500HBAW_2.25 series

500W Half-Brick - Single Output DC-DC Converter - Wide Input - Isolated & Regulated

DC-DC Converter 500 Watt

- **Wide 2:1 input voltage range**
- **High efficiency up to 94%**
- **I/O isolation test voltage 2.25kVDC**
- **Input under-voltage protection, output short-circuit, over-current, over–voltage, over-temperature protection**
- **Parallel current sharing function**
- **Shell operating temprature range Tc: -40°C to +100°C**
- **Industry standard 1/2 brick**

500HBAW_2.25 series product output power is 500W. It features 2:1 wide voltage input range, efficiency up to 94%, 2250VDC isolation voltage, allowable working temperature 40°C - 100°C, with input under-voltage protection and output over-voltage protection, output over-current protection, output short-circuit protection, over-temperature protection, remote control and compensation, output voltage adjustment, parallel current sharing and other functions. Through the additinoal circuit, it can meet CISPR32/EN55032 Class A, and it is widely used in battery-powered equipment, industrial control, electric power, instrumentation, communication, intelligent robots and other fields.

Common specifications

Short circuit protection:	Hiccup, continuous, self-recovery
Cooling:	Free air convection or forced convection
Operation temperature range:	-40°C to +100°C (Shell temperature Tc)
Storage temperature range:	-55°C to +125°C
Storage humidity:	5~95 %RH Non-condensing
Pin soldering resistance Temperature:	Soldering spot is 1.5mm away from case for 10 seconds +300°C
Vibration:	10-150Hz, 5G, 0.75mm. along X, Y and Z
Switching frequency:	PWM mode 280 kHz
Hot plug:	Unavailable
Case material:	Aluminum alloy + black flame retardant and heat resistant plastic
Dimension:	61.00 × 57.90 × 12.70 mm
MTBF (MIL-HDBK-217F@25°C):	1,000,000 hours
Weight:	130.0g (Typ.)

Input specifications

Item	Test condition	Min	Typ	Max	Units
Input current (Full load / no-load)	24VDC input • 12V, 24V output • 15V, 28V output		22581/340 22607/340	23077/380 23098/380	mA mA
Reflected ripple current	24VDC input		500		mA
Surge voltage	(1sec. max.)	-0.7		50	VDC
Start-up voltage				18	VDC
Input under-voltage protection		15.5			VDC
Start-up time	Nominal input voltage & constant resistance load			100	ms
Input filter	Capacitance filter				
ON/OFF* (Module on)	ON/OFF pin open or pulled high (TTL 3.5-12VDC)				
ON/OFF* (Module off)	ON/OFF pin pulled low to GND (0-1.2VDC)				
ON/OFF* (Input current when off)			25	40	mA

Note:

1. The maximum capacitive load offered were tested at input voltage range and full load;
2. Unless otherwise specified, parameters (this datasheet) were measured under the conditions of Ta = 25°C, humidity <75%RH with nominal input voltage and rated output load;
3. All index testing methods in this datasheet are based on company corporate standards;
4. We can provide product customization service, please contact our technicians directly for specific information;
5. Products are related to laws and regulations: see „Features" and „EMC";
6. Our products shall be classified according to ISO14001 and related environmental laws and regulations, and shall be handled by qualified units.

Output specifications

Item	Test condition	Min	Typ	Max	Units
Voltage accuracy	0% -100% load		±1	±3	%Vo
Line regulation	Input voltage variation from low to high at full load		±0.2	±0.5	%Vo
Load regulation	5% -100% load		±0.25	±0.75	%Vo
Transient recovery time	25% load step change, 2A/us		300	500	µs
Transient response deviation	25% load step change, 2A/us		±3	±5	%Vo
Temp. coefficient	Nominal full load			±0.03	%/°C
Ripple & noise*	24VDC nominal input voltage 20MHz bandwidth, 5%-100% load • 12V, 15V output • 24V, 28V output			 150 220	 mVp-p mVp-p
Parallel current sharing accuracy**	24VDC nominal input voltage, 100% load, 2pcs parallel		±8	±10	%Io
Trim	Input voltage range	90		110	%Vo
Sense	Input voltage range			110	%Vo
Over-voltage protection	Input voltage range	110	115	130	%Vo
Over-current protection	Input voltage range	110	115	130	%Io
Over-temperature protection	Product surface temperature		110	120	°C

Note: * Under 0% -5% load conditions, ripple & noise does not exceed 5%Vo. The "Tip and barrel method" is used for ripple and noise test, output parallel 1uF ceramic capacitor+10uF tantalum capacitor+minimum capacitive load;
** Number of parallel connections: 4pcs max, the current sharing accuracy is only for reference when 2pcs products are connected in parallel.

Isolation specifications

Item	Test condition	Min	Typ	Max	Units
Isolation (Input-Output)	• Electric Strength Test for 1 minute with a leakage current of 1mA max. 2250VDC Min. • Case Electric Strength Test for 1 minute with a leakage current of 1mA max. 2250VDC Min.				
Insulation Resistance	Input-output resistance at 500VDC	100			MΩ
Isolation Capacitance	Input-output capacitance at 100KHz/0.1V		3000		pF

Example:
500HBAW_2412S2.25
500 = 500 Watt; HB = Half-Brick; A = Pinning; W = Wide input (2:1);
24 = 24Vin; 48 = 48Vout; S = Single Output; 2.25 = 2.25kVDC Isolation

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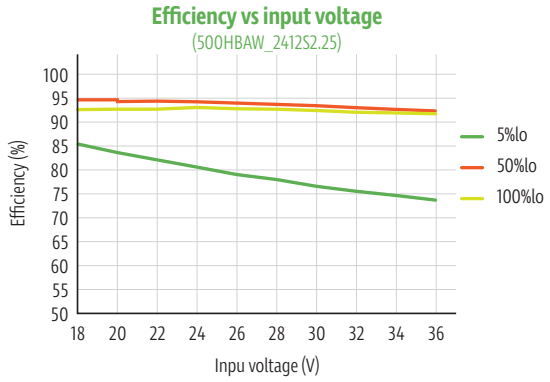
EMC specifications				
Emissions	CE	CISPR32/EN55032	CLASS A (additional circuit) (see Fig.4 for recommended circuit)	
Emissions	RE	CISPR32/EN55032	CLASS A (additional circuit) (see Fig.4 for recommended circuit)	
Immunity	ESD	IEC/EN61000-4-2	Contact ±6kV, Air ±8kV	perf. Criteria B
Immunity	RS	IEC/EN61000-4-3	10V/m (see Fig.4 for recommended circuit)	perf. Criteria A
Immunity	EFT	IEC/EN61000-4-4	±2kV (see Fig.4 for recommended circuit)	perf. Criteria A
Immunity	Surge	IEC/EN61000-4-5	line to line ±2kV (see Fig.4 for recommended circuit)	perf. Criteria B
Immunity	CS	IEC/EN61000-4-6	10 Vr.m.s (see Fig.4 for recommended circuit)	perf. Criteria A

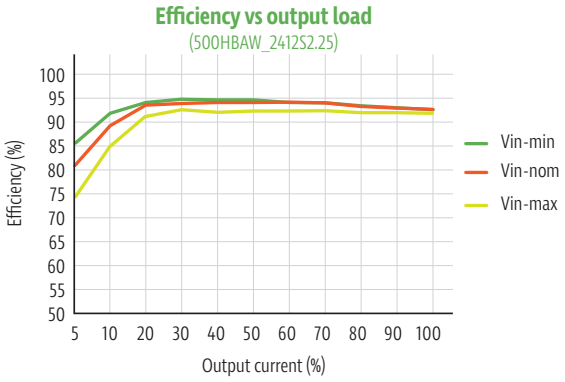
Product Selection Guide

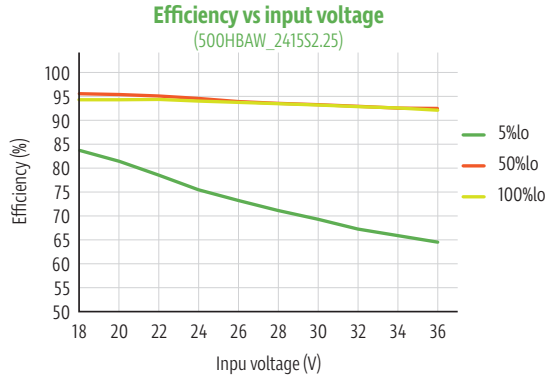
Approval	Model	ON/OFF logic*	Input Voltage (VDC)		Output		Full Load Efficiency (%) Min./Typ.	Capacitive Load (µF) Max.	Capacitive Load (µF)Min.
			Nominal (Range)	Max.**	Voltage (VDC)	Current(mA) Max./Min.			
-	500HBAW_2412S2.25	N	24 (6-42)	40	12	42000/0	91/93	12000	470
-	500HBAW_2412S2.25	N	24 (6-42)	40	15	34000/0	92/94	10000	470
-	500HBAW_2412S2.25	N	24 (6-42)	40	24	21000/0	91/93	6000	470
-	500HBAW_2412S2.25	N	24 (6-42)	40	28	18000/0	92/94	5000	470

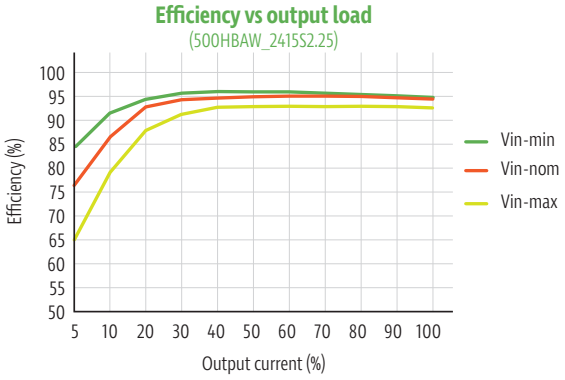
Notes: * "P" means positive logic, „N" means negative logic;
** Exceeding the maximum input voltage may cause permanent damage;
In order to ensure the stability of the output voltage, the output side of the product must be connected with a minimum capacitive load.

Product characteristic curve



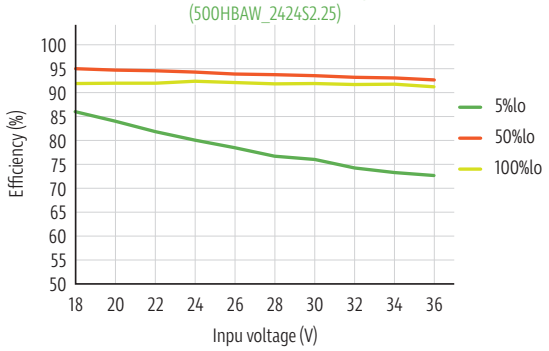






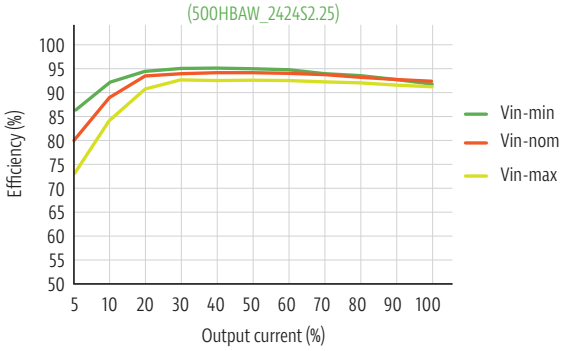
Efficiency vs input voltage

(500HBAW_2424S2.25)



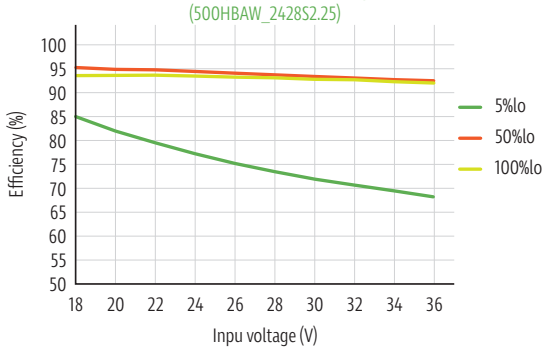
Efficiency vs output load

(500HBAW_2424S2.25)



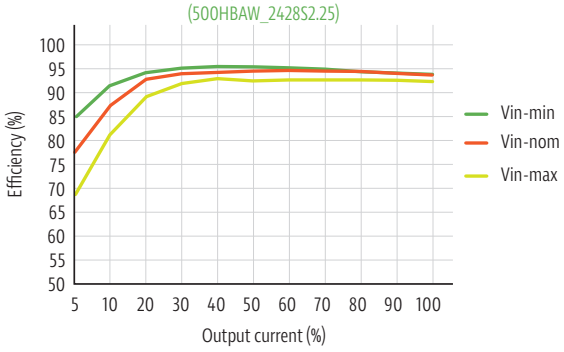
Efficiency vs input voltage

(500HBAW_2428S2.25)



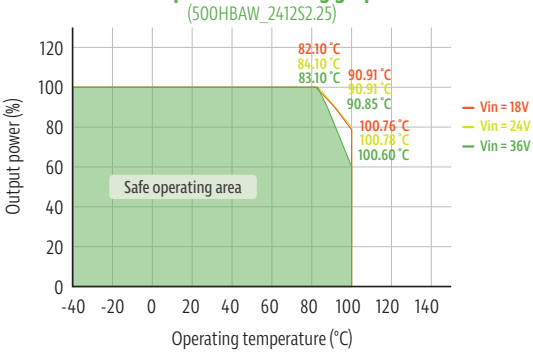
Efficiency vs output load

(500HBAW_2428S2.25)



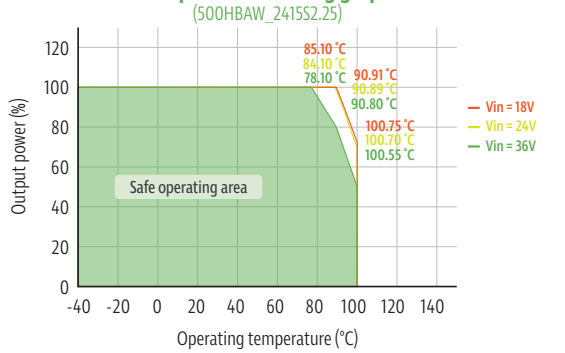
Temperature derating graph

(500HBAW_2412S2.25)



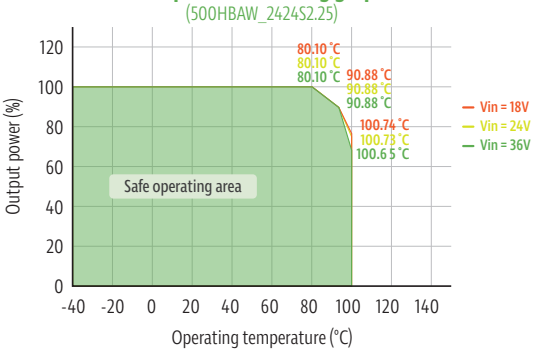
Temperature derating graph

(500HBAW_2415S2.25)



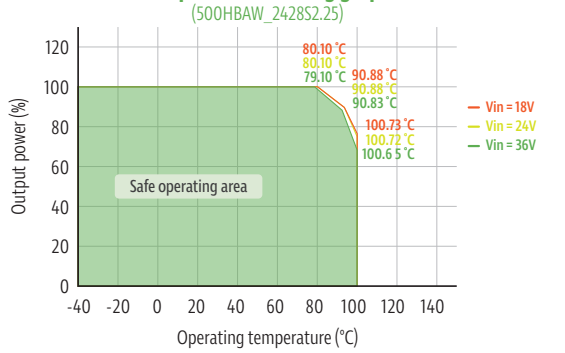
Temperature derating graph

(500HBAW_2424S2.25)



Temperature derating graph

(500HBAW_2428S2.25)



Remote sense connection if not used

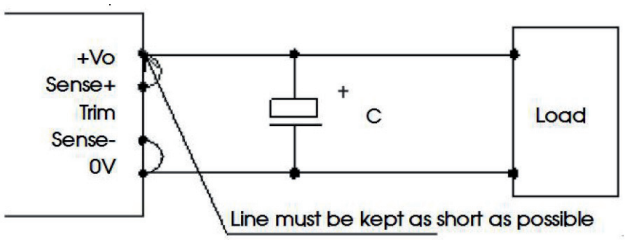


Fig. 1

Notes:
1. If the sense function is not used for remote regulation the user must connect the +Sense to +Vo and -Sense to 0V at the DC-DC converter pins and will compensate for voltage drop across pins only.
2. The connections between Sense lines and their respective power lines must be kept as short as possible, otherwise they may be picking up noise, interference and/or causing unstable operation of the power module.

Remote sense connection used for compensation

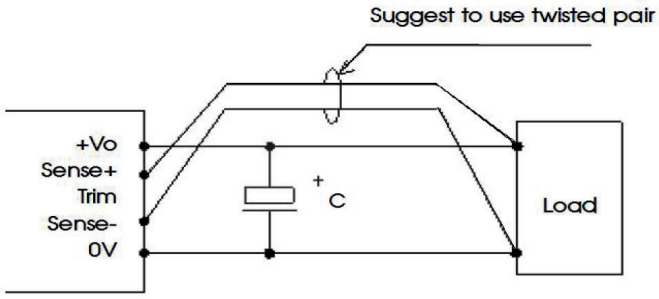


Fig. 2

Notes:
1. Using remote sense with long wires may cause unstable output, please contact technical support if long wires must be used.
2. PCB-tracks or cables/wires for Remote Sense must be kept as short as possible. Twisted pair or shielded wires are suggested for remote compensation and must be kept as short as possible.
3. We recommend using adequate cross section for PCB-track layout and/or cables to connect the power supply module to the load in order to keep the voltage drop below 0.3V and to make sure the power supply's output voltage remains within the specified range.
4. Note that large wire impedance may cause oscillation of the output voltage and/or increased ripple. Consult technical support or factory for further advice of sense operation.

Typical application circuit

All DC-DC converters of this series are tested before delivery using the recommended circuit shown in Fig. 2.
Input and/or output ripple can be further reduced by appropriately increasing the input & output capacitor values Cin and Cout and/or by selecting capacitors with a low ESR (equivalent series resistance). Also make sure that the capacitance is not exceeding the specified max. capacitive load value of the product.

Fig. 3

Output voltage	Capacitance value	
	Cout(min.)	Cin
12V/15V/24V/28V	470µF/35V	220 µF/63V

EMC recommended circuit

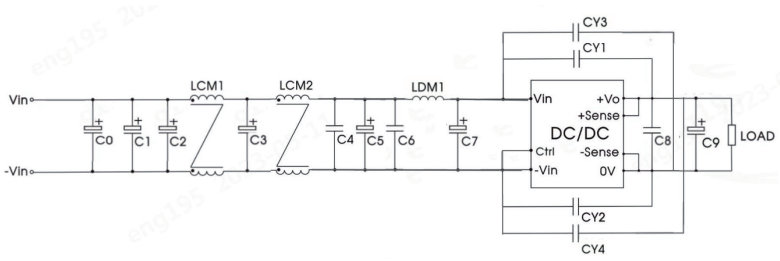


Fig. 4

Device	Parameter description
C0, C1, C2, C3, C5, C7	330µF/63V Electrolytic capacitance
C4, C6, C8	2.2µF/100V Ceramic capacitor
C9	470µF/63V Electrolytic capacitance
LCM1	FL2D-D0-561 : 560uH
LCM2	FL2D-D0-201 : 200uH
LDM1	CPQ2918-100M : 10uH
CY1, CY2, CY3, CY4	4.7nF/400VAC Safety Y capacitor

Trim function for output voltage adjustment (open if unused)

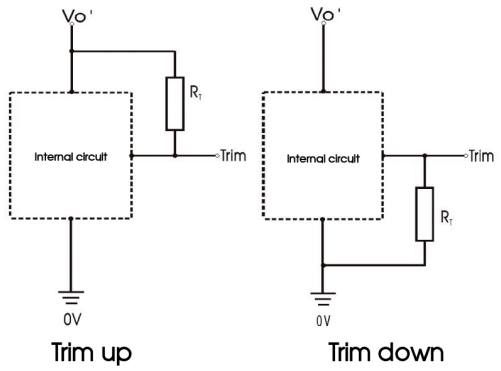


Fig. 5

TRIM resistor connection (dashed line shows internal resistor network)

Calculating Trim resistor values:

Trim up

$$R_T = \left(\frac{5.11 V_{nom}(100+\Delta\%)}{1.225\Delta\%} - \frac{511}{\Delta\%} - 10.22 \right)(k\Omega)$$

Trim down

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

Notes: RT is Trim resistance

$$\Delta\% = \left| \frac{V_{nom} - V_{out}}{V_{nom}} \right| \times 100$$

V_{nom} is the typical output voltage

V_{out} to set the output voltage

Reflected ripple current test circuit

All DC-DC converters of this series are tested using the recommended circuit shown in Fig. 6.

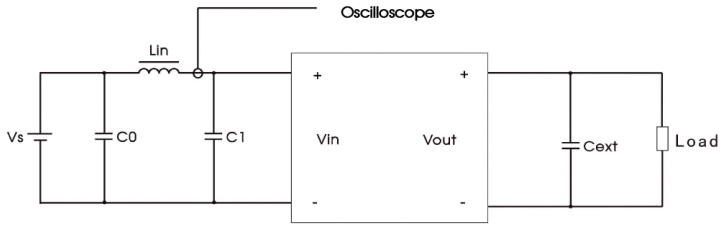


Fig. 6

Components	Recommended Component Value
C0	220µF/63V
Lin	10uH/40A
C1	470µF/63V
Cext	470µF/35V

The products do support parallel connection of their output

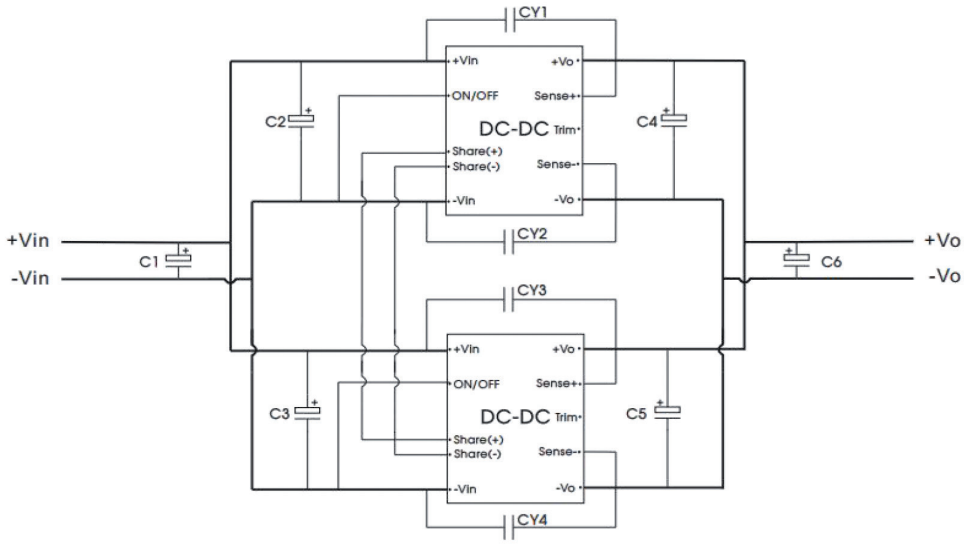


Fig. 7
Parallel current sharing wiring diagram

When the parallel current balancing function is used, ensure that the cable lengths of power modules are equal, the maximum number of parallel connections is 4 .

Vin (VDC)	Vout (VDC)	C1/C2/C3	C4/C5/C6	CY1/CY2/CY3/CY4
24	12/15/24/28	220uF/63V	470uF/35V	222M/Y2

Recommended solution for thermal testing

In the process of application, the thermal design of the product can be evaluated in combination with the product temperature derating curve, or the stable working interval of the product can be determined by the temperature of the thermal test point in Figure 8. When the temperature at point A is lower than 100°C, it is the stable working range of the product.

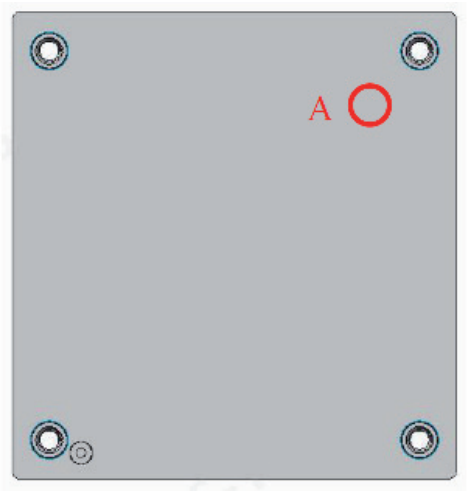
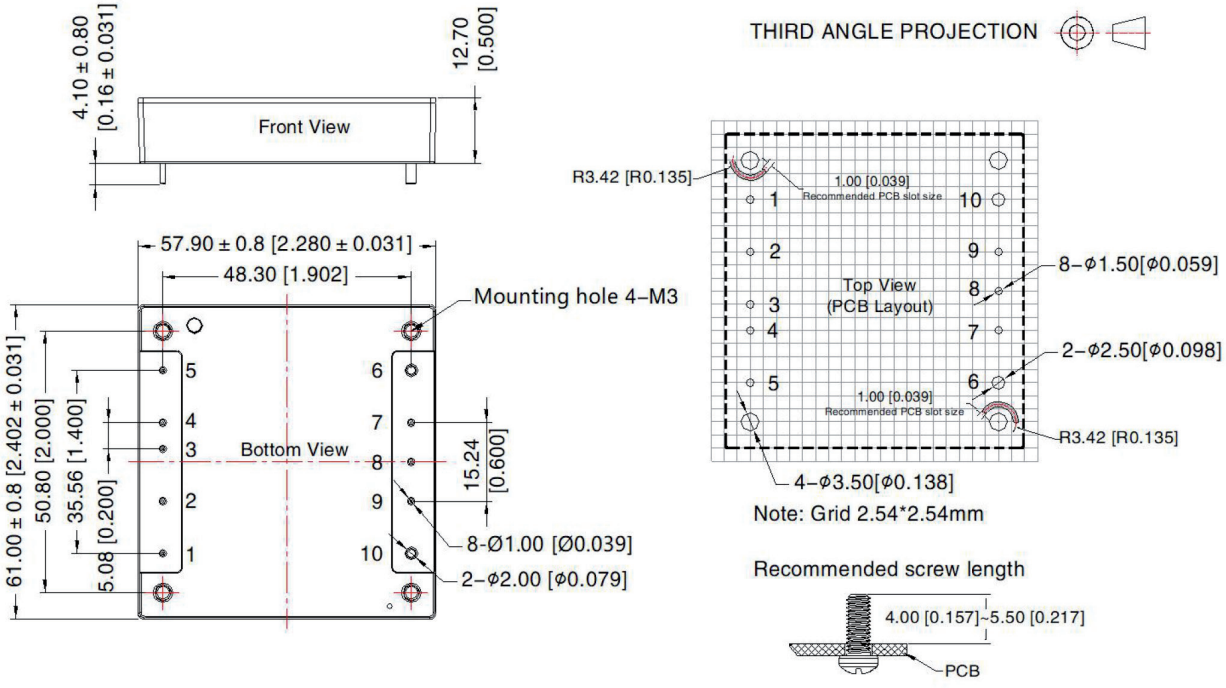


Fig. 8
Top view of the product

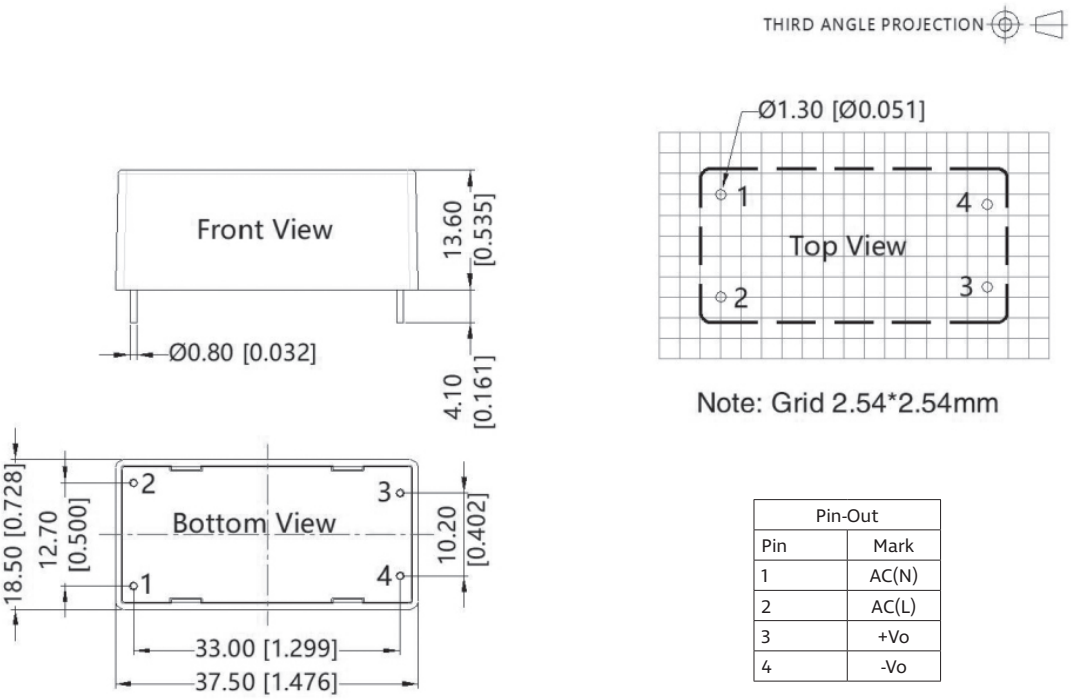
Dimensions and recommended layout



Note:
Unit: mm[inch]
Pin 1, 2, 3, 4, 5, 7, 8, 9 diameter: 1.00[0.039]
Pin 6, 10 diameter: 2.00[0.079]
Pin diameter tolerances: ±0.10[±0.004]
General tolerances: ±0.50[±0.020]
Mounting hole screwing torque: Max 0.4 N • m

Pin-Out			
Pin	Mark	Pin	Mark
1	+Vin	6	-Vo
2	ON/OF	7	Sense-
3	Share (+)	8	Trim
4	Share (-)	9	Sense+
5	-Vin	10	+Vo

Dimensions and Recommended Layout



Pin-Out	
Pin	Mark
1	AC(N)
2	AC(L)
3	+Vo
4	-Vo

Note:
Unit: mm [inch]
Pin section tolerances: ±0.10 [±0.004]
General tolerances: ±0.50 [±0.020]