16-40V input, 28V/22A output half brick power module

Product Overview and Applications:

The HB24 series power module is a 1/2 brick isolation module with a 16-36V input range, a maximum power of 616W, and a maximum efficiency of 92.0%. It has protection functions such as input undervoltage, output overvoltage, output overcurrent, output short circuit, and over temperature protection. In addition, its electrical performance indicators meet the GJB-181A-2003 standard, and its environmental performance also meets the relevant requirements of GJB150-86. It has superior thermal performance and extremely high stability, which can meet the requirements of high size, weight, power density, environment, etc., and is widely used in various demanding electronic systems such as aviation, airborne, missile borne, vehicle mounted, ground equipment, radar, weapons, communication, control, etc.

Performance:

- Input voltage range: 16-40V
- Output voltage range: 22.4V-30.8V
- Efficiency up to 92.0%
- Superior thermal performance
- Overvoltage, overcurrent, short circuit, and over temperature protection
- Built in anti-backflow function

Optional features:

- Open frame, Baseplate, Encapsulated etc.
- Automatic restart or lock protection mode
- Positive and negative switch logic

Open- frame

Baseplate

Encapsulated Type-I

Encapsulated Type-II (Cold plate)

Flange encapsulated

Ordering Information

HB24	X	280	X	022	R	X	X	X	X
Series Name	Temperature Grade	Rated output Voltage	Enable Logic	Rated output Current	Pin Length	Protection Options	Package options	Leadfree Compliant	Special code
	C: -40°C - 85°C H: -40°C -100°C M: -55°C-100°C	(unit: 0.1V) 280=28.0V	P: Positive N: Negative	(unit: 1A) 022=22A	5.1mm (encapsulated) 6.1mm (Open-frame) 5.1mm (Cold, Flange)	0: Lock 2: Auto restart	0: Open frame 1: Baseplate 2: Encapsulated 3: Flange encapsulated 6: Cold-plate	G: leadfree H: Installation through-hole (non-open) O: Coating (0/1 package)	

Electrical characteristics

Typical conditions: TA=25 ° C, airflow rate=1.5m/s (300LFM), Vin=24VDC

Parameter	Min.	Typical	Max.	Unit	Notes
Absolute Maximum Rating					
Input Voltage					
Non-Operating Voltage	50			V	Continuous Input
Operating Voltage			40	V	Continuous Input
Surge operating voltage			50	V	100ms, square wave
Isolation voltage					
Input - Output			1500	V_{DC}	Within 1 minute
Input – Baseplate			1000	V_{DC}	Within 1 minute
Output - Baseplate			1000	V_{DC}	Within 1 minute
Operation Temperature					
C Level	-40		85	°C	Baseplate Temperature
H Level	-40		100	°C	Baseplate Temperature
M Level	-55		100	°C	Baseplate Temperature
Storage Temperature	-55		125	°C	
Efficiency					
100% load	89.5	91.0		%	
Input characteristics					
Input Operating Voltage range	16	24	40	V	
Input undervoltage locking					
Turn on input voltage threshold	13.5	14.3	15.3	V	
Turn off input voltage threshold	12.3	13.3	14.3	V	
Recommended external input capacitance		220		µF	ESR0.1-0.2Ω
Max. input current			50	A	V_{in}=16V-40V, full load
No-load input current	416	554	691	mA	
No-load loss	10	13.3	16.6	W	
Standby input current		12	15	mA	Remote control off
Recommended fuses			70	A	Quick fuse
Output characteristics					
Output Voltage		28.0		V	
Output Voltage Tol.	-3		+3	%	Full condition range
Output voltage adjustment range	80		110	%	
Remote compensation range of output voltage			0.5	V	
Max. output Current			22	A	
Max. output Power			616	W	

Parameter	Min.	Typical	Max.	Unit	Notes
Output characteristics					
Output voltage adjustment rate					
Line Regulation		0.2	0.5	%	V_{in}=16V-40V, 50% load
Load Regulation		0.2	0.5	%	No load - full load
Temperature Regulation		0.2		%	Ta = -55°C~85°C
Output Voltage RMS and Noise					
Vp-p		200	400	mVp-p	Full load, 20MHz bandwidth
RMS value		60	100	mVrms	Full load, 20MHz bandwidth
Output overcurrent protection	22.7	27.5	33.0	A	
Output overvoltage protection	32.2	35	42	V	
capacitive loading			10,000	µF	
Dynamic characteristics					
Peak deviation		6		%	Load 50%~75%~50%, 50%~25%~50%;
Recovery time		300		µs	Load current change rate 0.1A/us
Output voltage rise time		60		ms	10%-90% V_{OUT}
Output voltage power-on delay time		20		ms	$V_{ON/OFF}$-10% V_{OUT}
Isolation characteristics					
Isolation voltage (Dielectric Strength)					Reference max. absolute rated value
Isolation Resistance	100			MΩ	
Isolation Capacitance		4700		pF	
Temperature limit derating curve					
Semiconductor junction temperature			125	°C	
PCB board temperature			125	°C	
Transformer temperature			125	°C	
Maximum heat dissipation baseplate temperature			100	°C	
General characteristics					
Switching frequency	360	400	440	kHz	
Enable control					
Positive logic	3.5		15	V	
Negative logic	0		1.2	V	
Over-temperature Protection (Open- frame)		120		°C	
Over-temperature Protection (encapsulated)		105		°C	Baseplate temperature
Calculated MTBF		1.2		10^6hrs.	Baseplate temperature 40°C
Weight					
Encapsulated		165		g	Tolerance ±10g
Open frame		75		g	Tolerance ±10g
Flange Encapsulated		160		g	Tolerance ±10g
Baseplate		105		g	Tolerance ±10g
Cold plate		160		g	Tolerance ±10g

Characteristic curve (28V/22A)

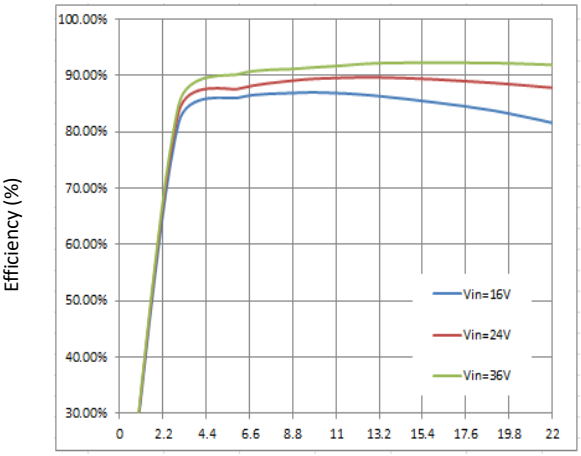


Figure 1. Efficiency and load current (25 ° C)

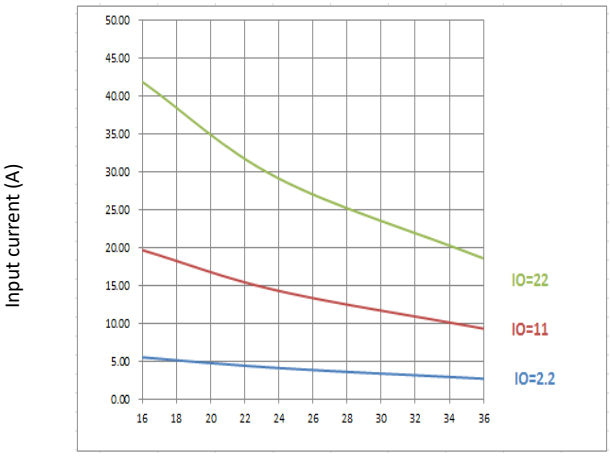


Figure 2. Input characteristics

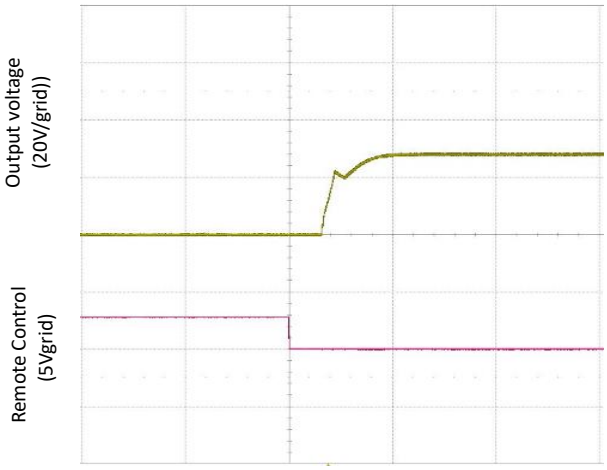


Figure 3. Remote open response (typical input, full load output)

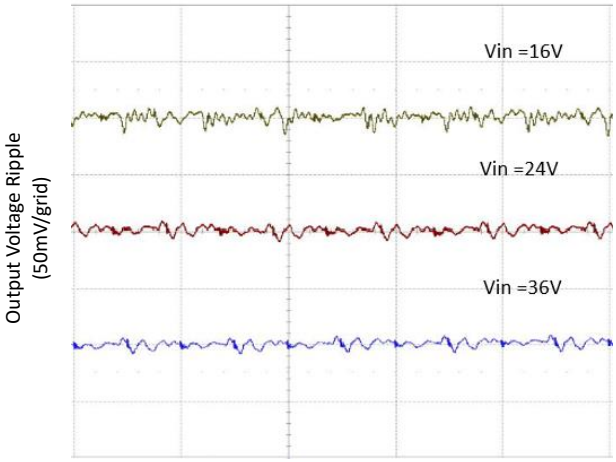


Figure 4. Full load output voltage ripple

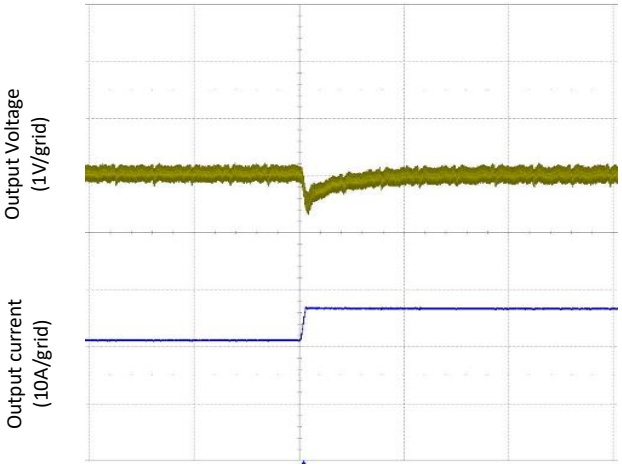


Figure 5. Dynamic response
(Typical input voltage, load down from 50% to 25% of full load with a slope of 0.1A/microsecond)

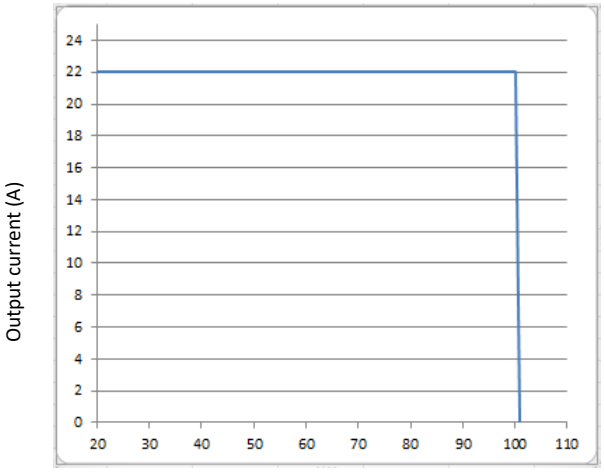


Figure 6. Derating curve (non-open) (°C)

Function Description

Enable control

The converter can be switched by changing the voltage between the ON/OFF pin and Vin (-). The switch of HB series converter can choose positive logic control or negative logic control.

For negative logic control, the converter is turned on when the ON/OFF pin is at a logic low level; When the ON/OFF pin is at a logic high level, the converter is turned off; For positive logic control, when the ON/OFF pin is at a logic high level, the converter is turned on; When the ON/OFF pin is at a logic low level, the converter is turned off.

Due to the internal pull-up circuit, connecting a small external switch between the ON/OFF pin and Vin (-) can control the converter.

The logic low level range is 0V to 1.2V, and the maximum external pulling current is 1mA. The external switch must be able to maintain the logic low level of the ON/OFF pin when pulling 1mA current; The logic high level range is 3.5V -15V, and the maximum voltage that the internal circuit of the converter can generate on the ON/OFF pin is not higher than 15V. The maximum allowable leakage current when the ON/OFF pin is high is 50μA.

Output voltage SENSE

The SENSE pin is used to measure the voltage at the load point, and accurately adjust the voltage at the load point to eliminate the impact of voltage drop on the circuit.

The SENSE (+) and SENSE (-) pins should be connected to the location where the voltage needs to be regulated. The voltage between the SENSE pin and the corresponding output pin cannot exceed 0.5V.

When SENSE is not in use, the SENSE pins should be connected to their respective output terminals (positive and negative).

If the SENSE pin is floating, the output voltage of the converter will be slightly higher than the set output voltage. And because the overvoltage protection circuit measures the voltage on the output pin (voltage between pin 8 and pin 4), the rise of the output voltage should not exceed the minimum overvoltage protection point specified in the output indicator table to avoid entering the overvoltage protection.

Output voltage adjustment (Trim)

The voltage adjustment pin is used to regulate the output voltage. Connecting an external resistor between the voltage pin and SENSE (+) can increase the output voltage; Connecting an external resistor between the voltage adjustment pin and SENSE (-) can lower the output voltage. The range of output voltage adjustment is 80% -110% of its calibration voltage.

The formula for adjusting the external resistance value of the reducing voltage is:

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

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

Vnom = Original setting value
Vadj = Voltage adjustment value

The formula for adjusting the external resistance value of the raised voltage is:

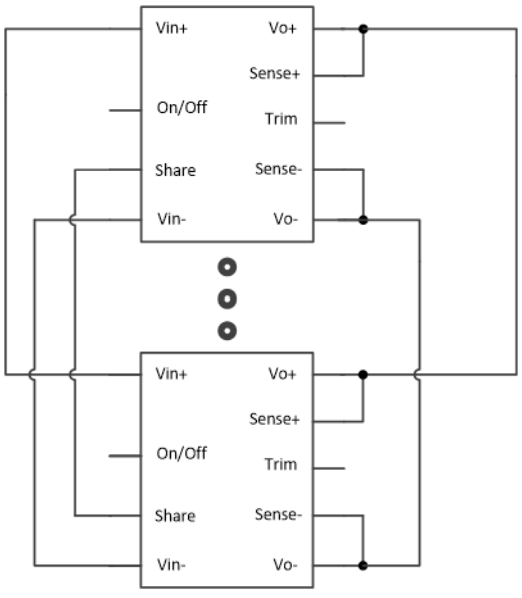
$$R_{up}=\left(\frac{V_{nom}(100+\Delta)}{1.225\Delta}-\frac{100}{\Delta}-2\right)(k\Omega)$$

Vnom = original set value

When using the output voltage adjustment or Remote function to make the output voltage of the converter higher than the set voltage, be careful not to exceed the maximum output power specified in the output indicator table.

Paralleled current sharing

The parallel current sharing function allows multiple power converters to be used in parallel to expand output power. When used in parallel, the Share pins should be connected together, and the module achieves active current sharing function through Share. The parallel schematic diagram is as follows:



The Share signal is only for current sharing purposes and cannot be subjected to external voltage or Vin external resistors. When wiring the Share signal, attention should be paid to avoiding interference.

The power converter has a built-in anti backflow function, which does not require an external anti backflow circuit.

Protection Function

Input undervoltage lock

When the input voltage rises to the starting input voltage threshold, the converter is turned on; When the input voltage drops to the threshold for turning off the input voltage, the converter shuts down. The hysteresis voltage effectively prevents the converter from oscillating between opening and closing.

Overvoltage protection

When the output voltage exceeds the output overvoltage protection point, the converter will shut down to protect both the converter and the load. For self-locking protection modules, the converter can be started by restarting the ON/OFF switch or inputting voltage. For modules that automatically restart, after the overvoltage condition disappears, the module will resume operation on its own.

Overcurrent protection

When the load current exceeds the overcurrent value, the converter will shut down. For self-locking protection modules, the converter can be started by restarting the ON/OFF switch or inputting voltage. For modules that automatically restart, the converter will shut down and continuously attempt to restart when the load current exceeds the overcurrent value. When the overcurrent condition disappears, the module automatically resumes operation.

Over Temperature Protection

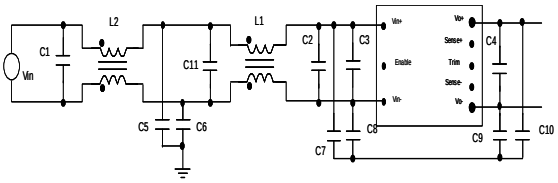
The temperature sensor is installed on the converter circuit board at a location that can reflect the temperature of the main components. If an over temperature condition is detected, the converter will shut down. For self-locking protection modules, the converter can be started by restarting the ON/OFF switch or inputting voltage. For modules that automatically restart, after the over temperature condition disappears, the module will resume operation on its own.

Electromagnetic interference (EMI)

The power module generates two types of electromagnetic interference noise, radiation and conduction, during operation. Radiation noise mainly comes from the rapid changes in voltage and current in the module, which in turn are caused by the opening and closing of power switching devices. At the same time, the mechanical structure of the module also has a certain impact on radiation noise. In general module design, an absorber (Snubber) is used to reduce high-frequency oscillations caused by rapidly changing voltage and current during power device switching. When selecting a metal substrate, grounding it or connecting it to a point with a relatively stable potential can provide a certain shielding effect.

Conducted noise can be further divided into differential mode noise and common mode noise. Differential mode noise appears between the positive and negative pins of the input and output, mainly at the input end; The pulse width modulation (PWM) of the power switching devices in the power module is the root cause of such noise; All modules include input differential mode L-C filtering. Common mode noise occurs between input and output pins and ground, and its strength is related to many internal and external factors; The module also contains common mode filtering capacitors. To further reduce noise interference, external differential mode and common mode filters are generally required in applications. Electromagnetic interference is a systemic issue that is influenced by various factors beyond the module, such as cabinet design, wiring design of circuit boards using modules, etc.; Therefore, the structure of the filter and the parameters of the filtering elements may vary depending on the system.

EMC Recommended Configuration Parameters:

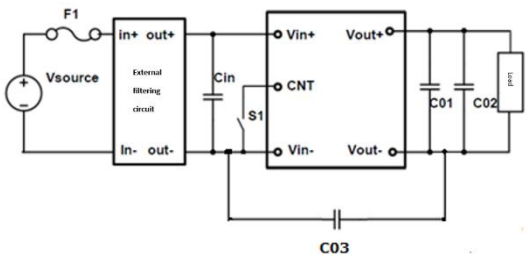


C1, C2, C3, and C4 are differential mode filtering capacitors. Among them, C2 should be a large capacity capacitor with low equivalent series resistance (ESR), such as an electrolytic capacitor; C1, C3, and C4 are generally ceramic capacitors with small equivalent series resistance and equivalent series inductance (ESL), providing low resistance circuits for high-frequency noise currents. Regarding the selection of C2 capacity, for modules with a minimum input voltage of 36V, it is recommended to use 50-100uF for every 100 watts of input power; For modules with a minimum input voltage of 18V, it is recommended to use 200-400uF for every 100 watts of input power. The voltage level of the capacitor should be greater than the highest input voltage. C2 also needs to have sufficient current rating to meet the long-term operation needs of high temperature and large load. The main function of C2 is to prevent the output impedance of the power supply at the input end of the module from being too high, in order to ensure stable operation of the module under various practical conditions. If the output impedance of the power supply is low and the distance to the module is close, the capacity of C2 can also be appropriately reduced. C2 provides a pathway for the input ripple current generated by the module while ensuring stability. Capacitors C7-C10 are common mode high-frequency decoupling capacitors, with capacitance values typically ranging from 10nF to 0.1uF. According to the different grounding methods for input and output, some of these capacitors must be high-voltage

capacitors. In most applications, increasing the output capacitor C4 can improve the output dynamic response and reduce voltage oscillations caused by output lead inductance. Usually, these output capacitors should also be capacitors with low equivalent series resistance (such as ceramic capacitors). L1 and L2 need to be selected based on the actual input current and system EMC requirements, generally ranging from tens of uH to hundreds of uH.

Application guidance

Typical application



F1: 70A fuse (fast melting)
C_{in}: Recommended 220uF/100V high-frequency low ESR electrolytic capacitors, connected in parallel with 2.2uF/100V ceramic capacitors;
C_{01}: Recommended 22uF ceramic capacitor;
C_{02}: Recommended 100uF tantalum or electrolytic capacitors;
C_{03}: Recommended 2.2nF/2000Vdc ceramic capacitors.

Installation and welding

Module installation

Modules can be installed in different directions, but it is necessary to ensure smooth air ducts. Generally, power devices are placed at the end of the air duct or have separate air ducts. This installation can ensure the cooling of the power module and increase the service life of the components.
1. It is necessary to ensure that there are no electrical connections between the module's substrate and the safety ground, as well as between the substrate and other pins.
2. If a heat sink is added to the substrate of the module, the position and size of the screws should refer to the structural dimension diagram.

Module welding

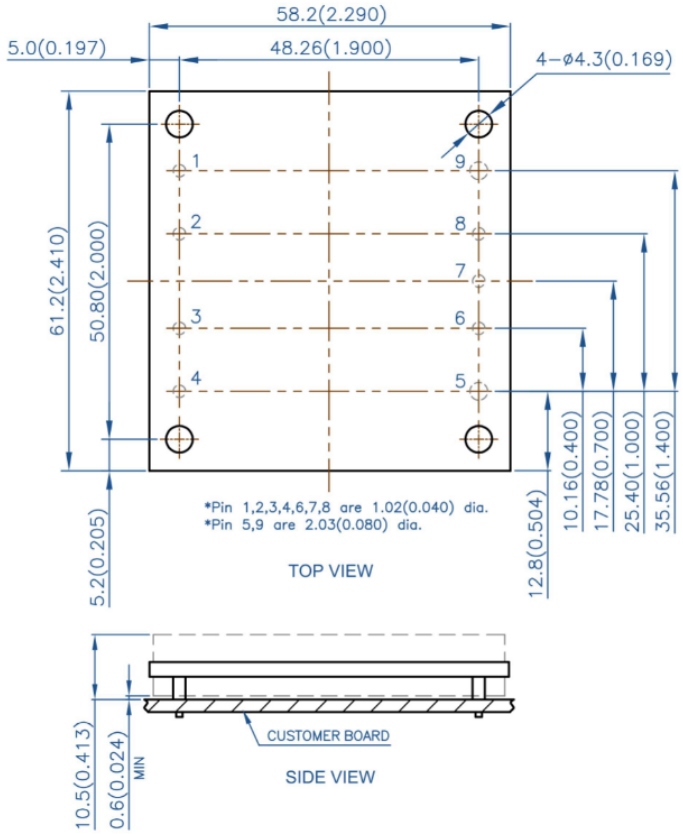
The module meets the standard wave soldering technology. When wave soldering, the pins of the module must be preheated at 110 ℃ for 20-30 seconds, and wave soldering at 235 ℃ for less than 10 seconds. When manually soldering, the temperature of the soldering iron should be set at 425 ℃, and it is necessary to ensure that the direct contact time with the pins does not exceed 3 seconds. Long term high-temperature welding can cause damage to the interior of the module. The module solder joints can be cleaned using IPA or appropriate solvents.

Special remarks

1. If the input voltage is repeatedly restarted quickly multiple times, the power module will cause the slow start circuit to fail during restart, which may lead to module damage. The recommended restart interval for input voltage should be greater than 1 second;
2. Repeated rapid restarts of the control voltage on the enable pin (ON/OFF) can cause the slow start circuit to fail when the power module restarts, which may lead to module damage. The recommended restart interval for the control voltage on the enable pin (ON/OFF) should be greater than 1 second;
3. The voltage of each pin of the power module must not exceed the maximum voltage specified in the specification sheet, especially the input positive pin, otherwise it may cause damage to the module;
4. The power module requires an additional input capacitor to be used. The specific recommended input capacitor value can be determined by the manufacturer. However, if the input capacitor is too small or non-existent, it can cause the power module to oscillate, which may lead to module failure.

Mechanical dimension

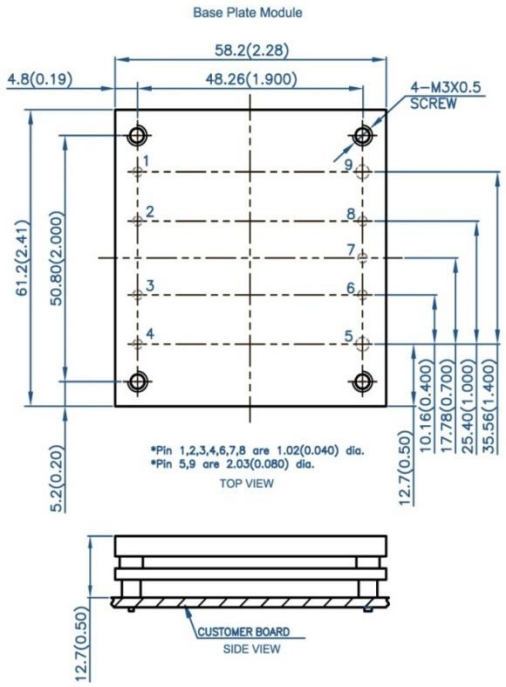
0： Open Frame



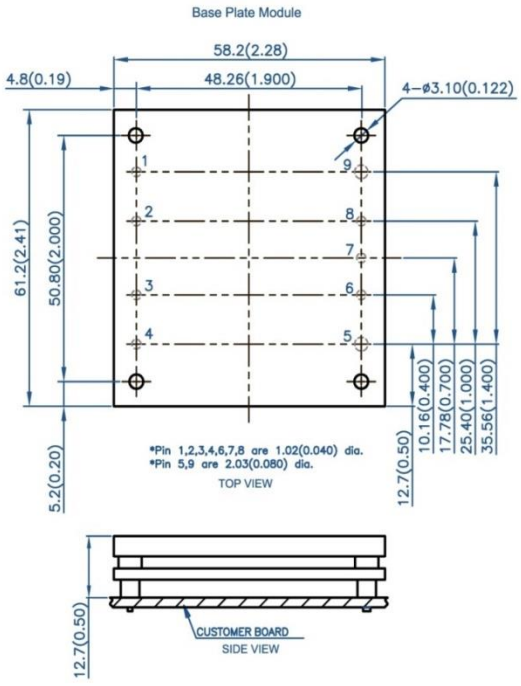
PIN	Name	Function
1	Vin(+)	Input positive
2	ON/OFF	Enable
3	Share	Current sharing bus
4	Vin(-)	Input negative
5	Vout(-)	Output negative
6	Sense(-)	Output voltage SENSE negative
7	Trim	Output voltage adjustment
8	Sense(+)	Output voltage SENSE positive
9	Vout(+)	Output positive

Tolerance： x.x ±0.5mm, x.xx ±0.25mm

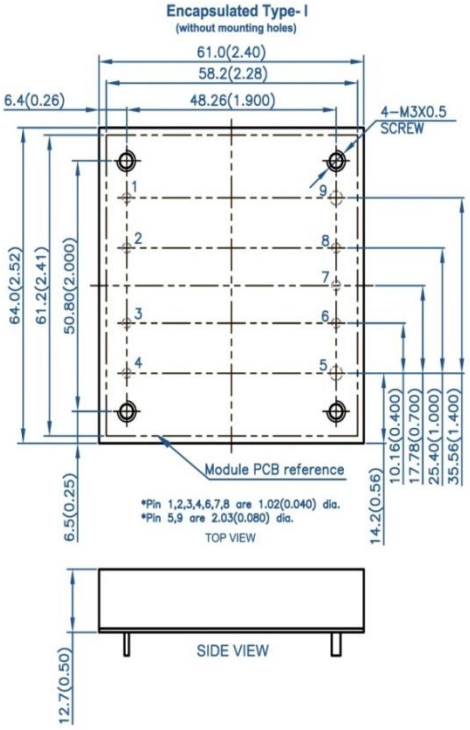
1: Baseplate (threaded hole)



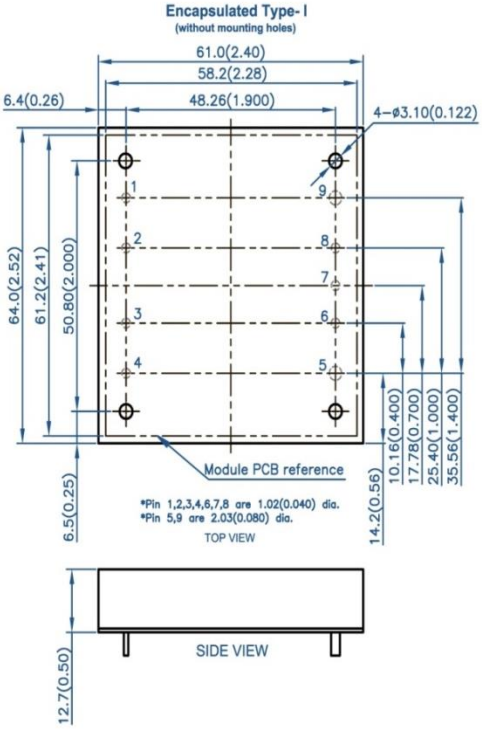
1H: Baseplate (through-hole)



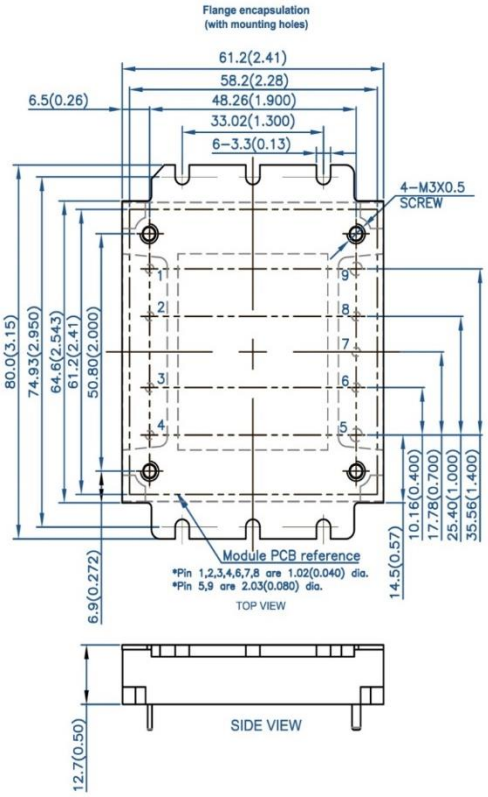
2: Encapsulated (theaded hole)



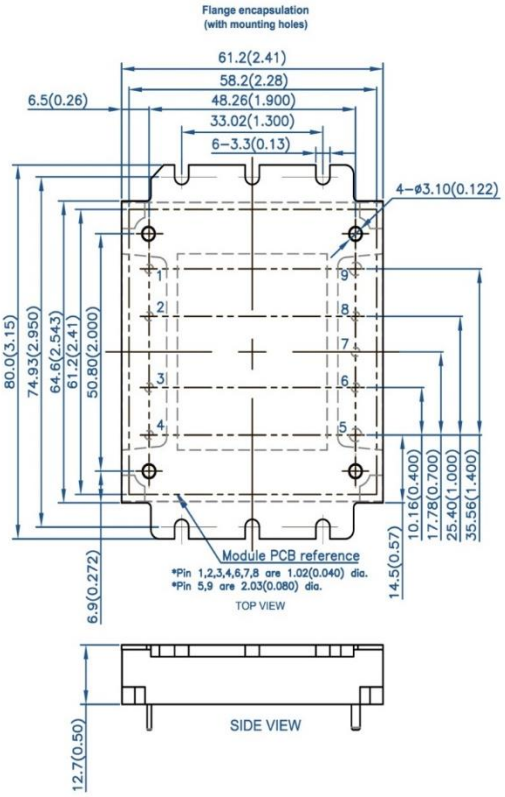
2H: Encapsulated (through-hole)



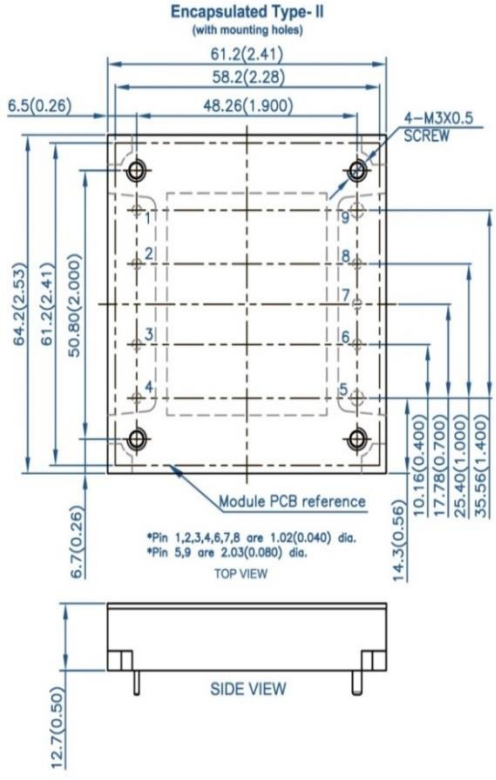
3: Flange encapsulated (threaded hole)



3H: Flange encaplulated (through-hole)



6: Cold plate (threaded hole)



6H: Cold plate (through-hole)