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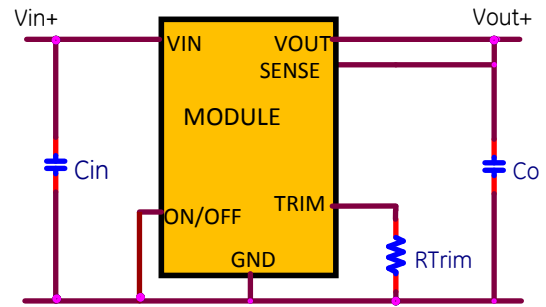
# IND045XW Hornet: Non-Isolated DC-DC Voltage Regulator Modules

24Vdc input; 3Vdc to 18Vdc output; 45W Max Power



### Applications

- ✓ Industrial Equipment
- ✓ Control Boards
- ✓ Test Equipment



### Electrical Features

- 24V Input voltage with  $\pm 20\%$  Tolerance
- Output voltage programmable from 3Vdc to 18Vdc via external resistor
- Remote On/Off for optional external control
- Fixed switching frequency
- Output overcurrent protection (non-latching)

### Mechanical Features

- Small size: 20.3 mm x 11.4 mm x 8.5 mm (0.8 in x 0.45 in x 0.335 in)
- Operating range:  $-40^{\circ}\text{C}$  to  $105^{\circ}\text{C}$  ambient
- Operating shock to 40G per Mil Std. 810F, Method 516.4 Procedure I
- Operating vibration per Mil Std. 810F, Method 514.5 Procedure I

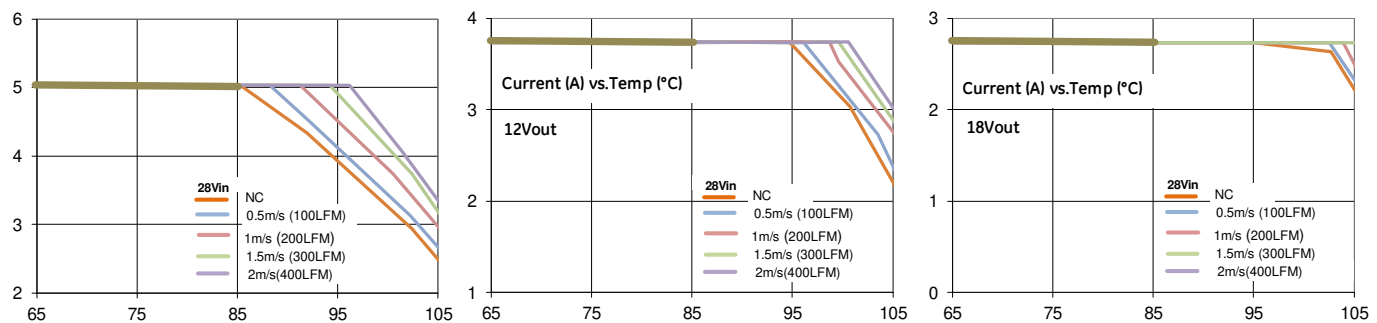
### Process and Safety

- Qualified for 1000h High Temperature Operating Bias, 1000h 85RH/ $85^{\circ}\text{C}$  Temperature, Humidity and Bias, 700 cycle  $-40$  to  $125^{\circ}\text{C}$  thermal cycling.
- ANSI/UL# 60950-1 2<sup>nd</sup> Revised October 14, 2014, CSA+ C22.2 No. 60950-1-07, Second Ed. + A2:2014 (MOD) Recognized, DIN EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011, + A2:2013 (VDE+ 0805-1) Licensed.
- ISO\*\* 9001 and ISO 14001 certified manufacturing facilities.
- Compliant to RoHS II EU "Directive 2011/65/EU".
- Compatible in a Pb-free or SnPb reflow environment.
- Suitable for aqueous clean.
- Suitable for conformal coating with dip and vapor deposition. Conformal coating can provide the protection to meet Salt Fog Test per IEC 60068-2-52 (Severity 3) and Mixed Gas Flow test per Telcordia GR-3108 Outdoor Levels.
- 3 year warranty.

Device Code	Input Voltage	Output Voltage	Output Current (Max.)	On/Off Logic	Comcode
IND045XW	19.2 – 28.8Vdc	3.0 – 18.0Vdc	5A(@3Vout)	Negative	1600102906A

### Thermal Performance

Full rated output with natural convection up to  $85^{\circ}\text{C}$  at 3.3Vout and up to  $95^{\circ}\text{C}$  at 18Vout.. Thermal curves for 3 voltages below.



**Electrical Specifications**

Parameter	Device	Symbol	Min	Typ	Max	Unit
Operating Input Voltage	All	V <sub>IN</sub>	19.2	24	28.8	Vdc
Input No Load Current (V <sub>IN</sub> = 28.0Vdc, I <sub>o</sub> = 0, module enabled)	V <sub>O,set</sub> = 3 Vdc	I <sub>IN,No load</sub>		26		mA
	V <sub>O,set</sub> = 18Vdc	I <sub>IN,No load</sub>		50		mA
External Capacitance, Ceramic ESR ≥ 1 mΩ	All	C <sub>O,max</sub>		—	47*	μF
Efficiency 28V <sub>INDC</sub> , T <sub>A</sub> =25°C, I <sub>o</sub> as per Figure 2		η	94.7(12V), 95.8(18V)			%
Switching Frequency	All	f <sub>sw</sub>	—	300	—	kHz
Output Voltage (Over all line, load, and temperature conditions)	All	V <sub>O, set</sub>	-3.0	—	+3.0	% V <sub>O, set</sub>
On/Off Logic High (MODULE OFF) Input High Voltage	All	V <sub>IH</sub>	1.5	—	36	Vdc
On/ Off Logic Low (MODULE ON) Input Low Voltage	All	V <sub>IL</sub>	-0.2	—	1	Vdc

\*Additional External Capacitance possible using Tunable Loop

**Characteristic Curves**

The following figures provide typical characteristics for the IND045XW Hornet at 25°C.

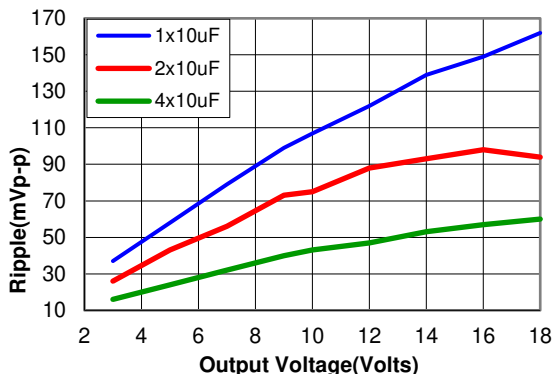


Figure 1. Output Ripple Voltage for various output voltages and external caps @28Vin. Additional Decoupling cap of 0.01uF used on input and output side

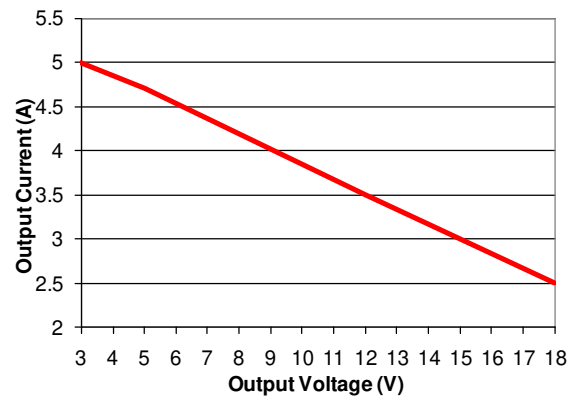


Figure 2. Graph showing maximum output current capability at different output voltages.

Use electrical profile in Figure 2 for determining baseline output current for a specific voltage. Then thermal curves.

**Trim**

Rtrim for a desired output voltage, should be as per the following table. The formula in the last column helps determine Rtrim for other voltages.

Vo (V)	3.3	5.0	6	9	12	15	18	$R_{trim} = \left[ \frac{70}{(V_o - 0.7)} \right] k\Omega$
Rtrim (kΩ)	26.92	16.27	13.2	8.43	6.19	4.89	4.04	

**On/Off**

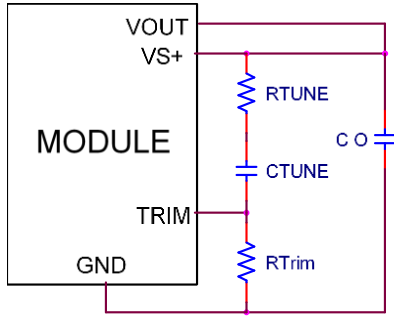
On/Off pin must be connected to Ground. If the On/Off pin is left floating the module will be left in the OFF state.

**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 listed on the first page of this document. For the converter output to be considered meeting the requirements of safety extra-low voltage (SELV), the input must meet SELV requirements. The power module has extra-low voltage (ELV) outputs when all inputs are ELV. The input to these units is to be provided with a fast-acting fuse with a maximum rating of 8A in the positive input lead.

**Tunable Loop**

The module is designed for 47uF capacitor on its output. For applications where more than 47uF capacitors would be used on the output, an additional Resistor (R<sub>tune</sub>) and Capacitor (C<sub>tune</sub>) would be required in the circuit schematic to compensate for the additional capacitance. The placement is between the Sense+ pin and Trim pin as per figure below:



**Figure. 3. Circuit diagram showing connection of R<sub>TUNE</sub> and C<sub>TUNE</sub> to tune the control loop of the module**

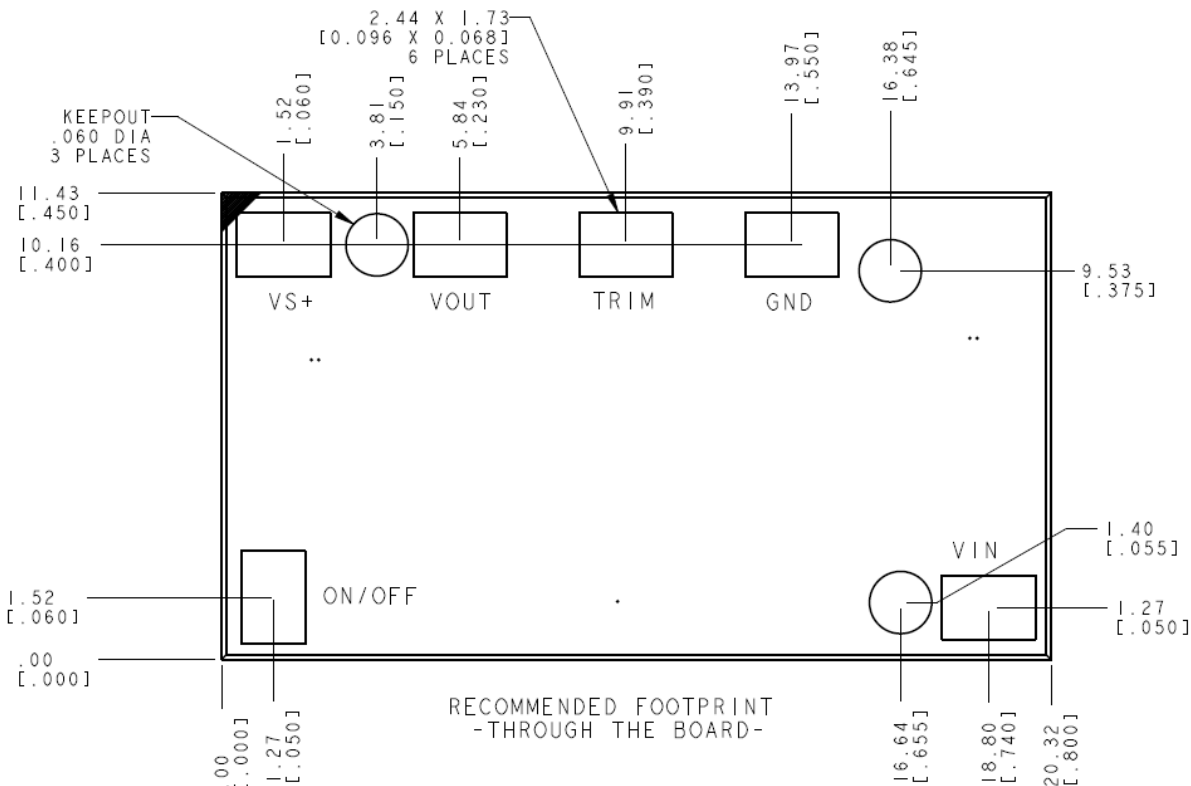
The recommended values for R<sub>tune</sub> and C<sub>tune</sub> for different amounts of external capacitance are as per the table below:

Vo=5V	Co	2x22μF	4x22μF	6x22μF	Vo=12V	Co	2x22μF	4x22μF	6x22μF
	R <sub>TUNE</sub>		220Ω	150Ω		150Ω	R <sub>TUNE</sub>		270Ω
C <sub>TUNE</sub>		680pF	1nF	1.8nF	C <sub>TUNE</sub>		1nF	1.8nF	2.7nF

**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.)



## Nozzle Recommendations

The minimum recommended inside nozzle diameter for reliable operation is 3mm. The maximum nozzle outer diameter, which will safely fit within the allowable component spacing, is 7 mm.

## Bottom Side / First Side Assembly

This module is not recommended for assembly on the bottom side of a customer board. If such an assembly is attempted, components may fall off the module during the second reflow process

## Lead Free Soldering

The modules are lead-free (Pb-free) and RoHS compliant and fully compatible in a Pb-free 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

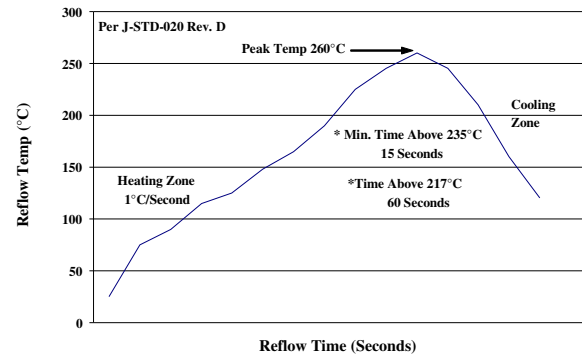
## MSL Rating

The modules have a MSL rating of 2a.

## Pb-free Reflow Profile

Power Systems will comply with J-STD-020 Rev. D (Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices) for both Pb-free solder profiles and MSL classification procedures. The suggested Pb-free solder paste is Sn/Ag/Cu (SAC).

The following profile is the recommended linear reflow profile using Sn/Ag/Cu solder. Soldering outside of the recommended profile requires testing to verify results and performance.



## Storage and Handling

J-STD-033 Rev. A (Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices) is recommended. 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  $\leq 30^{\circ}\text{C}$  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:  $< 40^{\circ}\text{C}$ ,  $< 90\%$  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

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