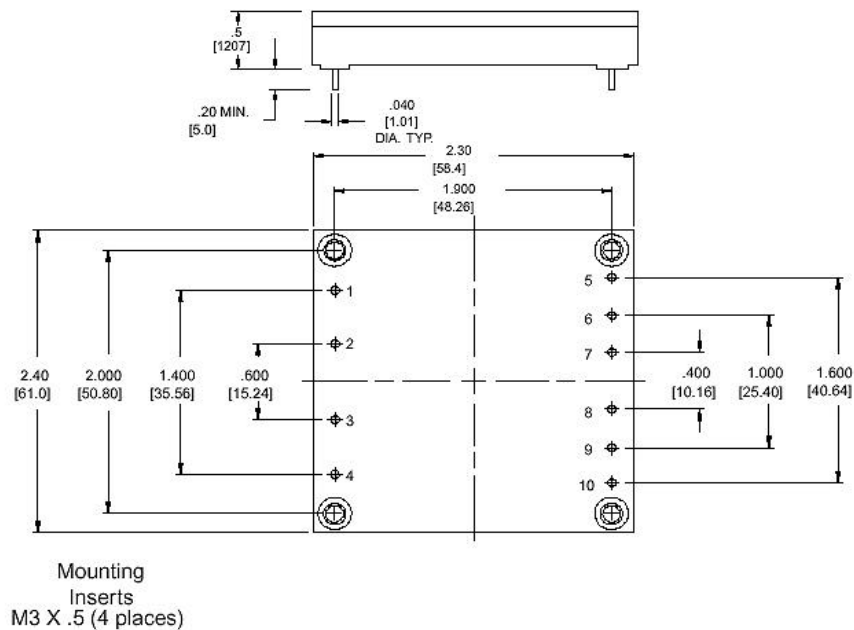


Figure 8. AA60A series mechanical outline ( inches [(mm)]).



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**Mechanical Specifications** *(continued)*

**SOLDERING CONSIDERATIONS**

The AA60A 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.

Please call 1-888-41-ASTEC for further inquiries  
or visit us at [www.astecpower.com](http://www.astecpower.com)