KBVW006A0B Series (Sixteenth-Brick) DC-DC Converter Power Modules

36–75V_{dc} Input; 12.0V_{dc} Output; 6A Output Current

BARRACUDA* SERIES
RoHS Compliant



Description

The OmniOn Power™ KBVW006A0B, Sixteenth-brick low-height power module is an isolated dc-dc converters that can deliver up to 6A of output current and provide a precisely regulated output voltage of 12.0V over a wide range of input voltages (V_{IN} = 36 -75V_{dc}). The modules achieve typical full load efficiency of 91%. The open frame modules construction, available in both surface-mount and through-hole packaging, enable designers to develop cost and space efficient solutions.

Applications

- Distributed Power Architectures
- Wireless Networks
- Access and Optical Network Equipment
- Industrial Equipment

Options

- Negative Remote On/Off logic (preferred)
- Over current/Over temperature/Over voltage protections (Auto-restart) (preferred)
- Surface Mount version (-S)
- Heat Plate version (-H)
- For additional options, see Table 2 (Device Options) under “Ordering Information” section.

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Features

- Wide input voltage range: 36-75 V_{dc}
- Monotonic startup into prebiased load
- Output Voltage adjust: 80% to 110% of $V_{o, nom}$
- Remote sense
- Constant switching frequency
- Positive remote On/Off logic
- Input under/over voltage protection
- Output overcurrent and overvoltage protection
- Over-temperature protection
- Industry standard, DOSA compliant footprint 33.0 mm x 22.9 mm x 9.3 mm (1.30 x 0.90 x 0.366 in)
- Low profile height and reduced component skyline
- High efficiency: 91.0%
- Wide operating temperature range (-40°C to 85°C)
- Compliant to RoHS Directive 2011/65/EU and amended Directive (EU) 2015/863 (-Z versions)
- Compliant to REACH Directive (EC) No 1907/2006
- Compliant to IPC-9592A (May 2010), Category 2, Class II
- ANSI/UL# 62368-1 and CAN/CSA† C22.2 No. 62368-1 Recognized, DIN VDE‡ 0868-1/A11:2017 (EN62368-1:2014/A11:2017
- CE mark meets 2014/35/EU directive§
- Meets the voltage and current requirements for ETSI 300- 132-2 and complies with and licensed for Basic insulation rating
- 2250 V_{dc} Isolation tested in compliance with IEEE 802.3¤ PoE standards
- ISO**9001 and ISO 14001 certified manufacturing facilities

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UL is a registered trademark of Underwriters Laboratories, Inc.

† CSA is a registered trademark of Canadian Standards Association.

‡ VDE is a trademark of Verband Deutscher Elektrotechniker e.V.

§ This product is intended for integration into end-user equipment. All of the required procedures of end-use equipment should be followed.

¤ IEEE and 802 are registered trademarks of the Institute of Electrical and Electronics Engineers, Incorporated.

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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	Device	Symbol	Min	Max	Unit
Input Voltage					
Continuous	All	V_{IN}	-0.3	80	V_{dc}
Transient Operational (≤ 100ms)	All	$V_{IN, trans}$	-0.3	100	V_{dc}
Operating Ambient Temperature (see Thermal Considerations section)	All	T_A	-40	85	°C
Storage Temperature	All	T_{stg}	-55	125	°C
I/O Isolation Voltage (100% factory Hi-Pot tested)	All	-	-	2250	V_{dc}

Electrical Specifications

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

Parameter	Device	Symbol	Min	Typ	Max	Unit
Operating Input Voltage	All	V_{IN}	36	48	75	V_{dc}
Maximum Input Current (V_{IN}= $V_{IN, min}$ to $V_{IN, max}$, I_O=$I_{O, max}$)	All	$I_{IN, Max}$			2.8	A_{dc}
Input No Load Current (V_{IN} = 48V, (I_O = 0, module enabled)	All	$I_{IN,No load}$		45		mA
Input Stand-by Current (V_{IN} = 48V, module disabled)	All	$I_{IN,stand-by}$		8	10	mA
Inrush Transient	All	I^2t			0.5	A^2s
Input Reflected Ripple Current, peak-to-peak (5Hz to 20MHz, 12µH source impedance; $V_{IN,min}$ to $V_{IN,mix}$; I_o= $I_{o, max}$; see Test configuration section)	All			30		mA_{p-p}
Input Ripple Rejection (120Hz)	All			50		dB

CAUTION: This power module is not internally fused. An input line fuse must always be used.

This power module can be used in a wide variety of applications, ranging from simple standalone operation to being part of complex power architecture. 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 fast-acting fuse with a maximum rating of 5A (see Safety Considerations section). 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.

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Electrical Specifications (continued)

Parameter	Device	Symbol	Min	Typ	Max	Unit
Nominal Output Voltage Set-point (V_{IN}= 48V I_O=$I_{O,max}$, T_A=25°C)	All	$V_{O,set}$	11.67	12.0	12.25	V_{dc}
Output Voltage (Over all operating input voltage, resistive load, and temperature conditions until end of life)	All	V_O	11.46	-	12.36	V_{dc}
Output Regulation						
Line (V_{IN}=$V_{IN,min}$ to $V_{IN,max}$)	All		-	-	±0.2	% $V_{O,set}$
Load (I_O=$I_{O,min}$ to $I_{O,max}$)	All		-	-	±0.2	% $V_{O,set}$
Temperature (T_{ref}=T_A, min to $T_{A,max}$)	All		-	-	±1.0	% $V_{O,set}$
Output Ripple and Noise (C_o=1uF,ceramic+10µF,tantalum V_{IN}=$V_{IN,min}$ to $V_{IN,max}$, I_O= $I_{O,max}$, T_A=$T_{A,min}$ to $T_{A,max}$)						
RMS (5Hz to 20MHz bandwidth)	All		-	40	-	mV_{rms}
Peak-to-Peak (5Hz to 20MHz bandwidth)	All		-	120	-	mV_{pk-pk}
External Capacitance[1]	All	$C_{O,max}$	0	-	2,000	µF
Output Current	All	I_O	0	-	6	A_{dc}
Output Current Limit Inception (Hiccup Mode) (V_O= 90% of $V_{O,set}$)	All	$I_{O,lim}$	105	120	140	% I_O
Output Short-Circuit Current (V_O≤ 250mV) (Hiccup Mode)	All	$I_{O,s/c}$		2.5		A_{rms}
Efficiency V_{IN}=48V, T_A=25°C, I_O=$I_{o,max}$, V_O = $V_{O,set}$	All	η		91.0		%
Switching Frequency	All	f_{sw}		350		kHz
Dynamic Load Response (C_o=1uF,ceramic+10µF, tantalum, dI_o/dt=0.1A/µs; V_{IN} = 48V; T_A=25°C) Load Change from I_o= 50% to 75% or 25% to 50% of $I_{o,max}$						
Peak Deviation		V_{pk}	-	360	-	mV
Settling Time (V_O<10% peak deviation)	All	ts	-	200	-	µs

[1] See Note 2 under Feature Specifications.

Isolation Specifications

Parameter	Device	Symbol	Min	Typ	Max	Unit
Isolation Capacitance	All	C_{iso}	-	1000	-	pF
Isolation Resistance	All	R_{iso}	10	-	-	MΩ
I/O Isolation Voltage (100% factory Hi-pot tested)	All	All	-	-	2250	V_{dc}

General Specifications

Parameter	Device	Symbol	Min	Typ	Max	Unit
Calculated Reliability based upon Telcordia SR-332 Issue 2: Method I Case 3 (I_O=80%x$I_{O,max}$, T_A=40°C, airflow = 200 lfm, 90% confidence)	All	FIT		89.8		10^9/Hours
	All	MTBF		11,133,281		Hours
Weight (Open Frame)	All			13(0.46)		g (oz.)
Weight (with Heatplate)	All			21(0.74)		g (oz.)

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Feature Specifications

Unless otherwise indicated, specifications apply over all operating input voltage, resistive load, and temperature conditions. See Feature Descriptions for additional information.

Parameter	Device	Symbol	Min	Typ	Max	Unit
Remote On/Off Signal Interface (V_{IN}=$V_{IN,\ min}$ to $V_{IN,\ max}$; open collector or equivalent, Signal referenced to V_{IN}- terminal) Negative Logic: device code suffix "1" Logic Low = module On, Logic High = module Off Positive Logic: No device code suffix required Logic Low = module Off, Logic High = module On						
Logic Low - Remote On/Off Current	All	$I_{on/off}$	-	-	0.15	mA
Logic Low - On/Off Voltage	All	$V_{on/off}$	-0.7	-	0.6	V_{dc}
Logic High Voltage (Typ=Open Collector)	All	$V_{on/off}$	2.4	-	15	V_{dc}
Logic High maximum allowable leakage current	All	$I_{on/off}$	-	-	25	µA
Turn-On Delay and Rise Times (I_O=$I_{O,\ max}$, V_{IN}=$V_{IN,\ nom}$, T_A = 25°C)						
Case 1: Input power is applied for at least 1second, and then the On/Off input is set from OFF to ON (T_{delay} = on/off pin transition until V_O = 10% of $V_{O,\ set}$)	All	T_{delay}	-	20	-	msec
Case 2: On/Off input is set to Module ON, and then input power isapplied (T_{delay} = V_{IN} reaches $V_{IN,\ min}$ until V_O = 10% of $V_{O,\ set}$)	All	T_{delay}	-	-	150	msec
Output voltage Rise time (time for Vo to rise from 10% of $V_{O,\ set}$ to 90% of $V_{O,\ set}$)	All	T_{rise}	-	5	12	msec
Output Voltage Overshoot - Startup I_O=$I_{O,\ max}$, V_{IN}=$V_{IN,\ min}$ to $V_{IN,\ max}$, T_A=25°C	All			-	3	% $V_{o,\ set}$
Prebiased Output Load Performance: Output Start up characteristic	All	Monotonic				
Back Bias current drawn from output (Module Enabled)	All			-50		mA_{dc}
Back Bias current drawn from output (Module Disabled)	All			-50		mA_{dc}
Remote Sense Range	All	V_{SENSE}			10	% $V_{o,\ set}$
Output Voltage Adjustment Range	All		80		110	% $V_{o,\ set}$
Output Overvoltage Protection	All	$V_{o,limt}$	13.8	-	16.5	V_{dc}
Overtemperature Protection – Hiccup Auto Restart	All	T_{ref}	-	135	-	°c
Input Undervoltage Lockout Turn-on Threshold Turn-off Threshold Hysterisis	All	V_{UVLO}	 - 27.5 1	 32 30 2	 34.5 - -	 V_{dc} V_{dc} V_{dc}

1. The module has an adaptable extended Turn-On Delay interval, T_{delay}, of 25mS. The extended T_{delay} will occur when the module restarts following either: 1) the rapid cycling of Vin from normal levels to less than the Input Undervoltage Lockout (which causes module shutdown), and then back to normal; or 2) toggling the on/off signal from on to off and back to on without removing the input voltage. The normal Turn-On Delay interval, T_{delay}, will occur whenever a module restarts with input voltage removed from the module for the preceding 1 second.
2. The module requires a minimum of 220 µF external output capacitor to prevent shutdown during no load to full load transients and to avoid exceeding the OVP maximum limits during startup into open loop fault conditions.

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Characteristic Curves

The following figures provide typical characteristics for the module at 25°C. The figures are identical for either positive or negative remote On/Off logic.

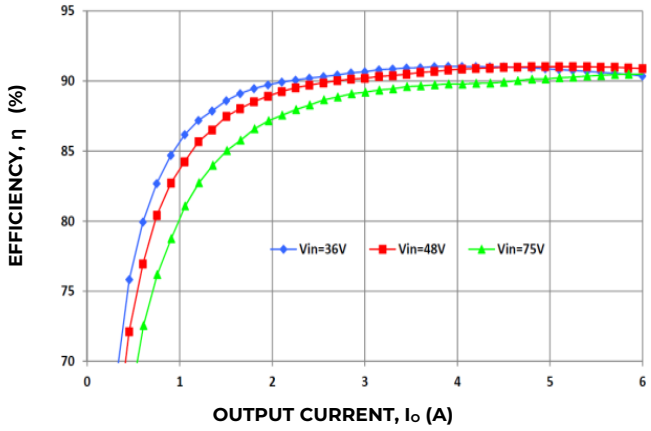


Figure 1. Converter Efficiency versus Output Current.

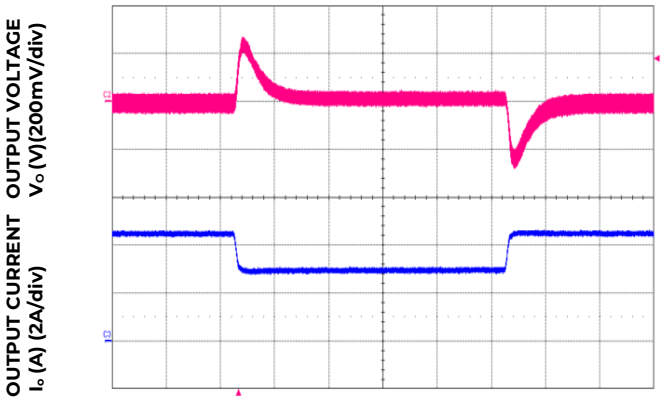


Figure 4. Transient Response to 0.1A/µS Dynamic Load Change from 50% to 75% to 50% of full load, Vin=48V

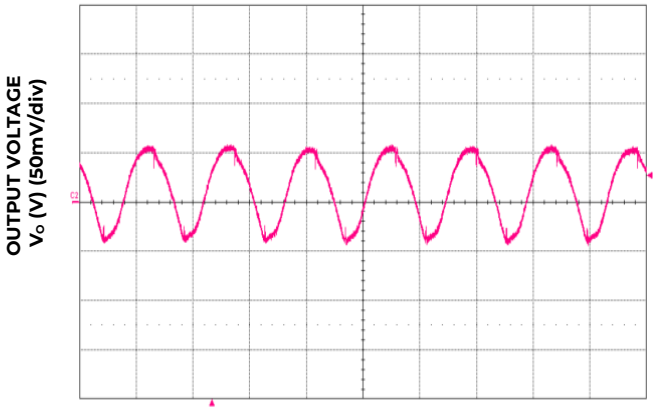


Figure 2.Typical output ripple and noise ($I_o = I_{o,max}$).

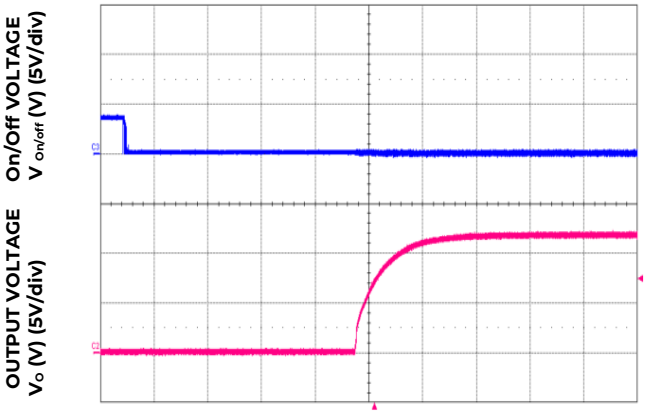


Figure 5. Typical Start-up Using Remote On/Off, negative logic version shown (V_{IN} = 48V, $I_o = I_{o,max}$).

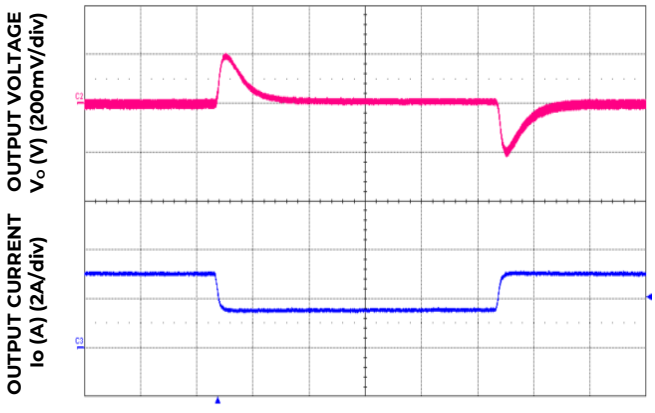


Figure 3. Transient Response to 0.1A/µS Dynamic Load Change from 25% to 50% to 25% of full load, V_{in}=48V

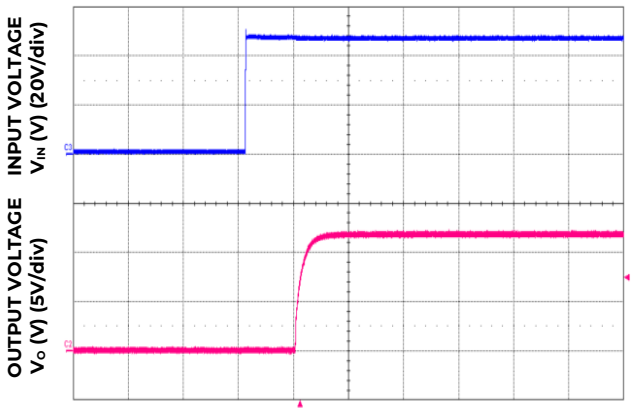


Figure 6. Typical Start-up Using Input Voltage (V_{IN} = 48V, $I_o = I_{o,max}$).

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Test Configurations

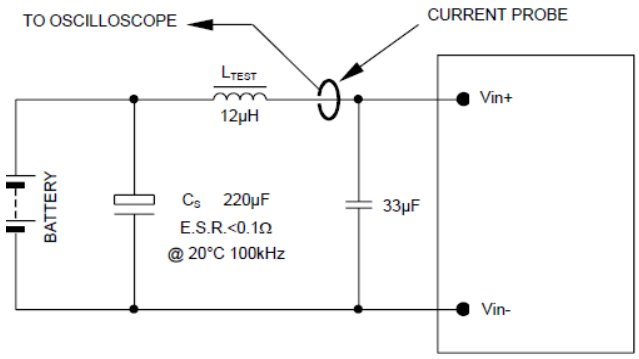


Figure 7. Input Reflected Ripple Current Test Setup.

NOTE: Measure input reflected ripple current with a simulated source inductance (L_{TEST}) of 12µH. Capacitor C_S offsets possible battery impedance. Measure current as shown above.

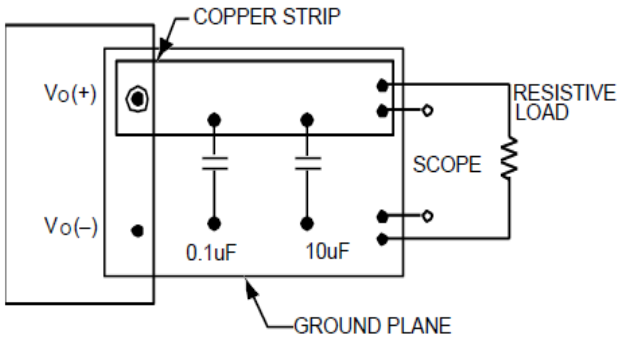


Figure 8. Output Ripple and Noise Test Setup.

NOTE: All voltage measurements to be taken at the module terminals, as shown above. If sockets are used then Kelvin connections are required at the module terminals to avoid measurement errors due to socket contact resistance.

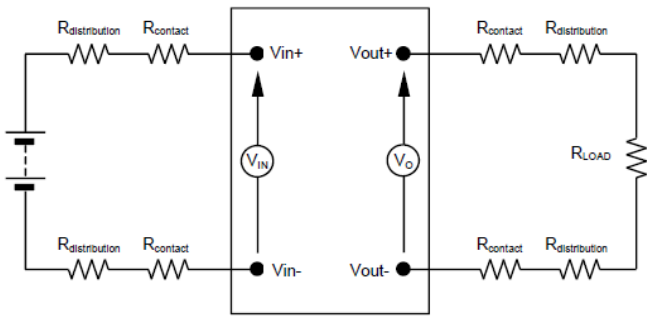


Figure 9. Output Voltage and Efficiency Test Setup.

NOTE: All voltage measurements to be taken at the module terminals, as shown above. If sockets are used then Kelvin connections are required at the module terminals to avoid measurement errors due to socket contact resistance.

$$\text{Effieiency } \eta = \left[\frac{V_o . I_o}{V_{IN} . I_{IN}} X\ 100 \right] K\Omega$$

Design Considerations

Input Filtering

The power module should be connected to a low ac-impedance source. Highly inductive source impedance can affect the stability of the power module. For the test configuration in Figure 7, a 33µF electrolytic capacitor (ESR<0.7Ω at 100kHz), mounted close to the power module helps ensure the stability of the unit. Consult the factory for further application guidelines.

Safety Considerations

For safety agency approval the power module must be installed in compliance with the spacing and separation requirements of the end-use safety agency standards, i.e., UL ANSI/UL* 62368-1 and CAN/CSA+ C22.2 No. 62368-1 Recognized, DIN VDE 0868- 1/ A11:2017 (EN62368-1:2014/A11:2017)

If the input source is non-SELV (ELV or a hazardous voltage greater than 60 V_{dc} and less than or equal to 75V_{dc}), for the module's output to be considered as meeting the requirements for safety extra-low voltage (SELV) or ES1, all of the following must be true:

- The input source is to be provided with reinforced insulation from any other hazardous voltages, including the ac mains.
- One VI_N 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 or ES1 reliability test is conducted on the whole system (combination of supply source and subject module), as required by the safety agencies, to verify that under a single fault, hazardous voltages do not appear at the module's output.

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Safety Considerations (continued)

Note: Do not ground either of the input pins of the module without grounding one of the output pins.

This may allow a non-SELV/ES1 voltage to appear between the output pins and ground.

All flammable materials used in the manufacturing of these modules are rated 94V-0, or tested to the UL60950 A.2 for reduced thickness.

The power module has safety extra-low voltage (SELV) or ES1outputs when all inputs are SELV or ES1.

For input voltages exceeding –60 V_{dc} but less than or equal to –75 V_{dc}, these converters have been evaluated to the applicable requirements of BASIC INSULATION between secondary DC MAINS DISTRIBUTION input (classified as TNV-2 in Europe) and unearthed SELV outputs.

The input to these units is to be provided with a maximum 5A Fast– acting fuse in the ungrounded lead.

Feature Descriptions

Remote On/Off

Two remote on/off options are available. Positive logic turns the module on during a logic high voltage on the ON/OFF pin, and off during a logic low. Negative logic remote On/Off, device code suffix “1”, turns the module off during a logic high and on during a logic low.

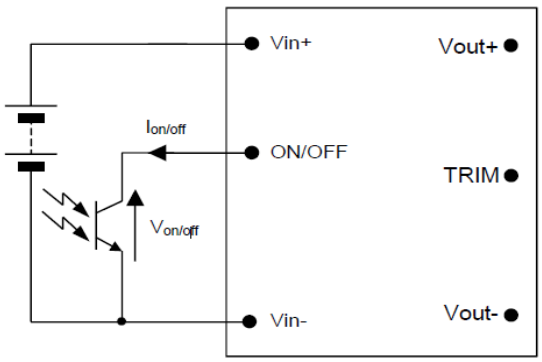


Figure 10 Remote On/Off Implementation.

To turn the power module on and off, the user must supply a switch (open collector or equivalent) to control the voltage ($V_{on/off}$) between the ON/OFF terminal and the V_{IN}(-) terminal (see Figure 10). Logic low is - 0.75V ≤ Von/off ≤ 0.6V. The maximum Ion/off during a logic ow is 0.15mA; the switch should maintain a logic low level whilst sinking this current.

During a logic high, the typical maximum Von/off generated by the module is 3.9V, and the maximum allowable leakage current at Von/off = 2.4V is 25µA.

If not using the remote on/off feature:

For positive logic, leave the ON/OFF pin open.

For negative logic, short the ON/OFF pin to V_{IN}(-).

Remote Sense

Remote sense minimizes the effects of distribution losses by regulating the voltage at the remote-sense connections (See Figure 11). The voltage between the remote-sense pins and the output terminals must not exceed the output voltage sense range given in the Feature Specifications table:

$[V_O(+) – V_O(–)] – [SENSE(+) – SENSE(–)] ≤ 0.5$ V

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, which at the same 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 (Maximum rated power = $V_{o,set}$ x $I_{o,max}$).

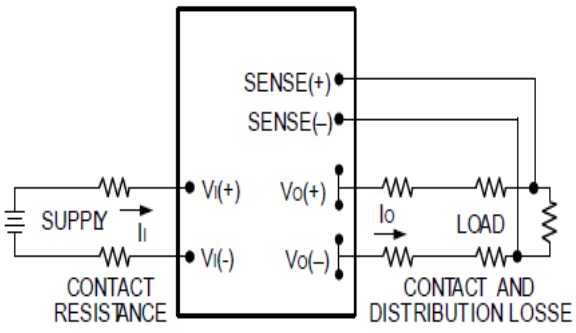


Figure 11. Circuit Configuration for remote sense .

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Input Undervoltage Lockout

At input voltages below the input undervoltage lockout limit, the module operation is disabled. The module will only begin to operate once the input voltage is raised above the undervoltage lockout turn-on threshold, $V_{UV/ON}$.

Once operating, the module continues to operate until the input voltage is taken below the undervoltage turn-off threshold, $V_{UV/OFF}$.

Overtemperature Protection

To provide protection under certain fault conditions, the unit is equipped with a thermal shutdown circuit. The unit will shutdown if the thermal reference point T_{ref} (Figure 13), exceeds 125°C (typical), but the thermal shutdown is not intended as a guarantee that the unit will survive temperatures beyond its rating. The module can be restarted by cycling the dc input power for at least one second or by toggling the remote on/off signal for at least one second. If the auto-restart option (4) is ordered, the module will automatically restart upon cool-down to a safe temperature.

Output Overvoltage Protection

The output over voltage protection scheme of the modules has an independent over voltage loop to prevent single point of failure. This protection feature latches in the event of over voltage across the output. Cycling the on/off pin or input voltage resets the latching protection feature. If the auto restart option (4) is ordered, the module will automatically restart upon an internally programmed time elapsing.

Overcurrent Protection

To provide protection in a fault (output overload) condition, the unit 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. If the unit is not configured with auto–restart, then it will latch off following the over current condition. The module can be restarted by cycling the dc input power for at least one second or by toggling the remote on/off signal for at least one second.

If the unit is configured with the auto-restart option (4), it will remain in the hiccup mode as long as the overcurrent condition exists; it operates normally, once the output current is brought back into its specified range. The average output current during hiccup is 10% $I_{O, max.}$

Pre-Bias Startup

The module starts up monotonically into pre-biased load from $0.0V_{dc}$ up to V_{out} - $0.6V_{dc}$.

Output Reverse Current with Pre-Bias Output Voltage

The module does not sink appreciable current (current flow into the module) that can compromise the reliability of the product. This condition is valid for either during startup or shutdown over the output pre-bias voltage range of $0.0V_{dc}$ up to V_{out} -$0.6V_{dc}$. The test conditions for startup or shutdown are applicable for application and removal of input voltage, V_{in} or by enabling and disabling the module via remote On/Off.

Output Voltage Programming

Trimming allows the output voltage set point to be increased or decreased from the default value; this is accomplished by connecting an external resistor between the TRIM pin and either the V_O(+) pin or the V_O(-) pin.

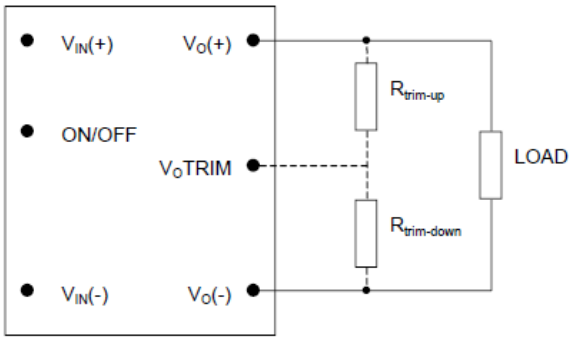


Figure 12. Circuit Configuration to Trim Output Voltage.

Connecting an external resistor ($R_{trim-down}$) between the TRIM pin and the V_O(-) (or Sense(-)) pin decreases the output voltage set point. To maintain set point accuracy, the trim resistor tolerance should be ±1.0%.

The following equation determines the required external resistor value to obtain a percentage output voltage change of Δ%

$$R_{trim\text{-}down} = \left[\frac{511}{\Delta\%} - 10.22\right] K\Omega$$

$$\text{Where, } \Delta\% = \left(\frac{V_{o,set} - V_{desired}}{V_{o,set}}\right) X\ 100$$

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Output Voltage Programming (continued)

For example, to trim-down the output voltage of the module by 8% to 11.04V, $R_{trim-down}$ is calculated as follows:

$$\Delta\% = 8$$

$$R_{trim-down} = \left[\frac{511}{8} - 10.22\right] K\Omega$$

$$R_{trim-down} = 53.655\ K\Omega$$

Connecting an external resistor ($R_{trim-up}$) between the TRIM pin and the $V_O(+)$ (or Sense (+)) pin increases the output voltage set point. The following equation determines the required external resistor value to obtain a percentage output voltage change of Δ%:

$$R_{trim-up} = \left[\frac{511 \times V_{o,set} \times (100+\Delta\%)}{1.225 \times \Delta\%} - \frac{511}{\Delta\%} - 10.22\right] K\Omega$$

Where $$\Delta\% = \left(\frac{V_{desired} - V_{o,set}}{V_{o,set}}\right) X\ 100$$

For example, to trim-up the output voltage of the module by 5% to 5.2V, $R_{trim-up}$ is calculated is as follows:

$$\Delta\% = 5$$

$$R_{trim-up} = \left[\frac{511 \times 12.0V \times (100+5\%)}{1.225 \times 5} - \frac{511}{5} - 10.22\right] K\Omega$$

$$R_{trim-down} = 938.8\ K\Omega$$

The voltage between the $V_O(+)$ and $V_O(-)$ terminals must not exceed the minimum output overvoltage protection value shown in the Feature Specifications table. This limit includes any increase in voltage due to remote-sense compensation and output voltage set-point adjustment trim.

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, which at the same 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 (Maximum rated power = $V_{O,set} \times I_{O,max}$).

Thermal Considerations

The power modules operate in a variety of thermal environments; however, sufficient cooling should be provided to help ensure reliable operation.

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. The thermal data presented here is based on physical measurements taken in a wind tunnel.

The thermal reference point, T_{ref} used in the specifications is shown in Figure 13. For reliable operation this temperature should not exceed 125°C.

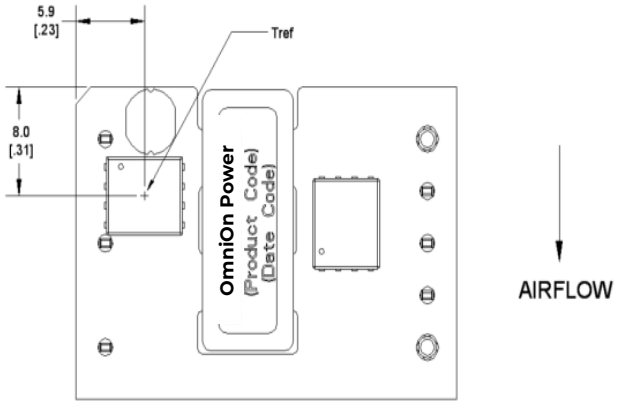


Figure 13. Tref Temperature Measurement Locations for Open Frame Module.

The thermal reference point, Tref, used in the specifications for modules with heatplate is shown in Figure 14. For reliable operation this temperature should not exceed 110°C.

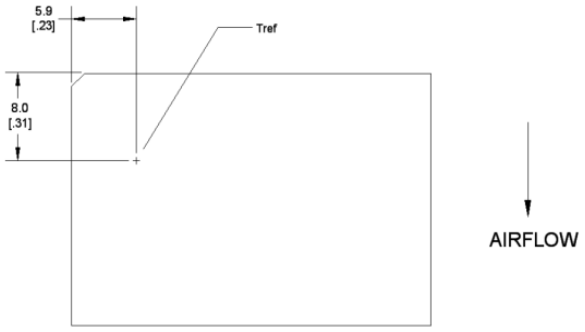


Figure 14. T_{ref} Temperature Measurement Location for Module with Heatplate.

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Heat Transfer via Convection

Increased airflow over the module enhances the heat transfer via convection. Derating curves showing the maximum output current that can be delivered by each module versus local ambient temperature (T_A) for natural convection and up to 2m/s (400 LFM) forced airflow are shown in Figures 15 & 16 a.

Please refer to the Application Note "Thermal Characterization Process For Open-Frame Board-Mounted Power Modules" for a detailed discussion of thermal aspects including maximum device temperatures.

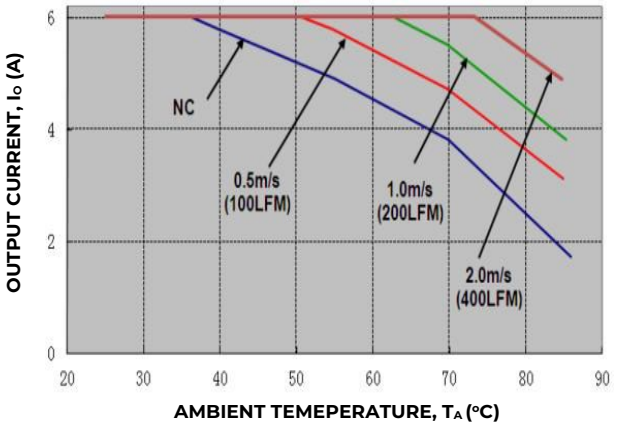


Figure 15. Output Current Derating for the Open Frame Module; Airflow in the Transverse Direction from V_{out}(+) to V_{out} (-); V_{in} =48V.

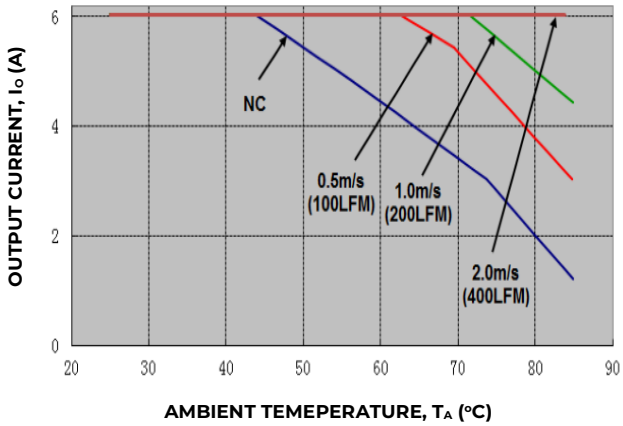


Figure 16 a. Output Current Derating for the Module with Heatplate; Airflow in the Transverse Direction from V_{out}(+) to V_{out}(-); V_{in} =48V.

Heat Sink Attachment

The heatplate used on the module does not have tapped holes for heat sink attachment. A heat sink can be attached using adhesives made for this purpose. When curing these types of adhesives, do not exceed the maximum storage temperature of 125°C.

Heat Transfer via Conduction

Modules with heat plate option (-H) can also be used in cold wall applications for heat transfer via conduction cooling. Figure 16b shows the derating curve for this application.

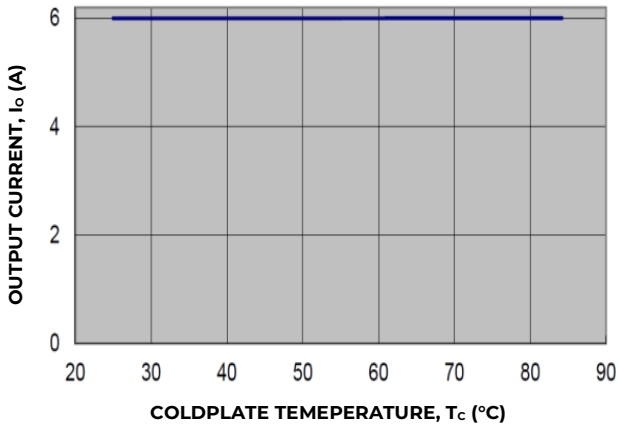


Figure 16b. Output Current Derating for the Module with Heatplate in a cold wall application; V_{in} =48V.

Surface Mount Information

Pick and Place

The modules use an open frame construction and are designed for a fully automated assembly process. The modules are fitted with a label designed to provide a large surface area for pick and place operations. The label meets all the requirements for surface mount processing, as well as safety standards, and is able to withstand reflow temperatures of up to 300°C. The label also carries product information such as product code, serial number and the location of manufacture.

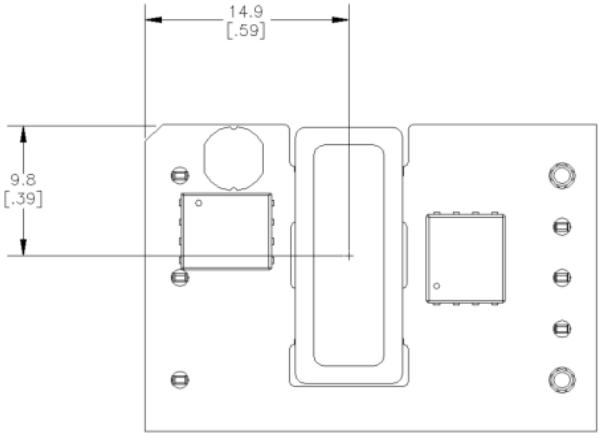


Figure 17. Pick and Place Location.

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Nozzle Recommendations

The module weight has been kept to a minimum by using open frame construction. Even so, these modules have a relatively large mass when compared to conventional SMT components. Variables such as nozzle size, tip style, vacuum pressure and placement speed should be considered to optimize this process. The minimum recommended nozzle diameter for reliable operation is 6mm. The maximum nozzle outer diameter, which will safely fit within the allowable component spacing, is 9 mm.

Oblong or oval nozzles up to 11 x 9 mm may also be used within the space available.

Tin Lead Soldering

The power modules are lead free modules and can be soldered either in a lead-free solder process or in a conventional Tin/Lead (Sn/Pb) process. 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 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.

In a conventional Tin/Lead (Sn/Pb) solder process peak reflow temperatures are limited to less than 235°C (see Figs 18 and 19). Typically, the eutectic solder melts at 183°C, 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, IR (radiant infrared), or a combination of convection/IR. For reliable soldering the solder reflow profile should be established by accurately measuring the modules CP connector temperatures.

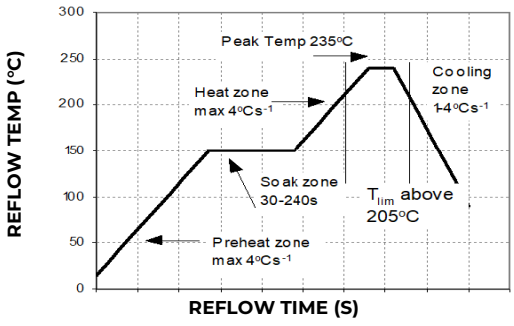


Figure 18. Reflow Profile for Tin/Lead (Sn/Pb) process.

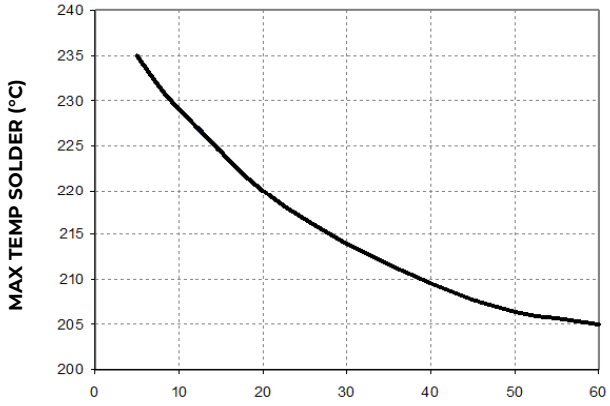


Figure 19. Time Limit Curve Above 205°C for Tin/Lead (Sn/Pb) process

Lead Free Soldering

The –Z version of the modules are lead-free (Pb-free) and RoHS compliant and are both forward and backward compatible in a Pb-free and a SnPb soldering process. Failure to observe the instructions below may result in the failure of or cause damage to the modules and can adversely affect long-term reliability.

Pb-free Reflow Profile

Power Modules (with the exception of modules that come with heat plate option –H) will comply with J-STD-020 Rev. C (Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices) for both Pb-free solder profiles and MSL classification procedures. This standard provides a recommended forced-air-convection reflow profile based on the volume and thickness of the package (Table 4-2). The suggested Pb-free solder paste is Sn/Ag/Cu (SAC). The recommended linear reflow profile using Sn/Ag/Cu solder is shown in Figure 20.

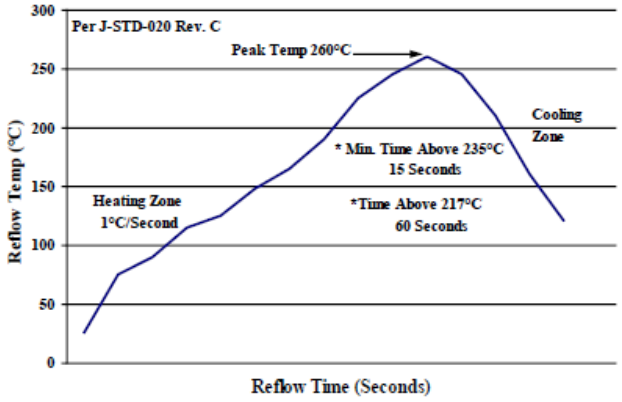


Figure 20. Recommended linear reflow profile using Sn/Ag/Cu solder.

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MSL Rating

The modules have a MSL rating as indicated in the Device Codes table, last page of this document.

Through-Hole Lead-Free Soldering

Information The RoHS-compliant, Z option, through-hole products use the SAC (Sn/Ag/Cu) Pb-free solder and RoHS-compliant components. They are designed to be processed through single or dual wave soldering machines. The pins have a RoHS-compliant, pure tin finish that is compatible with both Pb and Pb-free wave soldering processes. A maximum preheat rate of 3°C/s is suggested. The wave preheat process should be such that the temperature of the power module board is kept below 210°C. For Pb solder, the recommended pot temperature is 260°C, while the Pb-free solder pot is 270°C max.

Reflow Lead-Free Soldering Information

The RoHS-compliant through-hole products (with the exception of modules that come with heat plate option – H) can be processed with the following paste-through-hole Pb or Pb-free reflow process. Max. sustain temperature:

245°C (J-STD-020C Table 4-2: Packaging Thickness>=2.5mm / Volume > 2000mm^3),

Peak temperature over 245°C is not suggested due to the potential reliability risk of components under continuous high-temperature.

Min. sustain duration above 217°C: 90 seconds

Min. sustain duration above 180°C: 150 seconds

Max. heat up rate: 3°C/sec

Max. cool down rate: 4°C/sec

In compliance with JEDEC J-STD-020C spec for 2 times reflow requirement.

Pb-free Reflow Profile

BMP module (with the exception of modules that come with heat plate option –H) will comply with J-STD-020 Rev. C (Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices) for both Pb-free solder profiles and MSL classification procedures. BMP will comply with JEDEC J-STD-020C specification for 3 times reflow requirement. The suggested Pb-free solder paste is Sn/Ag/Cu (SAC). The recommended linear reflow profile using Sn/Ag/Cu solder is shown in Figure 21.

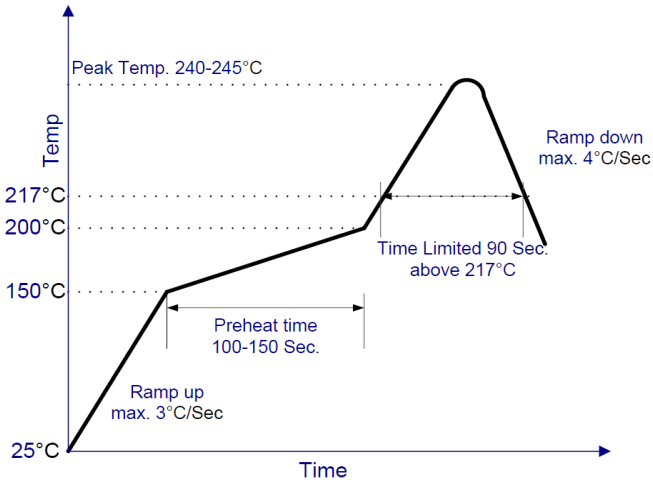


Figure 21. Recommended linear reflow profile using Sn/Ag/Cu solder.

Storage and Handling

The recommended storage environment and handling procedures for moisture-sensitive surface mount packages is detailed in J-STD-033 Rev. A (Handling, Packing, Shipping and Use of Moisture/ Reflow Sensitive Surface Mount Devices). Moisture Barrier Bags (MBB) with desiccant are required for MSL ratings of 2 or greater. These sealed packages should not be broken until time of use. Once the original package is broken, the floor life of the product at conditions of ≤ 30°C and 60% relative humidity varies according to the MSL rating (see J-STD-033A). The shelf life for dry packed SMT packages will be a minimum of 12 months from the bag seal date, when stored at the following conditions: < 40°C, < 90% relative humidity.

Post Solder Cleaning and Drying Considerations

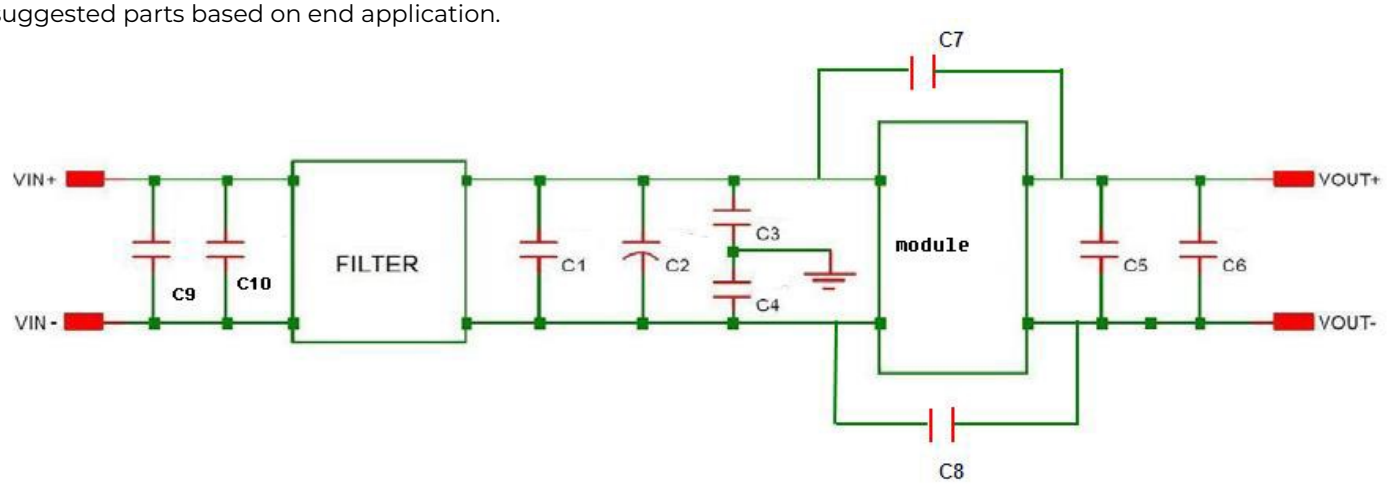
Post solder cleaning is usually the final circuit-board assembly process prior to electrical board testing. The result of inadequate cleaning and drying can affect both the reliability of a power module and the testability of the finished circuit-board assembly. For guidance on appropriate soldering, cleaning and drying procedures, refer to OmniOn Power™ Board Mounted Power Modules: Soldering and Cleaning Application Note (AN04-001)

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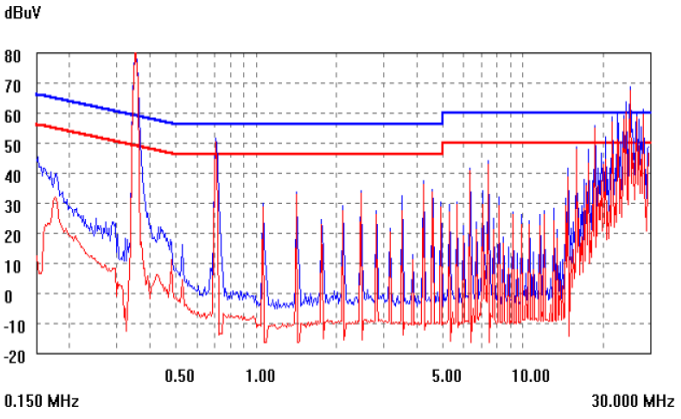
EMC Considerations

The circuit and plots in Figure 22 show a suggested configuration to meet the conducted emission limits of EN55032 Class B.

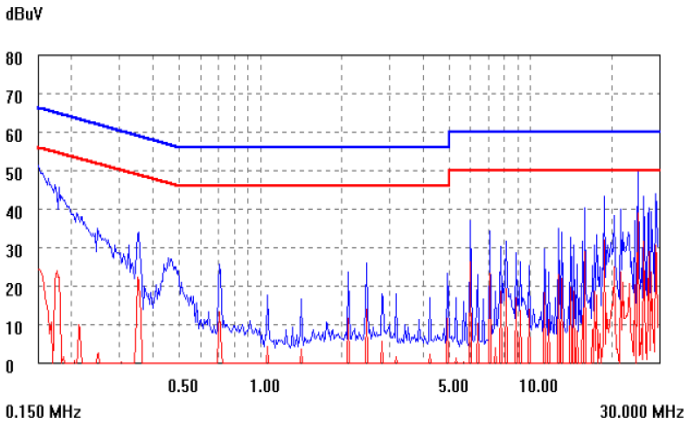
Note: Customer is ultimately responsible for the proper layout, component selection, rating and verification of the suggested parts based on end application.



Reference	Description	MPN
C1	X7R 2.2uf 100V 1210 SIZE	C1210X225K101TX
C2	100uF 100V	UPW2A101MPD
C3	2pcs 15nF 1500V in parallel	C1210X153K152TX
C4	2pcs 15nF 1500V in parallel	C1210X153K152TX
C5	1000pF 50V	GRM155R71H102KA01D
C6	10uF 25V	TAJD106K025ESA
C7	2pcs 15nF 1500V in parallel	C1210X153K152TX
C8	2pcs 15nF 1500V in parallel	C1210X153K152TX
C9	X7R 2.2uf 100V 1210 SIZE	C1210X225K101TX
C10	X7R 2.2uf 100V 1210 SIZE	C1210X225K101TX
Filter	Two stage EMI filter	FLT007A0



Without Filter



With Filter

Figure 22. EMC Considerations

For further information on designing for EMC compliance, please refer to the FLT007A0 data sheet (DS05-028).

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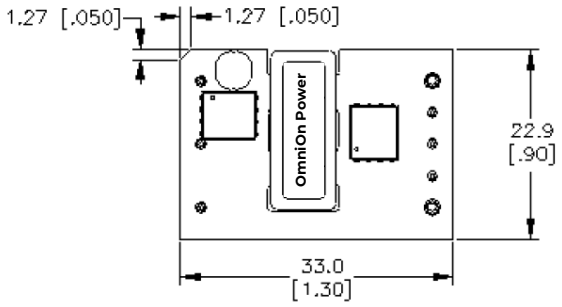
Mechanical Outline for Surface Mount Module (-S Option)

Dimensions are in millimeters and [inches].

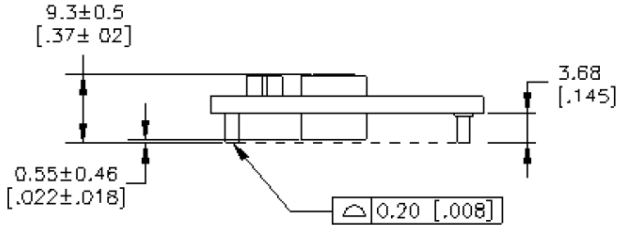
Tolerances: x.x mm ± 0.5 mm [x.xx in. ± 0.02 in.] (unless otherwise indicated)

x.xx mm ± 0.25 mm [x.xxx in ±0.010 in.]

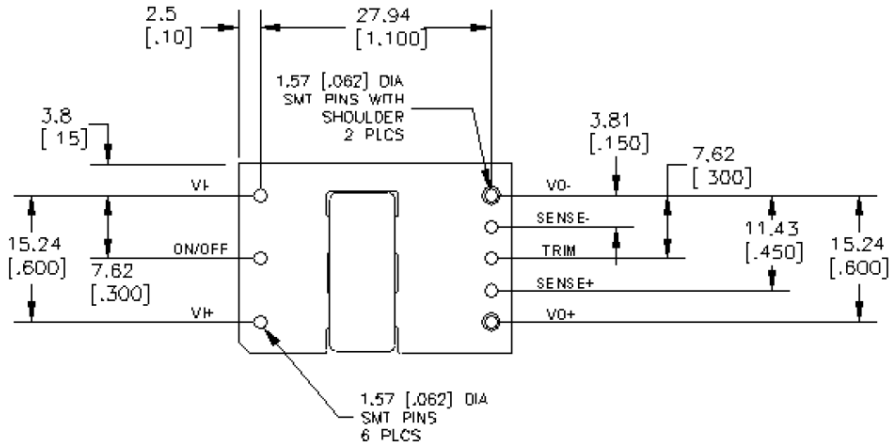
Top View



Side View



Bottom View*



Pin	Function
1	$V_{IN}(+)$
2	ON/OFF
3	$V_{IN}(-)$
4	$V_o(-)$
5	SENSE(-)
6	TRIM
7	SENSE(+)
8	$V_o(+)$

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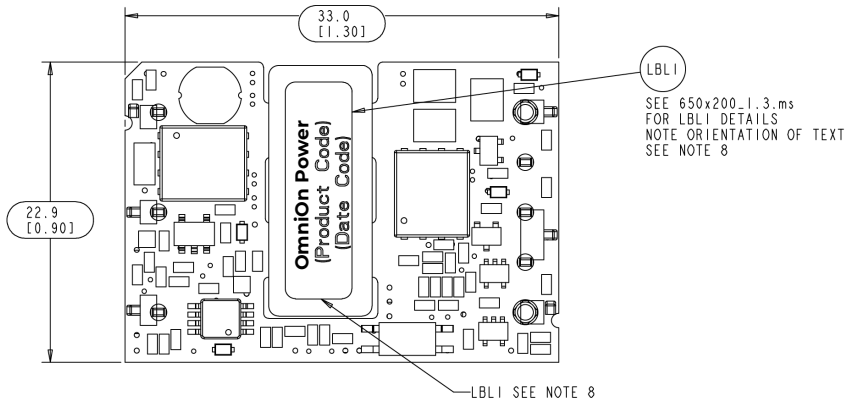
Mechanical Outline for Through-Hole Module

Dimensions are in millimeters and [inches].

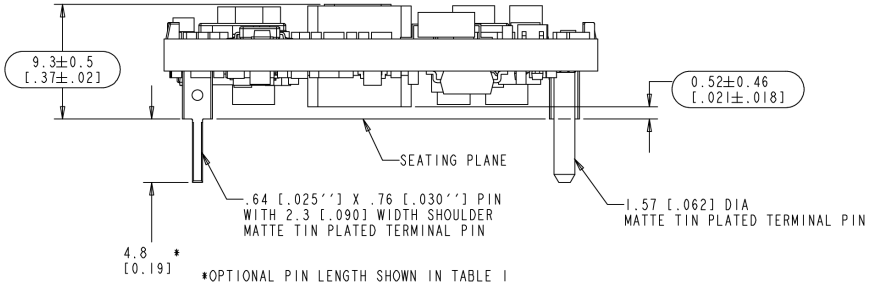
Tolerances: x.x mm ± 0.5 mm [x.xx in. ± 0.02 in.] (unless otherwise indicated)

x.xx mm ± 0.25 mm [x.xxx in ±0.010 in.]

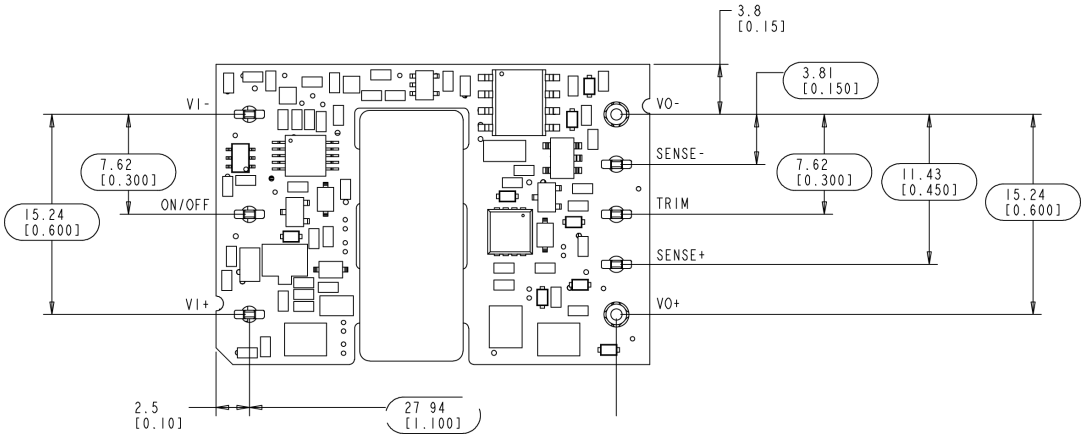
Top View



Side View



Bottom View



Pin	Function
1	V_{IN}(+)
2	ON/OFF
3	V_{IN}(-)
4	V_o(-)
5	SENSE(-)
6	TRIM
7	SENSE(+)
8	V_o(+)

Device Code Suffix	Lead Length (mm)	Lead Length (Inch)
6	3.68mm ± 0.25mm	0.145in ± 0.010in
8	2.79mm ± 0.25mm	0.110in ± 0.010in

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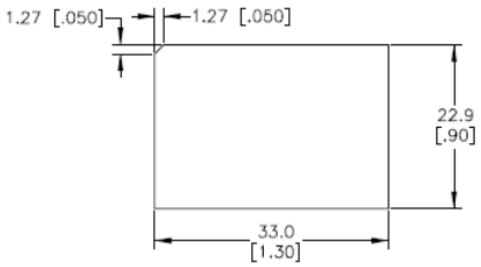
Mechanical Outline for Through-Hole Module with Heat Plate (-H Option)

Dimensions are in millimeters and [inches].

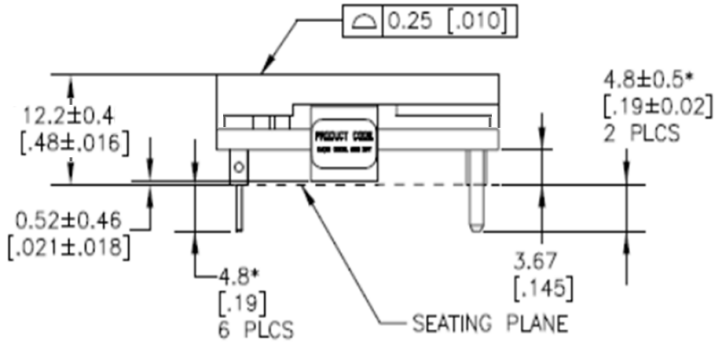
Tolerances: x.x mm ± 0.5 mm [x.xx in. ± 0.02 in.] (unless otherwise indicated)

x.xx mm ± 0.25 mm [x.xxx in ±0.010 in.]

Top View

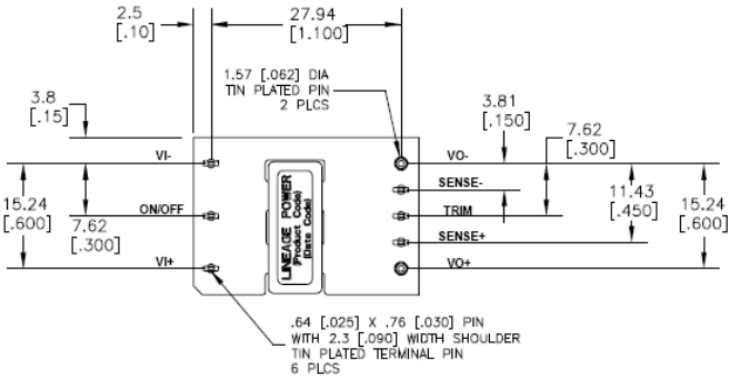


Side View



*For optional pin lengths, see Table 2, Device Options

Bottom View*



Pin	Function
1	$V_{IN}(+)$
2	ON/OFF
3	$V_{IN}(-)$
4	$V_o(-)$
5	SENSE(-)
6	TRIM
7	SENSE(+)
8	$V_o(+)$

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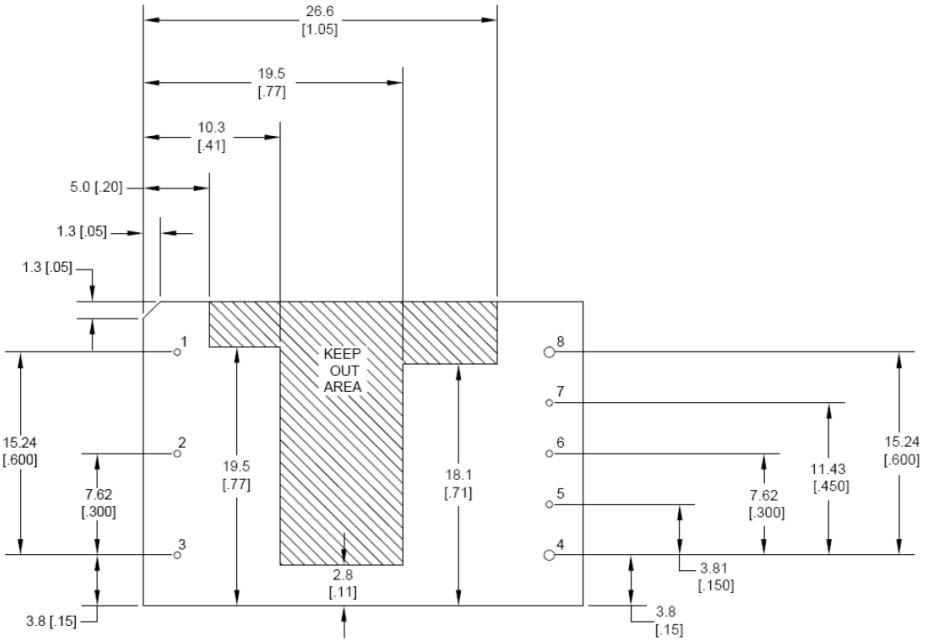
Recommended Pad Layout

Dimensions are in millimeters and [inches].

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

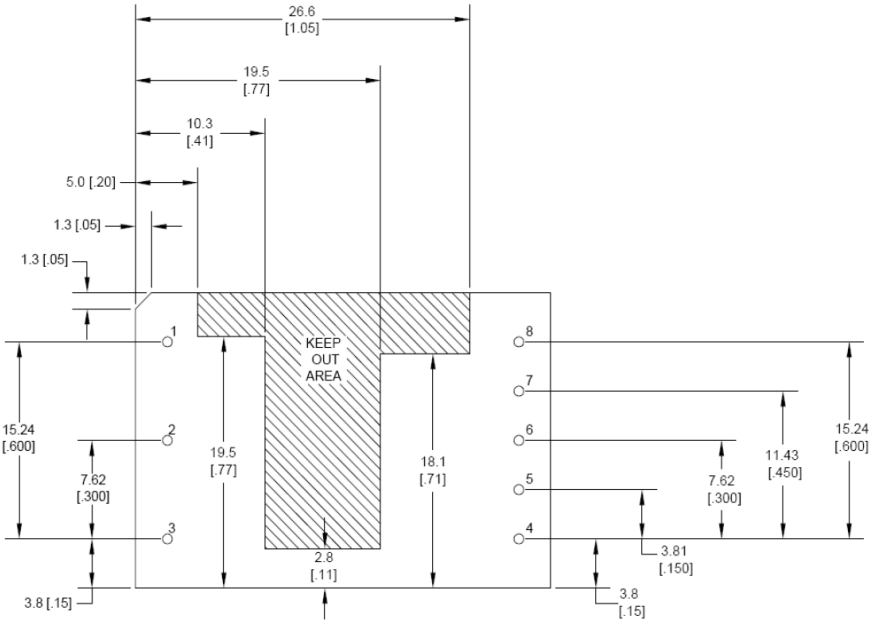
x.xx mm ± 0.25 mm [x.xxx in ± 0.010 in.

Pin	Function
1	Vi(+)
2	ON/OFF
3	vi(-)
4	Vo(-)
5	SENSE(-)
6	TRIM
7	SENSE(+)
8	Vo(+)



SMT Recommended Pad Layout (Component Side View)

Pin	Function
1	Vi(+)
2	ON/OFF
3	vi(-)
4	Vo(-)
5	SENSE(-)
6	TRIM
7	SENSE(+)
8	Vo(+)



TH Recommended Pad Layout (Component Side View)

NOTES:

FOR 0.030” X 0.025” RECTANGULAR PIN, USE 0.050” PLATED THROUGH HOLE DIAMETER

FOR 0.62 DIA” PIN, USE 0.076” PLATED THROUGH HOLE DIAMETER

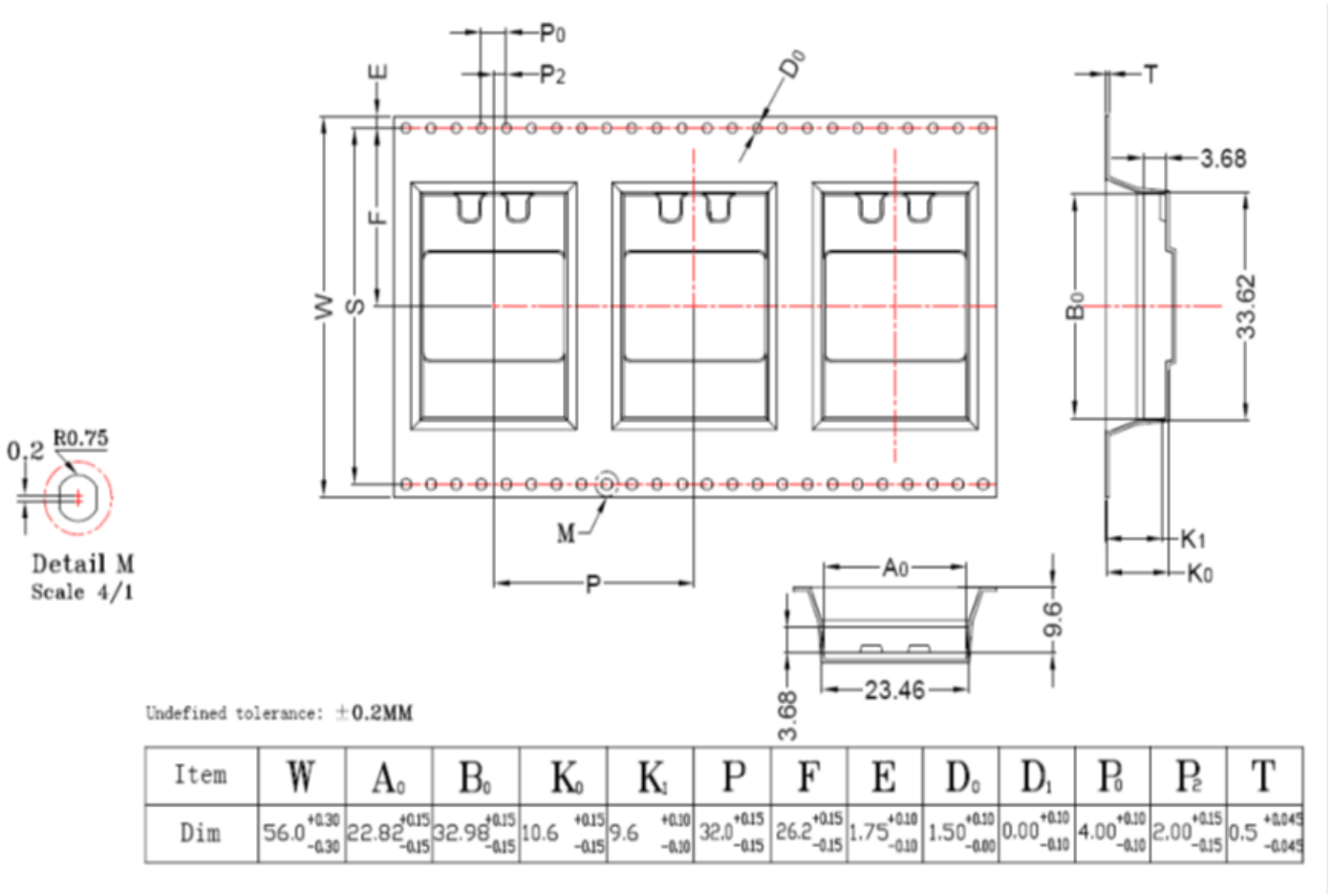
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Packaging Details

The SMT modules are supplied in tape & reel as standard. Details of tape dimensions are shown below. Modules are shipped in quantities of 140 modules per reel.

Tape Dimensions

Dimensions are in millimeters.



Item	W	A_0	B_0	K_0	K_1	P	F	E	D_0	D_1	P_0	P_2	T
Dim	$56.0^{+0.30}_{-0.30}$	$22.82^{+0.15}_{-0.15}$	$32.98^{+0.15}_{-0.15}$	$10.6^{+0.15}_{-0.15}$	$9.6^{+0.10}_{-0.10}$	$32.0^{+0.15}_{-0.15}$	$26.2^{+0.15}_{-0.15}$	$1.75^{+0.10}_{-0.10}$	$1.50^{+0.10}_{-0.00}$	$0.00^{+0.10}_{-0.10}$	$4.00^{+0.10}_{-0.10}$	$2.00^{+0.15}_{-0.15}$	$0.5^{+0.045}_{-0.045}$

Surface Mount Module Tape & Reel Package

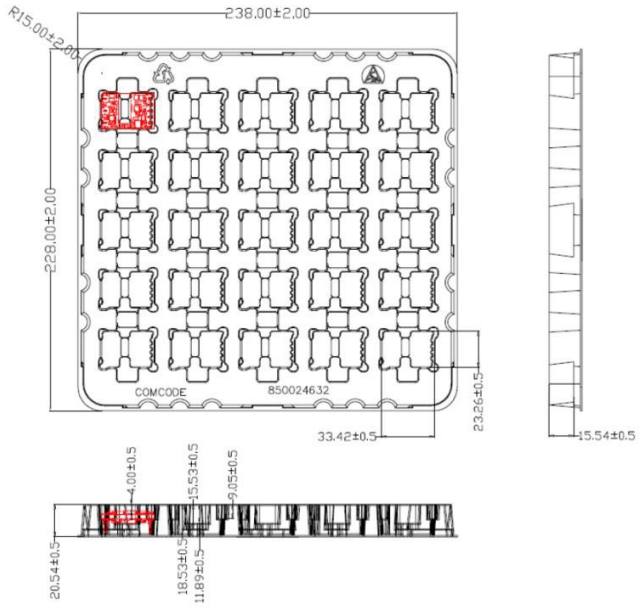
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Packaging Details (continued)

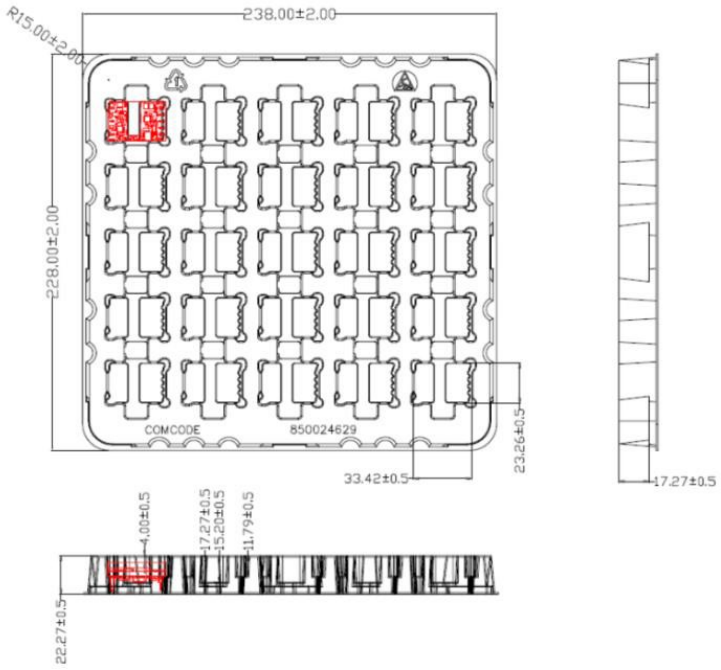
The SMT modules are supplied in tape & reel as standard. Details of tape dimensions are shown below.

Tape Dimensions

Dimensions are in millimeters.



Package Tray for Through-Hole Modules



Package Tray for Modules with Heat Plate

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Ordering Information

Please contact your OmniOn Power™ Sales Representative for pricing, availability and optional features.

Product Code	Input Voltage	Output Voltage	Output Current	On/Off Logic	Connector Type	MSL Rating	Ordering Codes
KBVW006A0B41Z	48V (36-75V$_{dc}$)	12.0V	6A	Negative	Through hole	2a	CC109170544
KBVW006A0B641Z	48V (36-75V$_{dc}$)	12.0V	6A	Negative	Through hole	2a	150024448
KBVW006A0B841Z	48V (36-75V$_{dc}$)	12.0V	6A	Negative	Through hole	2a	150024014
KBVW006A0B1-21Z	48V (36-75V$_{dc}$)	12.0V	6A	Negative	Through hole	2a	150037121
KBVW006A0B41-HZ	48V (36-75V$_{dc}$)	12.0V	6A	Negative	Through hole	n/a	150021662
KBVW006A0B41-SRZ	48V (36-75V$_{dc}$)	12.0V	6A	Negative	Surface mount	2a	150021663

Table 1. Device Codes

	Characteristic	Character and Position											Definition
Ratings	Form Factor	K											K = Sixteenthth Brick
	Family Designator		BV										BV = BARRACUDA Series
	Input Voltage		W										W = Wide Range, 36V-75V
	Output Current				006A0								006A0 = 006.0 Amps Maximum Output Current
	Output Voltage					B							B = 12.0V nominal
Options	Pin Length						6 8						Omit = Default Pin Length shown in Mechanical Outline Figures 6 = Pin Length: 3.68 mm ± 0.25mm , (0.145 in. ± 0.010 in.) 8 = Pin Length: 2.79 mm ± 0.25mm , (0.110 in. ± 0.010 in.)
	Action following Protective Shutdown							4					Omit = Latching Mode 4 = Auto-restart following shutdown (Overcurrent/ Overvoltage)
	On/Off Logic								1				Omit = Positive Logic 1 = Negative Logic
										-			
	Customer Specific										XY 21		XY= Customer Specific Modified Code, Omit for Standard Code 21 = Meets 100us Vin dropout test with minimal external Cin
	Mechanical Features										SR H		Omit = Standard open Frame Module SR = Surface mount connections & tape/reel package H = Heat plate, for use with heat sinks
	RoHS											Z	Omit = RoHS 5/6, Lead Based Solder Used Z = RoHS Compliant

Table 2. Device Coding Scheme and Options

Contact Us

For more information, call us at
1-877-546-3243 (US)
1-972-244-9288 (Int'l)

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Change History (excludes grammar & clarifications)

Revision	Date	Description of the change
2.4	04/21/2022	Updated as per template, ROHS
2.5	12/06/2023	Updated as per OmniOn template
2.6	12/26/2025	Updated Mechanical Outline for Through-Hole Module

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