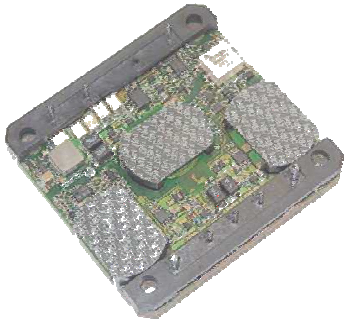
# HEHB-50A-48V-3.3V

## $48V_{in}$ $50A_{out}$ $3.3V_{out}$ DC-DC Converter
## High Efficiency, Isolated Half Brick

### Features

- Very high efficiency: 91% at 25A load, 90% at full rated load current
- Wide input voltage range (35 to 75Vdc)
- Total weight: 77 grams (2.67 oz.) Open-Frame Version
- Low profile, industry standard footprint and pinout: 2.3" x 2.4" x 0.44" (58.4mm x 61.0mm x 11.2mm)
- Back Bias protection
  Monolithic start-up, with pre-biased output
- Parallel for increased power:
  External Clock Synchronization (Option)
  Current Share, Primary (Option)
- Soft Start
- Remote ON/OFF
- Output voltage trim – Industry standard trim equation
- Remote sense
- Fixed Switching Frequency
  (Output ripple frequency @ 420 KHz)
- Under voltage lockout (UVLO), Input – auto recover
- Over voltage protection – auto recover
- Over current protection – auto recover
- Over temperature protection – auto recover
- Operating temperature range: -40°C to +100°C
- Input to Output Isolation at 2000Vdc, 10MΩ
- Pending- UL/$_C$UL, CSA/CSA$_{US}$, TUV and KEMA
- ISO 9001 Certified manufacturing processes

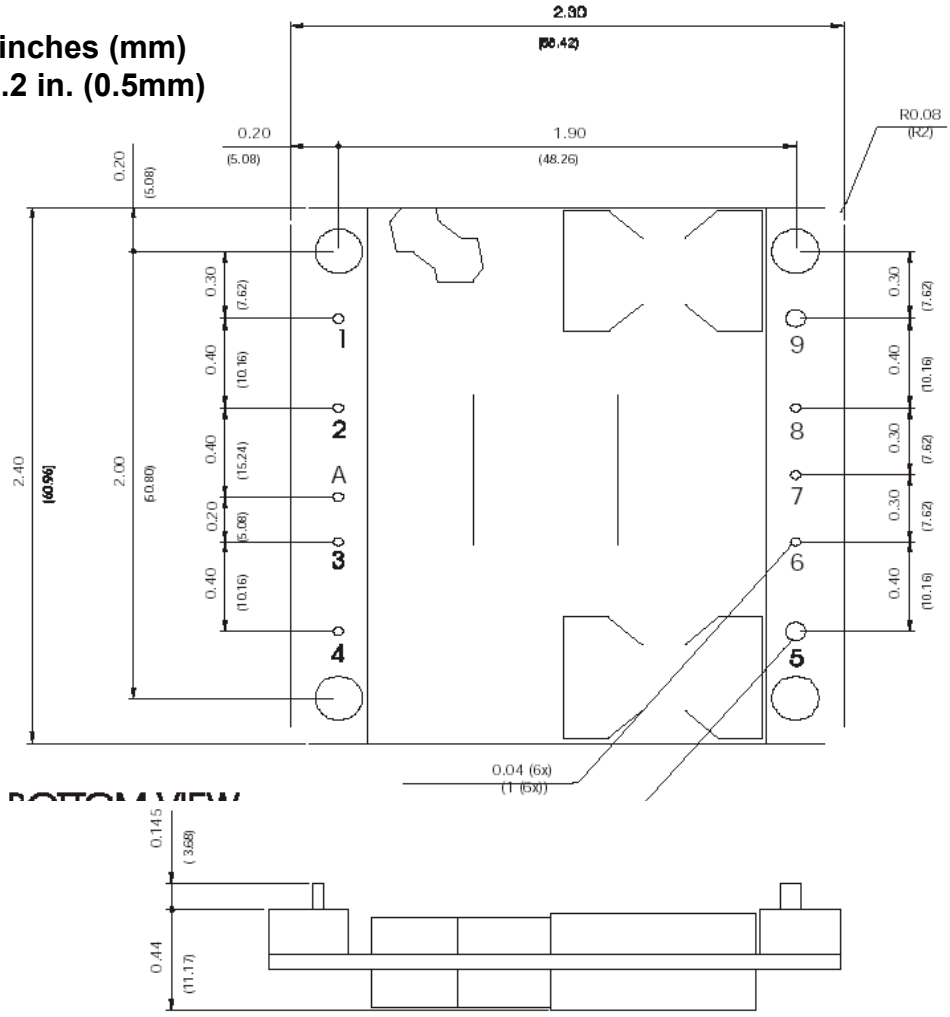


### Product Highlights

- HEHB Family of dc-dc converters is Magnetek's solution for next generation, cutting-edge board applications.
- Synchronous rectification uses MOSFET instead of Schottky diodes providing extreme reduction in heat generation, boosting efficiency, eliminating the need for a heat sink and increased reliability.
- Low profile (0.44"), open frame construction allows smaller card pitch and improves system ventilation.
- Fixed switching frequency provides predictable EMI characteristics.

## Mechanical Drawings

**- All dimensions are in inches (mm)**
**Tolerances: x.xx in. +/-0.2 in. (0.5mm)**




SIDE VIEW

| PINOUT Description | | |
|---|---|---|
| **Pin** | **Name** | **Function** |
| 1 | Vin (-) | Negative terminal for the input bus |
| 2 | (No Pin) | Optional Current Share, -F Only |
| A | (No Pin) | Optional Clock Sync, -F Only |
| 3 | ON/OFF | Remote Enable/Disable terminal, input signal TTL |
| 4 | Vin (+) | Positive terminal for the input bus |
| 5 | Vout (+) | Positive terminal for output voltage |
| 6 | Sense (+) | Positive remote sense |
| 7 | TRIM | Output voltage TRIM |
| 8 | Sense (-) | Negative remote sense |
| 9 | Vout (-) | Return terminal for output voltage |

## Specifications

# HEHB–50A–48V–3.3V

(Typical values are at nominal input line, full load, airflow 300 LFM, 25°C ambient temperature unless otherwise specified)

| Input Characteristics | Notes & Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| Operating Input Voltage Range | Note 1 | 35 | 48 | 75 | V |
| Input Surge Voltage | T< 100msec | | | 100 | V |
| Input Under-Voltage Lockout | | | | | |
| *Turn-On Voltage Threshold* | | | | 35.4 | V |
| *Turn-Off Voltage Threshold* | | | | 32.1 | V |
| *Lockout Hysteresis Voltage* | | | 3.3 | | V |
| Maximum Input Current ($I_{INmax}$) | $V_{IN}$=36V; Full Load at nominal output voltage | | | 5.2 | A |
| No-load Input Current | | | 60 | 70 | mA |
| Off Converter Input Current | | | 11 | 13 | mA |
| | | | | | |
| Inrush Current Transient Rating | | | 0.03 | | $A^2s$ |
| Input Reflected-Ripple Current | RMS; see figures 6,7,8 | | 10 | 15 | mA |

| Output Characteristics | Notes & Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| Output Voltage Set Point | 50 % Load | 3.27 | 3.30 | 3.33 | V |
| Output Voltage Regulation | | | | | |
| *Over Load* | | | ± 5 | ± 8 | mV |
| *Over Line* | | | ± 4 | ± 6 | mV |
| *Over Temperature* | | | ± 10 | ± 25 | mV |
| Total Output Voltage Range | over sample, line, load, temperature and life | 3.24 | | 3.36 | V |
| Output Voltage Ripple and Noise | 20 MHz bandwidth | | | | |
| *Peak to Peak* | Full load see figures 6 & 9 | | 30 | 60 | mV |
| *RMS* | | | 6 | 10 | mV |
| Operating Output Current Range | | 0 | - | 50 | A |
| Output DC Current Limit Inception (hiccup mode: 30msec ON, 220msec OFF) | See Figure 5 | 55 | | 60 | A |
| Admissible Output Capacitance | Full load, resistive | 0 | | 50,000 | µF |

| Dynamic Characteristics | Notes & Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| Output Voltage during Load Current Transient | 15µF load cap. 5A/µs; see figure 3,4 | | | | |
| *Step Change in $I_{OUT}$ (0.1A/µs)* | 50% to 75% Iout max | | 65 | | mV |
| *Step Change in $I_{OUT}$ (1A/µs)* | 75% to 50% Iout max | | 130 | | mV |
| *Settling Time to 1% of Vout nom* | | | | 200 | µs |
| Turn On Transient | See figures 1, 2 | | | | |
| *Turn On Time* | Full load | | 160 | 200 | ms |
| *Rise time* | From 10% to 90% Vnom | | 20 | 40 | ms |
| *Output Voltage Overshoot* | 10,000 µF load capacitance, Iout= 0A | | 0 | | % |

| Efficiency | Notes & Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| 100% Load | Vin = 50V | | 91 | | % |
| 75% Load | | | 92 | | % |
| 50% Load | | | 91 | | % |

**NOTE 1 :** Absolute max. continuous input voltage = 80V (operating) ; 100V (Surge).

| Isolation Characteristics | Notes & Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| | | | | | |
| Isolation Voltage input to output | Basic isolation | 2000 | | | $V_{DC}$ |
| | | | | | |
| Isolation Voltage Input to plate | Basic isolation | 2000 | | | $V_{DC}$ |
| Isolation Capacitance | | | 2200 | | pF |
| Isolation Resistance | | 10 | | | MΩ |

| General Characteristics | Notes & Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| Operating Range Temperature | With appropriate power derating | -40 | | +100 | °C |
| Storage Temperature | Maximum Rating | -50 | | +120 | °C |
| Relative Humidity | Non condensing | 5 | | 95 | % |
| Calculated MTBF | Bellcore Issue 4<br>RDF93 HRD Issue 5 | TBA | | | |

| Feature Characteristics | | Min. | Typ. | Max | Units |
|---|---|---|---|---|---|
| Switching frequency | | | 420 | | kHz |
| ON/OFF Control | | | | | |
| *Off-State Voltage* | | 1.5 | | 5 | V |
| *On-State Voltage* | | 0 | | 1.2 | V |
| Output Voltage Trim Range | | -20 | | +10 | % |
| Current Share (-F Option) | 50% of $I_{MAX}$ | | ± 3 | ± 5 | % |
| Output Over-Voltage Protection | | 115 | 120 | 130 | % |
| Over-Temperature shutdown | PCB Hot spot | | 125 | | °C |

| Safety and Regulatory (PENDING) |
|---|
| TUV and KEMA certified for basic insulation compliance to EN06950 requirements<br>UL and CSA 22.2 No. 950-95(US and Canada) certified with basic insulation for compliance to UL60950.<br>Note : An external input fuse must always be used for compliance to listed safety requirements. |
| CE compliant per 72/23/EEC (Low voltage directive) and 93/68/EEC to facilitate CE Mark at system level. |
| Material flammability rating, UL94V-0 |
| NEBS compliant |

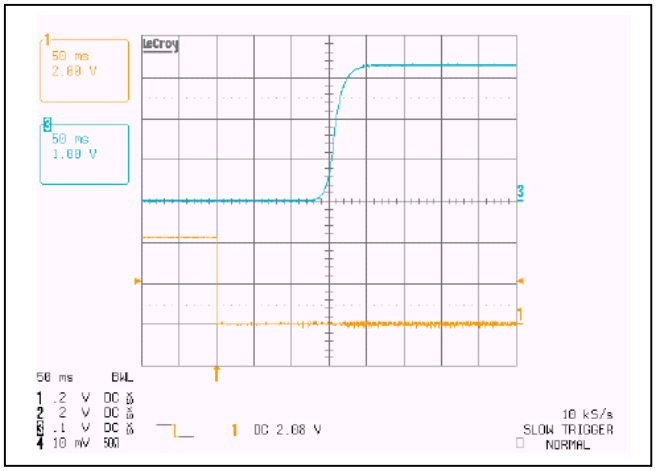



**Figure 1**. *Vout,* Turn-on transient at full rated current (resistive load) (Vin=48V) (5 ms/div, 0.5V/div)

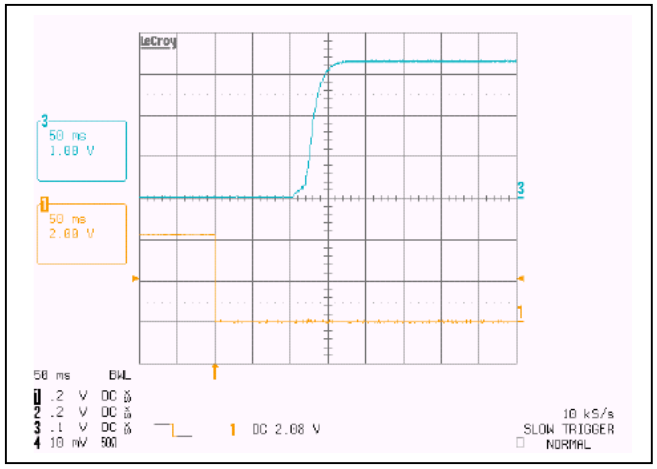



**Figure 2**. *Vout,* Turn-on transient at NO load (Vin=48V) (5 ms/div, 0.5V/div)

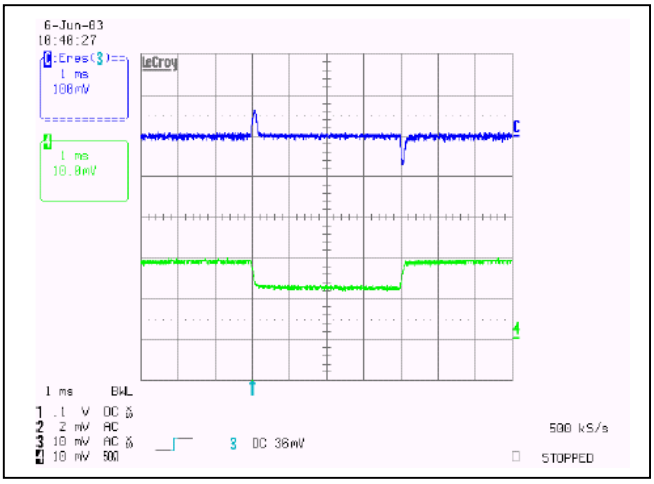



**Figure 3**. Output voltage response to dynamic change in load current: 75% $I_o$ to 50%$I_o$ , where:
di / dt = 0.1 A / μs
Load capacitance: 15μF, 30 mΩ ESR tantalum
1μF ceramic capacitor

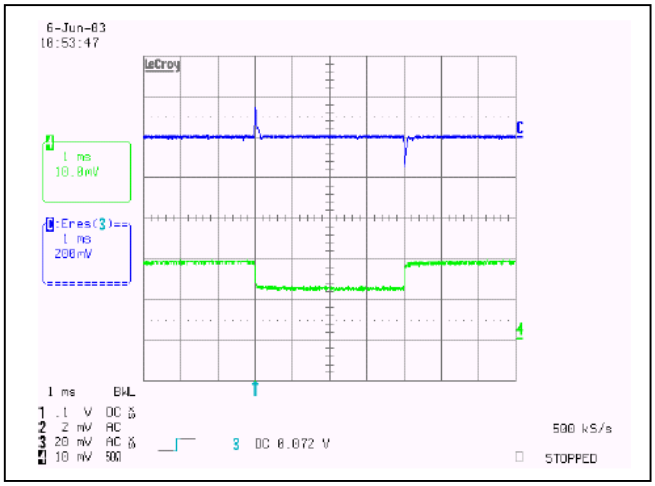



**Figure 4**. Output voltage response to dynamic change in load current: 75% $I_o$ to 50%$I_o$ , where:
di / dt = 1.3 A / μs
Load capacitance: 15μF, 30 mΩ ESR tantalum
1μF ceramic capacitor

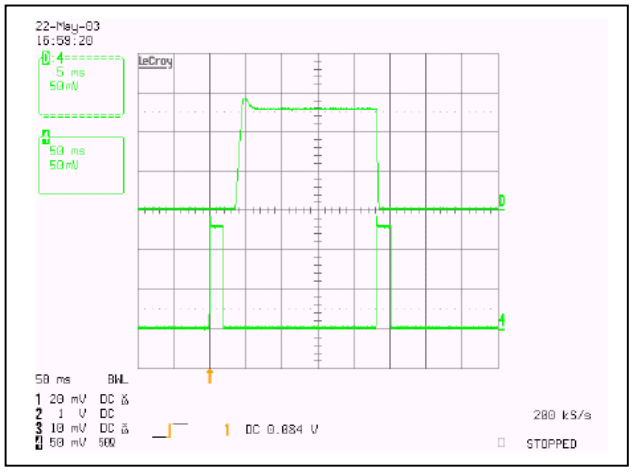



**Figure 5**. Output current (50A/div) as a function of time while attempting to enable into a short circuit, <10mΩ.
Top trace is an expansion of time of the bottom trace.

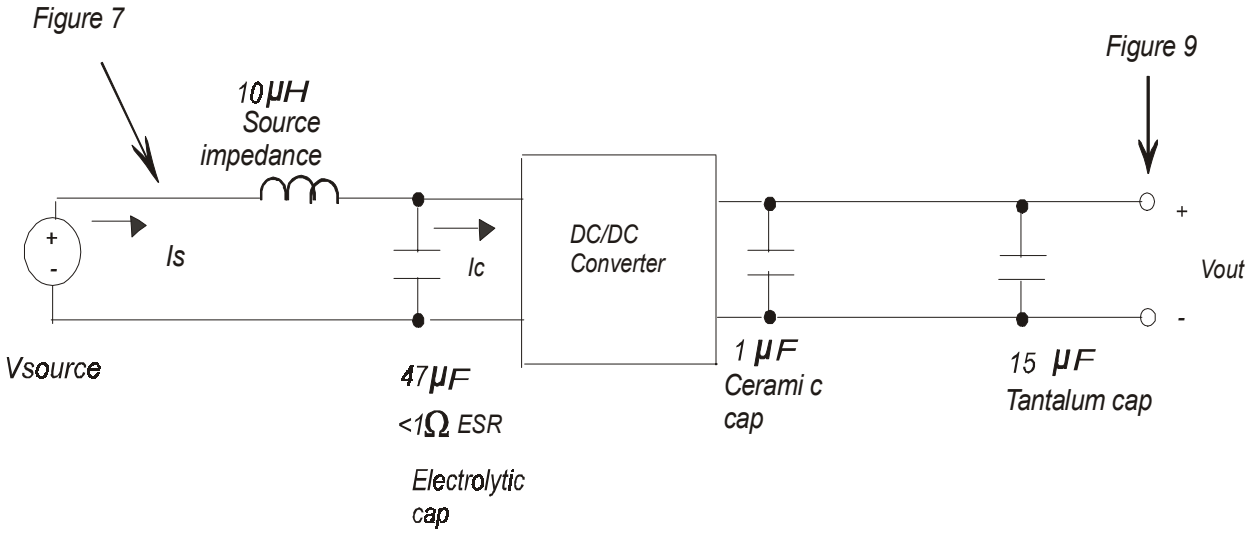



**Figure 6**. Test set-up diagram showing measurement point for Input Reflected Ripple Current and Output Voltage Ripple.

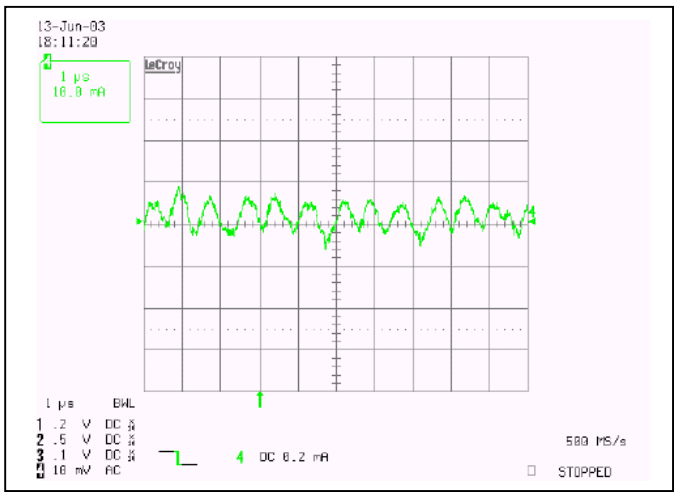



**Figure 7**. Input Reflected Ripple Current, set-up per figure 6; 10µH source impedance. Nominal input voltage at full rated load.

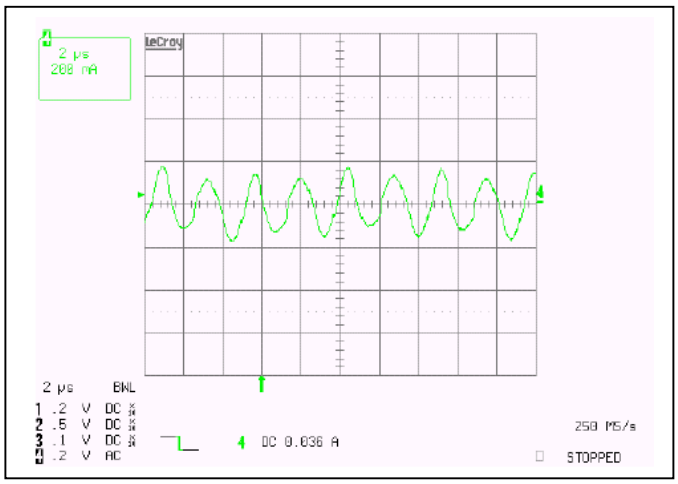



**Figure 8**. Input terminal ripple current (ic) at full rated load and nominal input voltage.

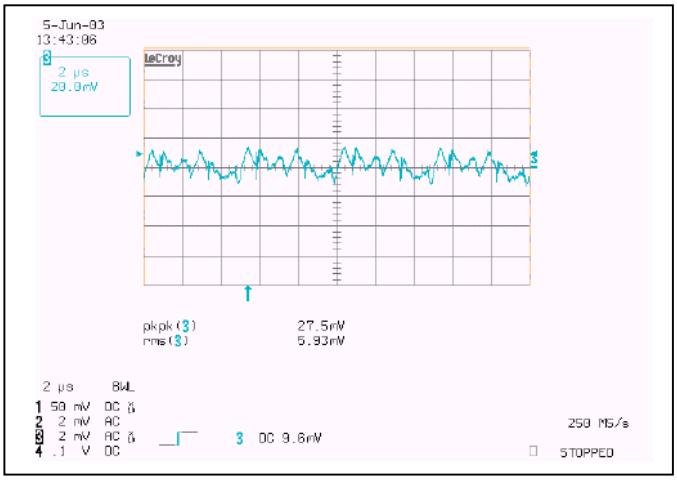



**Figure 9**. Output Voltage Ripple at Nominal input voltage and full rated load, set-up per figure 6, where:
Bandwidth; 20kHz
Load Capacitance; 15µF electrolytic capacitor
1µF ceramic capacitor

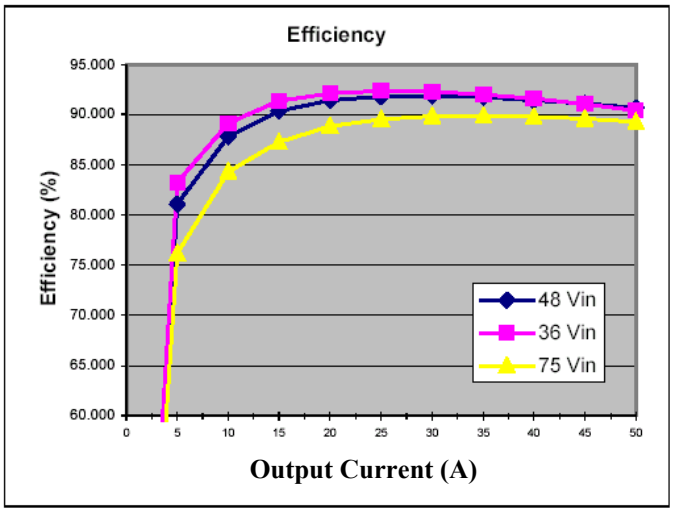



**Figure 10**. Efficiency vs. load current for minimum, nominal and maximum input voltage at 25°C.

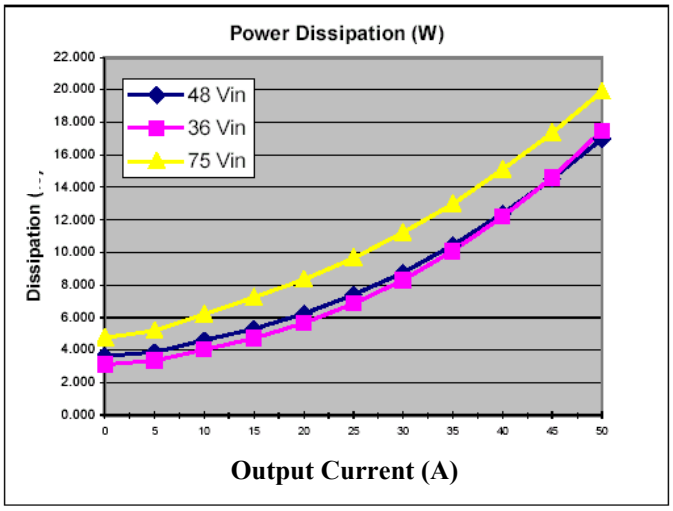



**Figure 11** Power dissipation vs. load current for minimum, nominal and maximum input voltage at 25°C.

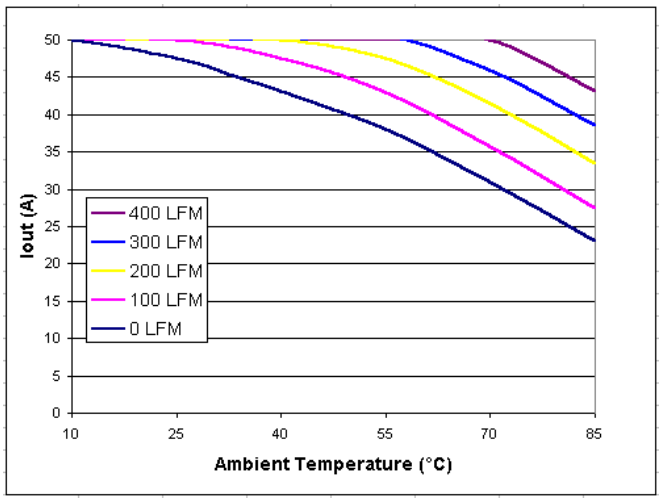



**Figure 12**: Maximum output current de-rating curves vs. ambient air temperature for airflow rates of 0 LFM through 400 LFM with air flowing from **input to output** and nominal input voltage.

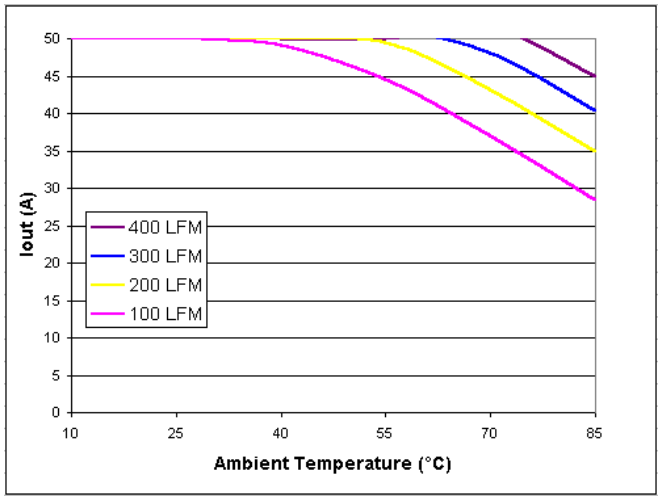


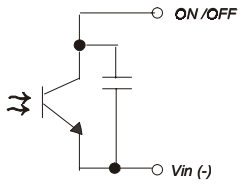

**Figure 13**: Maximum output current de-rating curves vs. ambient air temperature for airflow rates of 100 LFM through 400 LFM with air flowing from **pin 1 to pin 4 (Transversal)** and nominal input voltage.

## Features and Pins description

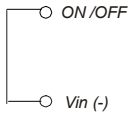
### REMOTE ON-OFF CONTROL

The default logic is negative, where the Remote On/Off (pin 2) input is referenced to -Vin (pin 1). The Remote On/Off signal must be lower than 0.8V to enable the output voltage, and higher than 2.7V to disable the output voltage.

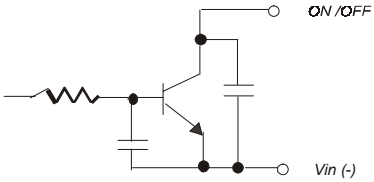
**Positive logic is an available option, add "–P" to the end of the ordering code.**



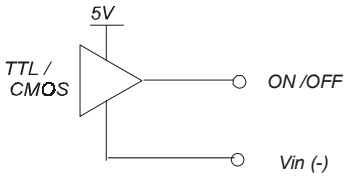

Remote Enable Circuit




Negative logic
(permanently Enabled)




Open Collector Enable Circuit



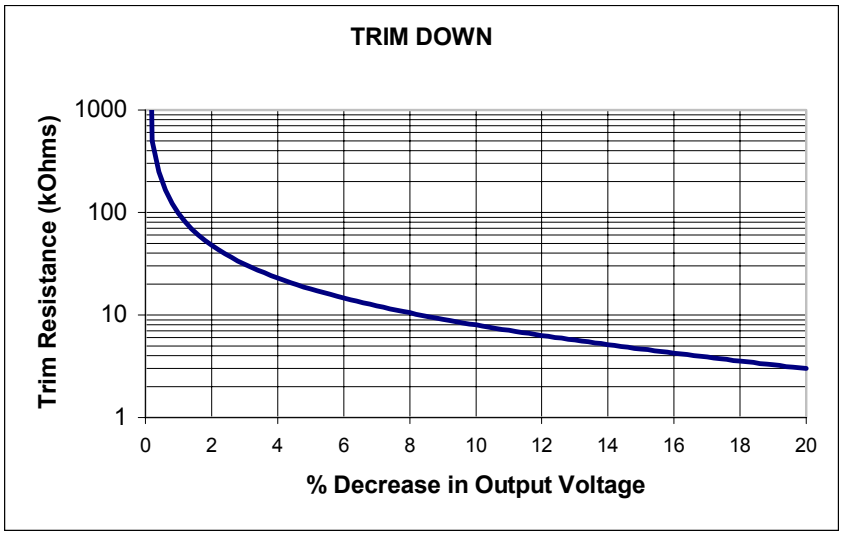

D i r e c t L o g i c D r i v e

### TRIMMING

The output voltage can be trimmed by means of an external resistor connected between Trim (pin 6) and +Sense (pin 6) or -Sense (pin 8). The selection of the resistor follows the industry standard trim equation.

An external resistor connected between Trim and –Sense pins will decrease the output voltage. For a decrease of $\Delta$% of the nominal output voltage, calculate the value of the external resistor using the following equation:

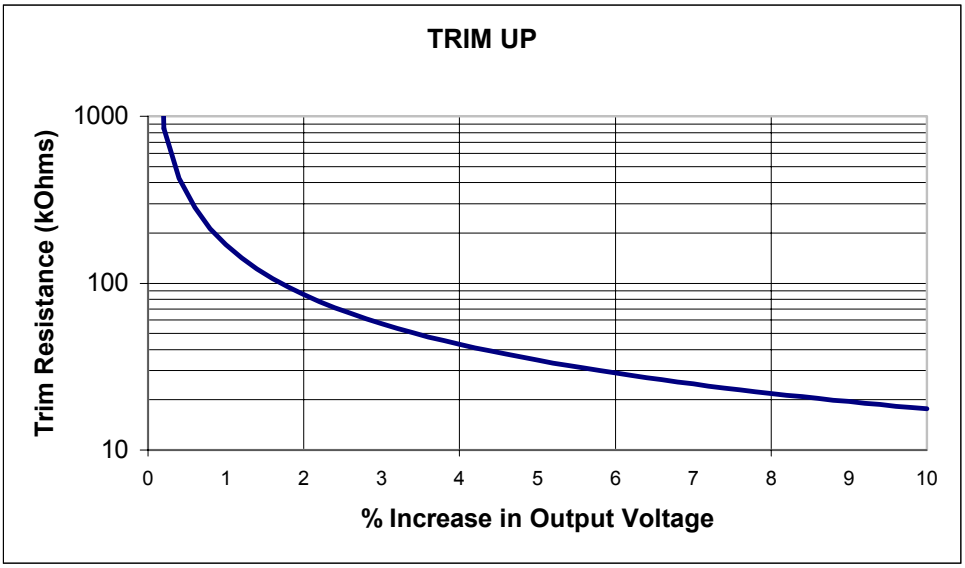
$$\mathbf{R_{trim\text{-}down}} = \left(\frac{100\%}{\Delta}\right) - 2k\Omega, \quad \text{where} \quad \Delta = \left(\frac{V_{nominal} - V_{target}}{V_{nominal}}\right) \times 100\%$$



A resistor connected between Trim and + S pins will increase the output voltage. For a desired increase of ∆% of the nominal output voltage, the value of the resistor should be:

$$\mathbf{R_{trim\text{-}up}} = \frac{\left(\frac{V_{nom}}{V_{ref}} - 2\right) \bullet V_{tar} + V_{nom}}{V_{tar} - V_{nom}} k\Omega ,$$

Where $V_{nom}$ = Nominal Voltage, $V_{tar}$ = Target Voltage, $V_{ref}$ =1.225 V




## SENSE (+ or -)

The +Sense or –Sense pins must be connected to the load or output pins of the converter. To ensure tight regulation at the system critical load, then the remote sense pins should be connected to the system critical load. Reference applicable section of data sheet for maximum voltage compensation.

Ensure sufficient margin to the over voltage threshold, review applicable sections of the data sheet and system loading: output over-voltage protection –Vs- system transient load condition(s).

## THERMAL CONSIDERATIONS

The converter has internal thermal protection preventing hot spots on PCB from exceeding MFR's recommended temperatures for reliable operation, reference over temperature protection threshold (Section: Feature Characteristics). Margin to the temperature protection limit should be verified in the application, and should not exceed 120°C on the thermal reference points as shown in Figure 14.

During an abnormal condition inducing an increase in the converter temperature, the converter output voltage will fold back when the over temperature protection threshold is reached. The converter will auto-recover when the fault condition is corrected and time allowed for the converter to cool down.

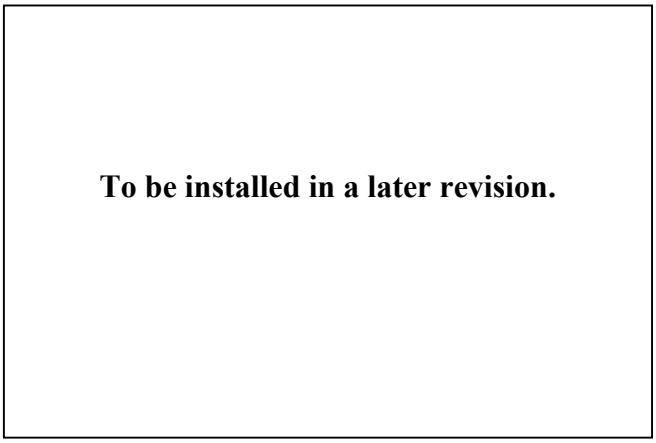



**Figure 14,** Thermal reference points

## OVER CURRENT PROTECTION

The overcurrent limit inception is typically 110% of the rated output current will cause the output voltage enter fault protection, or hiccup reference Figure 5. The converter will enter fault protection typically at 125% of rated output current. When the fault is removed the converter will auto recover.

## Ordering information:

| Product Family Code | Rated Output Current | Input Voltage | Output Voltage | Option 1- Remote On/Off Logic | Option 2- Mechanical | Option 3- Parallel | Option 4- Pin Length |
|---|---|---|---|---|---|---|---|
| HEHB | 50A | 48V | 3.3V | Default → Negative<br>P → Positive | Default → Open Frame<br>PL → Cold Plate | Default→ None<br>F→ Clock Sync & Current share | Default → 0.15”<br>1 → 0.25”<br>2 → 0.11”<br>3 → 0.20” |

**Example** **HEHB-50A-48V-3.3V-PPLF1** Standard Half Brick with Positive Logic Remote On/Off, Cold Plate, (Clock Sync and Current Share) and 0.25” pin length options.

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