23V-33V Input 28V/15A Output Half Brick Converter

Features

- High efficiency, 90.5% (28Vin，28V/15A)
- Wide DC input rage 23V-33V
- Optimal thermal performance
- No minimum load required
- Fixed frequency operation
- 1500VDC in-out isolation
- Current Sharing

Part Numbering System

HB	24	X	320	P	016	X	X	X	X	A
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	Suffix
HB	24: 23-33V	C: -40˚C --80˚C H: -40˚C --100˚C M: -55˚C --100˚C	Unit: 0.1V 320= 28V	P: Positive N: Negative	Unit: A 016 = 16A	R: 0.180"	0: Lock-up 2: Auto-restart	0: Open-frame 1: Baseplate 2: Encapsulated	G: Lead-free	1.Over temperature constant output current ; 2.I/0 Overvoltage Lock out 3.Over temperature anto-restart

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)	Vi	-0.5	40	Vdc
Input Voltage (< 100ms, operating)	Vi	-	50	Vdc
Input Voltage (continuous, non-operating)	Vi	-	50	Vdc
I/O Isolation Voltage		-	1500	Vdc
Operating Ambient Temperature				
“C” Temperature grade	To	-40	80	˚C
“H” Temperature grade	To	-40	100	˚C
“M” Temperature grade	To	-55	100	˚C
Storage Temperature	Tstg	-55	125	˚C

Electrical Specifications

These specifications are valid over the converter’s full range of input voltage, resistive load, and operating temperature unless noted otherwise.

Input Specifications

Parameter	Symbol	Min	Typical	Max	Unit
Input Voltage	Vi	23	28	33	Vdc
Input Current	Iin_{Max}	-	-	40	A
Quiescent Input Current (Typical Vin; Ta = 25°C)	Iin_{Qsnt}	-	200	240	mA
Standby Input Current (Typical Vin; Ta = 25°C)	Iin_{Stdby}	-	8	12	mA
Inrush Transient	I^2t	-	-	0.1	A^2s
Input Ripple Rejection			60	-	dB
Input Turn-on Voltage Threshold	-	20.5	21.5	22	V
Input Turn-off Voltage Threshold	-	18.7	19.2	19.7	V
Input Voltage ON/OFF Hysteresis	-		2.2		V
Input Over Voltage Protection Set Point		35.5	36.5	37.5	

Output Specifications

Parameter	Symbol	Min	Typical	Max	Unit
Output Voltage Set Point	Vo		28		Vdc
Output Voltage Set Point Accuracy (Vi = Typical Vin; Io = Io_max; Ta = 25°C)	-	-1		+1	%Vo
Output Regulation:					
Line Regulation (full range input voltage, 1/2 full load)	-	-	0.5	1	%Vo
Load Regulation (full range load, Typical Vin)	-	-	0.5	1	%Vo
Temperature (Ta = -55°C to 100 °C)	-	-	0.2	0.5	%Vo
Output Current	Io	0	-	15	A
Output Power	Po	0		420	W
Efficiency (Typical Vin; Io_max, T_A = 25ºC)	η	89	90.5	-	%
Output ripple frequency	-	220	250	280	kHz
Output Ripple and Noise Voltage					
RMS	-	-	40	80	mVrms
Peak-to-peak (5 Hz to 20 MHz bandwidth, Typical Vin)			120	150	mVp-p
External Load Capacitance	-	-	-	8000	μF

Output Specifications (continued)

Parameter	Symbol	Min	Typ	Max	Unit
Output Constant Current Set Point		15.5	16.5	17.5	A
Output Over Voltage Protection Set Point (10% of full load)		36	37.5	38.5	V
Output Trim Range in % of Vo typical		16	-	33	V
Output Current Sharing Accuracy (at rated load)				10	%
Output Remote Sense Range in % of Vo_ typical				3	V
Dynamic Response (Vi = Typical Vin; Ta = 25°C; Load transient 0.1A/μs) Load steps from 50% to 75% of full load: Peak deviation Settling time (within 10% band of Vo deviation) Load step from 50% to 25% of full load Peak deviation Settling time (within10% band of Vo deviation)			 6 1000 6 1000		 %Vo μs %Vo μs

General Specifications

Parameter	Symbol	Min	Typ	Max	Unit
Remote Enable Logic Low: $I_{ON/OFF}$ = 1.0mA $V_{ON/OFF}$ = 0.0V Logic High: $I_{ON/OFF}$ = 0.0μA Leakage Current	 $V_{ON/OFF}$ $I_{ON/OFF}$ $V_{ON/OFF}$ $I_{ON/OFF}$	 0 - 3.5 -	 - - - -	 1.2 1.0 15 50	 V mA V μA
Over-temperature Protection set point	To	-	120	-	°C
Isolation Capacitance	-	-	2700	-	pF
Isolation Resistance	-	10	-	-	MΩ
Calculated MTBF Telecordia SR-332, full load, 40°C, Typ. Vin			2.8		10^6-hour
Calculated MTBF Telecordia SR-332, 50% load, 25°C, Typ. Vin			5.8		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 HB24 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 switch 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 maximum voltage at the ON/OFF pin generated by the converter internal circuitry is less than 15V. The maximum allowable leakage current is 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 to the point where regulation is desired. The voltage between the SENSE pins and the output pins must not exceed 0.5V:

[Vout(+) - Vout(-)] - [SENSE(+) - SENSE (-)] < 0.5V

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 9 and Pin 5), the total voltage rise should not exceed the minimum OVP setpoint given in the specifications table.

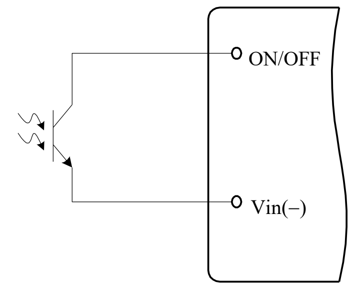


Fig. 1 Opto Coupler Enable Circuit

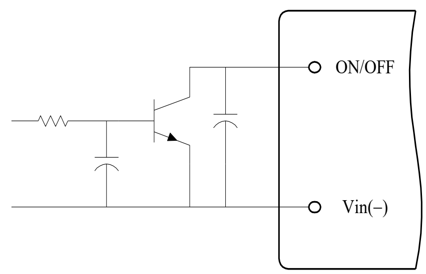


Fig. 2 Open Collector Enable Circuit

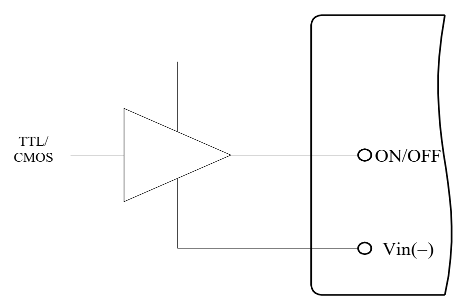


Fig. 3 Direct Logic Drive

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 16 V to 33 V 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

$$Rdown = (\frac{100}{\Delta} - 2)(k\Omega)$$

Where

$$\Delta = (\frac{|Vnom - Vadj|}{Vnom}) \times 100$$

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

$$Rup = (\frac{Vo(100+\Delta)}{1.225\Delta} - \frac{100}{\Delta} - 2)(k\Omega)$$

Where

Vo = 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.

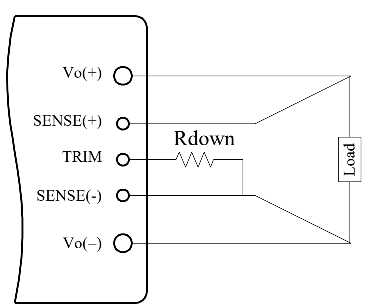


Fig. 4 Circuit to Decrease Output Voltage

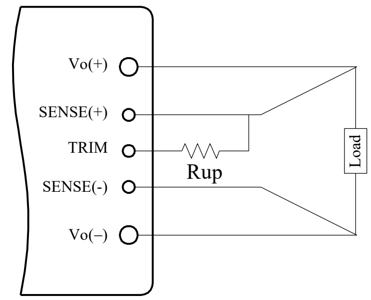


Fig. 5 Circuit to Increase Output Voltage

Active Current Share (Parallel)

Share pin is designed for active current share among modules in parallel.

The active current share feature allows multiple converters to share load current. For the parallel operation of multiple converters, The Share pin on each converter should be connected together. It is suggested to have a ground plane on the system board for Vin(-) to reduce the ground noise impact on the current share accuracy. The loop formed by the trace connecting the Share pins and the ground trace should be minimized to avoid noise coupling into the current share circuitry. A typical current share scheme for the HB24 series of converters is shown in Fig. 6.

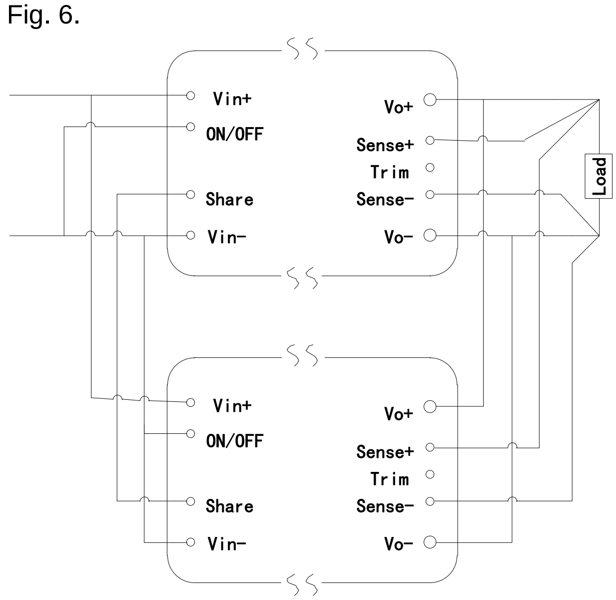


Fig. 6 Circuit Configuration for Active Current Share

Input Under/Over-Voltage Lockout

This feature prevents the converter from turning on until the input voltage reaches 21.5V typical, and shuts down the converter if the input voltage falls below 19.2V typical. The 2.2V hysteresis prevents oscillations. If the input voltage across36.5V,the converter shuts down and lock-up.

Output Current Limit

The maximum current limit remains a constant value as given in the Specifications table.

Output Over-Voltage Protection

If the voltage across the output pins exceeds the output voltage protection threshold as given in the Specifications table, the converter will shut down to protect the converter and the load.

As a standard feature, the converter will shut down and latch off when this fault occurs. The converter can be restarted by toggling the ON/OFF switch or recycling the input voltage. With the auto-restart option, the converter will operate in a hiccup mode until the over-voltage cause 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.

Design Considerations

As with any DC/DC converter, the stability of the HB24 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 adding external input capacitors for typical source impedance, it is recommended to add 100 μF low ESR electrolytic capacitors at the input of the converter for each 100W output power, which reduces the potential negative impact of the source impedance on the converter stability. These electrolytic capacitors should have sufficient RMS current rating over the operating temperature range.

The converter is designed to be stable without additional output capacitors. To further reduce the output voltage ripple or improve the transient response, additional output capacitors are often used in applications. When additional output capacitors are used, a combination of ceramic capacitors and tantalum/polymer capacitors shall be used to provide good filtering while assuring the stability of the converter.

Safety Considerations

The HB24 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 the 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.

Thermal Considerations

The HB24 Series of converters can operate in various thermal environments. Due to the high efficiency and optimal heat distribution, these converters exhibit excellent thermal performance.

The maximum allowable output power of any power converter is usually determined by the electrical design and the maximum operating temperature of its components. The HB24 Series of converters have been tested comprehensively under various conditions to generate the derating curves with the consideration for long term reliability.

The thermal derating curves are highly influenced by the test conditions. One of the critical variables is the interface method between the converter and the test fixture board. There is no standard method in the industry for the derating tests. Some suppliers use sockets to plug in the converter, while others solder the converter into the fixture board. It should be noticed that these two methods produce significantly different results for a given converter. When the converter is soldered into the fixture board, the thermal performance of the converter is significantly improved compared to using sockets due to the reduction of the contact loss and the thermal impedance from the pins to the fixture board. Other factors affecting the results include the board spacing, construction (especially copper weight, holes and openings) of the fixture board and the spacing board, temperature measurement method and ambient temperature measurement point. The thermal derating curves in this datasheet are obtained using a PWB fixture board and a PWB spacing board with no opening, a board-to-board spacing of 1”, and the converter is soldered to the test board with thermal relieves.

Note that the natural convection condition was measured at 0.05 m/s to 0.15 m/s (10ft./min. to 30 ft./min.

Heat Transfer without a Baseplate

With single-board DC/DC converter designs, convection heat transfer is the primary cooling means for converters without a baseplate. Therefore, airflow speed should be checked carefully for the intended operating environment. Increasing the airflow over the converter enhances the heat transfer via convection.

Figure7 shows a recommended temperature monitoring point for open frame modules. For reliable operation, the temperature at this location should not continuously exceed 120 °C.

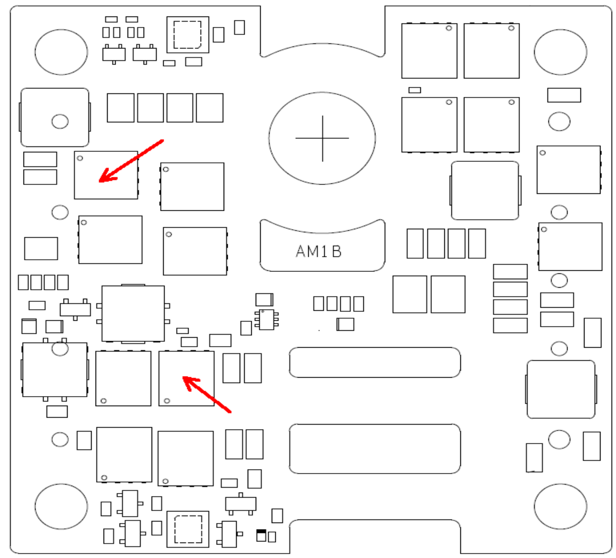


Figure 7. Temperature Monitoring Location

Heat Transfer with a Baseplate

The HB24 Series of converters have the options of using a baseplate for enhanced thermal performance.

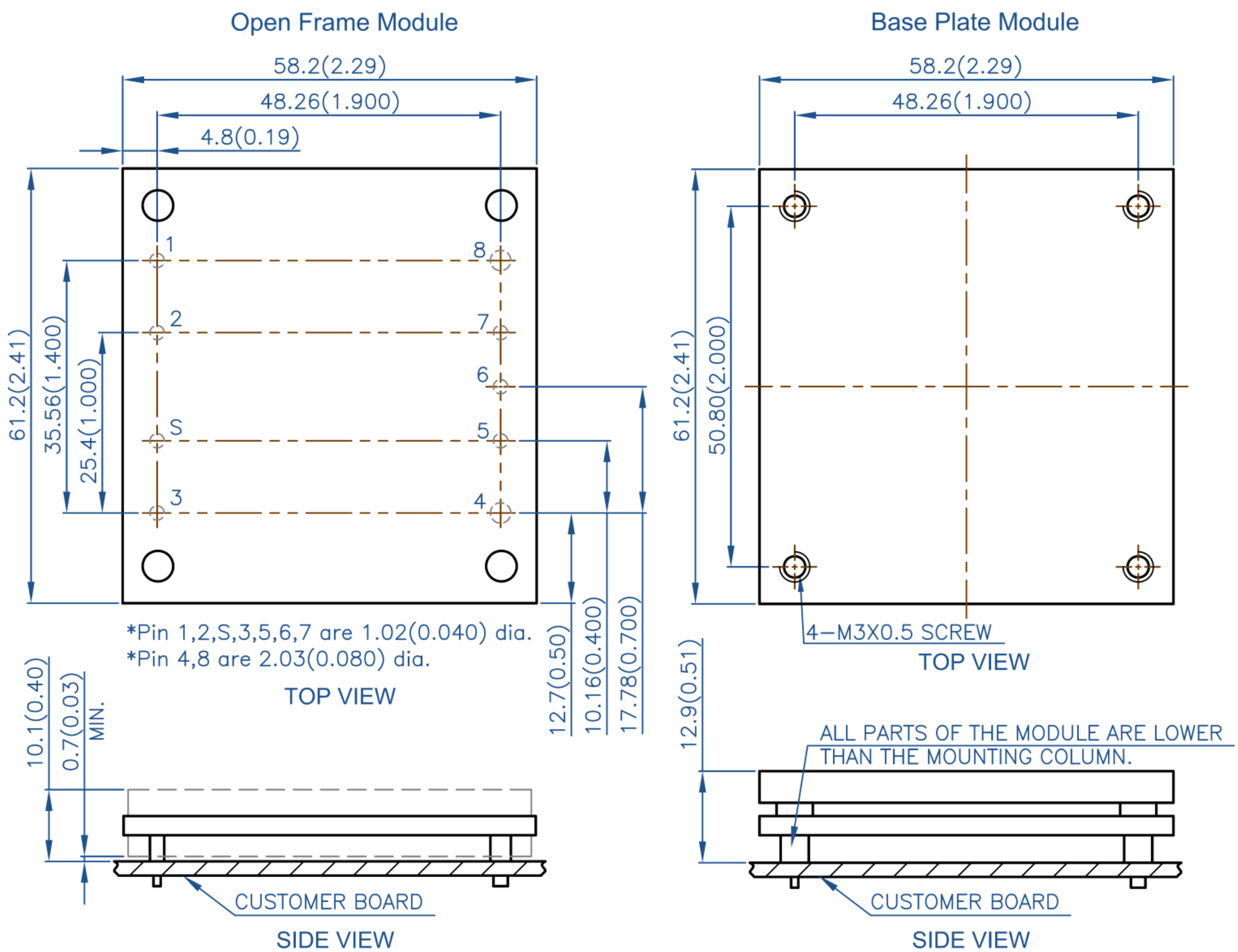
The typical height of the converter with the baseplate option is 0.50’’. The use of an additional heatsink or cold-plate can further improve the thermal performance of the converter.

For reliable operation, the baseplate temperature should not continuously exceed 100 °C.

EMC Considerations

The EMC performance of the DC/DC converters is related to the EMI filter design and its layout on the system board. Customers shall use common practices in EMI filter designs for DC/DC converters to minimize both differential-mode and common-mode noises. EMI is largely a system issue and proper system design (filtering and shielding) is often the most important means to meet conducted and radiated EMI standards.

Mechanical Information

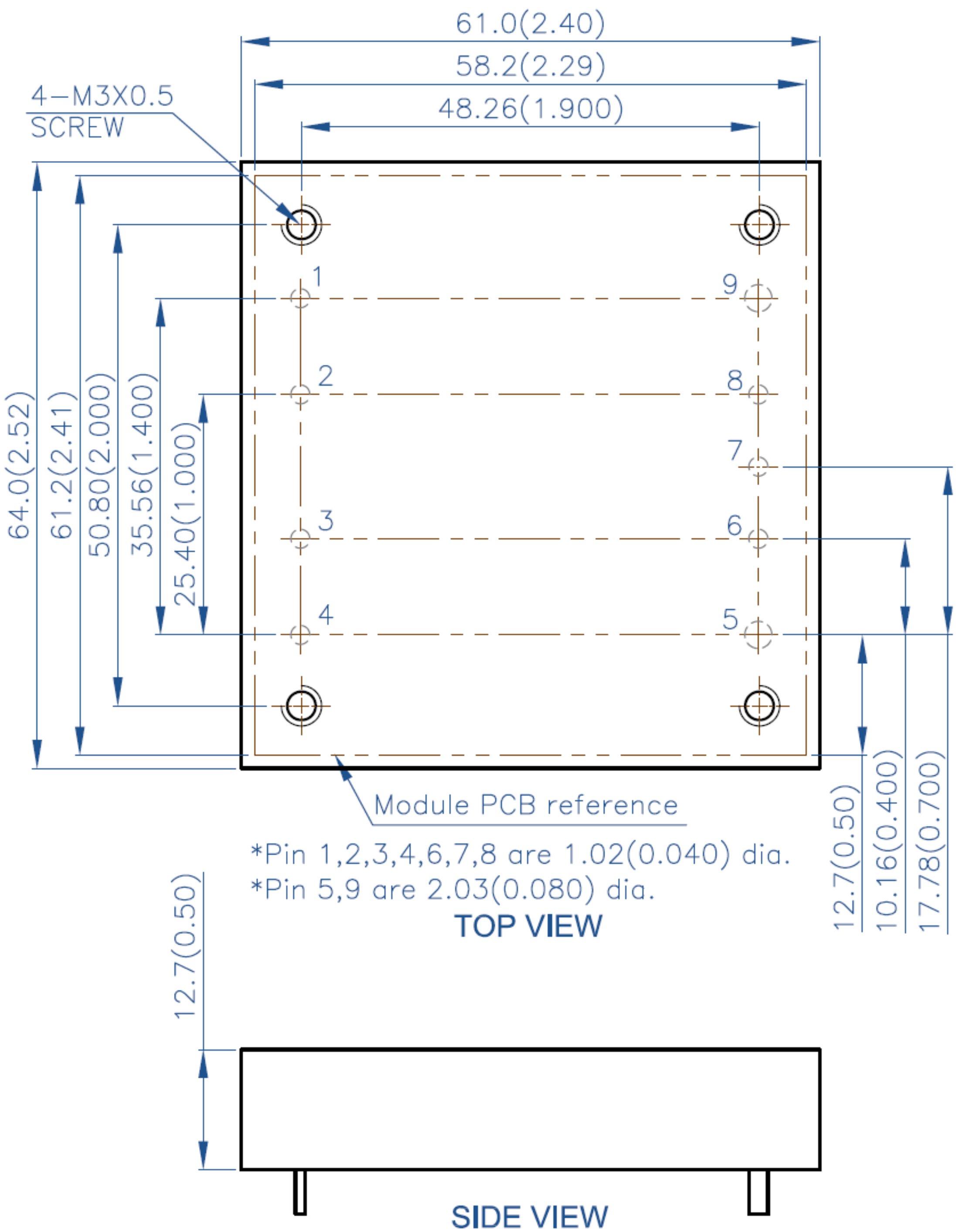


Pin	Name	Function
1	Vin(+)	Positive input voltage
2	ON/OFF	Remote control
3	Share	Current share
4	Vin(−)	Negative input voltage
5	Vout(−)	Negative output voltage
6	SENSE(−)	Negative remote sense
7	TRIM	Output voltage adjust
8	SENSE(+)	Positive remote sense
9	Vout(+)	Positive output voltage

Notes:

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

Encapsulated Type- I
(without mounting holes)



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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.