# HHS04

High-Efficiency 200W Half Brick DC/DC Converter

## FEATURES

- 52.5V 200W Half-Brick DC/DC Converter
- High-Efficiency 92% at Full Load
- 2250Vdc Isolation
- Remote-Sense
- Remote on/off
- Trim Capability
- Industry Standard Pin-out
- 0.42" (10.67mm) Height

## DESCRIPTION

The HHS04-520 is an industry standard foot-print half-brick DC/DC converter that complies with IEEE802.3af standard for Power over LAN applications, which requires basic isolation of 2250Vdc and stringent start-up characteristics and low-noise operation. It delivers 200W of isolated 52.5V at 92% efficiency over voltage input range of 36V to 75V. Standard features are remote on/off, remote sense, trim capability, over-voltage, over-current and over-temperature protection. The HHS04-520 can operate in parallel for additional power with external circuitry. The HHS04-520 measures 2.40"(L) x 2.28"(W) x 0.43"(H) and has an operating temperature range of –40°C to +100°C.

## SELECTION GUIDE

| Order Code | Input Voltage | Output Voltage | Output Current | Output Power | Efficiency |
|---|---|---|---|---|---|
| | V (nom.) | V | A | W (MAX.) | % (TYP.) |
| **HHS04-520-0B** | 48 | 52.5 | 3.81 | 200 | 92.0% |

## INPUT CHARACTERISTICS

| Parameter | Conditions | MIN. | TYP. | MAX. | Units |
|---|---|---|---|---|---|
| Input Voltage | | 36 | 48 | 75 | V |
| Under Voltage Lockout | Turn-on | 32 | | 36 | |
| | Turn-off | 30 | | 34 | |
| | Turn-on | 75 | | 79 | |
| | Turn-off | 76 | | 80 | |
| Reflected Ripple | 12µH Source Inductance | | | 7.5 | mA p-p |
| Inrush Transient | | | | 2 | $A^2s$ |

## OUTPUT CHARACTERISTICS

| Parameter | Conditions | MIN. | TYP. | MAX. | Units |
|---|---|---|---|---|---|
| Voltage set point | | 51.30 | 52.50 | 53.88 | Vdc |
| Risetime | 10% to 90% | 5 | | 30 | mSec |
| Turn-on delay | Enable <2V to $V_{OUT}$ >10% | | | 100 | mSec |
| Line regulation | | | | ±0.1% | $V_{OUT}$ |
| Load regulation | | | | ±0.22% | |
| Total regulation[1] | | 50.93 | | 54.08 | $V_{DC}$ |
| Output trim[6] | | -2.5 | | +0.5 | |
| Remote-sense[6] | | 0.5 | | | |
| Transient response | 50% to 75% of Iomax 1A/µs | | ±3% | | Vo |
| | 50% to 25% of Iomax 1A/µs | | ±3% | | |
| Over-voltage (latching) | | 58 | | 65 | $V_{DC}$ |
| Over-current (self recovery) | | 4.5 | | 6.5 | $A_{DC}$ |
| Output ripple & noise[2] | <500kHz | | | 150 | mV p-p |
| | 500kHz to 1MHz | | | 50 | |
| | >1MHz | | | 30 | |
| External capacitance[3] | | 200 | | 1000 | µF |

## GENERAL CHARACTERISTICS

The enable signal is logic low, referenced to Vi(-). The pin should be tied to Vi(-) if it is not used. (Isink = 1mA MAX., Voff =15V MAX.).

## TEMPERATURE CHARACTERISTICS

| Parameter | Conditions | MIN. | TYP. | MAX. | Units |
|---|---|---|---|---|---|
| Operating[4] | Measured on baseplate | -40 | | 100 | °C |
| Storage | | -55 | | 125 | |

## PROTECTION CHARACTERISTICS

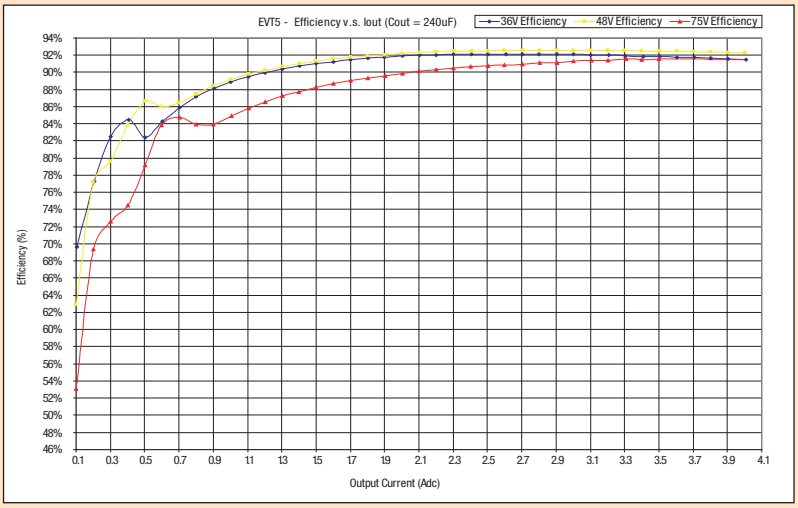
| Parameter | Conditions | MIN. | TYP. | MAX. | Units |
|---|---|---|---|---|---|
| Over-temperature[5] (Self-recovery) | Temperature at sensor | 109 | 115 | 121 | °C |

1. Includes line & load regulation/thermal & aging effects on regulation.
2. 10µF low ESR electrolytic + 1µF ceramic de-coupling capacitor at measurement point.
3. At least minimum external capacitance required.
4. Baseplate operating temperature measured at indicated Temperature Measurement Location with 200LFM airflow over entire converter.
5. Over-Temperature Protection sensor trip range. Sensor is located on inner surface of FR4 PC Board to protect components on entire converter.
6. Remote Sense and Output Trim are not additive.

## ISOLATION CHARACTERISTICS

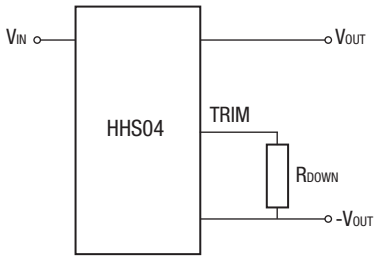
| Parameter | Conditions | MIN. | TYP. | MAX. | Units |
|---|---|---|---|---|---|
| Input-Output | | | | 2250 | Vdc |
| Input-case/Output-case | | | | 1125 | |
| Isolation capacitance | | 1500 | | 4500 | pF |
| Isolation resistance | | 10 | | | MΩ |
| Insulation class, Certified to C-CSA-US, 60950 | Basic | | | | |

## EFFICIENCY CURVES

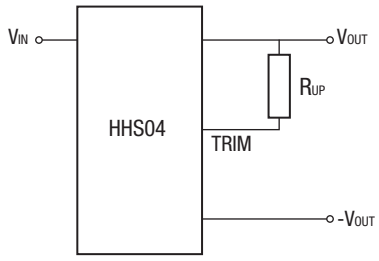



## OUTPUT VOLTAGE ADJUSTMENT

### TRIM DOWN




### TRIM UP

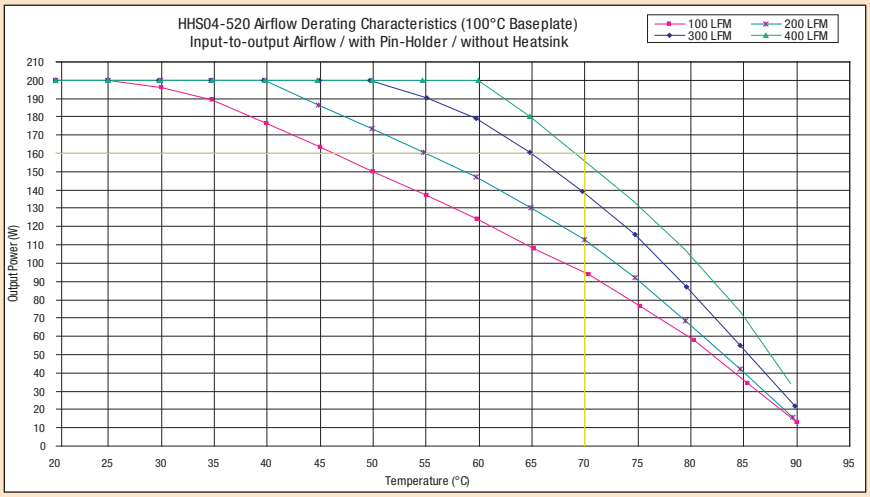


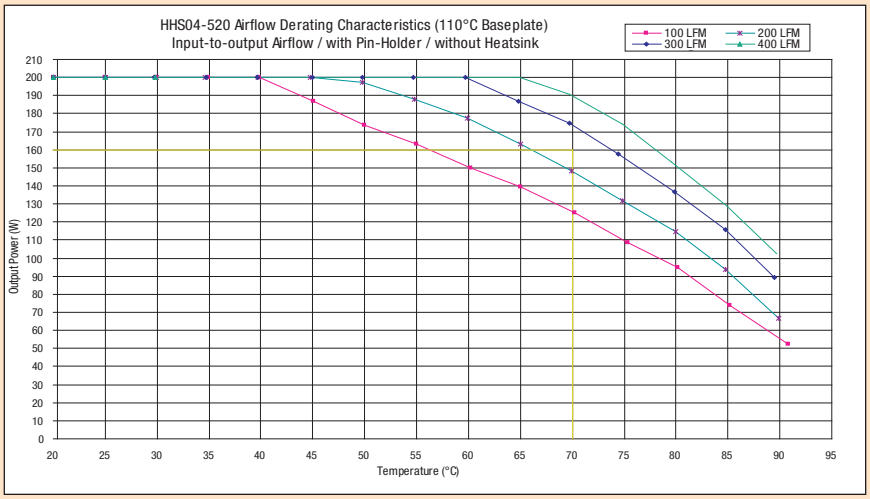

When the output voltage is trimmed up, output current must be derated so that the maximum output power (shown in the selection table) is not exceeded.

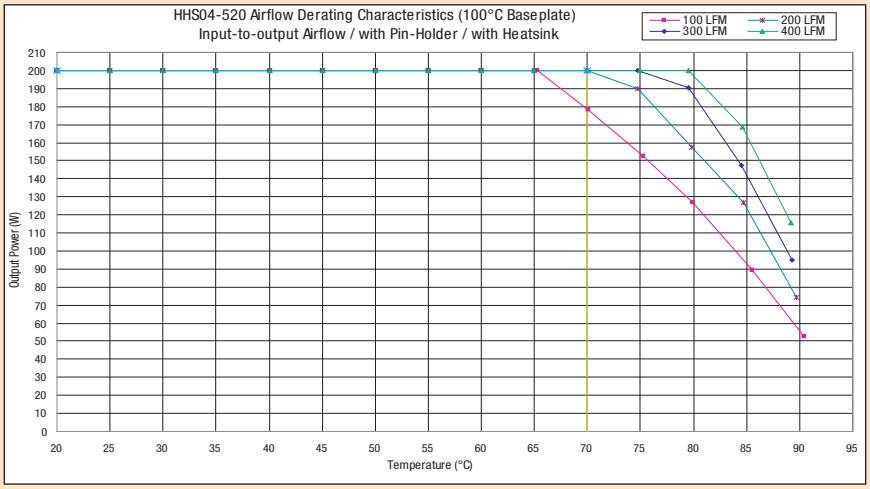
$$Rtrim\_down: = \frac{100}{\Delta\%} - 2 \ (k\Omega)$$

$$Rtrim\_up: = \frac{Vo \cdot (100+\Delta\%)}{1.225 \cdot \Delta\%} - \frac{100+2 \cdot \Delta\%}{\Delta\%} \ (k\Omega)$$

## THERMAL DERATING GRAPHS

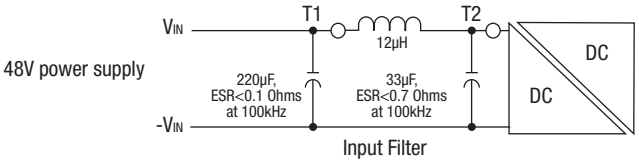



Heatsink used is 2.28" L x 2.4" W x 0.7" H, non-anodized, mounted to baseplate, where noted above.

## INPUT REFLECTED RIPPLE



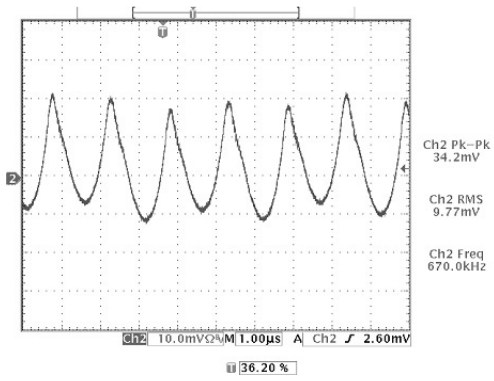

T1: measured between the 48V power supply and the filter.

T2: measured between the filter and the unit under test.

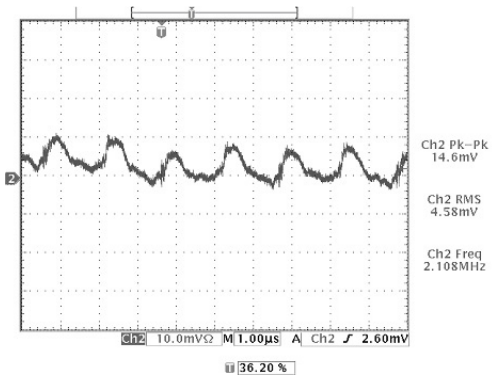
$C_{OUT}$=200µF

| | $I_{OUT}$=0.38A | | $I_{OUT}$=3.8A | |
|---|---|---|---|---|
| | T1 | T2 | T1 | T2 |
| | (mA pk-pk) | (mA pk-pk) | (mA pk-pk) | (mA pk-pk) |
| | (mA rms) | (mA rms) | (mA rms) | (mA rms) |
| 36V input | 1.62 | 65.2 | 2.13 | 87.6 |
| | 0.348 | 22.8 | 0.67 | 24 |
| 48V input | 0.922 | 53.2 | 1.46 | 68.4 |
| | 0.413 | 15.48 | 0.458 | 19.9 |
| 75V input | 0.84 | 30.6 | 1.01 | 34 |
| | 0.404 | 8.81 | 0.51 | 10.6 |

T2: $V_{IN}$=48V $I_{OUT}$:3.8A 20mA/div



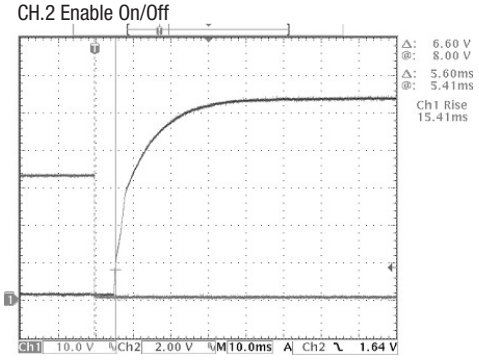

T1: $V_{IN}$=48V $I_{OUT}$:3.8A 1mA/div




## START-UP

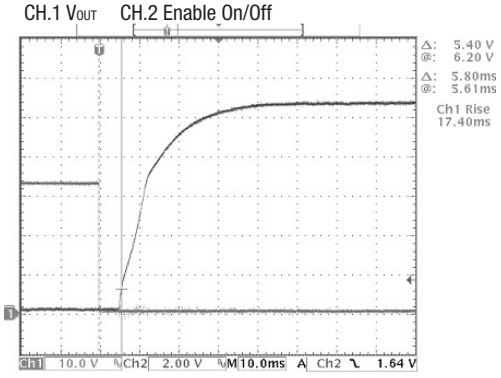
$V_{IN}$=48V $I_{OUT}$=1.0A $C_{OUT}$=240µF

CH.1 $V_{OUT}$ CH.2 Enable On/Off



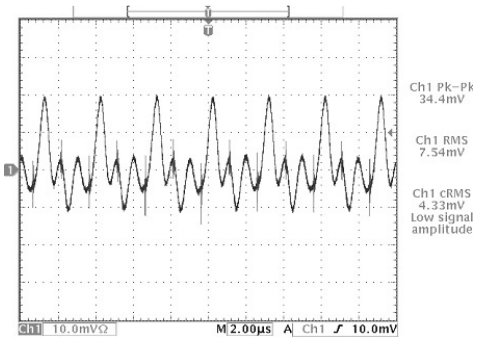

$V_{IN}$=48V $I_{OUT}$=1.0A $C_{OUT}$=1020µF

CH.1 $V_{OUT}$ CH.2 Enable On/Off

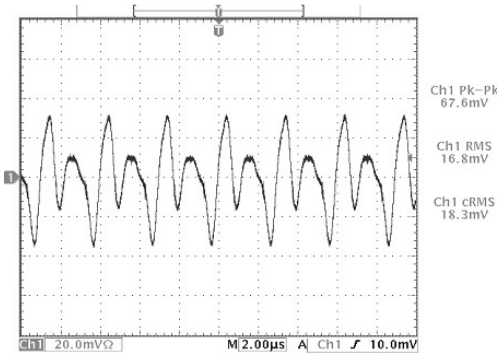


## OUTPUT RIPPLE

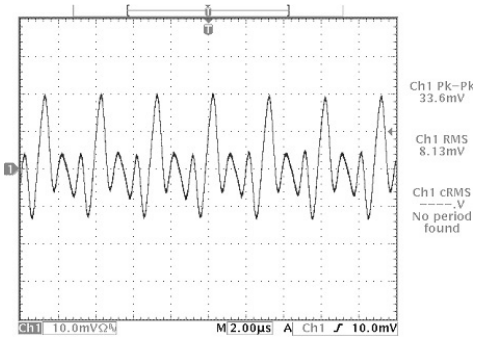
$V_{IN}$=36V $I_{OUT}$=3.81A $C_{OUT}$=240µF



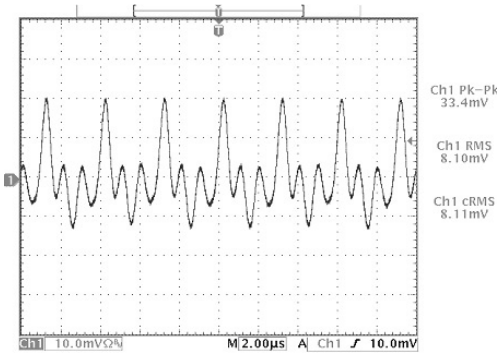

$V_{IN}$=75V $I_{OUT}$=3.81A $C_{OUT}$=240µF




$V_{IN}$=48V $I_{OUT}$=0.81A $C_{OUT}$=240µF

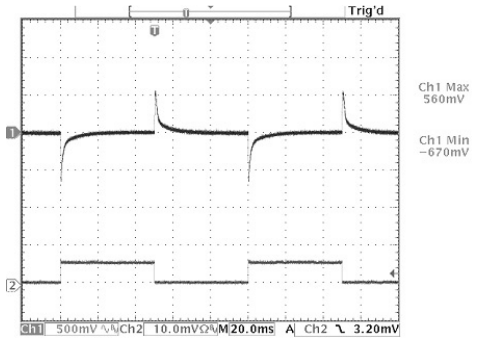



$V_{IN}$=48V $I_{OUT}$=3.81A $C_{OUT}$=240µF

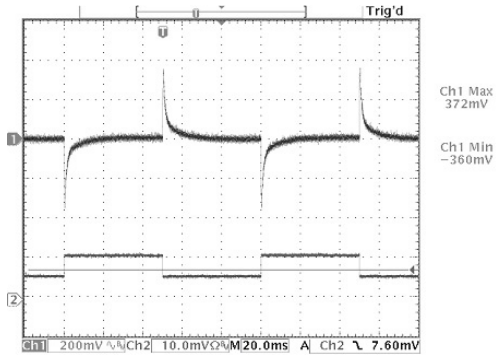



## OUTPUT TRANSIENT RESPONSE

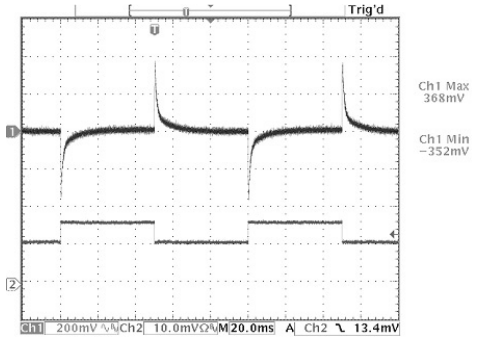
$V_{IN}$=48V $I_{OUT}$=0A-1A $C_{OUT}$=240µF
CH.1 $V_{OUT}$ CH.2 $I_{OUT}$ (1A/10mV)



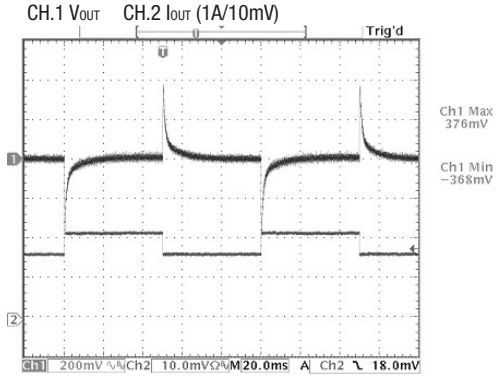

$V_{IN}$=48V $I_{OUT}$=1A-2A $C_{OUT}$=240µF
CH.1 $V_{OUT}$ CH.2 $I_{OUT}$ (1A/10mV)




$V_{IN}$=48V $I_{OUT}$=2A-3A $C_{OUT}$=240µF
CH.1 $V_{OUT}$ CH.2 $I_{OUT}$ (1A/10mV)



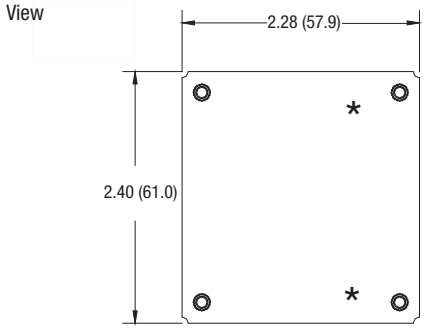

$V_{IN}$=48V $I_{OUT}$=3A-4A $C_{OUT}$=240µF
CH.1 $V_{OUT}$ CH.2 $I_{OUT}$ (1A/10mV)



## PACKAGE SPECIFICATIONS

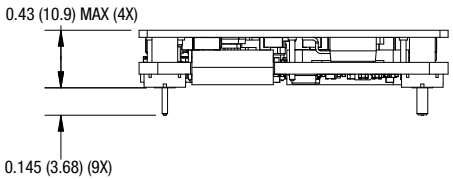
### MECHANICAL DIMENSIONS

Top View

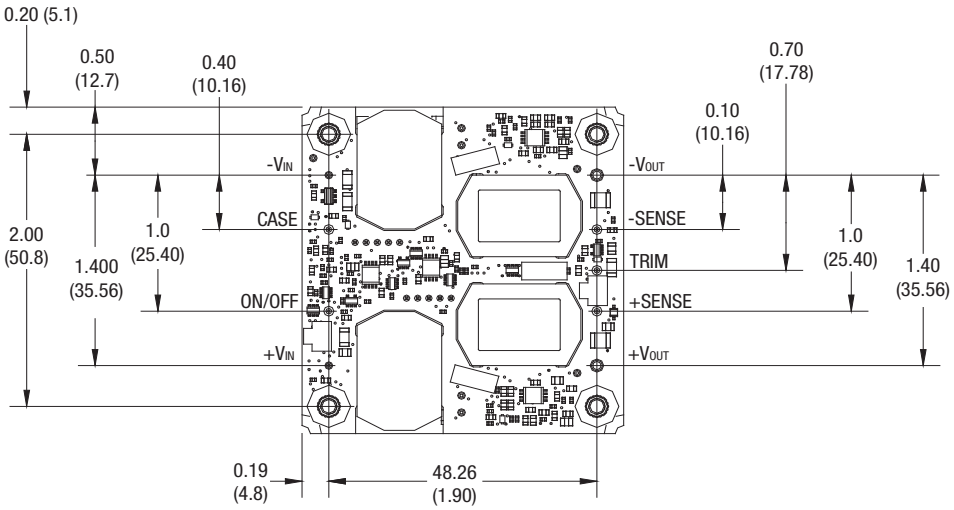



* Temperature measurement location

Side View




Bottom View




### PIN CONNECTIONS

| Pin | Diameter | Function |
|---|---|---|
| 1 | 0.040 (1.016) | $-V_{IN}$ |
| 2 | 0.040 (1.016) | CASE |
| 3* | 0.040 (1.016) | ON/OFF |
| 4 | 0.040 (1.016) | $+V_{IN}$ |
| 5 | 0.080 (2.032) | $+V_{OUT}$ |
| 6 | 0.040 (1.016) | +SENSE |
| 7 | 0.040 (1.016) | TRIM |
| 8 | 0.040 (1.016) | -SENSE |
| 9 | 0.080 (2.032) | $-V_{OUT}$ |

* See General Characteristics

Dimensions: 2.28 (57.9) L x 2.4 (61.0) W x 0.42 (10.6) H
All dimensions in inches (mm).

C&D TECHNOLOGIES



**C&D Technologies, Inc.**
1150 Eglinton Ave. East
Toronto, ON M3C 1H7, Canada

Tel: +1 866 740 1232
Fax +1 416 448 3203
email: sales.cps@cdtechno.com

**C&D Technologies, Inc.**
11 Cabot Boulevard, Mansfield,
MA 02048-1151, USA

Tel: +1 (508) 339-3000
Fax: +1 (800) 233-2765
email: sales@cdtechno.com