

NON-ISOLATED DC/DC CONVERTERS

10.8 Vdc - 13.2 Vdc Input 0.5 Vdc - 1.6 Vdc/120 A Outputs



Apr. 01, 2010

Bel Power Inc., a subsidiary of Bel Fuse Inc.

GRND-C2A160

RoHS Compliant

Rev.B

Features

- Non-Isolated
- Fixed Frequency
- High Efficiency
- 8 bit VID Digital Voltage Programming
- Class 1, Category 2, Non-Isolated DC/DC Converter (refer to IPC-9592)
- Input Under Voltage Lockout
- SCP/OCF
- Remote On/Off
- 2-Wire Remote Sense



Applications

- Networking
- Computers and peripherals
- Telecommunications

Description

The GRND-C2A160 is a non-isolated step down dc/dc converter providing up to 120 A of output current and designed to be compatible with Intel VRM11.1 requirements. Standard features include current monitor, remote on/off, over current protection, remote sense, 8 bit VID digital voltage programming and a power good signal. This product also makes use of selectable adaptive positioning to improve transient response performance. These products may be used almost anywhere low-voltage silicon is being employed and a nominal 12 Vdc source is available. Typical applications include file servers, work stations and other computing applications.

Part Selection

| Output Voltage | Input Voltage | Max. Output Current | Max. Output Power | Typical Efficiency | Model Number Active High |
|----------------|-----------------|---------------------|-------------------|--------------------|--------------------------|
| 0.5 - 1.6 Vdc | 10.8 - 13.2 Vdc | 120 A | 192 W | 84% | GRND-C2A160 |

Note: Add "G" suffix at the end of the model number to indicate "Tray Packaging".

Part Number Explanation

G R ND - C2 A 16 0
1 2 3 4 5 6 7

- 1---Goldfinger
- 2---RoHS 6, change "R" to "7" means RoHS 5
- 3---Series name
- 4---Series code
- 5---Wide input range (10.8-13.2V)
- 6---Wide output range (0.5-1.6V)
- 7---Suffix

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Absolute Maximum Ratings

| Parameter | Min | Typ | Max | Notes |
|----------------------------|--------|-----|--------|-------|
| Input Voltage (continuous) | -0.3 V | - | 15 V | |
| Remote On/Off | -0.3 V | - | 5 V | |
| Ambient Temperature | 0 °C | - | 65 °C | |
| Storage Temperature | -55 °C | - | 125 °C | |

Note: Ratings used beyond the maximum ratings may cause a reliability degradation of the converter or may permanently damage the device.

Input Specifications

| Parameter | Min | Typ | Max | Notes |
|---|--------|--------|--------------------|---|
| Input Voltage | 10.8 V | 12 V | 13.2 V | |
| Input Current (full load) | - | - | 30 A | |
| Input Current (no load) | - | 600 mA | 800 mA | |
| Input Current (no load) | - | 80 mA | 100 mA | |
| Remote Off Input Current | - | 10 mA | 25 mA | |
| Input Reflected Ripple Current (pk-pk) | - | 80 mA | 150 mA | With simulated source impedance of 100 nH, 5 Hz to 20 MHz; use two 1000uF/25 V electrolytic cap with ESR = 0.03 ohm max at 100 kHz. |
| Input Reflected Ripple Current (rms) | - | 25 mA | 50 mA | |
| I ² t Inrush Current Transient | - | - | 5 A ² s | |
| Turn-on Voltage Threshold | 9.4 V | 10 V | 10.6 V | |
| Under Voltage Threshold | 8.0 V | 9.0 V | 10 V | |

Note: All specifications are typical at nominal input, full load at 25 °C unless otherwise stated

Output Specifications

| Parameter | Min | Typ | Max | Notes |
|--|--------|----------|--------------------|--|
| Output Voltage Set Point | 1.27 V | 1.285 V | 1.3 V | VID=0X32, Iout=0 |
| Adaptive Positioning (Droop Impedance) | - | 0.8 mOhm | - | |
| Line Regulation | - | - | ±8 mV | |
| Regulation Over Temperature (0deg.C-65deg.C) | - | - | ±8 mV | |
| Output Current | 0 | - | 90 A | Thermal design |
| | 0 | - | 120 A | Peak current rating |
| Current Limit Threshold | 125 A | - | 155 A | |
| Short Circuit Surge Transient | - | - | 5 A ² s | |
| Ripple and Noise (rms) | - | 3 mV | 5 mV | Measured with 3*330uF/6mOhm ESR SP-CAP, and 10*22uF/0805 + 28*10uF/1206 ceramic capacitors on output |
| Ripple and Noise (pk-pk) | - | 6 mV | 10 mV | |

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Output Specifications (continued)

| Parameter | Min | Typ | Max | Notes | | |
|---|---------------|--------|-------|--|---|-------|
| Output Ripple and Noise(pk-pk) under worst case | - | - | 50 mV | over all operating input voltage, load and ambient temperature condition | | |
| Rise time | - | - | 5 mS | | | |
| Turn on Time | - | 2.5 mS | 5 mS | | | |
| Overshoot at Turn on | - | - | 1% | | | |
| Output Capacitance | 1490 uF | - | - | 3*330uF/6mOhm ESR SP-CAP, and 10*22uF/0805 + 28*10uF/1206 ceramic capacitors. Consult factory regarding external capacitance outside of this range | | |
| Transient Response | | | | | | |
| 50% ~ 100% Max Load | Overshoot | All | - | - | di/dt=300A/us, Vin=12Vdc, Ta=25°C, with typical cap bank on the output. | |
| | Settling Time | | - | - | | 25 uS |
| 100% ~ 50% Max Load | Overshoot | | - | - | | 50 mV |
| | Settling Time | | - | - | | 25 uS |

Note: All specifications are typical at nominal input, full load at 25 °C unless otherwise stated.

General Specifications

| Parameter | Min | Typ | Max | Notes |
|---|---|---------|-----|---|
| Efficiency | 82% | 84% | - | Vin=12 V, full load |
| Switching Frequency | - | 400 kHz | - | |
| FIT | TBD | | | Calculated Per Bell Core SR-332 (Vin=12 V, Io=80%load, Ta = 25 °C, FIT=10 ⁹ /MTBF) |
| Dimensions Inches (L x W x H) Millimeters (L x W x H) | 3.80 x 1.20 x 0.70 96.52 x 30.48 x 17.78 | | | |
| Weight | - | 50 g | - | |

Note: All specifications are typical at 25 °C unless otherwise stated.

Control Specifications

| Parameter | Min | Typ | Max | Notes |
|-----------------------|-------------|--------|------|--------------------------------------|
| Remote On/Off | | | | |
| Signal Low (Unit Off) | Active High | -0.3 V | - | The remote on/off pin open, Unit On. |
| Signal High (Unit On) | | 1 V | - | |
| Current Sink | 0 mA | - | 1 mA | |

NON-ISOLATED DC/DC CONVERTERS

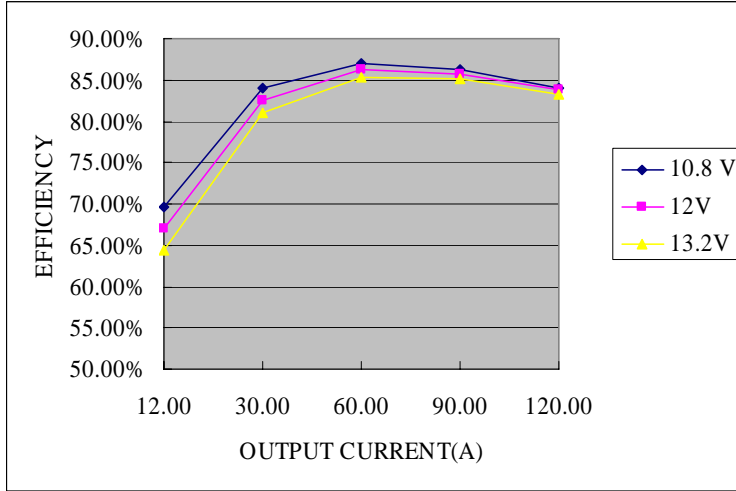
10.8 Vdc - 13.2 Vdc Input 0.5 Vdc - 1.6 Vdc/120 A Outputs



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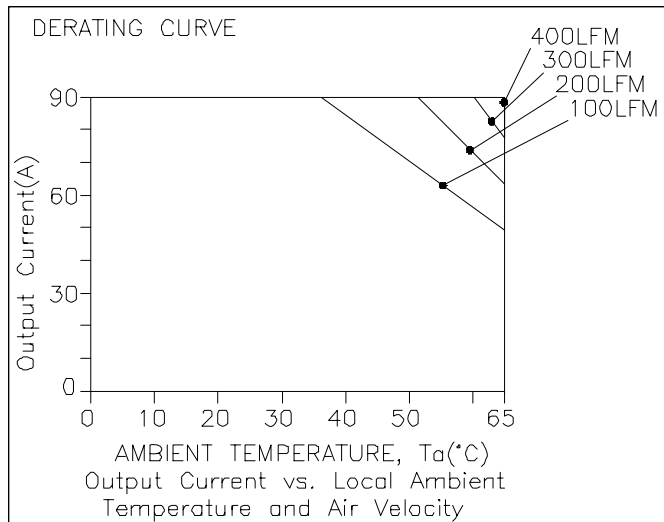
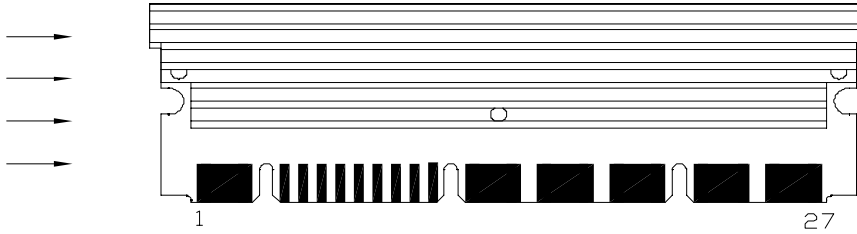
Efficiency Data



VID=0X32

Thermal Derating Curves

FORCED AIRFLOW



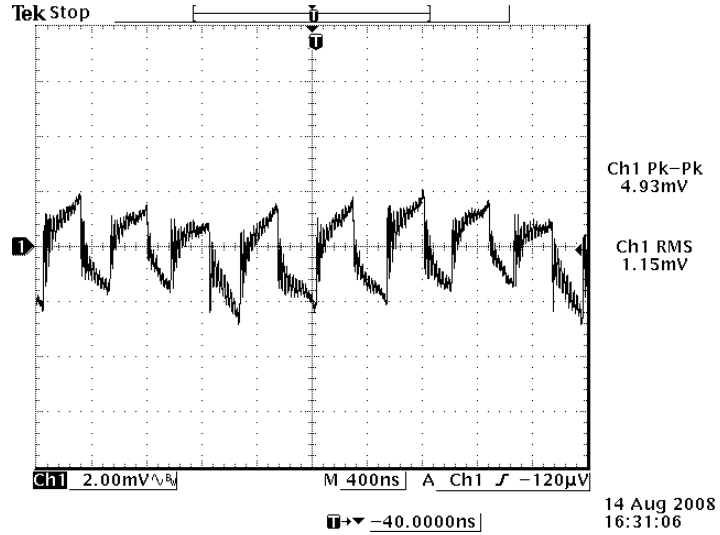
NON-ISOLATED DC/DC CONVERTERS
10.8 Vdc - 13.2 Vdc Input 0.5 Vdc - 1.6 Vdc/120 A Outputs



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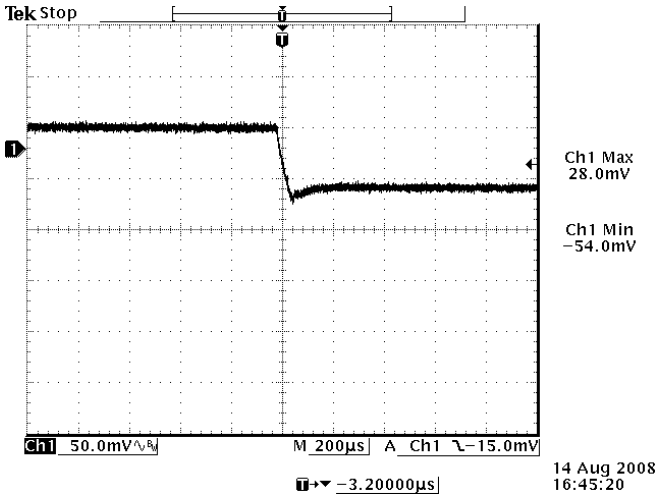
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Ripple and Noise Waveform

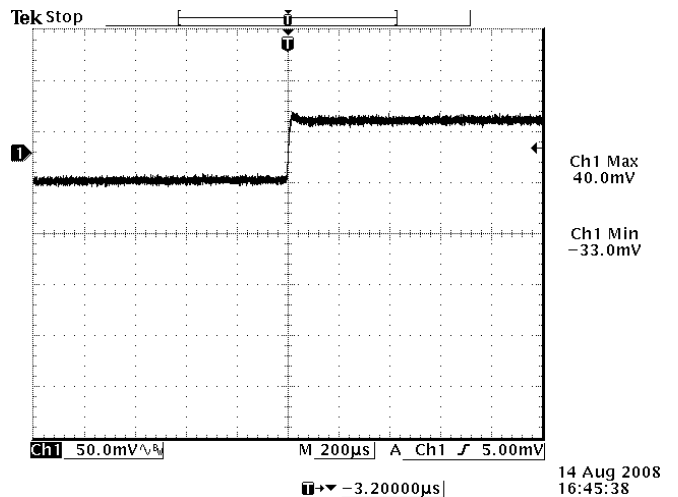


Ripple and noise at full load, 12V input, VID=0X32 and Ta=25 degC

Transient Response Waveforms



30 A to 90 A Load @ VID=0X32



90 A to 30 A Load @ VID=0X32

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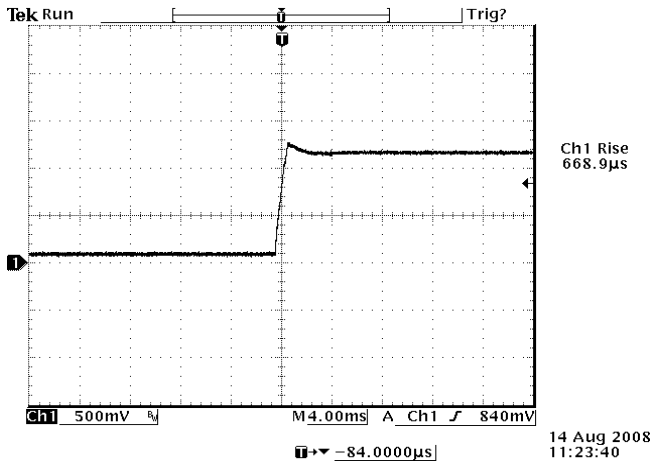


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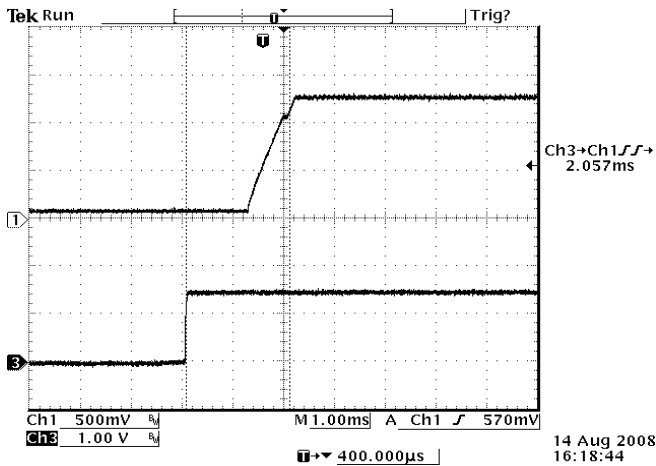
Startup & Shutdown

Rise time



Test Condition: VID=0x32, Iout=120A

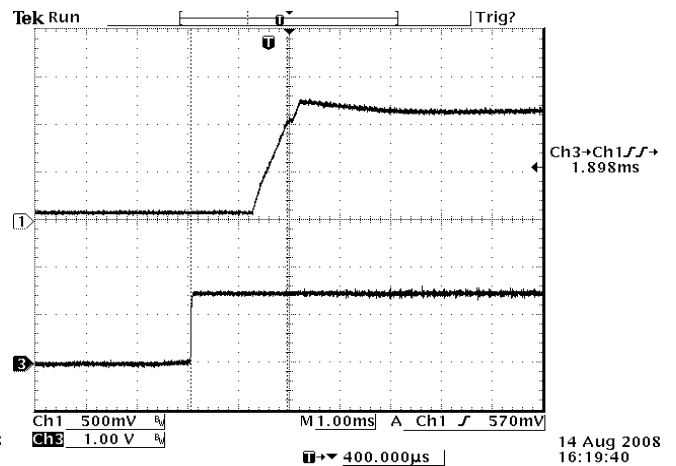
Startup time



Startup from on/off

Ch1: Vo, Ch3: on/off

Test Condition: VID=0x32, Iout=0A



Startup from on/off

Ch1: Vo, Ch3: on/off

Test Condition: VID=0x32, Iout=120A

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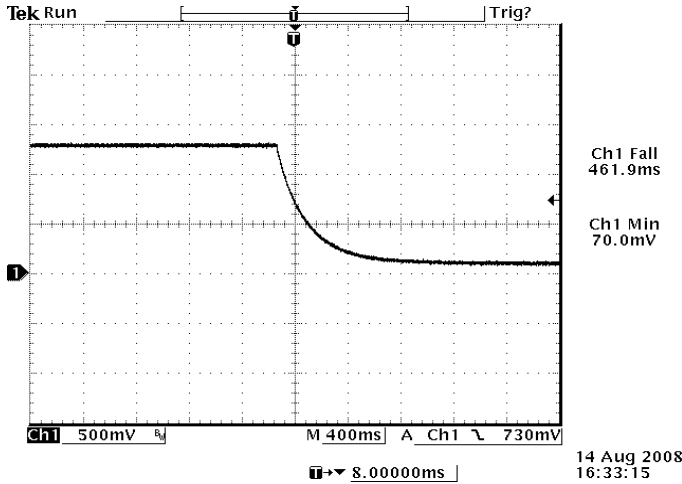


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Startup & Shutdown (continued)

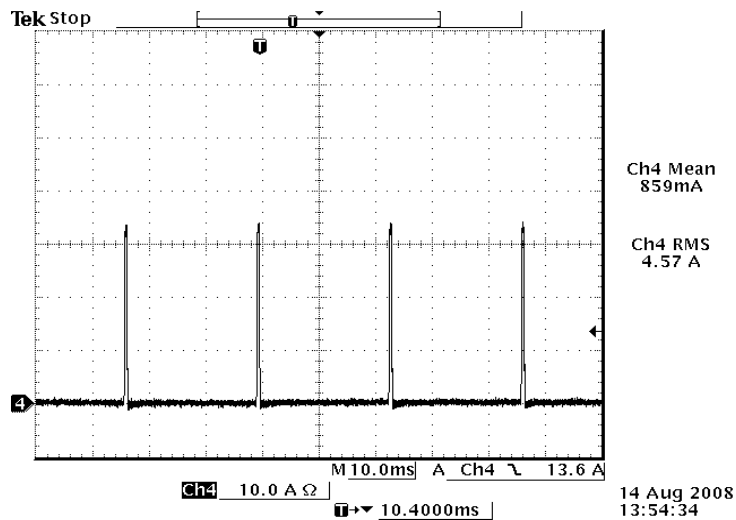
Shutdown



Test Condition: VID=0x32, Iout=0A

Over Current Protection

To provide protection in a fault output overload condition, the module is equipped with internal current-limiting circuitry and can endure current limiting for a few milli-seconds. If the overcurrent condition persists beyond a few milliseconds, the module will shut down into hiccup mode and restart once every 400mS. The module operates normally when the output current goes into specified range. The typical average output current is 5A during hiccup.



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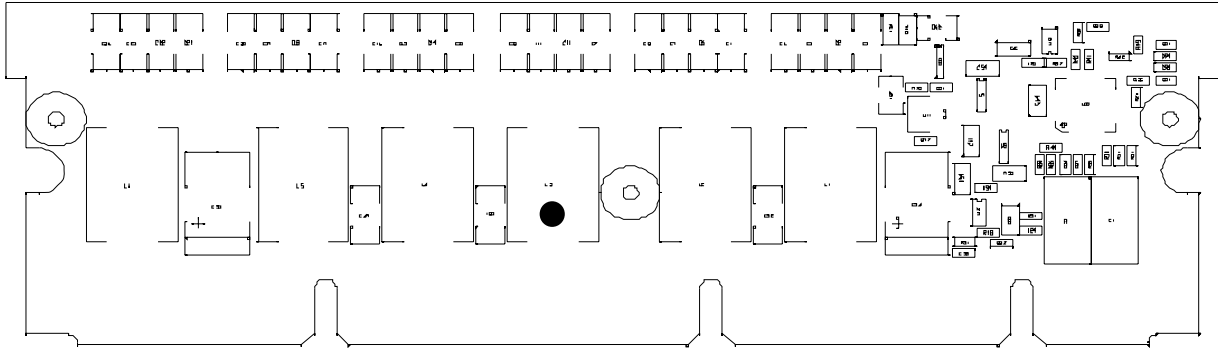
10.8 Vdc - 13.2 Vdc Input 0.5 Vdc - 1.6 Vdc/120 A Outputs



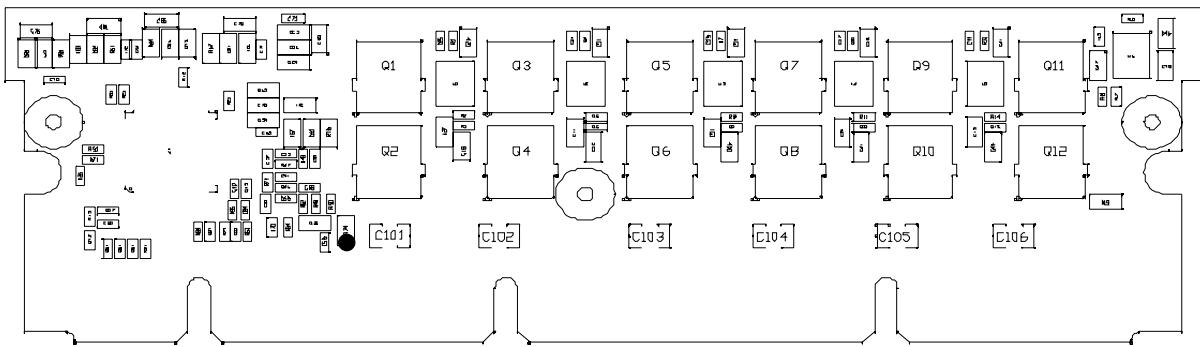
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Over Temperature Protection

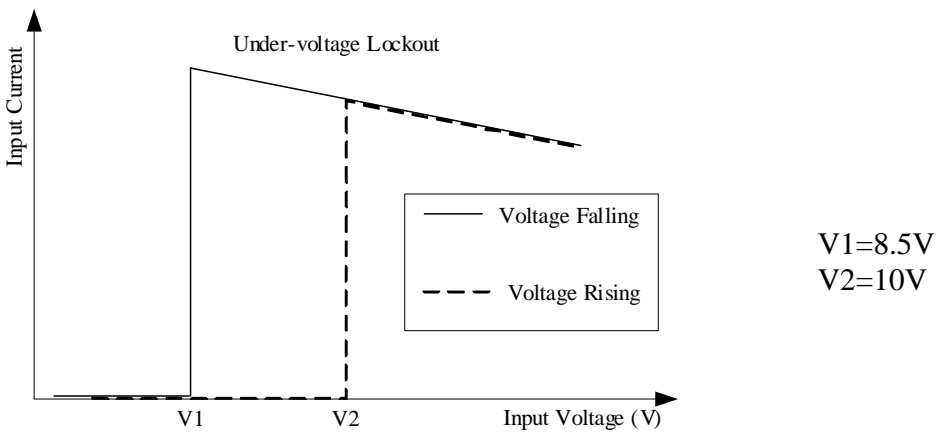


L3 is the hottest component



R74 is the thermal sense component

Input Under-voltage Lockout



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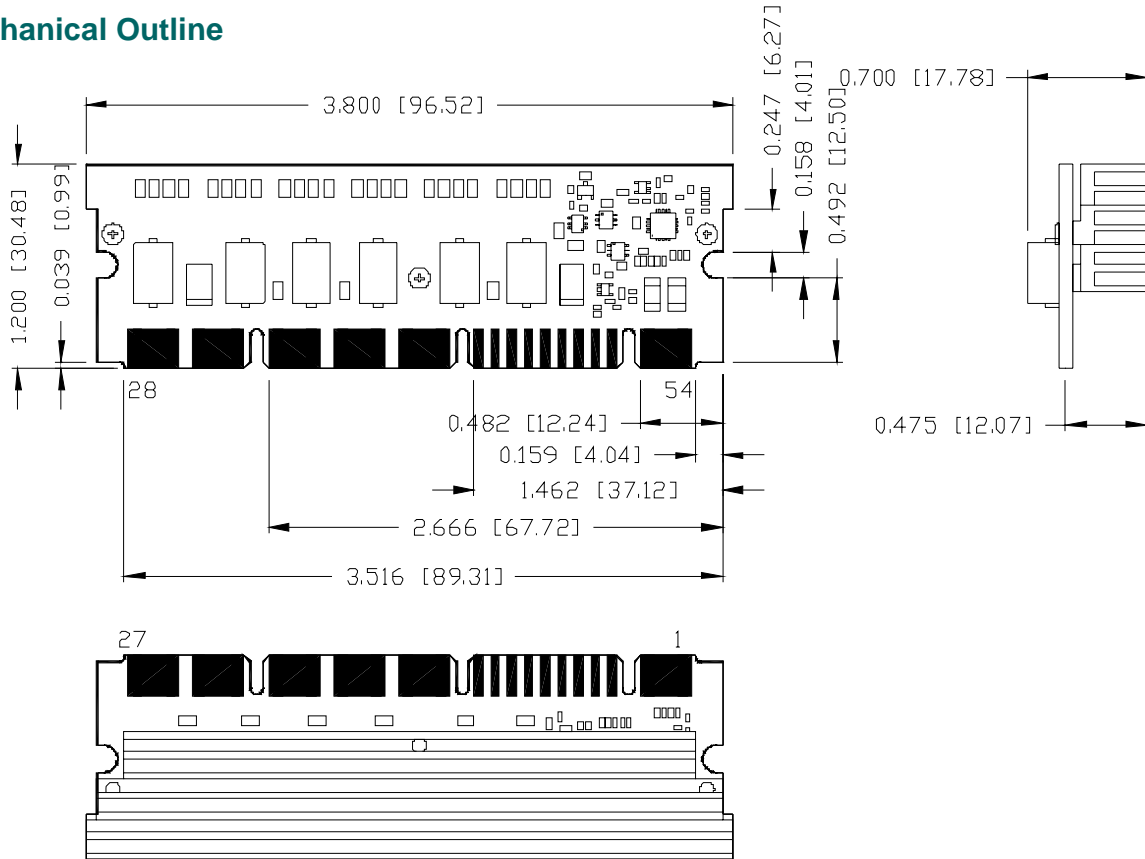
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Mechanical Outline



Pin Connections

| Row A | | | | Row B | | | |
|-------|------------|-----|----------|-------|----------|-----|------------|
| Pin | Function | Pin | Function | Pin | Function | Pin | Function |
| 1 | VIN- | 15 | VO+ | 40 | VO+ | 54 | VIN+ |
| 2 | VIN- | 16 | VO- | 39 | VO- | 53 | VIN+ |
| 3 | VIN- | 17 | VO- | 38 | VO- | 52 | VIN+ |
| 4 | VID4 | 18 | VO- | 37 | VO- | 51 | VID3 |
| 5 | VID2 | 19 | VO+ | 36 | VO+ | 50 | VID1 |
| 6 | VID0 | 20 | VO+ | 35 | VO+ | 49 | VID5 |
| 7 | VO_SEN+ | 21 | VO+ | 34 | VO+ | 48 | VO_SEN- |
| 8 | VR_Ready | 22 | VO- | 33 | VO- | 47 | VR_hot# |
| 9 | OUTEN | 23 | VO- | 32 | VO- | 46 | VID7 |
| 10 | IMON | 24 | VO- | 31 | VO- | 45 | PSI |
| 11 | VID6 | 25 | VO+ | 30 | VO+ | 44 | VRM_pres#0 |
| 12 | VRM_pres#2 | 26 | VO+ | 29 | VO+ | 43 | VRM_pres#1 |
| 13 | VO+ | 27 | VO+ | 28 | VO+ | 42 | VO+ |
| 14 | VO+ | | | | | 41 | VO+ |

Note:

- 1) Undimensioned components are shown for visual reference only.
- 2) All dimensions in inches (mm); Tolerances: x.xx +/-0.02 in. (x.x +/-0.5mm) x.xxx +/-0.010 in. (x.xx +/-0.25mm).

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Signal Definitions

| | |
|--|---|
| Vin+ | VRM Input Voltage |
| Vin- | VRM Input Ground |
| VID0, VID1, VID2, VID3, VID4, VID5, VID6, VID7 | Logic level inputs used to set the output voltage, refer to VID table. Connect VID0 thru VID7 pins to open-drain outputs with external pull-up resistors. Valid logic low is -0.3V to 0.4V, valid logic high level is 0.8V to 5.0V. |
| VO_SEN+, VO_SEN- | Remote voltage sense lines. Connect these at the point of load, to VO+ and VO- respectively. |
| VR_Ready | Open drain output signal indicating that the start-up sequence is complete output voltage has moved to the programmed VID value. |
| VR_HOT# | Open-drain output signal, pulled actively low indicating a thermal event has been detected on the VRM. |
| OUTEN | Logic level input used to enable the converter when high. Valid logic low is -0.3V to 0.4V, valid logic high level is 1.0V to 5.0V |
| IMON | Analog voltage signal representing the output load current |
| PSI | Logic level input, indicates when the CPU is in a low power state |
| VRM_pres#1, VRM_pres#2, VRM_pres#3 | VRM11.1 presence indicator(s) |
| VO+ | VRM Output Voltage |
| VO- | VRM Output Ground |

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VID CODES (VRM11.0 CODES)

| HEX (VID6 - VID0) | Vout (VDC) | |
|----------------------|---------------|---------|
| 0 | 0 | OFF |
| 0 | 1 | OFF |
| 0 | 2 | 1.60000 |
| 0 | 3 | 1.59375 |
| 0 | 4 | 1.58750 |
| 0 | 5 | 1.58125 |
| 0 | 6 | 1.57500 |
| 0 | 7 | 1.56875 |
| 0 | 8 | 1.56250 |
| 0 | 9 | 1.55625 |
| 0 | A | 1.55000 |
| 0 | B | 1.54375 |
| 0 | C | 1.53750 |
| 0 | D | 1.53125 |
| 0 | E | 1.52500 |
| 0 | F | 1.51875 |
| 1 | 0 | 1.51250 |
| 1 | 1 | 1.50625 |
| 1 | 2 | 1.50000 |
| 1 | 3 | 1.49375 |
| 1 | 4 | 1.48750 |
| 1 | 5 | 1.48125 |
| 1 | 6 | 1.47500 |
| 1 | 7 | 1.46875 |
| 1 | 8 | 1.46250 |
| 1 | 9 | 1.45625 |
| 1 | A | 1.45000 |
| 1 | B | 1.44375 |
| 1 | C | 1.43750 |
| 1 | D | 1.43125 |
| 1 | E | 1.42500 |
| 1 | F | 1.41875 |
| 2 | 0 | 1.41250 |
| 2 | 1 | 1.40625 |
| 2 | 2 | 1.40000 |
| 2 | 3 | 1.39375 |
| 2 | 4 | 1.38750 |
| 2 | 5 | 1.38125 |
| 2 | 6 | 1.37500 |
| 2 | 7 | 1.36875 |
| 2 | 8 | 1.36250 |
| 2 | 9 | 1.35625 |
| 2 | A | 1.35000 |
| 2 | B | 1.34375 |
| 2 | C | 1.33750 |
| 2 | D | 1.33125 |
| 2 | E | 1.32500 |
| 2 | F | 1.31875 |

| HEX (VID7 - VID0) | Vout (VDC) | |
|----------------------|---------------|---------|
| 3 | 0 | 1.31250 |
| 3 | 1 | 1.30625 |
| 3 | 2 | 1.30000 |
| 3 | 3 | 1.29375 |
| 3 | 4 | 1.28750 |
| 3 | 5 | 1.28125 |
| 3 | 6 | 1.27500 |
| 3 | 7 | 1.26875 |
| 3 | 8 | 1.26250 |
| 3 | 9 | 1.25625 |
| 3 | A | 1.25000 |
| 3 | B | 1.24375 |
| 3 | C | 1.23750 |
| 3 | D | 1.23125 |
| 3 | E | 1.22500 |
| 3 | F | 1.21875 |
| 4 | 0 | 1.21250 |
| 4 | 1 | 1.20625 |
| 4 | 2 | 1.20000 |
| 4 | 3 | 1.19375 |
| 4 | 4 | 1.18750 |
| 4 | 5 | 1.18125 |
| 4 | 6 | 1.17500 |
| 4 | 7 | 1.16875 |
| 4 | 8 | 1.16250 |
| 4 | 9 | 1.15625 |
| 4 | A | 1.15000 |
| 4 | B | 1.14375 |
| 4 | C | 1.13750 |
| 4 | D | 1.13125 |
| 4 | E | 1.12500 |
| 4 | F | 1.11875 |
| 5 | 0 | 1.11250 |
| 5 | 1 | 1.10625 |
| 5 | 2 | 1.10000 |
| 5 | 3 | 1.09375 |
| 5 | 4 | 1.08750 |
| 5 | 5 | 1.08125 |
| 5 | 6 | 1.07500 |
| 5 | 7 | 1.06875 |
| 5 | 8 | 1.06250 |
| 5 | 9 | 1.05625 |
| 5 | A | 1.05000 |
| 5 | B | 1.04375 |
| 5 | C | 1.03750 |
| 5 | D | 1.03125 |
| 5 | E | 1.02500 |
| 5 | F | 1.01875 |

| HEX (VID7 - VID0) | Vout (VDC) | |
|----------------------|---------------|---------|
| 6 | 0 | 1.01250 |
| 6 | 1 | 1.00625 |
| 6 | 2 | 1.00000 |
| 6 | 3 | 0.99375 |
| 6 | 4 | 0.98750 |
| 6 | 5 | 0.98125 |
| 6 | 6 | 0.97500 |
| 6 | 7 | 0.96875 |
| 6 | 8 | 0.96250 |
| 6 | 9 | 0.95625 |
| 6 | A | 0.95000 |
| 6 | B | 0.94375 |
| 6 | C | 0.93750 |
| 6 | D | 0.93125 |
| 6 | E | 0.92500 |
| 6 | F | 0.91875 |
| 7 | 0 | 0.91250 |
| 7 | 1 | 0.90625 |
| 7 | 2 | 0.90000 |
| 7 | 3 | 0.89375 |
| 7 | 4 | 0.88750 |
| 7 | 5 | 0.88125 |
| 7 | 6 | 0.87500 |
| 7 | 7 | 0.86875 |
| 7 | 8 | 0.86250 |
| 7 | 9 | 0.85625 |
| 7 | A | 0.85000 |
| 7 | B | 0.84375 |
| 7 | C | 0.83750 |
| 7 | D | 0.83125 |
| 7 | E | 0.82500 |
| 7 | F | 0.81875 |
| 8 | 0 | 0.81250 |
| 8 | 1 | 0.80625 |
| 8 | 2 | 0.80000 |
| 8 | 3 | 0.79375 |
| 8 | 4 | 0.78750 |
| 8 | 5 | 0.78125 |
| 8 | 6 | 0.77500 |
| 8 | 7 | 0.76875 |
| 8 | 8 | 0.76250 |
| 8 | 9 | 0.75625 |
| 8 | A | 0.75000 |
| 8 | B | 0.74375 |
| 8 | C | 0.73750 |
| 8 | D | 0.73125 |
| 8 | E | 0.72500 |
| 8 | F | 0.71875 |

| HEX (VID7 - VID0) | Vout (VDC) | |
|----------------------|---------------|---------|
| 9 | 0 | 0.71250 |
| 9 | 1 | 0.70625 |
| 9 | 2 | 0.70000 |
| 9 | 3 | 0.69375 |
| 9 | 4 | 0.68750 |
| 9 | 5 | 0.68125 |
| 9 | 6 | 0.67500 |
| 9 | 7 | 0.66875 |
| 9 | 8 | 0.66250 |
| 9 | 9 | 0.65625 |
| 9 | A | 0.65000 |
| 9 | B | 0.64375 |
| 9 | C | 0.63750 |
| 9 | D | 0.63125 |
| 9 | E | 0.62500 |
| 9 | F | 0.61875 |
| A | 0 | 0.61250 |
| A | 1 | 0.60625 |
| A | 2 | 0.60000 |
| A | 3 | 0.59375 |
| A | 4 | 0.58750 |
| A | 5 | 0.58125 |
| A | 6 | 0.57500 |
| A | 7 | 0.56875 |
| A | 8 | 0.56250 |
| A | 9 | 0.55625 |
| A | A | 0.55000 |
| A | B | 0.54375 |
| A | C | 0.53750 |
| A | D | 0.53125 |
| A | E | 0.52500 |
| A | F | 0.51875 |
| B | 0 | 0.51250 |
| B | 1 | 0.50625 |
| B | 2 | 0.50000 |
| F | E | OFF |
| F | F | OFF |

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Revision History

| Date | Revision | Changes Detail | Approval |
|----------|----------|---|----------|
| 2010-4-1 | B | 1. Change to Bel new datasheet format; remove "Preliminary". 2. In Absolute Maximum Ratings: 1)add remote on/off voltage; 2)update Ambient and storage temperature 3. Input spec: 1)update turn off voltage 4. Output spec: 1)add load and temperature regulation; 2)add short circuit surge transient; 3)add rise time; 4)update output current limit 5. Update efficiency curve, add thermal derating curve, add startup and shutdown figures, add OCP, OTP and UVLO figure 6. Add Signal Definitions and VID CODES. | Jack Fan |

RoHS Compliance

Complies with the European Directive 2002/95/EC, calling for the elimination of lead and other hazardous substances from electronic products.



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