# VPA Series DC/DC Converters


## General Description

The VPA Series™ DC/DC converters feature up to 86% efficiency, up to 10 watts of output power and wide input voltage ranges. The 28 volt models have an input range of 18 to 36 VDC and offer single outputs of 3.3, 5, 12 or 15 VDC. The 48 volt model has an input range of 20 to 60 VDC and supplies a single 5 volt output. These output voltages are accurate within 1%. The case operating temperature of -40°C to +90°C exceeds the usual commercial operating range, allowing use in a wider range of environments.

## Converter Design

VPA DC/DC converters use a single-ended forward topology with current mode pulse-width modulation. Switching frequency is 220 kHz. Input and output filtering plus heat sinking eliminate the need for external components. Start-up time is a low 6 milliseconds.

## Protection Features

The VPA Series includes several features to protect your system and the converter. The 28 volt models are transient protected for up to 45 VDC for 100 milliseconds and the 48 volt model for up to 72 VDC for 100 milliseconds. Short circuit protection from positive output to output common is provided by independent pulse-by-pulse current limiting. Further protection is provided by isolation to the standards of UL1459 — 700 VDC for the 28 volt models and 1544 VDC for the 48 volt model.

## Regulation and Stability

Line regulation and load regulation (25% to 100% load) are as low as 0.01% of the output voltage, depending on the model. Stability over 24 hours, with a 30 minute warm-up at full load, results in an output voltage drift of less than 0.05%. Long term stability (1000 hours of operation) features an output voltage drift of less than 0.1%.

## Noise Management

Input ripple rejection is greater than 40 dB from DC to 120 Hz, reducing power line noise. Input ripple is 140 mA p-p for the VPA2803R3S, 210 mA p-p for the other 28 volt models and 130 mA p-p for the 48 volt model over a DC to 20 MHz bandwidth. Output noise is just 60 mV p-p for the 28 volt models and 75 mV p-p for the 48 volt model over a DC to 20 MHz bandwidth. Using a 10 kHz to 1 MHz bandwidth, rms output noise is 6 mV for the 28 volt models and 5 mV for the 48 volt model. If input common and output common are to be connected, a 1 to 10 µF, 0.5 to 5 ohm ESR capacitor connected across the output terminals (pins 3 and 4) will reduce switching noise.

## Input to Output Capacitance

The low capacitance of 400 pF reduces the ground loops often found in converters with higher capacitances. The case is tied to the input common terminal (pin 2), reducing common mode noise at the output.

## Small Package

The 2.02 by 1.02 by 0.42 inch package weighs 29 grams and is water washable. This five sided copper package is 0.016 inches (0.41 mm) thick, providing both EMI shielding and heat sinking. The case shield is tied to the input common terminal (pin 2).

**Note:** The above paragraphs refer to typical specifications. See characteristics chart for detailed information.

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**interpoint**

# VPA Series DC/DC Converters

- Up to 10 watts of output power
- Up to 86% efficiency
- Single outputs of 3.3, 5, 12 and 15 VDC
- No external components required for filtering or heat sinking
- Low noise
- Isolation voltage up to 700 or 1544 VDC per UL1459
- Short circuit protection
- Small size: 2.02 x 1.02 x 0.42 inches
- Five sided, shielded, low-thermal gradient copper case

**To order call 1-800-822-8782**

**Interpoint Corporation**
**10301 Willows Road**
**P.O. Box 97005**
**Redmond, WA 98073-9705**
**TEL: (800) 822-8782**
**(206) 882-3100**
**FAX: (206) 882-1990**
**Internet: power@intp.com**

## CHARACTERISTICS : Tc = 25°C, nominal input voltage, full load unless otherwise noted.

**Operating Temperature Range (Case)**
- Full Power: -40°C to +90°C
- Absolute: -50°C to +100°C

**Storage Temperature Range (Case)**
- –55°C to +105°C

**Thermal Impedance:** case rise over ambient
- 15°C/ watt dissipated

**Isolation**
- Input to output: 28 volt — 700 VDC
  48 volt — 1544 VDC

**Weight**
- 29 grams, typical

**Capacitance**
- Input to output: 400 pF typical

**Conversion Frequency**
- 220 kHz, typical

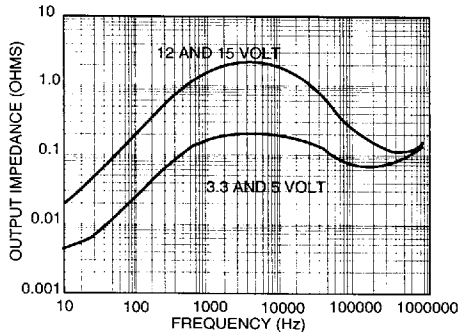
**Start-up Time**
- 6 milliseconds, typical

**Input Ripple Rejection**
- >40dB, to 120 Hz ripple, amplitude of 1% $V_{in}$

| | | VPA2803R3S | | | VPA2805S | | | VPA2812S | | | VPA2815S | | | VPA4805S | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PARAMETER | CONDITIONS | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | MIN | TYP | MAX | UNITS |
| INPUT VOLTAGE | NORMAL | 18 | 28 | 36 | 18 | 28 | 36 | 18 | 28 | 36 | 18 | 28 | 36 | 20 | 48 | 60 | VDC |
| | TRANSIENT[1] | — | — | 45 | — | — | 45 | — | — | 45 | — | — | 45 | — | — | 72 | |
| INPUT CURRENT | NO LOAD | — | 7 | — | — | 7 | — | — | 10 | — | — | 10 | — | — | 6 | — | mA |
| | FULL LOAD | — | 287 | — | — | 430 | — | — | 454 | — | — | 436 | — | — | 200 | — | |
| OUTPUT VOLTAGE | NOMINAL INPUT V | 3.30 | 3.33 | 3.36 | 4.95 | 5 | 5.05 | 11.90 | 12 | 12.10 | 14.9 | 15 | 15.10 | 4.95 | 5 | 5.05 | VDC |
| OUTPUT CURRENT | FULL LOAD | 0 | — | 2000 | 0 | — | 2000 | 0 | — | 900 | 0 | — | 700 | 0 | — | 1500 | mA |
| OUTPUT POWER | FULL LOAD | — | — | 6.6 | — | — | 10 | — | — | 10.8 | — | — | 10.5 | — | — | 7.5 | W |
| EFFICIENCY | FULL LOAD | — | 82 | — | — | 83 | — | — | 85 | — | — | 86 | — | — | 78 | — | % |
| LINE REGULATION | $V_{in}$ = MIN TO MAX | — | 0.5 | 1.0 | — | 0.01 | 0.2 | — | 0.2 | 0.8 | — | 0.2 | 0.8 | — | 0.01 | 0.2 | % |
| LOAD REGULATION | 25% TO FULL LOAD | — | 0.1 | 0.4 | — | 0.1 | 0.4 | — | 0.2 | 0.4 | — | 0.2 | 0.4 | — | 0.1 | 0.3 | % |
| OUTPUT RIPPLE[2] | 0 to 20 MHz | — | 60 | — | — | 60 | — | — | 60 | — | — | 60 | — | — | 75 | — | mV p-p |
| | 10 kHz to 1 MHz | — | 6 | — | — | 6 | — | — | 6 | — | — | 6 | — | — | 5 | — | mV rms |
| INPUT RIPPLE | 0 to 20 MHz | — | 140 | — | — | 210 | — | — | 210 | — | — | 210 | — | — | 130 | — | mA p-p |
| | 10 kHz to 1 MHz | — | 45 | — | — | 70 | — | — | 70 | — | — | 70 | — | — | 40 | — | mA rms |
| TRANSIENT | 50% to 75% STEP | | | | | | | | | | | | | | | | |
| RECOVERY[3] | | — | 100 | — | — | 250 | — | — | 250 | — | — | 400 | — | — | 500 | — | µs |
| RESPONSE[4] | | — | 130 | — | — | 90 | — | — | 250 | — | — | 350 | — | — | 125 | — | mV pk |
| STABILITY | SHORT TERM[5] | — | <0.05% | — | — | <0.05% | — | — | <0.05% | — | — | <0.05% | — | — | <0.05% | — | 24 HRS |
| | LONG TERM | — | <0.1% | — | — | <0.1% | — | — | <0.1% | — | — | <0.1% | — | — | <0.1% | — | 1000 HRS |

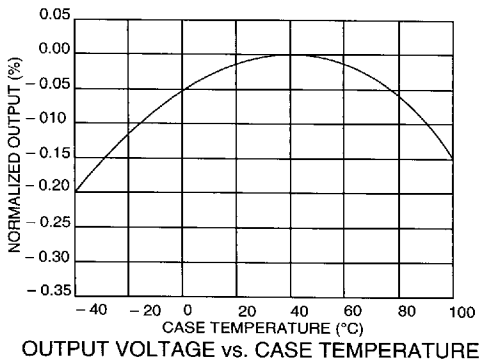
**Notes:**
1. Maximum transient duration is 100 milliseconds.
2. To simulate normal PCB decoupling, a 0.01 µF ceramic capacitor and a 1 µF tantalum capacitor are placed one inch from the converter when measuring output noise.
3. The time required to settle from a 50% to 75% step load change to within a 1% error band with a step rise time of 2 µs.
4. The peak overshoot during a transient as defined in note 3.
5. Following a 30 minute warm-up at full load and constant line voltage — the output voltage drift over a 24 hour period.

## TYPICAL PERFORMANCE CURVES (ALL MODELS UNLESS OTHERWISE NOTED)



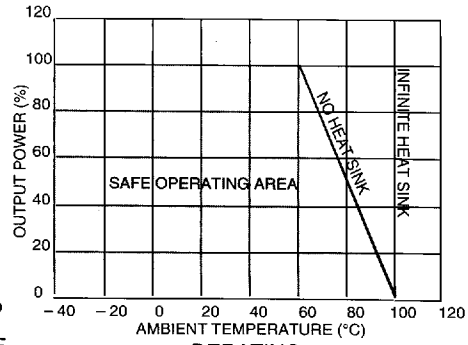

OUTPUT IMPEDANCE vs. FREQUENCY

**Figure 1**



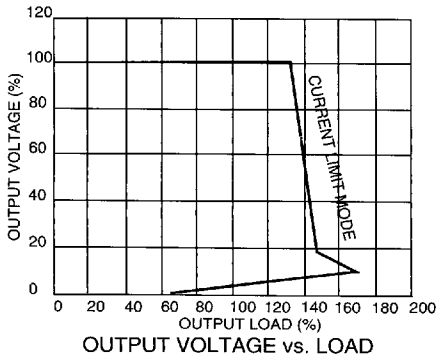

OUTPUT VOLTAGE vs. CASE TEMPERATURE

**Figure 2**



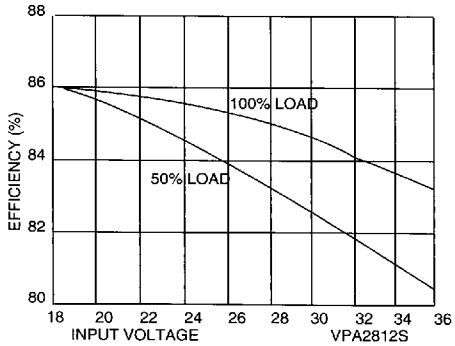

DERATING

**Figure 3**



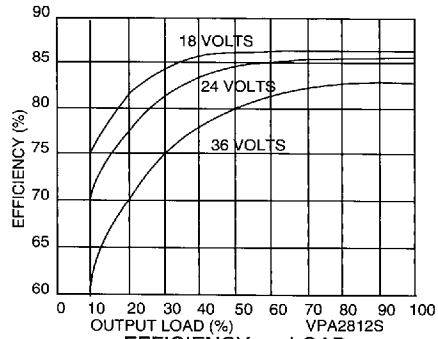

OUTPUT VOLTAGE vs. LOAD

**Figure 4**



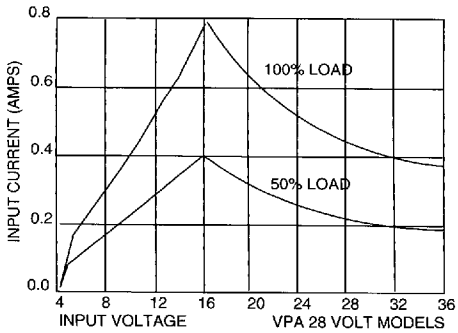

EFFICIENCY vs. LINE

**Figure 5**



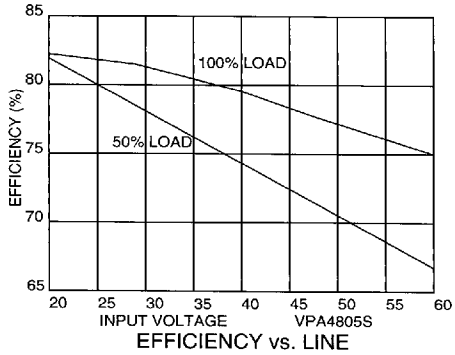

EFFICIENCY vs. LOAD

**Figure 6**



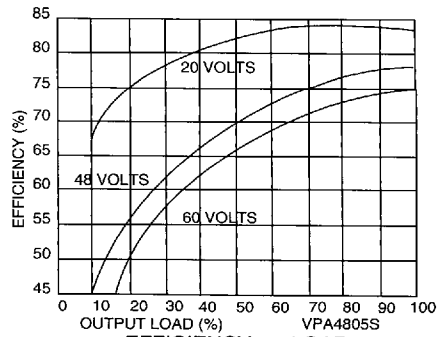

INPUT CURRENT vs. INPUT VOLTAGE

**Figure 7**



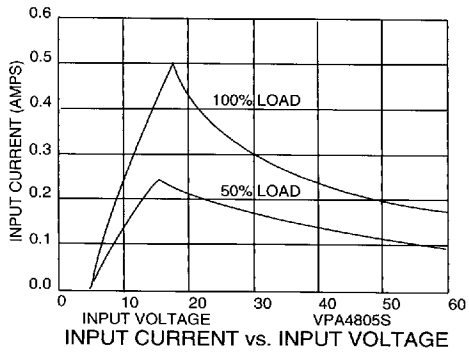

EFFICIENCY vs. LINE

**Figure 8**




EFFICIENCY vs. LOAD

**Figure 9**




INPUT CURRENT vs. INPUT VOLTAGE

**Figure 10**

NOTES:

1. The input current curves are for 10.8 watts of output power (figure 7).
   For 3.3 volt models the input current is approximately 35% less.
2. The efficiency curves were generated for 12 volt output models (figures 5 and 6).
   For other output models use the following adjustments:
   For the 3.33 volt output models, subtract approximately 3%
   For the 5.0 volt output models, subtract approximately 2%
   For the 15.0 volt output models, subtract approximately 1%

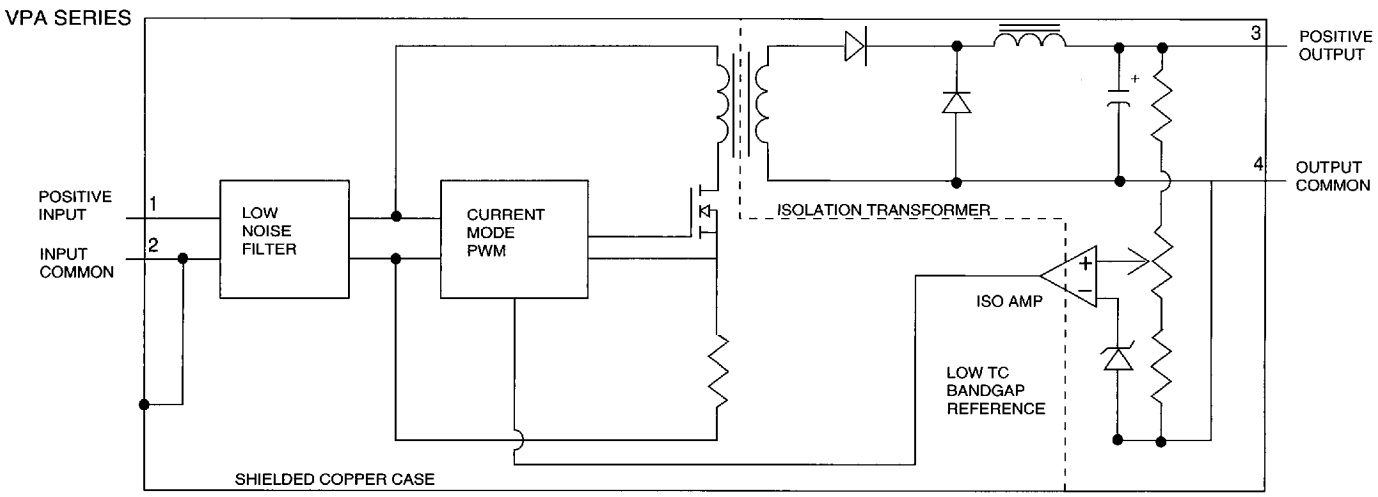
## OPTIONAL ENVIRONMENTAL SCREENING

Environmental screening consists of the following procedures (Methods and Conditions refer to MIL-STD-202):

- 96 hours of burn-in at 85°C, per method 108.
- Mechanical shock per method 213, condition D.
- Temperature shock per method 107, condition A (modified).
- Final electrical test per Interpoint acceptance test procedure.

To order optional screening, add suffix -/ST to model number. Example: VPA2805S/ST. On unscreened parts, the screening code block is blank. On screened parts, the block is marked "ST."

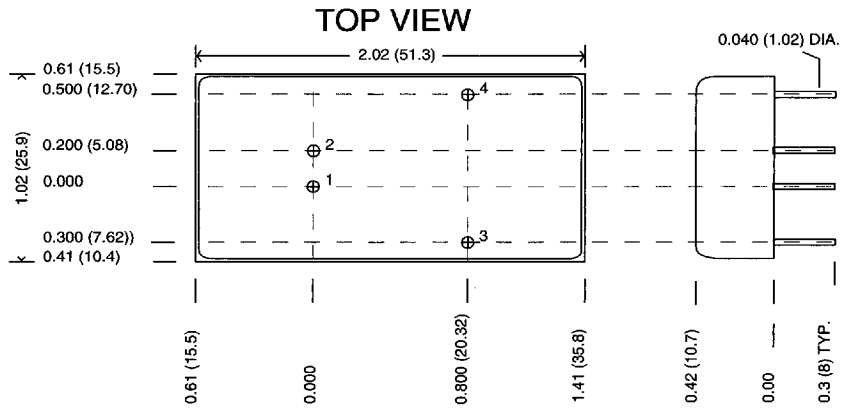
## BLOCK DIAGRAM




## METAL AND EPOXY CASE

| Designation | Pin # |
|---|---|
| Positive input | 1 |
| Input common | 2 |
| Positive output | 3 |
| Output common | 4 |

Note: Case is connected to input common (pin 2).




VPA SERIES CASE DRAWING
NOMINAL CASE DIMENSIONS IN INCHES (MM)
TOLERANCE X.XX ±0.020 (0.51), X.XXX ±0.005 (0.13)