

18-36V Input 28V/3A Output Eighth Brick Converter



Features

- Wide input voltage range: 18 – 36V
- High Efficiency: 91.5% at 28V/3A output
- Optimal thermal performance
- Remote sense, On/Off control,
- Over-voltage, over-current, short-circuit, and over temperature protection
- Monotonic start-up into pre-biased load
- 1,500V isolation voltage

Options

- Open-frame, Baseplate, or Encapsulated
- Auto-restart or lock-up protection mode
- Negative / Positive enable logic

For High Reliability Applications

Part Numbering System

EA	24	X	280	X	003	X	X	X	X
Series Name	Nominal Input Voltage	Temperature Grade (Baseplate Temperature)	Output Voltage	Enabling Logic	Rated Output Current	Pin Length	Electrical Option	Mechanical Options	Lead-free, ROHS Compliant
EA	24: 18-36V	C: -40--80°C H: -40--100°C M: -55--100°C	Unit: 0.1V 280: 28.0V	P: Positive N: Negative	Unit: A 003: 3A	R: 0.180"	0: Lock-up 2: Auto-restart	0: Open-frame 1: Baseplate 2: Encapsulated 3: with mounting holes	G: Lead-free

General Specification

Absolute Maximum Rating

Excessive stresses over these absolute maximum ratings can cause permanent damage to the converter. Also, exposure to absolute maximum ratings for extended periods of time can adversely affect the reliability of the converter. Operation should be limited to the conditions outlined under the Electrical Specification Section.

Parameter	Symbol	Min	Max	Unit
Input Voltage (continuous)	V_i	-0.5	36	Vdc
Input Voltage (< 100ms, operating)	$V_{i,trans}$	-	40	Vdc
Input Voltage (continuous, non-operating)	V_i	-	60	Vdc
I/O Isolation Voltage		-	1500	Vdc
Operating Ambient Temperature	T_o			
“C” Temperature grade		-40	80	°C
“H” Temperature grade		-40	100	°C
“M” Temperature grade		-55	100	°C
Storage Temperature	T_{stg}	-55	125	°C

Electrical Specifications

The specifications are valid over all operating conditions including input voltage, resistive load, and temperature except as noted.

Input Specifications

Parameter	Symbol	Min	Typ	Max	Unit
Input Voltage	V_i	18	24	36	Vdc
Input Current	I_{in_Max}	-	-	5.5	A
Quiescent Input Current (Typical V_{in})	I_{in_Qsnt}	-	110	150	mA
Standby Input Current	I_{in_Stdby}	-	4	6	mA
Inrush Transient	I^2_t	-	-	0.1	A ² s
Input Reflected-ripple Current, Peak-to-peak (5 Hz to 20 MHz, 12 μ H source impedance)	-	-	10	-	mA
Input Ripple Rejection (120 Hz)	-	-	60	-	dB
Input Turn-on Voltage Threshold	-	16.5	17	17.5	V
Input Turn-off Voltage Threshold	-	15	16	16.5	V
Input Voltage ON/OFF Hysteresis	-	-	1	-	V

Output Specifications

Parameter	Symbol	Min	Typ	Max	Unit
Output Voltage Set Point	V_o		28		Vdc
Output Voltage Set Point Accuracy (V_i = Typical V_{in} ; I_o = I_{o_max} ; T_a = 25°C)	-	-2		+2	% V_o
Output Voltage Set Point Accuracy (over all conditions)	-	-3		+3	% V_o
Output Regulation:					
Line Regulation (full range input voltage, 1/2 full load)	-	-	0.2	0.5	% V_o
Load Regulation (full range load, Typical V_{in})	-	-	0.2	0.5	% V_o
Temperature (T_a = -55°C to 100 °C)	-	-	0.1		% V_o
Output Ripple and Noise Voltage RMS	-	-	-	45	mVrms
Peak-to-peak (5 Hz to 20 MHz bandwidth, Typical V_{in})	-	-	-	75	mVp-p
External Load Capacitance	-	-	-	2,000	μ F
Output Current	I_o	0	-	3	A
Output Power	P_o	0		84	W

Output Specifications (continued)

Parameter	Symbol	Min	Typ	Max	Unit
Output Current-limit Trip Point ($V_o = 90\%$ of $V_{o,nom}$)	$I_{o,cli}$	3.6	3.8	4	A
Efficiency (Typical V_{in} ; I_{o_max} , $T_A = 25^\circ\text{C}$)	η	89.5	91.5	-	%
Startup Delay, duration from enabling signal to V_o reaches 10% of its set point. (Typical V_{in} ; I_{o_max} , $T_A = 25^\circ\text{C}$)			2		ms
Startup Time, duration for V_o to rise from 10% of its set point to within its regulation band. (Typical V_{in} ; I_{o_max} , $T_A = 25^\circ\text{C}$)			4		ms
Output Over Voltage trip point		33	35	37	V
Output Ripple Frequency	-	260	280	300	kHz
Output Trim Range in % of V_o typical		90	-	110	%
Dynamic Response (V_i = Typical V_{in} ; $T_A = 25^\circ\text{C}$; Load transient 0.1A/ μs) Load steps from 50% to 75% of full load: Peak deviation Settling time (within 10% band of V_o deviation) Load step from 50% to 25% of full load Peak deviation Settling time (within 10% band of V_o deviation)			6 200 6 200		% V_o μs % V_o μs

General Specifications

Parameter	Symbol	Min	Typ	Max	Unit
Remote Enable Logic Low: $I_{ON/OFF} = 1.0\text{mA}$ $V_{ON/OFF} = 0.0\text{V}$	$V_{ON/OFF}$ $I_{ON/OFF}$	0 -	- -	1.2 1.0	V mA
Logic High: $I_{ON/OFF} = 0.0\mu\text{A}$ Leakage Current	$V_{ON/OFF}$ $I_{ON/OFF}$	- -	- -	15 50	V μA
Over-temperature Protection	T_o	-	120	-	$^\circ\text{C}$
Isolation Capacitance	-	-	1200	-	pF
Isolation Resistance	-	10	-	-	M Ω
Calculated MTBF (Bellcore TR-332)			3.2		10^6 -hour

Feature Descriptions

Remote ON/OFF

The converter can be turned on and off by changing the voltage between the ON/OFF pin and Vin(-). The EA24 Series of converters is available with factory selectable positive logic and negative logic.

For the negative control logic, the converter is ON when the ON/OFF pin is at a logic low level and OFF when the ON/OFF pin is at a logic high level. For the positive control logic, the converter is ON when the ON/OFF pin is at a logic high level and OFF when the ON/OFF pin is at a logic low level.

With the internal pull-up circuitry, a simple external switch between the ON/OFF pin and Vin(-) can control the converter. A few example circuits for controlling the ON/OFF pin are shown in Fig. 1, 2 and 3.

The logic low level is from 0V to 1.2V and the maximum sink current during logic low is 1mA. The external switch must be capable of maintaining a logic-low level while sinking up to this current. The logic high level is from 3.5V to 15V. The converter has an internal pull-up circuit that ensures the ON/OFF pin at a high logic level when the leakage current at ON/OFF pin is no greater than 50μA.

Remote SENSE

The remote SENSE pins are used to sense the voltage at the load point to accurately regulate the load voltage and eliminate the impact of the voltage drop in the power distribution path.

SENSE(+) and SENSE(-) pins should be connected between the points where voltage regulation is desired. The voltage between the SENSE pins and the output pins must not exceed the smaller of 0.5V or 10% of typical output voltage.

$$[V_{out}(+) - V_{out}(-)] - [SENSE(+) - SENSE(-)] < \text{MIN}\{0.5V, 10\%V_o\}$$

When remote sense is not used, the SENSE pins should be connected to their corresponding output terminals (positive and negative). If the SENSE pins are left floating, the converter will deliver an output voltage slightly higher than its specified typical output voltage. Since the OVP (output over-voltage protection) circuit senses the voltage across the output pins (Pin 8 and Pin 4), the total voltage rise should not exceed the minimum OVP setpoint given in the Specifications table.

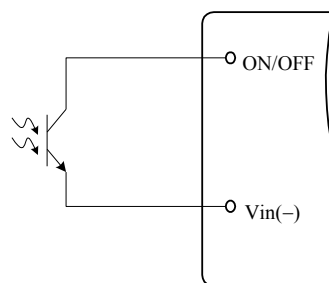


Fig. 1 Opto Coupler Enable Circuit

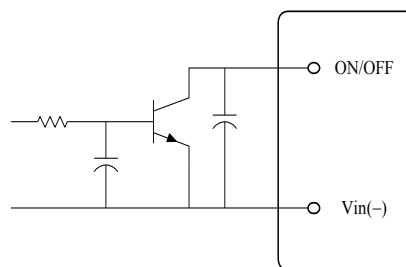


Fig. 2 Open Collector Enable Circuit

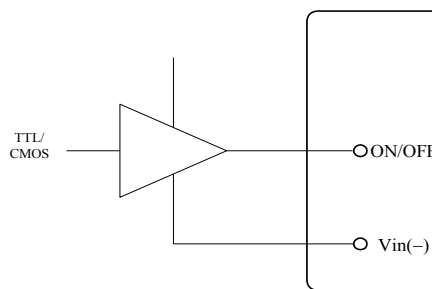


Fig. 3 Direct Logic Drive

Output Voltage Adjustment (Trim)

The trim pin allows the user to adjust the output voltage set point. To increase the output voltage, an external resistor is connected between the TRIM pin and SENSE(+). To decrease the output voltage, an external resistor is connected between the TRIM pin and SENSE(-). The output voltage trim range is 90% to 110% of its specified nominal output voltage. The circuit configuration for trim down operation is shown in Fig. 4.

To decrease the output voltage, the value of the external resistor should be

$$R_{down} = \left(\frac{511}{\Delta} - 10.22 \right) (k\Omega)$$

Where

$$\Delta = \left(\frac{|V_{nom} - V_{adj}|}{V_{nom}} \right) \times 100$$

and

V_{nom} = Nominal Voltage

V_{adj} = Adjusted Voltage

The circuit configuration for trim up operation is shown in Fig. 5.

To increase the output voltage, the value of the resistor should be

$$R_{up} = \left(\frac{5.11V_o(100 + \Delta)}{1.225\Delta} - \frac{511}{\Delta} - 10.22 \right) (k\Omega)$$

Where

V_o = Nominal Output Voltage

As the output voltage at the converter output terminals are higher than the specified nominal level when using the trim up and/or remote sense functions, it is important not to exceed the maximum power rating of the converter as given in the Specifications table.

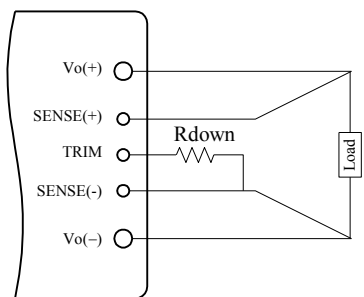


Fig. 4 Circuit to Decrease Output Voltage

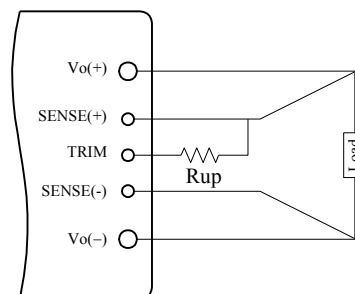


Fig. 5 Circuit to Increase Output Voltage

Input Under-Voltage Lockout

This feature prevents the converter from starting until the input voltage reaches the turn-on voltage threshold, and keeps the converter running until the input voltage falls below the turn-off voltage threshold. Both turn-on and turn-off voltage thresholds are defined in the Input Specifications table. The hysteresis prevents oscillations.

Output Over-Current Protection

This converter can be ordered in either latch-off or auto-restart version upon OCP, OVP, and OTP.

With the latch-off version, the converter will latch off when the load current exceeds the limit. The converter can be restarted by toggling the ON/OFF switch or recycling the input voltage.

With the auto-restart version, the converter will operate in a hiccup mode (repeatedly try to restart) until the cause of the over-current condition is cleared.

Output Over-Voltage Protection

With the latch-off version, the converter will latch off when the output voltage exceeds the limit. The converter can be restarted by toggling the ON/OFF switch or recycling the input voltage.

With the auto-restart version, the converter will operate in a hiccup mode (repeatedly try to restart) until the cause of the over-voltage condition is cleared.

Thermal Shutdown

As a standard feature, the converter will shut down and latch off if an over-temperature condition is detected. The converter has a temperature sensor located at a carefully selected position in the converter circuit board, which represents the thermal condition of key components of the converter.

The thermal shutdown circuit is designed to turn the converter off when the temperature at the sensor reaches 120°C. The module can be restarted by toggling the ON/OFF switch or recycling the input voltage. With the auto-restart option, the converter will resume operation after the converter cools down.

Thermal Considerations

The EA24 Series of converters can operate in various thermal environments. Due to the high efficiency and optimal heat distribution, these converters exhibit excellent thermal performance. Proper cooling can be verified by monitoring the temperature of the case not continuously exceeding 120 °C.

The maximum allowable output power of any power converter is usually determined by the electrical design and the maximum operating temperature of its components.

Design Considerations

Input Source Impedance

As with any DC/DC converter, the stability of the EA24 converters may be compromised if the source impedance is too high or inductive. It's desirable to keep the input source ac-impedance as low as possible. Although the converters are designed to be stable without an additional input capacitor for typical source impedance, it is recommended to use at least a 33 - 100 μ F low ESR electrolytic capacitor at the input of the converter to reduce the potential impact of the source impedance. This electrolytic capacitor should have sufficient RMS current rating over the operating temperature range.

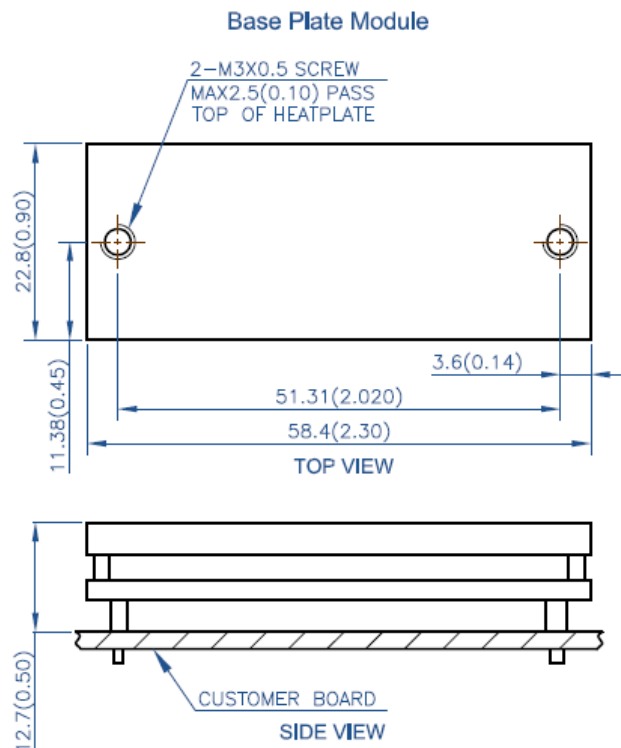
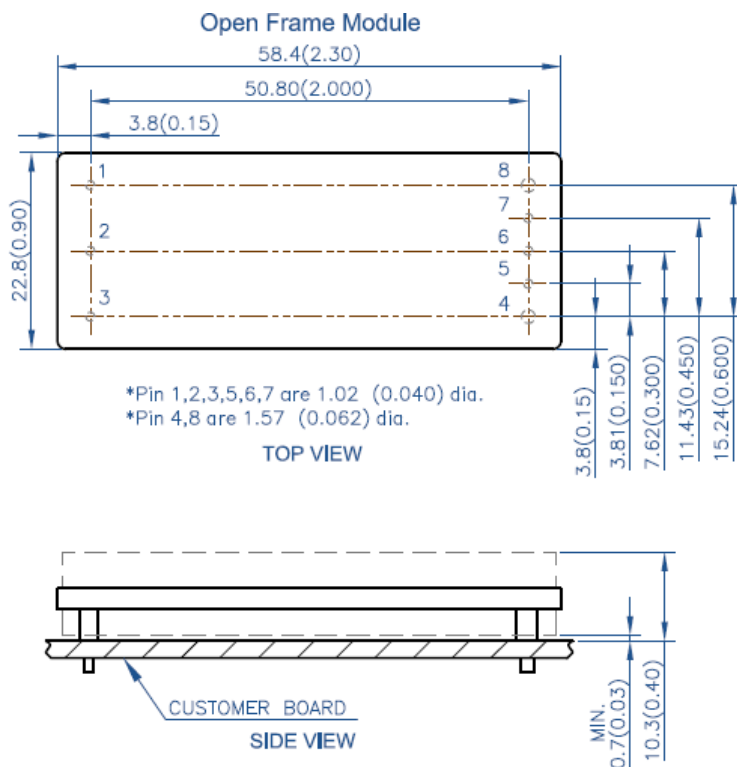
Safety Considerations

The EA24 Series of converters are designed in accordance with EN 60950 Safety of Information Technology Equipment Including Electrical Equipment. The converters are recognized by UL in both USA and Canada to meet 1500V Basic Insulation requirements in UL 60950, Safety of Information Technology Equipment and applicable Canadian Safety Requirement, and ULc 60950. Flammability ratings of the PWB and plastic components in the converter meet 94V-0.

To protect the converter and the system, an input line fuse is highly recommended on the un-grounded input end.

A maximum rating of 5A normal-blow fuse should be connected at the un-grounded input lead of each EA24 converter.

Mechanical Diagrams

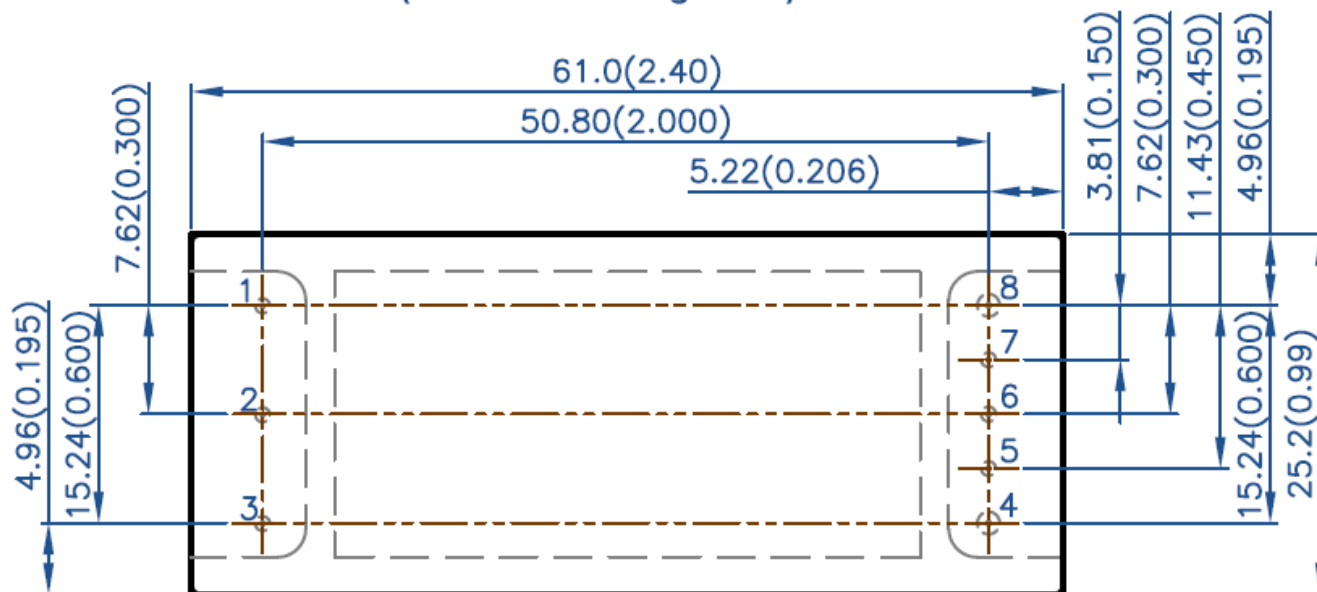


Pin	Name	Function
1	Vin(+)	Positive input voltage
2	ON/OFF	Remote control
3	Vin(-)	Negative input voltage
4	Vout(-)	Negative output voltage
5	SENSE(-)	Negative remote sense
6	TRIM	Output voltage adjust
7	SENSE(+)	Positive remote sense
8	Vout(+)	Positive output voltage

Notes:

All dimensions in mm (inches)
Tolerances: .x $\pm$.5 (.xx $\pm$ 0.02)
.xx $\pm$.25 (.xxx $\pm$ 0.010)

Encapsulated Type- I
(without mounting holes)



*Pin 1,2,3,5,6,7 are 1.02mm(0.040) dia.

*Pin 4,8 are 1.57mm(0.062) dia.

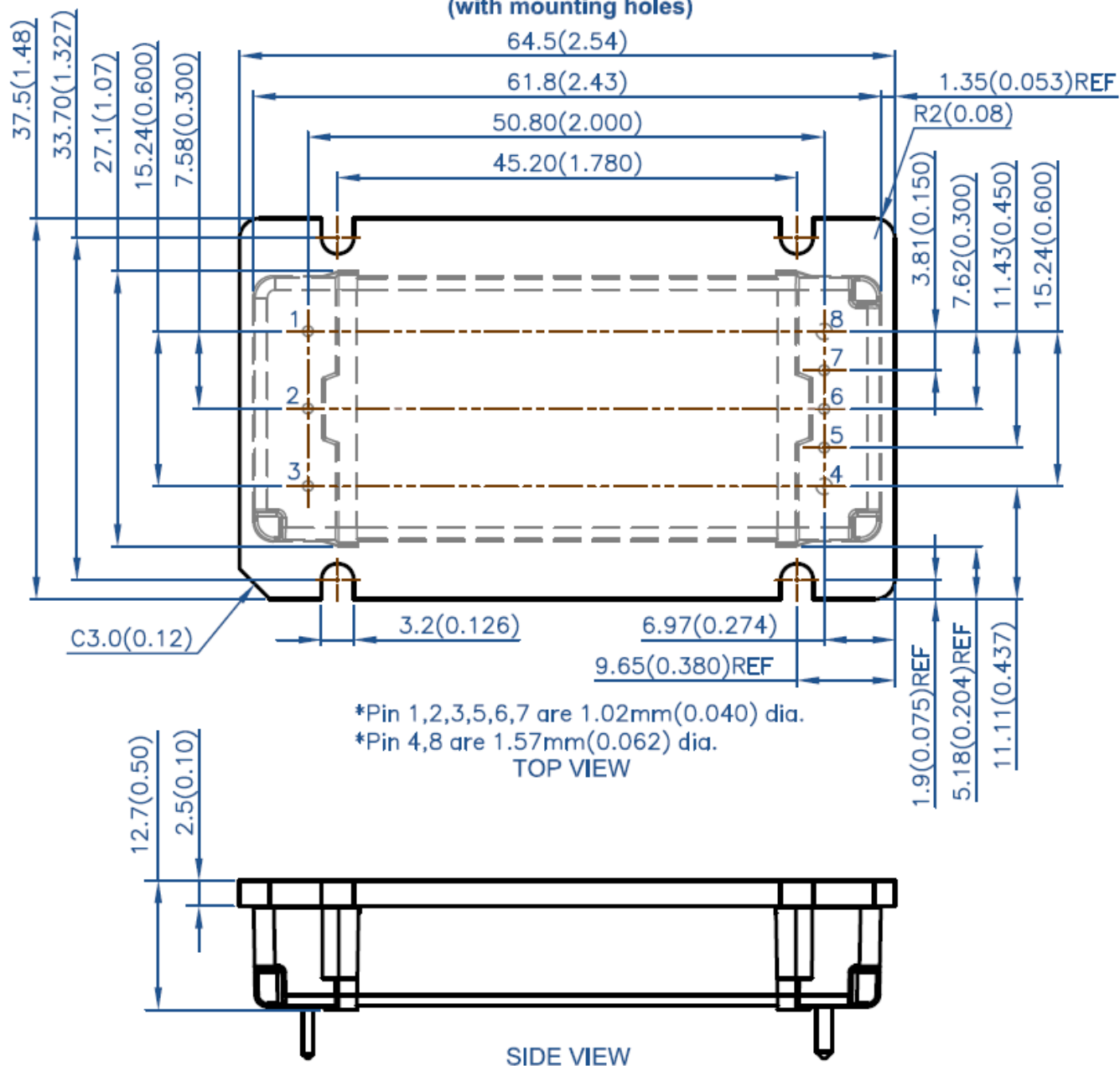
TOP VIEW



SIDE VIEW

Encapsulated Type- II

(with mounting holes)





EA24x280x003xxx

18-36V Input, 28V/3A Output DC/DC Converter

**For more information, please contact
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Warranty

Dr. Power offers a two (2) year limited warranty. Complete warranty information is listed on our web site or is available upon request. Information furnished by Dr. Power is believed to be accurate and reliable. However, no responsibility is assumed by Dr. Power for its use, nor for any infringements of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of Dr. Power.