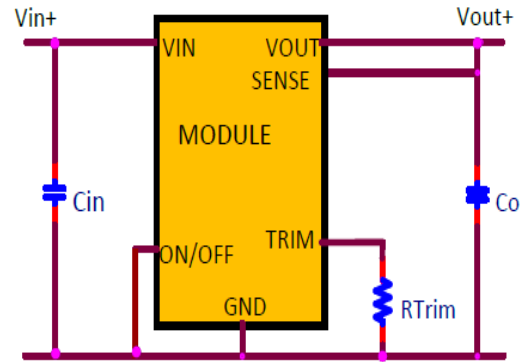


# IND045XW Hornet: Non-Isolated DC-DC Voltage Regulator Modules

24V<sub>dc</sub> input; 3V<sub>dc</sub> to 18V<sub>dc</sub> output; 45W Max Power



## Applications

- Industrial Equipment
- Control Boards
- Test Equipment

## Electrical Features

- 24V Input voltage with  $\pm 20\%$  Tolerance
- Output voltage programmable from 3V<sub>dc</sub> to 18V<sub>dc</sub> 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°C to 105°C ambient
- Operating shock to 40G per Mil Std. 810G, Method 516.4 Procedure I
- Operating vibration per Mil Std. 810G, Method 514.5 Procedure I

## Process and Safety

- Qualified for 1000h High Temperature Operating Bias, 1000h 85RH/85°C Temperature, Humidity and Bias, 700 cycle -40 to 125°C thermal cycling.
- ANSI/UL\* 62368-1 and CAN/CSA† C22.2 No. 62368-1 Recognized, DIN VDE‡ 0868-1/A11:2017 (EN62368-1:2014/A11:2017)
- ISO\*\* 9001 and ISO 14001 certified manufacturing facilities.
- Compliant to RoHS Directive 2011/65/EU and amended Directive (EU) 2015/863
- Compliant to REACH Directive (EC) No 1907/2006
- 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.

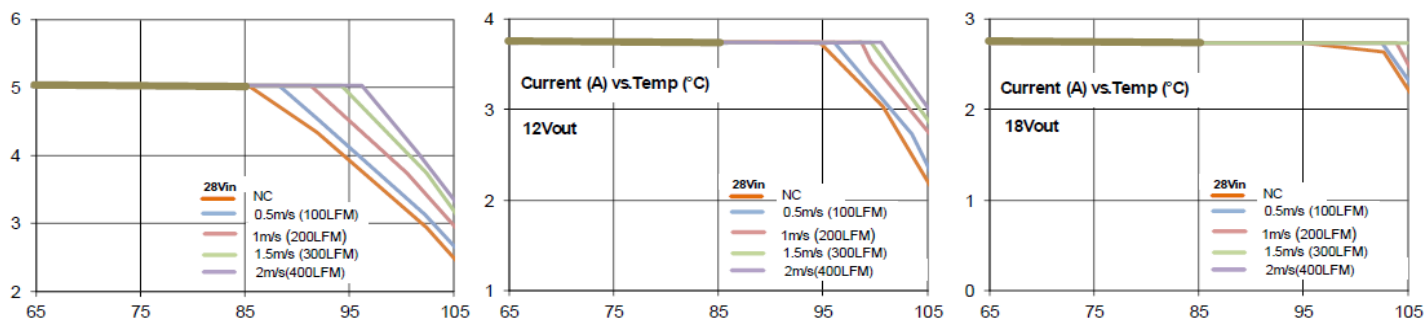
# Technical Specification

## Process and Safety (continued)

Device Code	Input Voltage	Output Voltage	Output Current (Max.)	On/Off Logic	Ordering Code
IND045XW	19.2 – 28.8V <sub>dc</sub>	3.0 – 18.0V <sub>dc</sub>	5A(@3V <sub>out</sub> )	Negative	1600102906A

## Thermal Performance

Full rated output with natural convection up to 85°C at 3.3V<sub>out</sub> and up to 95°C at 18V<sub>out</sub>. 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	V <sub>dc</sub>
Input No Load Current	V <sub>o,set</sub> = 3V <sub>dc</sub>	I <sub>IN,No Load</sub>		26		mA
(V <sub>IN</sub> = 28.0V <sub>dc</sub> , I <sub>o</sub> = 0, module enabled)	V <sub>o,set</sub> = 18V <sub>dc</sub>	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(5V)		%
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	V <sub>dc</sub>
On/ Off Logic Low (MODULE ON) Input Low Voltage	All	V <sub>IL</sub>	-0.2	-	1	V <sub>dc</sub>

\*Additional External Capacitance possible using Tunable Loop

## Characteristic Curves

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

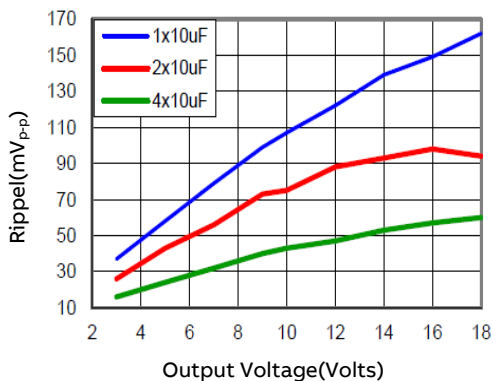


Figure 1. Output Ripple Voltage for various output voltages and external caps @28Vin. Additional Decoupling cap of 0.01uF used on input and output side

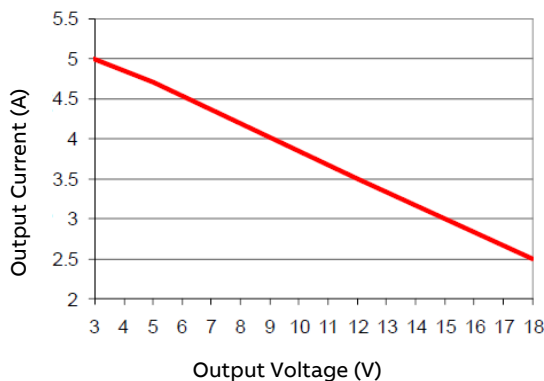


Figure 2. Graph showing maximum output current capability at different output voltages.

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

# Technical Specification (continued)

## Trim

R<sub>trim</sub> for a desired output voltage, should be as per the following table. The formula in the last column helps determine R<sub>trim</sub> for other voltages.

V <sub>o</sub> (V)	3.3	5.0	6	9	12	15	18	R <sub>trim</sub> $\left[ \frac{70}{(V_o-0.7)} \right]$ kΩ
R <sub>trim</sub> (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) or ES1, the input must meet SELV/ES1 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:

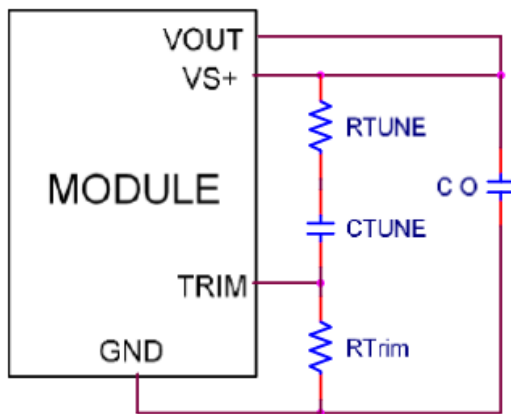


Figure. 3. Circuit diagram showing connection of RTUNE and CTUNE to tune the control loop of the module

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:

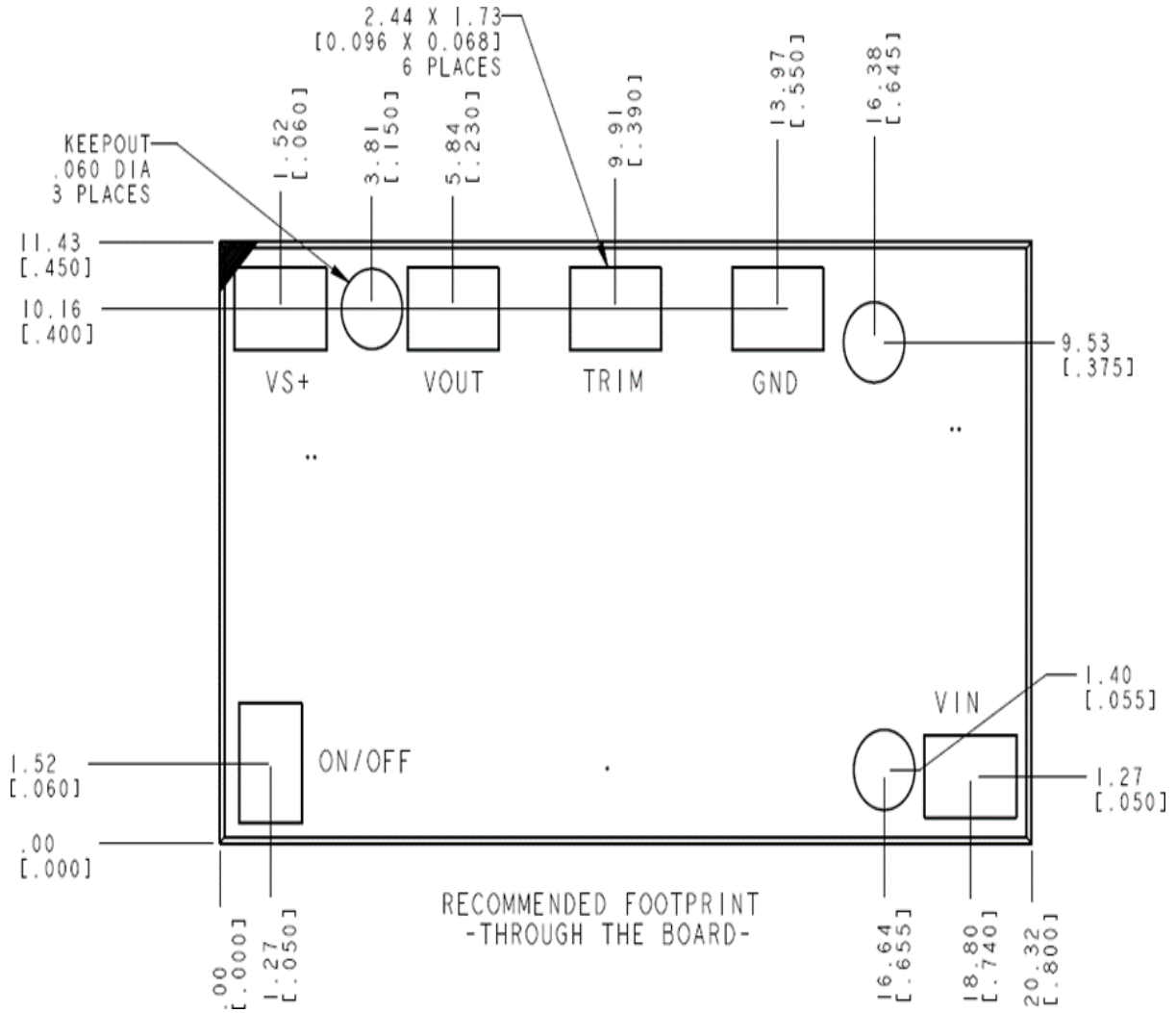
V <sub>o</sub> = 5V	C <sub>o</sub>	2x22μF	4x22μF	6x22μF	V <sub>o</sub> = 12V	C <sub>o</sub>	2x22μF	4x22μF	6x22μF
		R <sub>TUNE</sub>	220Ω	150Ω			150Ω	R <sub>TUNE</sub>	270Ω
C <sub>TUNE</sub>	680pF	1nF	1.8nF	C <sub>TUNE</sub>	1nF	1.8nF	2.7nF		

# Technical Specification (continued)

## 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.)



# Technical Specification

## 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

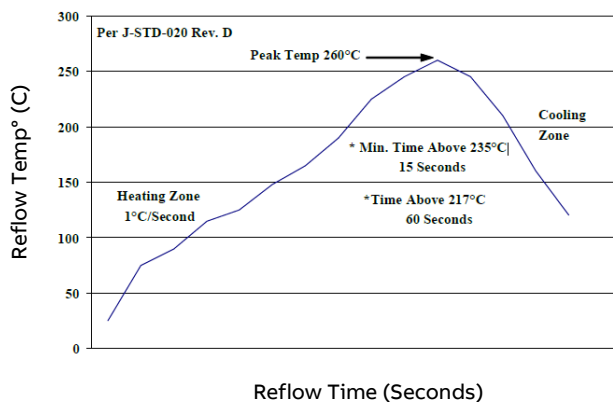
Post solder cleaning is usually the final circuit-board assembly process prior to electrical board testing. The result of inadequate cleaning and drying can affect both the reliability of a power module and the

## Contact Us

For more information, call us at

1-877-546-3243 (US)

1-972-244-9288 (Int'l)



## Change History (excludes grammar & clarifications)

Version	Date	Description of the change
6.3	11/11/2021	Updated as per template
6.4	05/31/2023	Correction in electrical features on page – 1



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