Technical Specification

DC-DC Converter，Quarter-Brick

PTPQ420-48S12CS

36Vdc to 75Vdc Input；12Vdc / 35A Output

RoHS Compliant

Features

- Compliance with RoHS EU Directive 2011/65/EU & (EU)2015/863
- Closed-loop Regulated
- Delivers up to 35A output current
- High efficiency, typ.95% at Vout half load
- Low output ripple and noise
- Exceptional thermal performance
- Industry standard "Quarter-brick" footprint
- Remote On/Off positive logic
- Constant switching frequency (150 KHz typical)
- Input under voltage lockout
- Output over voltage protection
- Output over current protection
- Short Circuit Protection
- Over temperature protection
- Adjustable output voltage (-20%~10%Vo(nom))
- Meets IEC60950-1&IEC/UL/EN62368-1

Applications

- Distributed Power Architectures
- Wireless Networks
- Access and Optical Network Equipment
- Enterprise Networks
- Latest generation IC's (DSP, FPGA, ASIC)
- and Microprocessor powered applications.

Options

- Remote On/Off logic
- Heatsink
- Trim Logic

Description

PTPQ420-48S12CS power module is a Quarter-brick DC/DC converter provides high efficiency single output, which makes it an ideal choice for optimum space. It can operate from 36-75Vdc input and provide up to 35A output current. The output can be trimmed from -20% to +10% of normal output voltage. The remote control option is positive logic. The converter turns on when the REM pin is at logic high and turns off when at logic low, both are referenced to -Vin. The converter is on when the REM pin is left open. The output voltage trim option is positive. The output voltage will increase when the TRIM pin connected to +S pin and decrease when it connected to -S pin.

Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only, functional operation of the device is not implied at these or any other conditions in excess of those given in the operations sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect the device reliability.

Parameter	Units	Specifications		Notes & conditions
		Min.	Max.	
Input Voltage	Vdc	0	80	Continuous
		0	100	Transient (100ms)
Voltage at TRIM Pin	Vdc	-0.3	5	
Operating Temperature	℃	-40	85	Ambient Temperature
Base Plate Operating Temperature	℃	-40	100	
Storage Temperature	℃	-55	125	
Operating Humidity	RH(%)	-	90	Non-condensing
Storage Humidity	RH(%)	-	90	Non-condensing
Operating Altitude	m	0	3000	
Storage Altitude	m	0	3000	

Electrical Specifications

Unless otherwise indicated, specifications apply over all operating input voltage, resistive load, and room temperature conditions.

Input Characteristics

Parameter	Units	Specifications			Notes & conditions
		Min.	Typ.	Max.	
Operating Input Voltage	Vdc	36	48	75	Converter guaranteed whole specification at input voltage range of 35 ~ 75V
Maximum Input Current	A	-	-	13.5	100% load Vin=Vin(min) to Vin(max)

No load Input Current	mA	-	130	200	No load Vin=36V~75V
Disabled Input Current	mA	-	10	20	
Input Reflected Ripple Current	mARMS	-	10	20	5 Hz to 20 MHz, 12 μH source impedance, 47μF aluminum electrolytic capacitor
	mAp-p	-	-	80	
Input External Capacitance	uF	100	-	-	Recommended ESR<2000mΩ at -40℃
Inrush Transient	A^2S	-	-	1	
Input Fuse	A	-	-	20	

Remote Control Characteristics

Parameter	Units	Specifications			Notes & conditions
		Min.	Typ.	Max.	
Logic High Voltage	Vdc	3.5	-	20	Converter guaranteed logic high when REM pin is left open
Logic Low Voltage	Vdc	0	-	1.2	
Current Sink	mA	-2	-	1	

Output Characteristics

Parameter	Units	Specifications			Notes & conditions
		Min.	Typ.	Max.	
Output Voltage Set Point	Vdc	11.7	12.0	12.3	Vin=Vin(nom), Io=0 to Io(max)
Total Output Voltage Range	V	10.8	-	12.3	
Output Voltage Precision	%Vo	-	0.5	1	40 ~75Vin Io=0 to Io(max) See note 1
Line Regulation	%Vo	-	0.2	0.3	40 ~75Vin See note 2
Load Regulation	%Vo	-	0.5	0.8	Vin=Vin(nom)
Temperature Coefficient	ppm/℃	-	-	200	Ambient Temperature -40℃～85℃

Output Voltage Adjustment Range		%Vo	-20	-	10	Rated power Io=0 to Io(max), see figure 6
Output Remote Sense		%Vo	-	-	5	41~75Vin Io=0 to Io(max)
Output Current		A	-	-	35	Vin=Vin(min) to Vin(max)
External Load Capacitance		uF	0	-	5000	ESR<350mΩ at -40℃, Vin=Vin(min) to Vin(max) Io=0 to Io(max)
Dynamic Response	Overshoot range	mV	-	±350	±800	50%~75%~50% Io(nom) di/dt=1A/μS Add 220μF external capacitor with low ESR on output
	Recovery time	μS	-	250	350	
Ripple and Noise		mVp-p	-	100	150	Measured with 10uF Tantalum capacitor and 1uF ceramic capacitor at output
		mVRMS	-	40	100	
Turn-on Delay Time		ms	-	30	50	Time from instant at which Vin=Vin(min) until Vo=10% of Vo(nom)
Turn-on Rise Time		ms	-	25	50	Time for Vo to rise from 10% of Vo(nom) to 90% of Vo(nom)

Note 1: At Vin = 36V to 40V, the lower limit is 10.8 V.

Note 2: At Vin= 36V to 40V the typical value is 0.6 V.

Protection Characteristics

Parameter		Units	Specifications			Notes & conditions
			Min.	Typ.	Max.	
Input Under Voltage Lockout	Turn-off Threshold	Vdc	30	-	33	
	Turn-on Threshold	Vdc	31	-	34	
	Hysteresis	Vdc	0.5	-	3	
Output Over Voltage Protection		Vdc	13.4	14.5	15.6	Under the converter's maximum allowable output power
Output Over Current Protection		A	37	42	52	Hiccup Mode Automatic recovery
Short Circuit Protection		Hour	4	-	-	Hiccup Mode Automatic recovery

Over temperature Protection	℃	105	115	125	Automatic recovery See OTP section
Over temperature Protection Hysteresis	℃	2	5	15	

General Specifications

Parameter	Units	Specifications			Notes & conditions
		Min.	Typ.	Max.	
Efficiency	%	93	95	-	50% load,48Vin
		92.5	94.5	-	100% load,48Vin
Switching Frequency	KHz	120	150	200	
MTBF	Mhours	5.5			Telcordia SR-332 Issue4, 2016, 40℃
FIT		182			10^9/MTBF
Thermal Stability Time	min	-	30	-	
Weight	g	61	66	71	
Safety	Compliant to IEC60950-1 & IEC62368-1, UL62368-1, EN62368-1 and GB4943				
Vibration	IEC60068-2-6:10-500Hz sweep,0.75mm excursion,10g acceleration,10minutes in each 3 perpendicular directions				
Transportation	ETS300019-1-2				
Shock	IEC60068-2-27:200g acceleration, duration 3 ms,6 drops in each 3 perpendicular directions				

Isolation Specifications

Parameter		Units	Specifications			Notes & conditions
			Min.	Typ.	Max.	
Isolation Voltage	Input-Output	Vdc	1500			Test duration 1 minute, Leak current less than 10mA, no arcing or breakdown
	Input-Heatsink	Vdc	1050			Test duration 1 minute, leak current less than 10mA,no arcing or breakdown
	Output-Heatsink	Vdc	500			Test duration 1 minute, leak current less than 10mA,no arcing or breakdown

Isolation Resistance	MΩ	100	-	-	Normal air pressure, 500Vdc, the isolation resistance is no less than 100MΩ
Isolation Capacitance	pF	-	4400	-	

Characteristic Curves

Efficiency

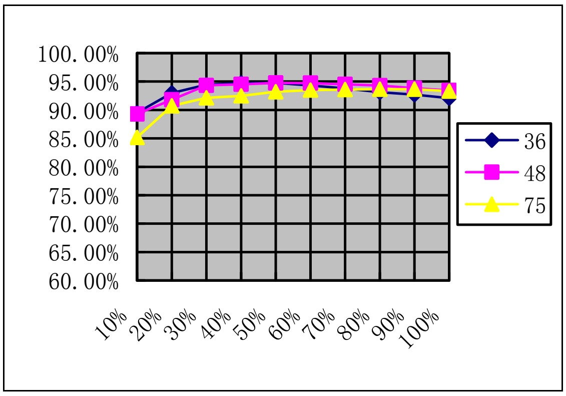


Figure1. Converter Efficiency Vs. Output Current @25℃

Derating

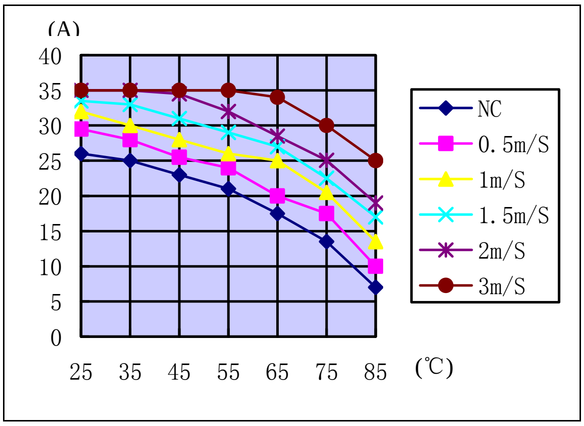


Figure2. Available load current Vs. ambient temperature and airflow for the module mounted horizontally, 48Vin

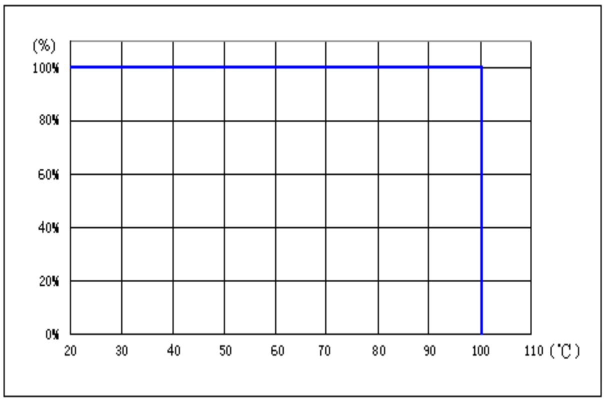
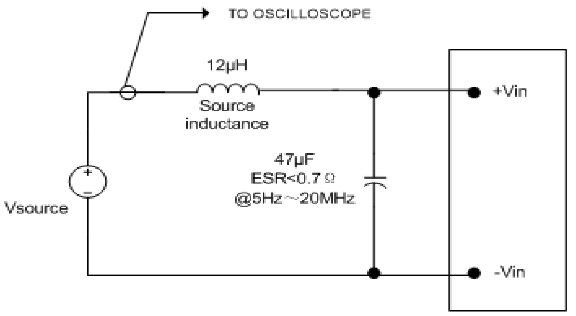


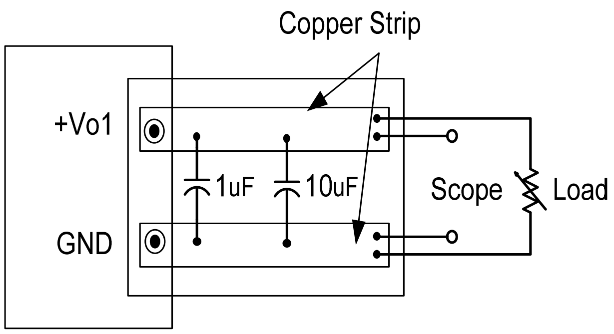
Figure3. Output power derating curve, load current Vs. baseplate temperature, 48Vin

Test Configurations



Note: Measure input reflected ripple current with a simulated source inductance of 12μH. The measurement points for input reflected ripple current is showed above.

Figure4. Input Reflected Ripple Current Test Setup



Note: Scope measurements should be made using a BNC socket, with a 1μF ceramic capacitor and a 10 μF tantalum capacitor. Position the oscilloscope between 51mm and 76mm (2 inch and 3 inch) from the module.

Figure5. Output Ripple and Noise Test Setup

Design Considerations

Input filtering

The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module. For the test configuration in Figure4 a 47μF electrolytic capacitor (ESR< 0.7Ω at 5Hz to 20MHz), mounted close to the power module helps ensure stability of the unit.

Safety Considerations

For safety-agency approval of the system in which the power module is used, the power module must be installed in compliance with the spacing and separation requirements of the end-use safety agency standard, i.e. CAN/CSA-C22.2, No. 60950-1 and IEC60950-1, and also compliance with UL62368-1, CAN/CSA C22.2 No. 62368-1-14, EN62368-1 and IEC62368-1, if the system in which the power module is to be used must meet safety agency requirements.

For all input voltages, other than DC mains, where the input voltage is less than .60V dc, if the input meets all of the requirements for SELV, the output is considered to remain with SELV limits. Signal component failure and fault tests were performed in the power converters.

If the input source is non-SELV (ELV or hazardous voltage greater than 60 Vdc and less than or equal to75Vdc), for the module's output to be considered as meeting the requirements for safety extra-low voltage (SELV), all of the following must be true.

- The input source is to be provided with reinforced insulation from any other hazardous voltage, including the AC mains.
- One V_{IN} pin and one V_{OUT} pin are to be grounded, or both the input and output pins are to be kept floating.
- The input pins of the module are not operator accessible.
- Another SELV reliability test is conducted on the whole system as required by the safety agencies, to verify that under a single fault, hazardous voltages do not appear at the module's output.

All flammable materials used in the manufacturing of these modules are rated 94V-0.

To preserve maximum flexibility, internal fusing is not included, however, to achieve maximum safety and system protection, always use an input line fuse. The safety agencies require a time delay fuse with a maximum rating of 20A. Based on the information provided in this data sheet on inrush energy and maximum dc input current, the same type of fuse with a lower rating can be used. Refer to the fuse manufacturer's data sheet for further information.

Feature Descriptions

Output Characteristics

The output trim-up voltage is linearly changed follow with change of input voltage. The output trim-up voltage keeps 13.2V when input voltage range is from 43Vdc to 75Vdc.
See figure 6.

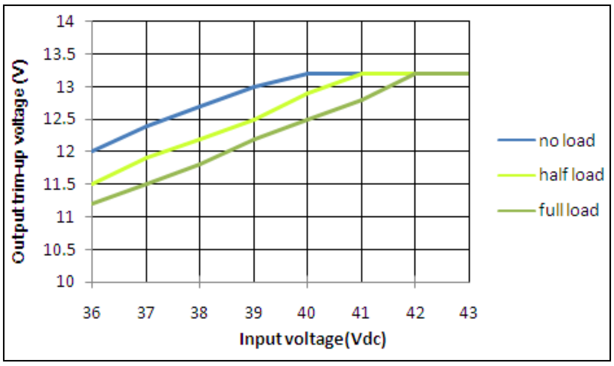


Figure 6 Output trim-up voltage vs. load current and input voltage at TP1 = +25°C.

The output voltage is linearly changed follow with change of input voltage and load current. The output voltage keeps 12V when input voltage range is from 40Vdc to 75Vdc.

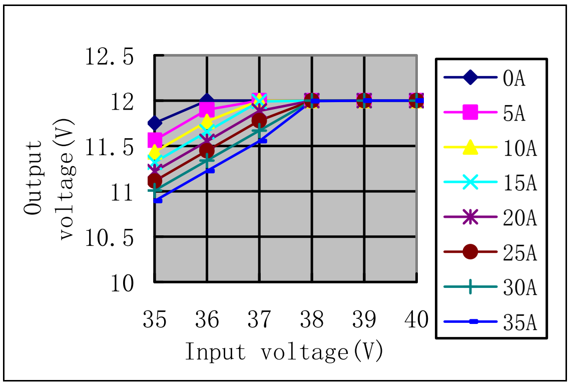


Figure 7 Output voltage vs. load current and input voltage at TP1 = +25°C.

Remote On/Off

The REM pin is used to turn the power converter remote on or off via a system signal. Two remote on/off logic are available. Negative logic turns the module on when the REM pin is at logic low and off when it is at logic high. Positive logic turns the module on during logic high and off during logic low.

To turn the power module on and off, the user must supply a switch to control the voltage between the REM pin and -Vin terminal (see Figure 8). A logic low is V_{REM} = 0 to 1.2 V. During logic high, the maximum V_{REM} voltage generated by the power module is 20V.

If not using the remote on/off feature, perform one of the following to turn the converter on:
For negative logic, short REM pin to -Vin.
For positive logic, leave REM pin open.

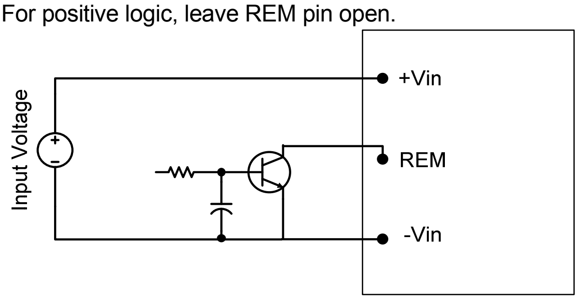


Figure 8 Remote On/Off Implementation

Remote Sense

Remote sense minimizes the effects of distribution losses by regulating the voltage at the remote sense connections (see Figure 9. The voltage between the remote sense pins and the output terminals must not exceed the output voltage sense range (≤5% Vo(nom)). The voltage between the $+V_O1$ and GND terminals must not exceed the minimum output over voltage protection value shown in the Electrical Specifications table. This limit includes any increase in voltage due to remote sense compensation and output voltage programming (trim). If not using the remote sense feature to regulate the output at the point of load, then connect +S to $+V_O1$ and -S to GND.

Although the output voltage can be increased by both the remote sense and by the trim, the maximum increase for the output voltage is not the sum of both. The maximum increase is the larger of either the remote sense or the trim. The amount of power delivered by the module is defined as the voltage at the output terminals multiplied by the output current. When using remote sense and trim, the output voltage of the module can be increased, at the same time output current would increase the power output of the module. Care should be taken to ensure that the maximum output power of the module remains at or below the maximum rated power.

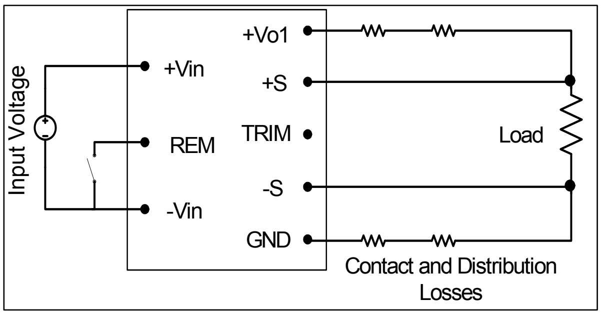


Figure9 Circuit Configuration for Remote Sense

Output Voltage Programming

Output voltage trim allows the user to increase or decrease the output voltage set point of a module. This is accomplished by connecting an external resistor between the TRIM pin and either the +S or -S pins. If not using the trim feature, leave the TRIM pin open.

To increase the output voltage, refer to Figure 10, a trim resistor, R_{trimup} is connected between the TRIM and +S.

$$R_{Trimup} = \left(\frac{V_{out}\times 5.11(1+\Delta\%)}{1.225\Delta\%} - \frac{5.11}{\Delta\%} - 10.22\right)k\Omega$$

R_{trimup} = Required value of trim-up resistor [kΩ]

$$\Delta\% = \left|\frac{V_{trimup} - V_{OUT}}{V_{OUT}} \times 100\ \%\right|$$

V_{OUT} = Nominal value of output voltage [V]

V_{trimup} = Desired (trimmed) output voltage [V].

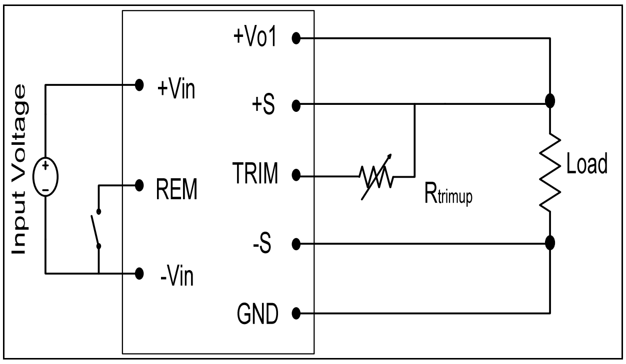


Figure10. Circuit Configuration to Increase Output Voltage.

Trimming beyond 110% of the rated output voltage is not an acceptable design practice, as this condition could cause unwanted triggering of the output over voltage protection (OVP) circuit. When trimming up, care must be taken not to exceed the converter's maximum allowable output power.

Trim-up resistor should not be less than 150kΩ, and trim pin voltage should not be higher than 5V.

To decrease the output voltage (see Figure.11), a trim resistor, $R_{trimdown}$, should be connected between the TRIM and -S, with a value of

$$R_{Trimdown} = \left(\frac{5.11}{\Delta\%} - 10.22\right)k\Omega$$

$R_{trimdown}$ = Required value of trim-down resistor [kΩ]

$$\Delta\% = \left|\frac{V_{trimdown} - V_{OUT}}{V_{OUT}} \times 100\ \%\right|$$

V_{OUT} = Nominal value of output voltage [V]

$V_{trimdown}$ = Desired (trimmed) output voltage [V].

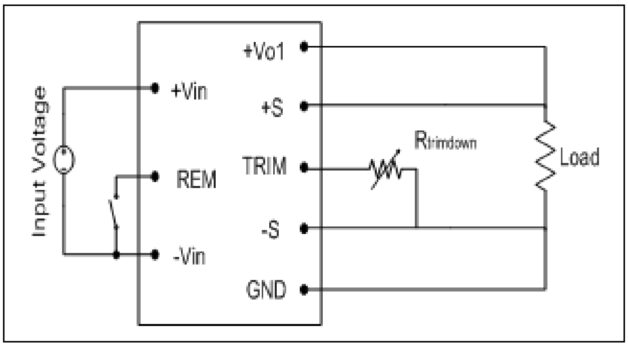


Figure11. Circuit Configuration to Decrease Output Voltage

Protection Features

Over Current Protection

To provide protection in an output overload fault condition, the module is equipped with internal current limiting circuitry, and can endure current limiting continuously.

At the point of current limit inception, the unit enters hiccup mode. The unit is configured with the auto-restart function, it will remain in the hiccup mode as long as the over current condition exists; it operates normally once the output current is reduced back into its specified range.

Output Over Voltage Protection

The output overvoltage protection consists of circuitry that monitors the voltage on the output terminals. When the output voltage exceeds the overvoltage protection threshold, the converter will operate in a hiccup mode until the overvoltage cause is cleared.

Over Temperature Protection

To provide protection under certain fault conditions, the module is equipped with a thermal shutdown circuit. The module will shutdown when the Tref temperature exceeds OTP set value, but the thermal shutdown is not intended as a guarantee that the module will survive when the temperatures beyond its rating. The module will automatically restarts after it cools down.

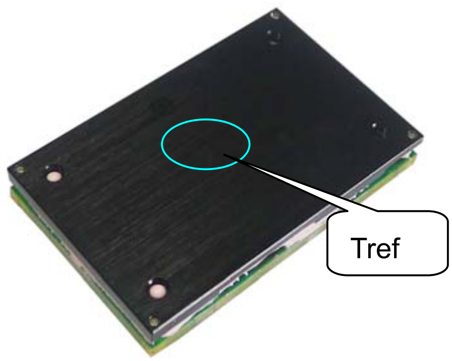


Figure 12 Tref Temperature Measurement Location

Input Under Voltage Lockout

Input under voltage lockout is standard with this converter, when input voltages below the input under voltage lockout limit, the module operation is disabled. It will only begin to operate once the input voltage is raised above the under voltage lockout turn-on threshold.

Thermal Considerations

The power modules operate in a variety of thermal environments; however, sufficient cooling should be provided to help ensure reliable operation of the unit.
Considerations include ambient temperature, airflow, module power dissipation, and the need for increased reliability. A reduction in the operating temperature of the module will result in an increase in reliability.

Heat Transfer via Convection

Increasing airflow over the module enhances the heat transfer via convection. Derating Figure showing the maximum output current that can be delivered by module versus local ambient temperature for natural convection.

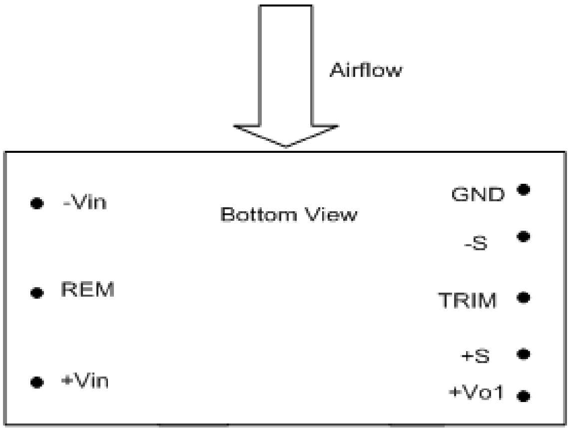


Figure13. Recommended Airflow Direction

Soldering Information （Wave Soldering）

The product is intended for through-hole mounting in a PCB. When wave soldering is used, the temperature on the pins is specified to maximum 270 °C for maximum 10 seconds.

Maximum preheat rate of 4 °C/s and temperature of max 150 °C is suggested, when hands soldering care should be taken to avoid direct contact between the hot soldering iron tip and the pins for more than a few seconds in order to prevent overheating.

A no-clean (NC) flux is recommended to avoid entrapment of cleaning fluids in cavities inside of the DC/DC power module. The residues may affect long time reliability and isolation voltage.

Soldering Information （PIP soldering）

PIP(Pin in Paste)Soldering Information

These power modules are large mass, low thermal resistance devices and typically heat up slower than other SMT components. It is recommended that the customer review data sheets in order to customize the solder reflow

profile for each application board assembly.
The following instructions must be observed when PIP soldering these units. Failure to observe these instructions may result in the failure of or cause damage to the modules, and can adversely affect long-term reliability.

Typically, the eutectic solder melts at 217℃, wets the land, and subsequently wicks the device connection. Sufficient time must be allowed to fuse the plating on the connection to ensure a reliable solder joint. There are several types of SMT reflow technologies currently used in the industry. These surface mount power modules can be reliably soldered using natural forced convection. For reliable soldering the solder reflow profile should be established by accurately measuring the modules pin connector temperatures.

Lead-free (Pb-free) solder processes

For Pb-free solder processes, a pin temperature (T_{PIN}) in excess of the solder melting temperature (T_L, +217 to +221°C for Sn/Ag/Cu solder alloys) for more than 30 seconds, and a peak temperature of +235°C on all solder joints is recommended to ensure a reliable solder joint.

For Pb-free solder processes, the product is qualified for MSL 3 according to IPC/JEDEC standard J-STD-020C. During reflow, T_P must not exceed +245°C at any time.

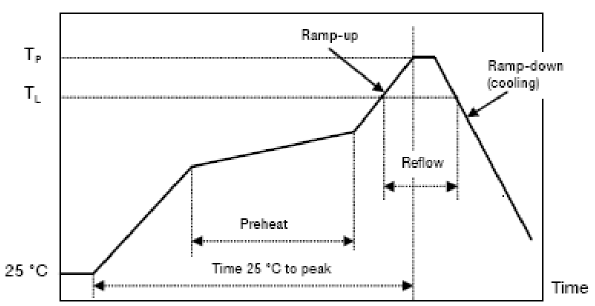


Figure14. Recommended reflow profile.

Reflow process specifications		**Pb-free**
Average ramp-up rate		3°C/s max
Solder melting temperature (lim)	T_L	+217°C
Time above T_L		30 s~90s
Minimum pin temperature	T_{pin}	+235°C
Peak product temperature	T_p	+245°C
Average ramp-down rate		6°C/s max
Time 25°C to peak		6 minutes max

Electromagnetic Compatibility (EMC)

The Figure 15 shows a suggested configuration to meet the conducted emission limits of EN55032 Class B.

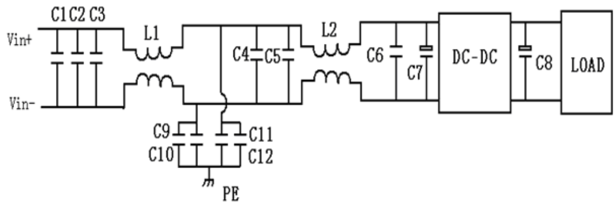


Figure15. Recommended EMC application

Component	Specifications
C1 C2 C3 C4 C5	SMD ceramic capacitor-1uF
C6	SMD ceramic capacitor-0.1uF
L1 L2	Magnetic material-473uH-+-25%
C9 C10 C11 C12	High dielectric strength surface attached safety capacitor-0.22uF/630V
C7	Electrolytic capacitor-100uF
C8	Electrolytic capacitor-470uF

Outline Diagram

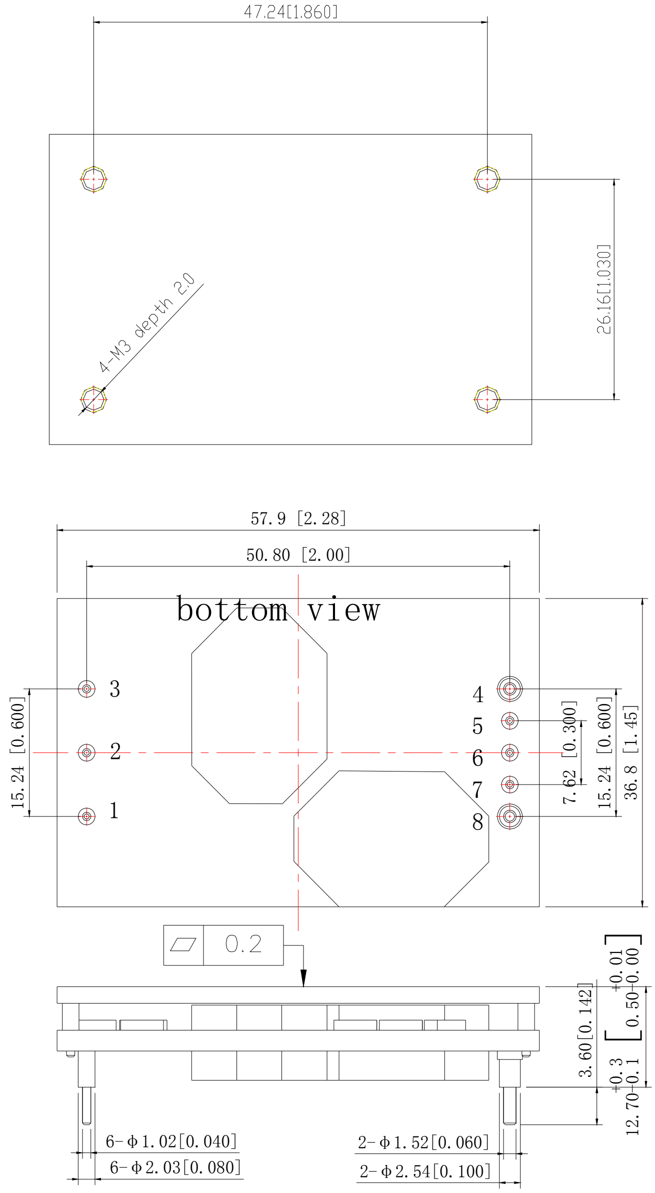


Figure16. Outline Diagram

Dimensions are in millimeters and (inches).

Tolerances: x.x mm ± 0.5 mm (x.xx in. ± 0.02 in.) [unless otherwise indicated]

x.xx mm ± 0.25 mm (x.xxx in. ± 0.010 in)

Pin Designations

Pin No.	Symbol	Function
1	+Vin	Positive input voltage
2	REM	Remote control
3	-Vin	Negative input voltage
4	GND	Negative output voltage
5	-S	Negative remote compensate
6	Trim	Adjustable output voltage
7	+S	Positive remote compensate
8	Vo1	Positive output voltage

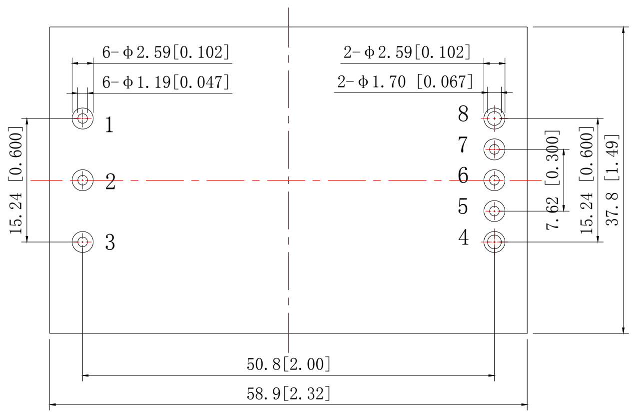


Figure17. Recommended Pad Layout

Dimensions are in millimeters and (inches).

Tolerances: x.x mm ± 0.5 mm (x.xx in. ± 0.02 in.) [unless otherwise indicated]

x.xx mm ± 0.25 mm (x.xxx in. ± 0.010 in)

Packaging Details

The modules are supplied in tape & reel or in trays as an option. Dimensions are in millimeters.

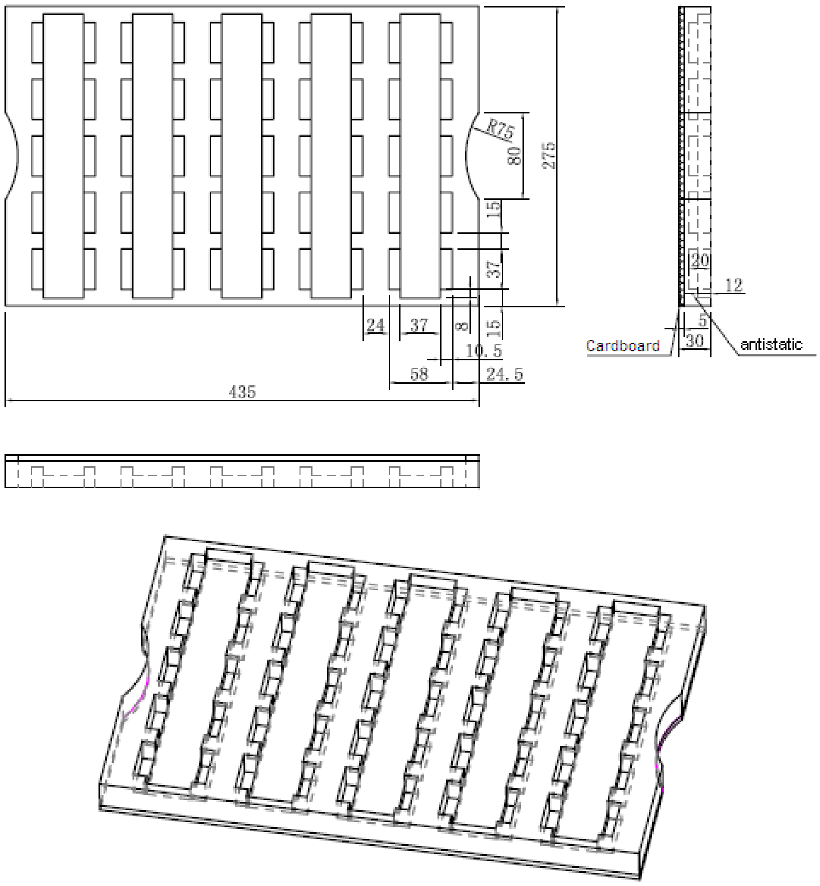


Figure 18. Packaging Tray Diagram

Tray Specifications

Material	PPE ,antistatic
Surface resistance	<10^{10}Ohm
Bakability	The trays can be baked at maximum125℃ for 48 hours maximum
Tray capacity	25 products/tray
Box capacity	125 products 5 full trays/box