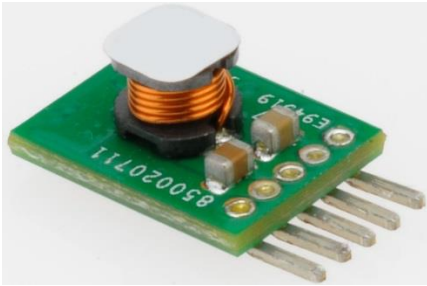


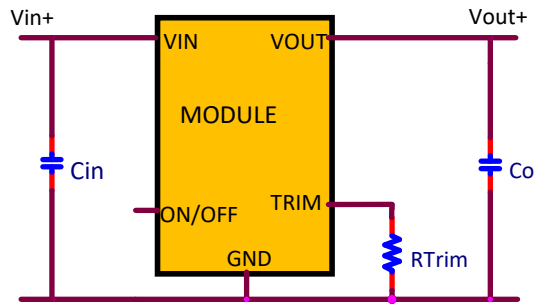
IND011SIP Hornet: Non-Isolated DC-DC Voltage Regulator Modules

12Vdc input; 0.6Vdc to 5.5Vdc output; 11W Max Power



Applications

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



Electrical Features

- 12V Input voltage with adequate Tolerance
- Output voltage programmable from 0.6Vdc to 5.5Vdc via external resistor
- Remote On/Off for optional external control
- Fixed switching frequency
- Output overcurrent protection (non-latching)

Mechanical Features

- Small size: 10.4 mm x 13.5 mm x 8.1 mm (0.41 in x 0.53 in x 0.32 in)
- Operating range: -40°C to 85°C ambient

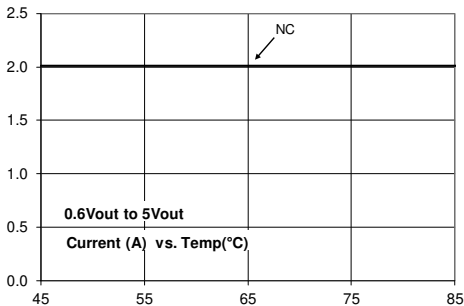
Process and Safety

- 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.

Device Code	Input Voltage	Output Voltage	Output Current (Max.)	On/Off Logic	Comcode
IND011SIP	9.6 – 14Vdc	0.6 – 5.5Vdc	2A	Positive	1600102909A

Thermal Performance

Full rated output with natural convection up to 85°C for all output voltages.



Electrical Specifications

Parameter	Device	Symbol	Min	Typ	Max	Unit
Operating Input Voltage	All	V _{IN}	9.6	12	14	Vdc
Input No Load Current (V _{IN} = 12.0Vdc, I _O = 0, module enabled)	V _{O,set} = 0.6 Vdc	I _{IN,No load}		20		mA
	V _{O,set} = 5Vdc	I _{IN,No load}		48		mA
External Capacitance, Ceramic ESR ≥ 1 mΩ	All	C _{O,max}	22	—	47*	μF
Efficiency 12V _{INDC} , T _A =25°C, I=12A, Vo=0.6 to 3.3Vdc		η	69.2(0.6V), 85.5(1.8V), 93.3(5V)			%
Switching Frequency	All	f _{sw}	—	600	—	kHz
Output Voltage (Over all line, load, and temperature conditions)	All	V _{O, set}	-3.0	—	+3.0	% V _{O, set}
On/Off Logic High (MODULE ON) Input High Voltage	All	V _{IH}	3	—	14	Vdc
On/ Off Logic Low (MODULE OFF) Input Low Voltage	All	V _{IL}	-0.3	—	0.3	Vdc

*Additional External Capacitance possible using Tunable Loop

Characteristic Curves

The following figures provide typical characteristics for the 2A Hornet at 25°C.

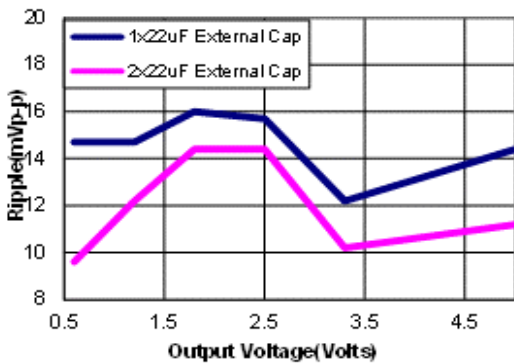


Figure 1. Output Ripple Voltage (20MHz BW) for various output voltages and external caps @12V_{in}. Additional Decoupling cap of 0.1uF used on input and output side

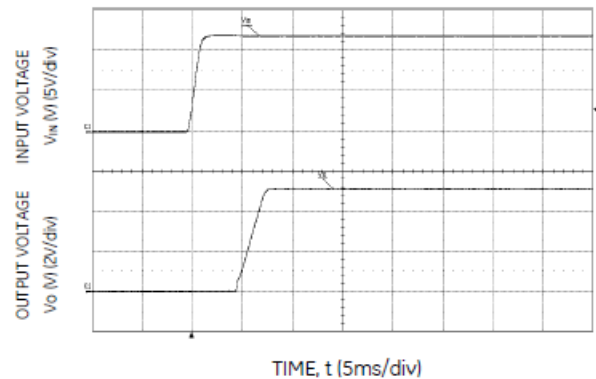


Figure 2. Typical Start-up using Input Voltage (V_{in}=12V, V_{out} = V_{out, max}, I_{out} = I_{out, max})

Trim

Without an external resistor between Trim and GND pins, the output of the module will be 0.6Vdc. R_{trim} for a desired output voltage, should be as per the following table. The formula in the last column helps determine R_{trim} for other voltages.

V _O (V)	0.6	0.9	1.0	1.2	1.5	1.8	2.5	3.3	5.0	$R_{trim} = \left[\frac{12}{(V_o - 0.6)} \right] k\Omega$
R _{trim} (kΩ)	Open	40	30	20	13.3	10	6.316	4.4	2.727	

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. An input fuse for the module is recommended. Due to the wide input voltage and output voltage ranges of the module, a 4A, 125Vdc fast acting fuse is recommended.

Tunable Loop

The module is designed for 200uF capacitor on its output. For applications where more than 47uF capacitors would be used on the output, an additional Resistor (R_{tune}) and Capacitor (C_{tune}) 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:

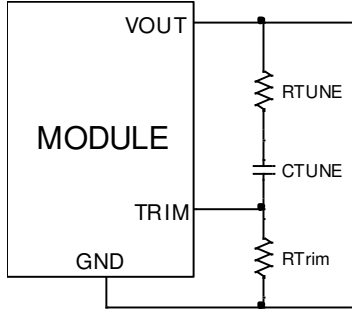


Figure. 3. Circuit diagram showing connection of R_{TUNE} and C_{TUNE} to tune the control loop of the module

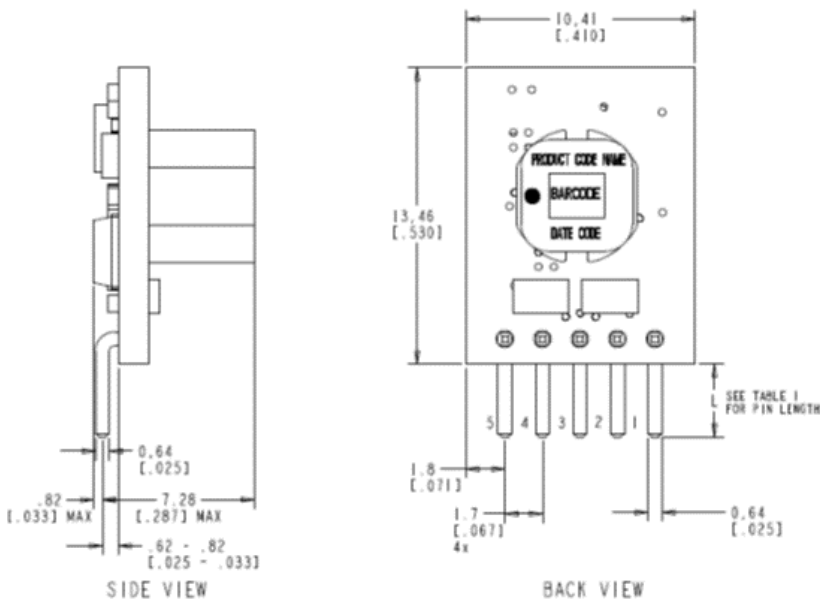
The recommended values for R_{tune} and C_{tune} for different amounts of external capacitance are as per the table below:

Co	2x47µF	3x47µF	4x47µF	10x47µF
R _{TUNE}	150	100	100	100
C _{TUNE}	10nF	18nF	18nF	22nF

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.)



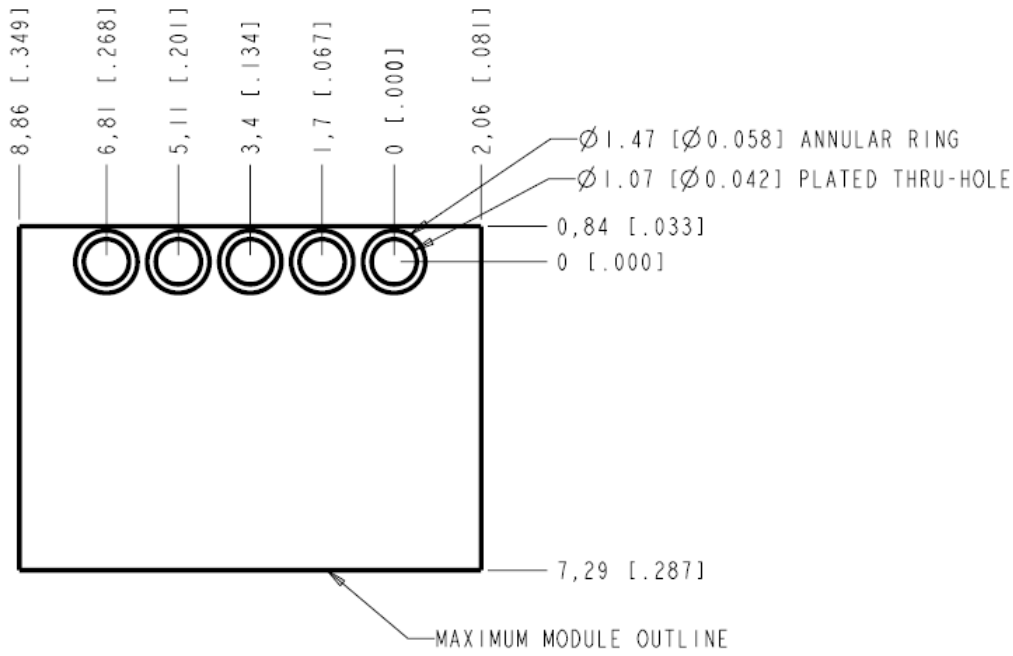
Pin Out

PIN	Function
1	On/Off
2	V _{in}
3	GND
4	V _{out}
5	Trim+

TABLE I

PRODUCT OPTION	PIN LENGTH "L" MM [INCH]
STANDARD	3.29 [0.130]
OPTION - 6	2.85 [0.112]
OPTION - 54	5.08 [0.200]

RECOMMENDED PAD LAYOUT



TO INCREASE COPPER ADHESION, ELLIPTICAL PADS CAN BE UTILIZED

Through-Hole Lead-Free Soldering Information

These RoHS-compliant 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 an RoHS-compliant 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. Not all RoHS-compliant through-hole products can be processed with paste-through-hole Pb or Pb-free reflow process

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