American Power Design, Inc.

"The best high voltage design solution"

E1 SERIES 1 WATT PROGRAMABLE REGULATED HV DC/DC CONVERTERS

FEATURES

- Customer Selects Output Voltage
- Fully Regulated Outputs to + or - 8000 Vdc
- 0-100% Programable Output
- High Stability (<0.005%/°C)
- Low Output Noise & EMI/RFI
- External Calibration Adjustment
- Continuous Short Circuit Protection
- IEC/UL/CSA/EN 62368 & CE Certified

The E1 Series miniature regulated high voltage DC/DC converter offers a 100% programable high voltage output using a 0-5Vdc analog signal. Their small size, low output ripple, and excellent regulation make them ideally suited for applications that demand a high degree of performance. All models will tolerate a short circuit indefinitely.

ELECTRICAL SPECIFICATIONS

Input Voltage Range	11.5V - 16Vdc
Output Voltage Accuracy	+/- 1%
Line Regulation	<0.05%
Load Regulation	<0.05%
Output Ripple	0.002% P-P
Programming Voltage	0 - 5Vdc @ <100uA
Programming Linearity (5% to 100% Vout)	<0.5%
Input Filter	Low ESR Capacitor
Reverse Input Protection	50Vdc
Short Circuit Protection	Continuous
Switching Frequency	180 - 250 kHz
Calibration Adjustment	5 to 10%
Response Time	<250 ms (Full Load, full scale response)
Programming Voltage Shutdown	> 5.2Vdc

GENERAL SPECIFICATIONS

Stability	< 0.01% / Hr.
Temp. Stability	+/- 0.005%/°C
Temp. (Operating , Case)	-10 to +60°C
Temp. (Storage)	-40 to +125°C
Humidity	0 to 95% (Non-Condensing)
Thermal Shock Limit	1°C / 10 Seconds
EMI/RFI	Six Sided Shield
Derating	None
Cooling	Free-Air Convection
Certifications	IEC/UL/CSA/EN 62368 & CE

PHYSICAL SPECIFICATIONS

Dimensions & Weight	1.1 x 1.4 x 0.5 inches @ 1.1 Oz
Dimensions & Weight	1.1 x 1.75 x 0.5 inches @ 1.3 Oz
Dimensions & Weight	1.1 x 2.6 x 0.5 inches @ 1.8 Oz
Encapsulation Material	UL 94V-0 Epoxy
Case Material	Nickle Plated Metal

(With Non-Conductive Base Plate)

E1 SERIES 1 WATT PROGRAMABLE REGULATED HV DC/DC CONVERTERS

OUTPUT VOLTAGES FROM 100V TO 2000VDC

REPRESENTATIVE MODEL LISTING

MODEL NUMBER		INPUT CURRENT		OUTPUT SPECIFICATIONS					SWITCHING FREQUENCY
Non-RoHs	RoHs	NO LOAD	FULL LOAD	VOLTAGE	RIPPLE	CURRENT	REGULATION		
							LOAD	LINE	
E1-P10	E1-P10/Y	<50 mA	<160 mA	0V to +100Vdc	<0.75% (0.75V p-p)	0 - 10mA	<0.1%	<0.1%	250 kHz
E1-N10	E1-N10/Y	<50 mA	<160 mA	0V to -100Vdc	<0.75% (0.75V p-p)	0 - 10mA	<0.1%	<0.1%	250 kHz
E1-P20	E1-P20/Y	<50 mA	<160 mA	0V to +200Vdc	<0.05% (0.1V p-p)	0 - 5mA	<0.1%	<0.1%	250 kHz
E1-N20	E1-N20/Y	<50 mA	<160 mA	0V to -200Vdc	<0.05% (0.1V p-p)	0 - 5mA	<0.1%	<0.1%	250 kHz
E1-P30	E1-P30/Y	<50 mA	<160 mA	0V to +300Vdc	<0.03% (90mV p-p)	0 - 3.3mA	<0.1%	<0.1%	250 kHz
E1-N30	E1-N30/Y	<50 mA	<160 mA	0V to -300Vdc	<0.03% (90mV p-p)	0 - 3.3mA	<0.1%	<0.1%	250 kHz
E1-P50	E1-P50/Y	<50 mA	<160 mA	0V to +500Vdc	<0.004% (20mV p-p)	0 - 2mA	<0.05%	<0.05%	250 kHz
E1-N50	E1-N50/Y	<50 mA	<160 mA	0V to -500Vdc	<0.005% (25mV p-p)	0 - 2mA	<0.05%	<0.05%	250 kHz
E1-P60	E1-P60/Y	<90 mA	<200 mA	0V to +600Vdc	<0.003% (18mV p-p)	0 - 1.67mA	<0.05%	<0.05%	200 kHz
E1-N60	E1-N60/Y	<90 mA	<200 mA	0V to -600Vdc	<0.003% (18mV p-p)	0 - 1.67mA	<0.05%	<0.05%	200 kHz
E1-P100	E1-P100/Y	<90 mA	<200 mA	0V to +1000Vdc	<0.005% (50mV p-p)	0 - 1mA	<0.05%	<0.05%	190 kHz
E1-N100	E1-N100/Y	<90 mA	<200 mA	0V to -1000Vdc	<0.002% (20mV p-p)	0 - 1mA	<0.05%	<0.05%	190 kHz
E1-P125	E1-P125/Y	<100 mA	<250 mA	0V to +1250Vdc	<0.004% (50mV p-p)	0 - 1mA	<0.05%	<0.05%	180 kHz
E1-N125	E1-N125/Y	<100 mA	<250 mA	0V to -1250Vdc	<0.003% (37mV p-p)	0 - 1mA	<0.05%	<0.05%	180 kHz
E1-P150	E1-P150/Y	<100 mA	<220 mA	0V to +1500Vdc	<0.002% (30mV p-p)	0 - 0.67mA	<0.05%	<0.05%	180 kHz
E1-N150	E1-N150/Y	<100 mA	<220 mA	0V to -1500Vdc	<0.002% (30mV p-p)	0 - 0.67mA	<0.05%	<0.05%	180 kHz
E1-P200	E1-P200/Y	<100 mA	<220 mA	0V to +2000Vdc	<0.002% (40mV p-p)	0 - 0.5mA	<0.05%	<0.05%	180 kHz
E1-N200	E1-N200/Y	<100 mA	<220 mA	0V to -2000Vdc	<0.002% (40mV p-p)	0 - 0.5 mA	<0.05%	<0.05%	180 kHz

E1-P100/Y

- Product Family
- Total Output Power
- Positive/Negative Output
- /Y RoHS Compliance

Customer Selects Output Voltage *

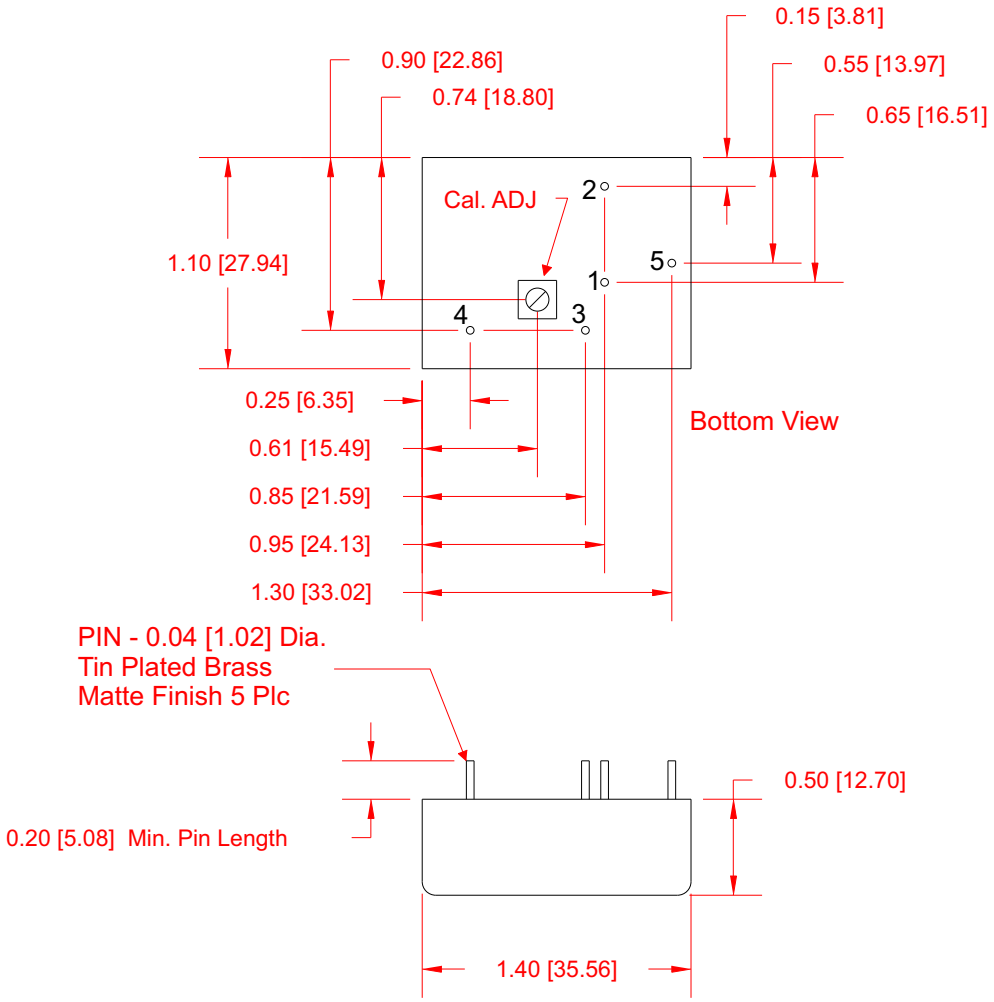
The E1 Series are designed such that the customer may order any output voltage (positive or negative) from 100Vdc to 2000Vdc at no additional charge.

***ACTUAL OUTPUT VOLTAGE IS 10X**

Output Voltage Restriction applies to 1.1 x 1.4 x 0.5 inch Case Only

E1 SERIES 1 WATT PROGRAMABLE REGULATED HV DC/DC CONVERTERS

OUTPUT VOLTAGES FROM 100V TO 2000VDC



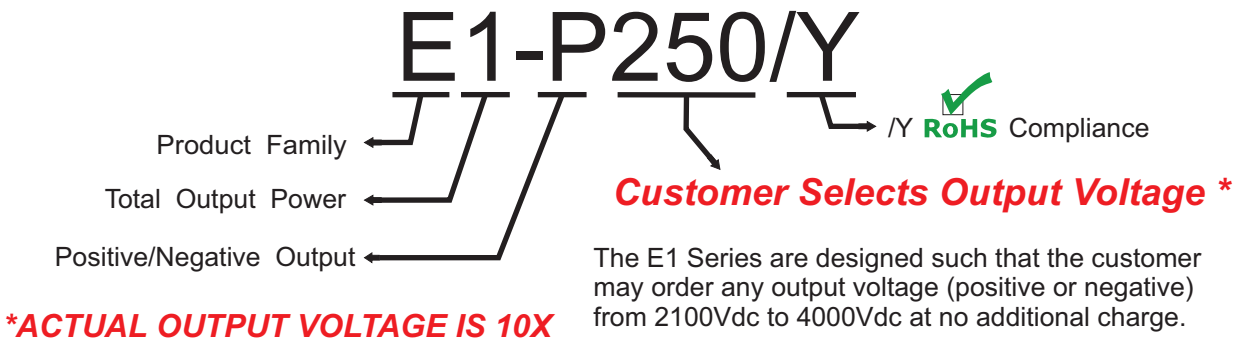
PIN #	FUNCTION
1	+ Input
2	Gnd
3	Control / Programming Voltage
4	HV Output
5	Case Gnd

Dimensions are in Inches
[Metric equivalents in brackets]

E1 SERIES 1 WATT PROGRAMABLE REGULATED HV DC/DC CONVERTERS

OUTPUT VOLTAGES FROM 2100V TO 4000VDC

REPRESENTATIVE MODEL LISTING									
MODEL NUMBER		INPUT CURRENT		OUTPUT SPECIFICATIONS					SWITCHING FREQUENCY
Non-RoHs	RoHs	NO LOAD	FULL LOAD	VOLTAGE	RIPPLE	CURRENT	REGULATION		
							LOAD	LINE	
E1-P250	E1-P250/Y	<100 mA	<250 mA	0V to +2500Vdc	<0.1% (2.5V p-p)	0 - 0.4mA	<0.05%	<0.05%	190 kHz
E1-N250	E1-N250/Y	<100 mA	<250 mA	0V to -2500Vdc	<0.2% (5.0V p-p)	0 - 0.4mA	<0.05%	<0.05%	190 kHz
E1-P300	E1-P300/Y	<100 mA	<250 mA	0V to +3000Vdc	<0.1% (3.0V p-p)	0 - 0.33mA	<0.05%	<0.05%	190 kHz
E1-N300	E1-N300/Y	<100mA	<250 mA	0V to -3000Vdc	<0.2% (6.0V p-p)	0 - 0.33mA	<0.05%	<0.05%	190 kHz
E1-P400	E1-P400/Y	<100 mA	<250 mA	0V to +4000Vdc	<0.1% (4.0V p-p)	0 - 0.25mA	<0.05%	<0.05%	190 kHz
E1-N400	E1-N400/Y	<100 mA	<250 mA	0V to -4000Vdc	<0.1% (4.0V p-p)	0 - 0.25mA	<0.05%	<0.05%	190 kHz



ACTUAL OUTPUT VOLTAGE IS 10X

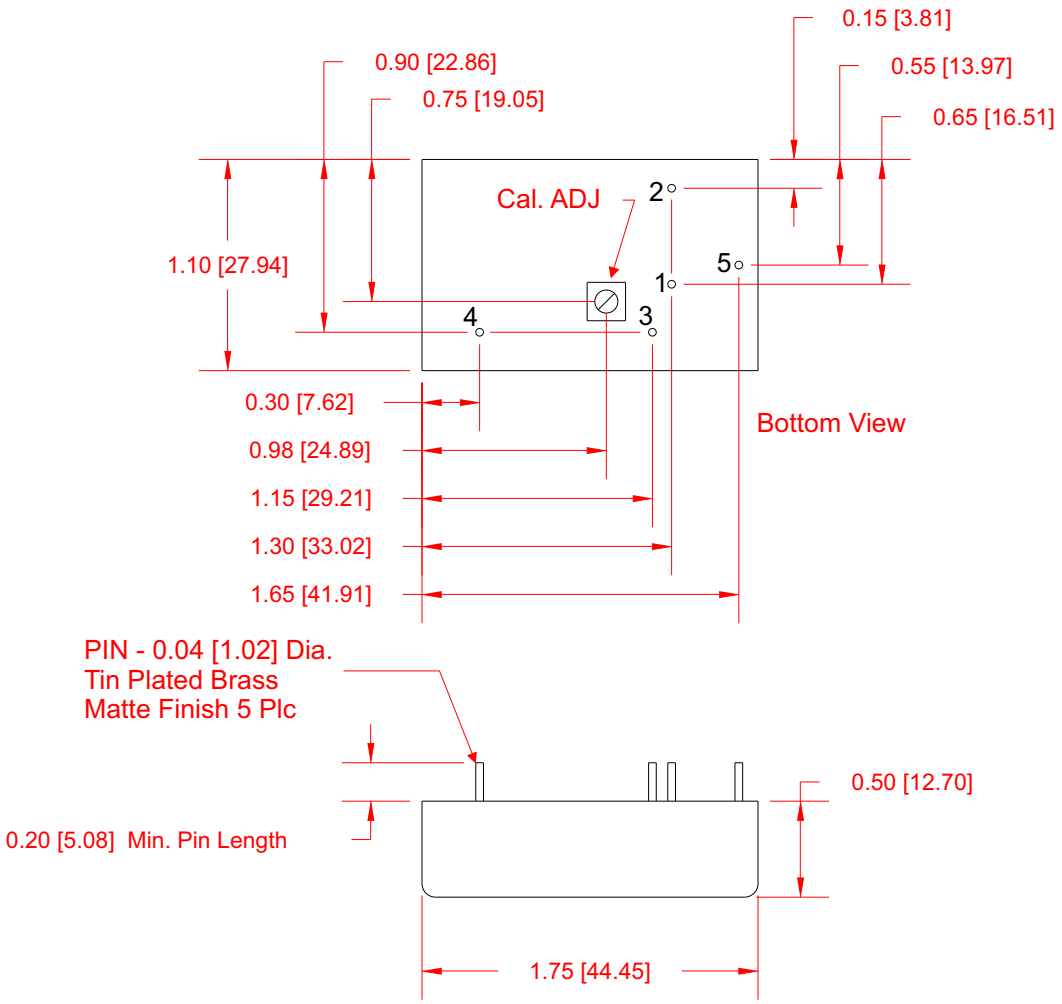
Customer Selects Output Voltage *

The E1 Series are designed such that the customer may order any output voltage (positive or negative) from 2100Vdc to 4000Vdc at no additional charge.

Output Voltage Restriction applies to 1.1 x 1.75 x 0.5 inches Case Only

E1 SERIES 1 WATT PROGRAMABLE REGULATED HV DC/DC CONVERTERS

OUTPUT VOLTAGES FROM 2100V TO 4000VDC



Dimensions are in Inches
[Metric equivalents in brackets]

PIN #	FUNCTION
1	+ Input
2	Gnd
3	Control / Programming Voltage
4	HV Output
5	Case Gnd

E1 SERIES 1 WATT PROGRAMABLE REGULATED HV DC/DC CONVERTERS

OUTPUT VOLTAGES FROM 4100V TO 8000VDC

REPRESENTATIVE MODEL LISTING									
MODEL NUMBER		INPUT CURRENT		OUTPUT SPECIFICATIONS					SWITCHING FREQUENCY
Non-RoHs	RoHs	NO LOAD	FULL LOAD	VOLTAGE	RIPPLE	CURRENT	REGULATION		
							LOAD	LINE	
E1-P500	E1-P500/Y	<100 mA	<230 mA	0V to +5000Vdc	<0.1% (5.0V p-p)	0 - 0.2mA	<0.05%	<0.05%	180 kHz
E1-N500	E1-N500/Y	<100 mA	<230 mA	0V to -5000Vdc	<0.1% (5.0V p-p)	0 - 0.2mA	<0.05%	<0.05%	180 kHz
E1-P600	E1-P600/Y	<100 mA	<230 mA	0V to +6000Vdc	<0.1% (6.0V p-p)	0 - 0.166mA	<0.05%	<0.05%	180 kHz
E1-N600	E1-N600/Y	<100mA	<230 mA	0V to -6000Vdc	<0.1% (6.0V p-p)	0 - 0.166mA	<0.05%	<0.05%	180 kHz
E1-P800	E1-P800/Y	<150 mA	<230 mA	0V to +8000Vdc	<0.15% (12V p-p)	0 - 0.125mA	<0.05%	<0.05%	180 kHz
E1-N800	E1-N800/Y	<150 mA	<230 mA	0V to -8000Vdc	<0.15% (12V p-p)	0 - 0.125mA	<0.05%	<0.05%	180 kHz

E1-P800/Y

- Product Family
- Total Output Power
- Positive/Negative Output
- /Y RoHS Compliance

ACTUAL OUTPUT VOLTAGE IS 10X

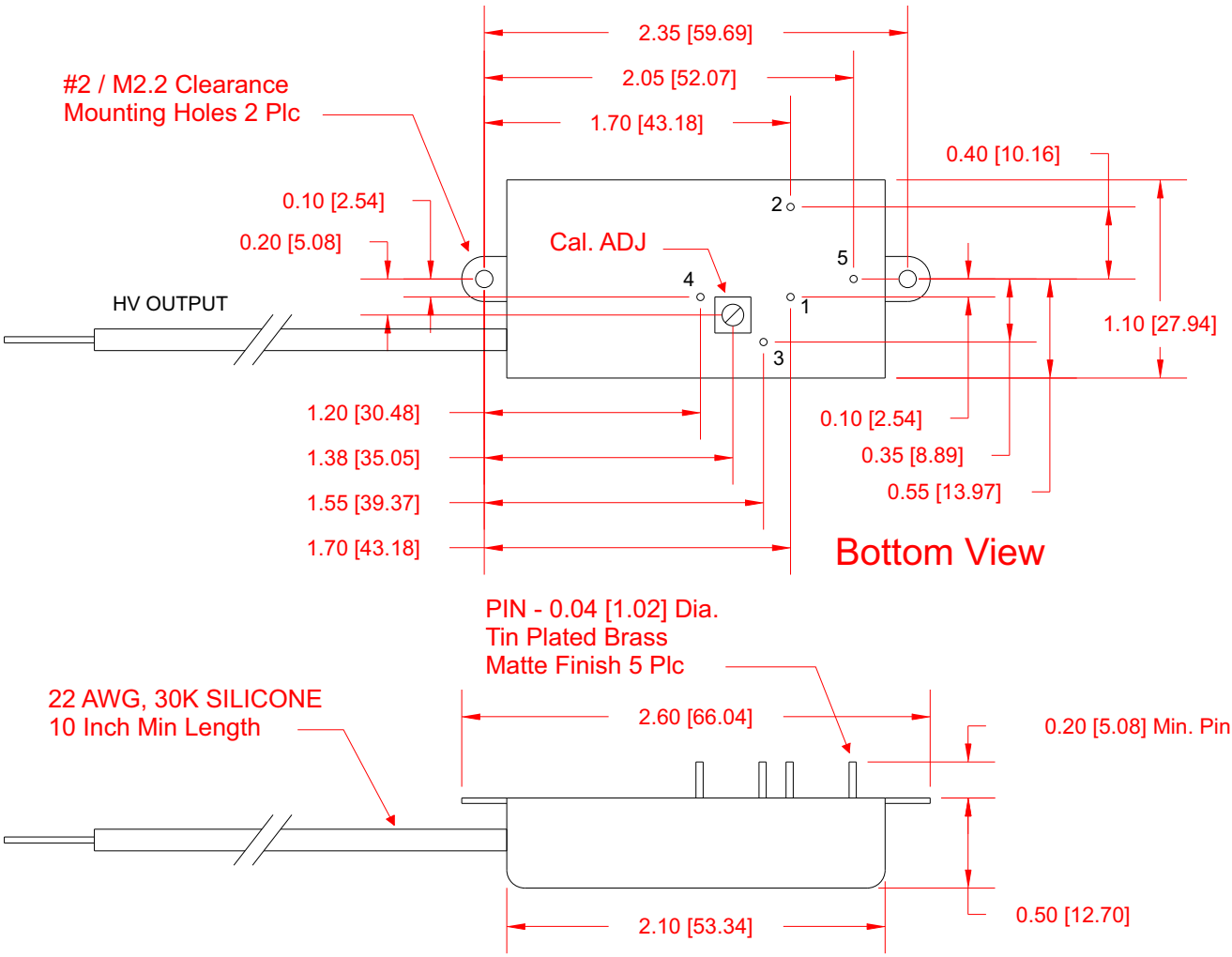
Customer Selects Output Voltage *

The E1 Series are designed such that the customer may order any output voltage (positive or negative) from 4100Vdc to 8000Vdc at no additional charge.

Output Voltage Restriction applies to 1.1 x 2.6 x 0.5 inches Case Only

E1 SERIES 1 WATT PROGRAMABLE REGULATED HV DC/DC CONVERTERS

OUTPUT VOLTAGES FROM 4100V TO 8000VDC



PIN #	FUNCTION
1	+ Input
2	Gnd
3	Control / Programming Voltage
4	HV Return
5	Case Gnd

Dimensions are in Inches
[Metric equivalents in brackets]

APPLICATION NOTES

INRUSH CURRENT

The inrush current of the E1 Series has been kept as low as possible. However, a series resistor may be inserted in the input line to limit this current further.

REVERSE INPUT PROTECTION

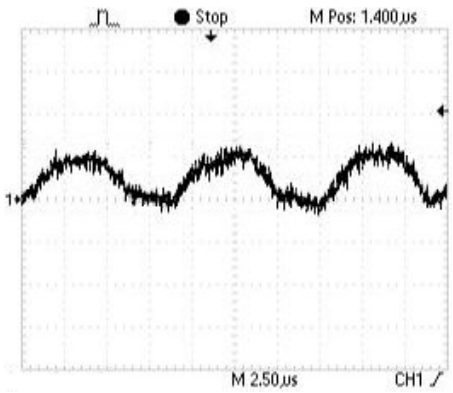
The E1 Series is equipped diode placed in series with the + Input (Pin 1) of the converter, this allows current to flow only if the correct polarity is applied.

SHORT CIRCUIT PROTECTION

The E1 Series is equipped with short circuit protection. The converter will fold-back the input power whenever a short circuit is applied to its output and automatically recover after the overload condition is removed.

RIPPLE AND NOISE

Figure below shows a typical output voltage ripple waveform, measured at full rated load current with no additional output filtering. External low ESR capacitors may be added across output to further reduce ripple.



STARTUP TRANSIENT

Figure below shows a typical output voltage during turn-on, measured at no load current with no additional output filtering.

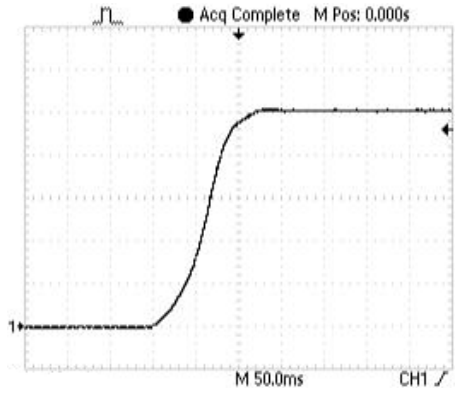
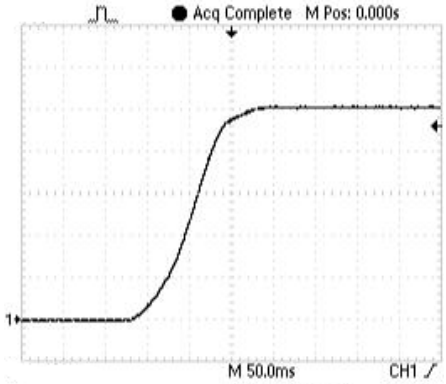


Figure below shows a typical output voltage during turn-on, measured at full rated load current with no additional output filtering.



APPLICATION NOTES

LOAD TRANSIENT

Figure below shows a typical output voltage response, measured during a transition from full rated load current to no load current with no additional output filtering.

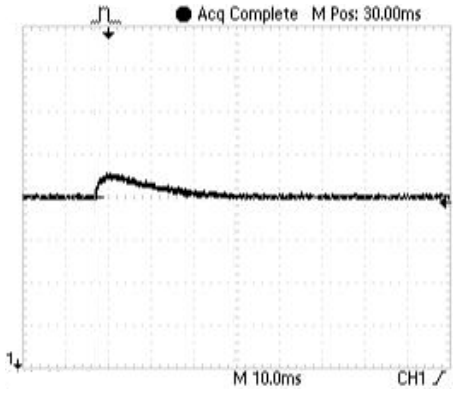
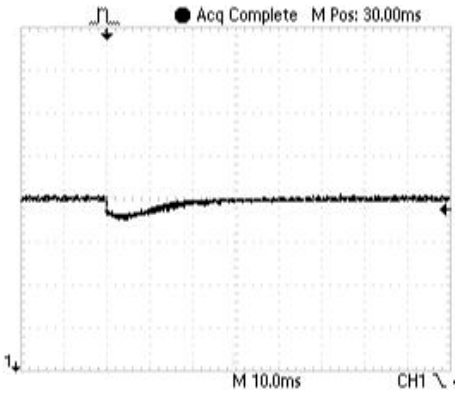


Figure below shows a typical output voltage response, measured during a transition from no load current to full rated load current with no additional output filtering.



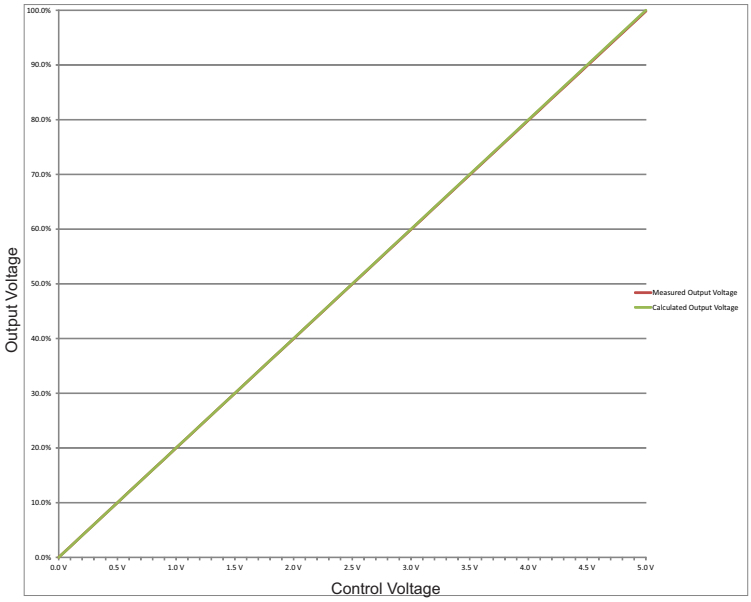
PROGRAMMING VOLTAGE

A 0V to +5V signal will program the power supply for 0 to 100% rated output voltage. The input impedance for this control pin is typically 100KΩ. If the programming signal exceeds 5.2Vdc the converter will shutdown and automatically recover when the programming signal returns to within normal operating range.

OUTPUT VOLTAGE TRACKING

The output voltage tracks the Control pin (Pin 3) within 0.5% from 5% to 100% of output voltage.

Figure below show a typical plot of both the actual and calculated output voltage as a function of control voltage.



Operating Conditions:

Nominal Input Voltage = Fixed
Output Load = Resistive (fixed at full output current @ 100% output voltage)

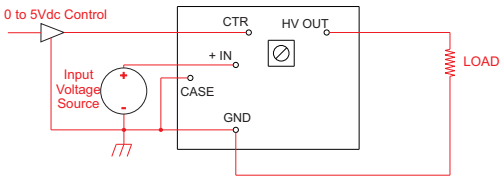
E1 SERIES 1 WATT PROGRAMABLE REGULATED HV DC/DC CONVERTERS

APPLICATION NOTES

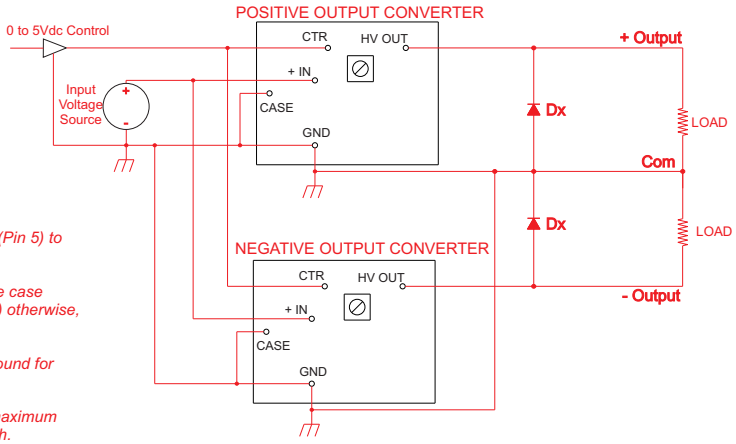
Connection Diagrams

The figures below show standard configurations for the E1 Series converter with output voltages up to 2kV.

Single Output Configuration



Dual Output Configuration



NOTE:

An internal RC network connects the Case (Pin 5) to Gnd (Pin 2).

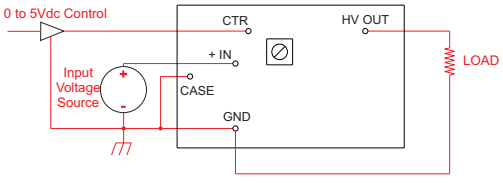
No more than 50 volts potential between the case ground (Pin 5) and the circuit ground (Pin 2) otherwise, the supply may be permanently damaged .

Case pin (Pin 5) should be connected to ground for optimum operation.

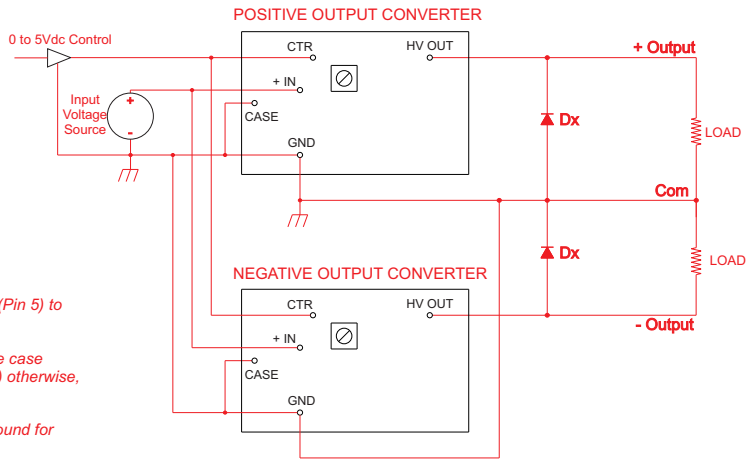
The ratings of Dx should be 1.5 times the maximum current and voltage expected in each branch.

The figures below show standard configurations for the E1 Series converter with output voltages from 2.1kV to 4kV.

Single Output Configuration



Dual Output Configuration



NOTE:

An internal RC network connects the Case (Pin 5) to Gnd (Pin 2).

No more than 50 volts potential between the case ground (Pin 5) and the circuit ground (Pin 2) otherwise, the supply may be permanently damaged .

Case pin (Pin 5) should be connected to ground for optimum operation.

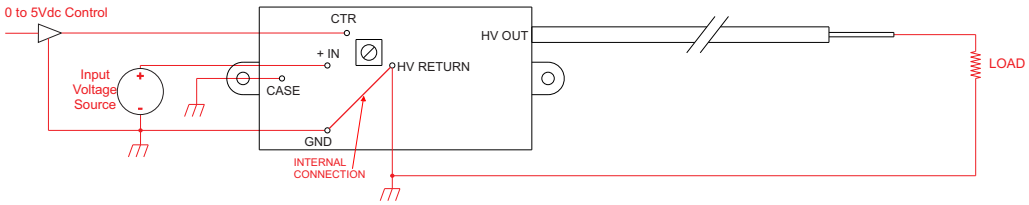
The ratings of Dx should be 1.5 times the maximum current and voltage expected in each branch.

APPLICATION NOTES

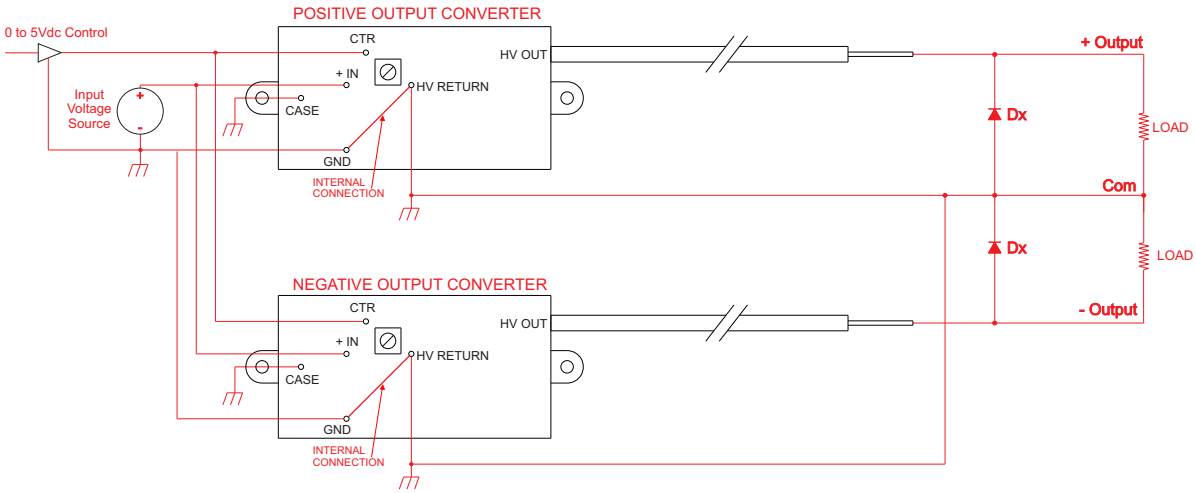
Connection Diagrams

The figures below show standard configurations for the E1 Series converter with output voltages from 4.1kV to 8kV.

Single Output Configuration



Dual Output Configuration



NOTE:

An internal RC network connects the Case (Pin 5) to Gnd (Pins 2 an 4).

No more than 50 volts potential between the case ground (Pin 5) and the circuit ground (Pins 2 and 4) otherwise, the supply may be permanently damaged .

Case pin (Pin 5) should be connected to ground for optimum operation.

The ratings of Dx should be 1.5 times the maximum current and voltage expected in each branch.

APPLICATION NOTES

CLEANING AGENTS

In order to avoid possible damage, any penetration of cleaning fluids must be prevented, since the power supplies are not hermetically sealed.

NUCLEAR AND MEDICAL APPLICATIONS

American Power Design products are not designed, intended for use in, or authorized for use as critical components in life support systems, equipment used in hazardous environments, or nuclear control systems without the express written consent of American Power Design, Inc.

TECHNICAL REVISIONS

The appearance of products, including safety agency certifications pictured on labels, may change depending on the date manufactured. Specifications are subject to change without notice.

SAFETY REQUIREMENTS

The converters meet North American and International safety regulatory requirements per CAN/CSA C22.2 No 62368-1:2014 / UL 62368-1:2014 / EN62368-1:2014/A11:2017. To comply with safety agencies requirements, an input line fuse must be used external to the converter. The table below provides the recommended fuse rating for use with this family of products.

Input Voltage Range	Fuse Rating
11.5-16Vdc	0.5A (fast-acting)

If one input fuse is used for a group of modules, the maximum fuse rating should not exceed 10A (fast-acting).

WARRANTY

All products manufactured by American Power Design, Inc. (APD) are warranted to be free of defects due to material or workmanship for a period of one year from date of shipment. At our option, APD will repair or replace any non-conforming product.
APD expressly disclaims any liability for consequential or incidental damages resulting from the use or misuse of its products by the purchaser or others.
This warranty is in lieu of all warranties expressed or implied, including the warranties of merchantability. No other warranties, obligations, or liabilities are expressed or implied.
All products being returned for repair require a return material authorization(RMA) assigned by APD prior to return shipment.