

## NON-ISOLATED DC/DC CONVERTERS

8.3 Vdc - 14 Vdc Input

0.75 Vdc - 5.0 Vdc/10 A Output

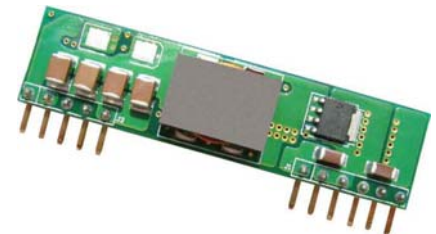
**bel**  
POWER PRODUCTS

**VRBC-10A2Ax**

**RoHS Compliant**

**Rev.A**

- Non-Isolated
- Fixed Frequency
- High Efficiency
- Low Cost
- Wide Input
- Flexible Output Voltage Sequencing
- Output Voltage Prebias
- Under-Voltage Lockout (UVLO)
- Over Temperature Shutdown
- OCP/SCP
- Wide Trim
- Remote Sense
- Remote On/Off
- Active Low/High (Option)
- Industrial Temperature Range



### Description

The Bel VRBC-10A2Ax are series of the non-isolated dc/dc converter Power Module. The modules use a SIP package. These converters are available in a range of output voltages from 0.75 Vdc to 5.0 Vdc over a wide range of input voltage ( $V_{IN} = 8.3 \text{ Vdc} - 14 \text{ Vdc}$ ). The Bel VRBC-10A2Ax has a sequencing feature that enables designers to implement various types of output voltage sequencing when powering. The efficiency is typically 95% at 5 Vdc output at full load.

### Part Selection

| Output Voltage | Input Voltage | Max. Output Current | Max. Output Power | Typical Efficiency | Model Number Active Low | Model Number Active High |
|----------------|---------------|---------------------|-------------------|--------------------|-------------------------|--------------------------|
| 0.75 V - 5.0 V | 8.3 V - 14 V  | 10 A                | 50.0 W            | 95%                | VRBC-10A2AL             | VRBC-10A2A0              |

- Notes:** 1. Add "G" suffix at the end of the model number to indicate Tray Packaging.  
2. All part numbers above indicate RoHS 6. Change the second letter "R" to "7" for RoHS 5 part numbers.

### Absolute Maximum Ratings

| Parameter                       | Min    | Typ | Max      | Notes |
|---------------------------------|--------|-----|----------|-------|
| Input Voltage (continuous)      | -0.3 V | -   | 15 V     |       |
| Output Enable Terminal Voltage  | -0.3 V | -   | 15 V     |       |
| Sequencing Voltage <sup>1</sup> | -0.3 V | -   | $V_{in}$ |       |
| Ambient Temperature             | -40 °C | -   | 85 °C    |       |
| Storage Temperature             | -55 °C | -   | 125 °C   |       |

- Notes:** All specifications are typical at 25 °C unless otherwise stated.  
1. VRBC-10A2Ax series of modules include a sequencing feature that enables users to implement various types of output voltage sequencing in their applications. This is accomplished via an additional sequencing pin. When the sequencing feature is not used, tie the SEQ pin to  $V_{in}$  or leave it unconnected.

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### Input Specifications

| Parameter                                 | Min   | Typ                  | Max                  | Notes   |
|---|-------|----------------------|----------------------|---|
| Input Voltage                             |       |                      |                      |   |
| Vo, set ≤ 3.63 V                          | 8.3 V | 12 V                 | 14 V                 |   |
| Vo, set > 3.63 V                          | 8.3 V | 12 V                 | 13.2 V               |   |
| Input Current (full load)                 | -     | -                    | 6.5 A                | An input line fuse must always be used.   |
| Input Current (no load)                   | -     | 80 mA                | -                    |   |
| Remote Off Input Current                  | -     | 2 mA                 | -                    |   |
| Input Reflected Ripple Current (pk-pk)    | -     | -                    | 100 mA               | Tested with one 1000 uF/25 V AL input capacitor with ESR=0.03 ohm max and 4 × 47 uF/25 V tan capacitors with ESR=0.013 ohm max at 100 kHz, & simulated source impedance of 1000 nH, 5 Hz to 20 MHz. |
| Input Reflected Ripple Current (rms)      | -     | -                    | 30 mA                |   |
| I <sup>2</sup> t Inrush Current Transient | -     | 0.2 A <sup>2</sup> s | 0.4 A <sup>2</sup> s |   |
| Turn-on Voltage Threshold                 | -     | 7.9 V                |                      |   |
| Turn-off Voltage Threshold                | -     | 7.8 V                |                      |   |

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

### Output Specifications

| Parameter                                      | Min               | Typ                | Max                | Notes  |
|--|-------------------|--------------------|--------------------|--|
| Output Voltage Set Point                       | -2% Vo,set        | -                  | 2% Vo,set          | Vin=12 V, full load  |
| Load Regulation                                | -                 | 0.3% Vo,set        | -                  |  |
| Line Regulation                                | -                 | 0.2% Vo,set        | -                  |  |
| Regulation Over Temperature (-40 °C to +85 °C) | -                 | 0.4% Vo,set        | -                  | Tref=Tamin to Tamax  |
| Output Current                                 | 0 A               | -                  | 10 A               |  |
| Current Limit Threshold                        | -                 | 200% Io            | -                  |  |
| Short Circuit Surge Transient                  | -                 | 1 A <sup>2</sup> s | 3 A <sup>2</sup> s |  |
| Ripple and Noise (pk-pk)                       | -                 | 40 mV              | 100 mV             | Tested with 0-20 MHz, with 10 uF tantalum capacitor & 1 uF ceramic capacitor |
| Ripple and Noise (rms)                         | -                 | 20 mV              | 40 mV              |  |
| Turn on Time                                   | -                 | 8 mS               | 20 mS              |  |
| Overshoot at Turn on                           | -                 | -                  | 1% Vo,set          |  |
| Output Capacitance                             | 0 uF              | -                  | 5000 uF            |  |
| <b>Transient Response</b>                      |                   |                    |                    |  |
| 50% ~ 100% Max Load                            | Vo = 0.75 V - 5 V | -                  | 100 mV             | di/dt=2.5 A/uS; Vin=12 V; and with 470 uF tantalum capacitors at the output  |
| Settling Time                                  |                   | -                  | 50 uS              |  |
| 100% ~ 50% Max Load                            |                   | -                  | 100 mV             |  |
| Settling Time                                  |                   | -                  | 50 uS              |  |

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

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0.75 Vdc - 5.0 Vdc/10 A Output

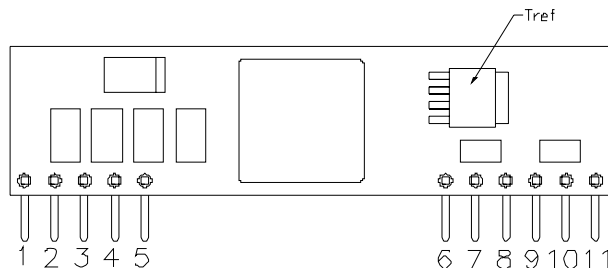


## General Specifications

| Parameter                              | Min                | Typ     | Max     | Notes  |
|--|--------------------|---------|---------|--|
| Efficiency                             |                    |         |         | Measured at Vin=12 V, full load  |
| Vo=5.0 V                               | -                  | 95%     | -       |  |
| Vo=3.3 V                               | -                  | 93%     | -       |  |
| Vo=2.5 V                               | -                  | 92%     | -       |  |
| Vo=1.8 V                               | -                  | 90%     | -       |  |
| Vo=1.5 V                               | -                  | 89%     | -       |  |
| Vo=1.2 V                               | -                  | 87.5%   | -       |  |
| Vo=0.75 V                              | -                  | 81%     | -       |  |
| Switching Frequency                    | 265 kHz            | 300 kHz | 335 kHz |  |
| Over Temperature Shutdown <sup>1</sup> | -                  | 130 °C  | -       |  |
| Output Voltage Trim Range              | 0.7525 V           | -       | 5.0 V   |  |
| Remote Sense Compensation              | -                  | -       | 0.5 V   |  |
| MTBF                                   | 5,114,191 hours    |         |         | Calculated Per Bell Core SR-332 (Io = 80% load; Vo=3.3 V; Vin=12 V; Ta = 25°C) |
| Dimensions                             |                    |         |         |  |
| Inches (L x W x H)                     | 2.0 x 0.5 x 0.32   |         |         |  |
| Millimeters (L x W x H)                | 50.8 x 12.7 x 8.13 |         |         |  |
| Weight                                 | -                  | 7.1 g   | -       |  |

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

1. The Tref temperature measurement location:



## Control Specifications

| Parameter                       | Min    | Typ    | Max      | Notes  |
|---------------------------------|--------|--------|----------|--|
| <b>Remote On/Off</b>            |        |        |          |  |
| Signal Low (Unit Off)           | -0.2 V | -      | 0.3 V    | VRBC-10A2A0; Remote On/Off pin open, Unit on.            |
| Signal High (Unit On)           | -      | -      | Vin, max |  |
| Signal Low (Unit On)            | -0.2 V | -      | 0.3 V    | VRBC-10A2AL; Remote On/Off pin open, Unit on.            |
| Signal High (Unit Off)          | 2.5 V  | -      | Vin, max |  |
| <b>Voltage Sequencing</b>       |        |        |          |  |
| Sequencing Delay Time           | 25 mS  | -      | -        | Delay from Vin, min to application of voltage on SEQ pin |
| Sequencing Slew Rate Capability | -      | -      | 2 V/mS   | Vinmin to Vinmax; Iomin to Iomax; Vseq<Vo                |
| Tracking Accuracy               |        |        |          |  |
| Power-Up                        | -      | 100 mV | 200 mV   |  |
| Power-Down                      | -      | 200 mV | 400 mV   |  |

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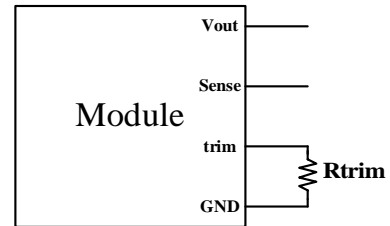
0.75 Vdc - 5.0 Vdc/10 A Output

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POWER PRODUCTS

### Output Trim Equations

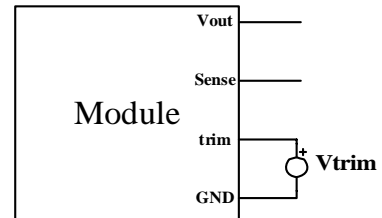
Equation for calculating the trim resistor (in  $\Omega$ ) given the desired output voltage ( $V_o$ ) is shown below. The  $R_{trim}$  resistor should be connected between the trim pin and GND.

$$R_{trim} = \left[ \frac{10500}{V_o - 0.7525} - 1000 \right]$$

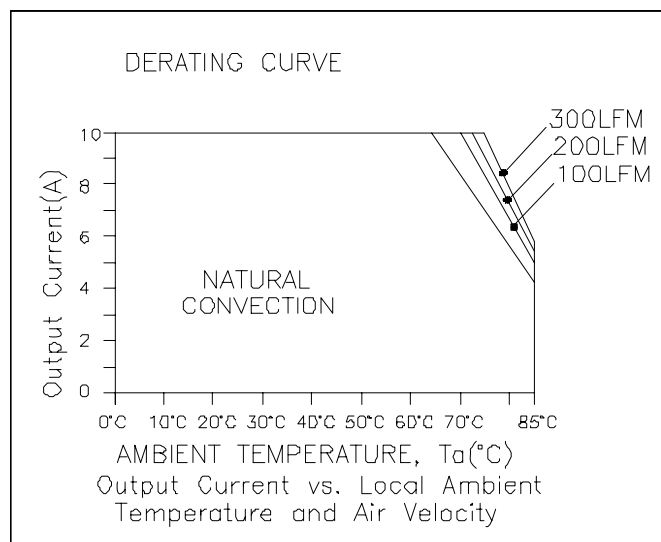


Equation for calculating the trim voltage (in V) given the desired output voltage ( $V_o$ ) is shown below. The  $V_{trim}$  voltage should be connected between the trim pin and GND.

$$V_{trim} = \{0.7 - 0.0667 \times (V_o - 0.7525)\}$$



### Thermal Derating Curve



$V_{in}=12\text{ V}, V_o=3.3\text{ V}$

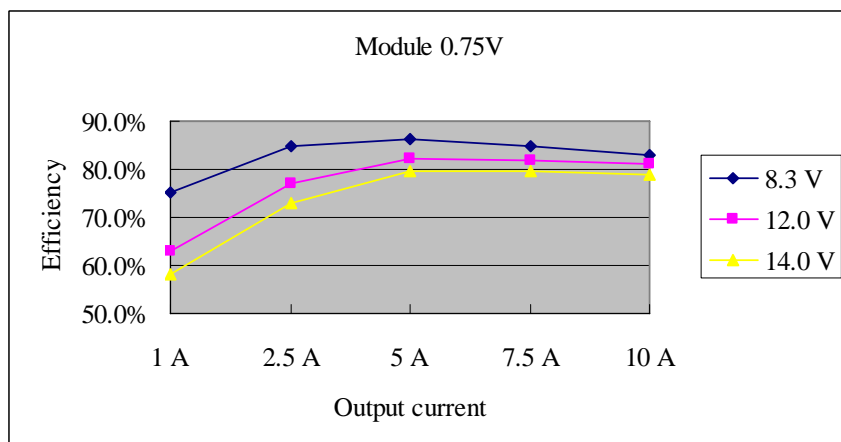
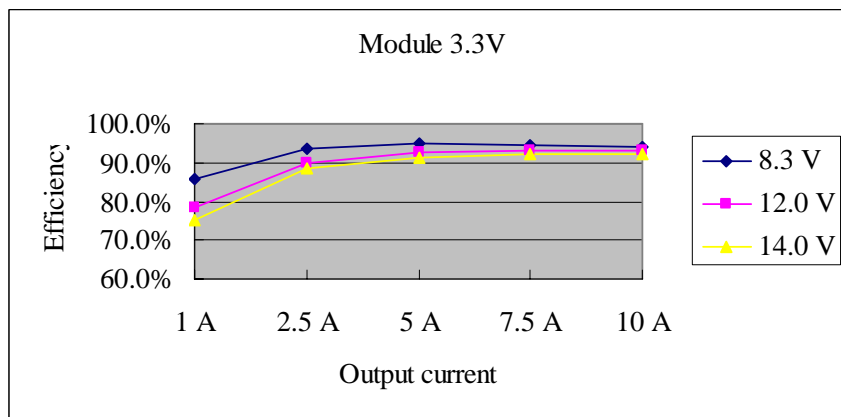
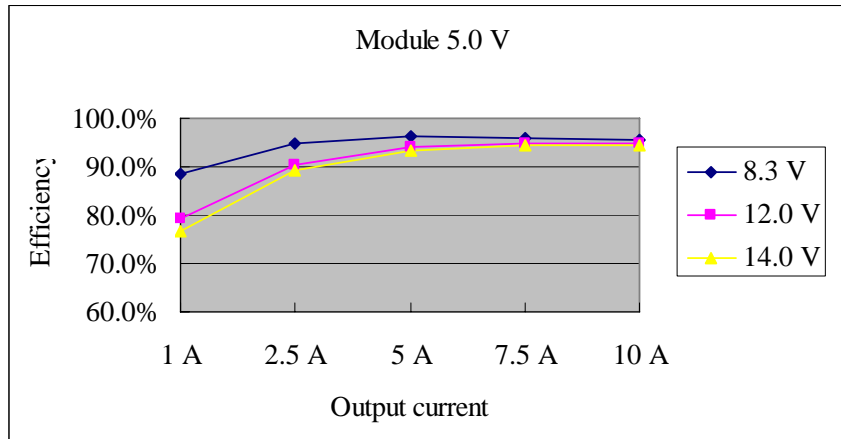
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## Efficiency Data



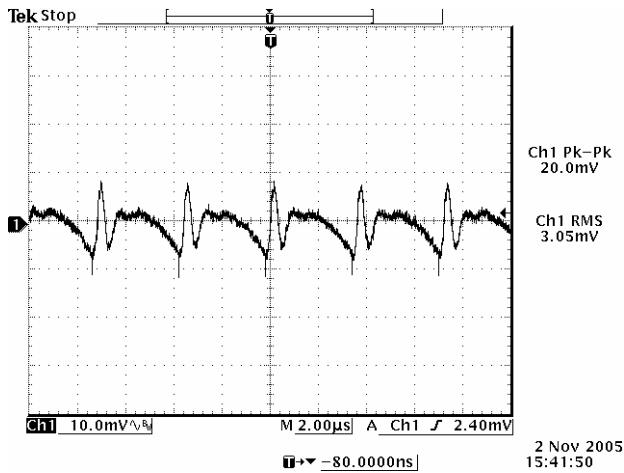
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8.3 Vdc - 14 Vdc Input

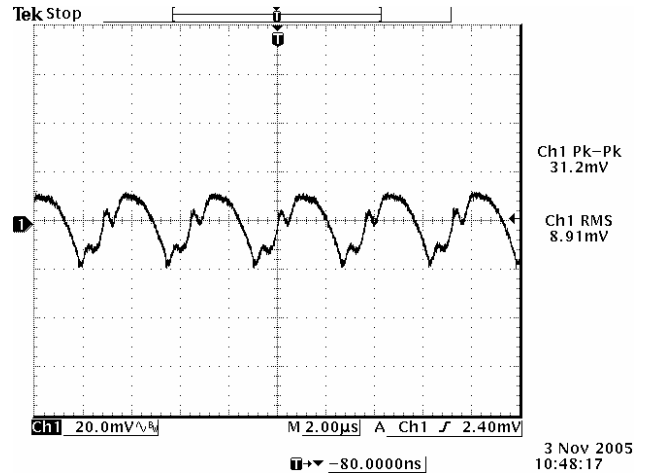
0.75 Vdc - 5.0 Vdc/10 A Output



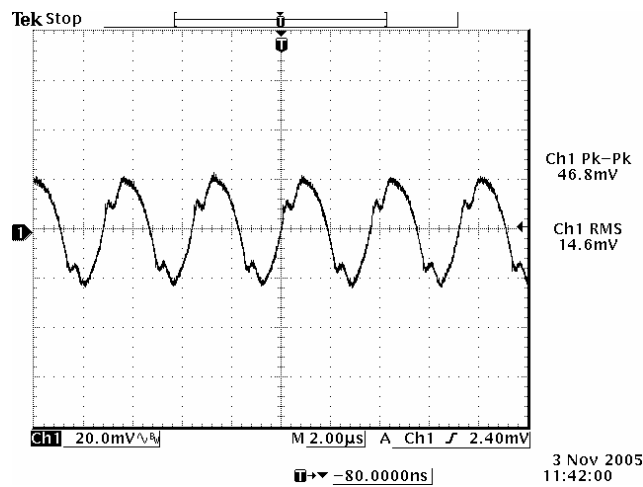
## Ripple and Noise Waveforms



12 Vdc input, 0.75 V output



12 Vdc input, 3.3 V output



12 Vdc input, 5.0 V output

**Note:** Ripple and Noise at full load, with 10 µF tantalum capacitor and 1 µF ceramic capacitor at the output, and  $T_a=25$  deg C.

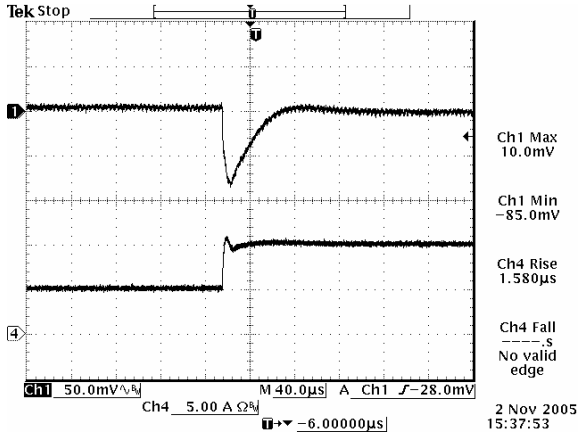
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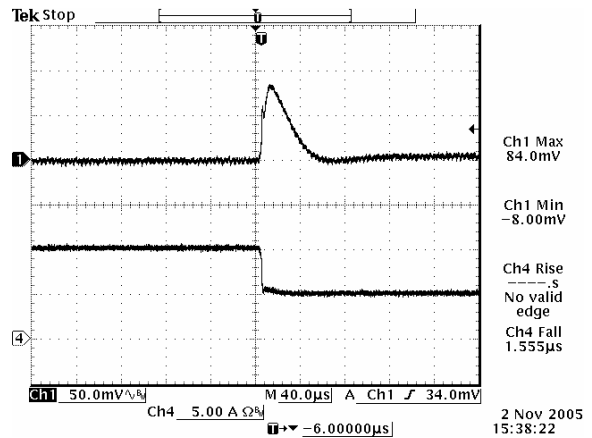
0.75 Vdc - 5.0 Vdc/10 A Output



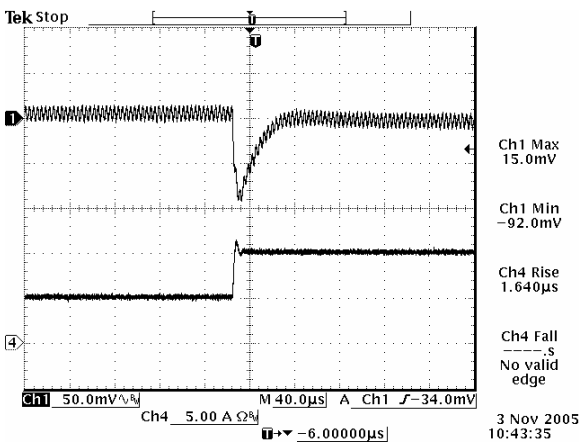
## Transient Response Waveforms



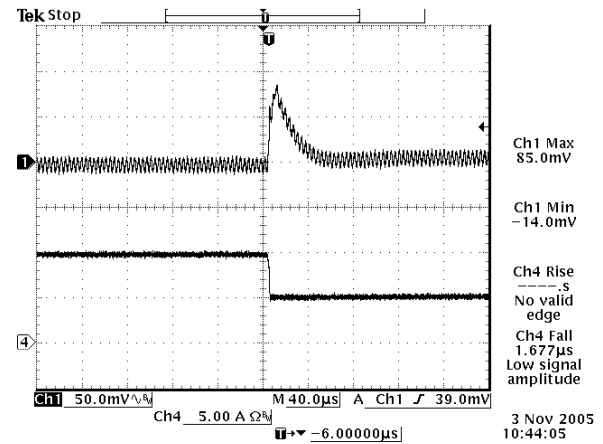
Transients 50% to 100% load 0.75 Vdc output



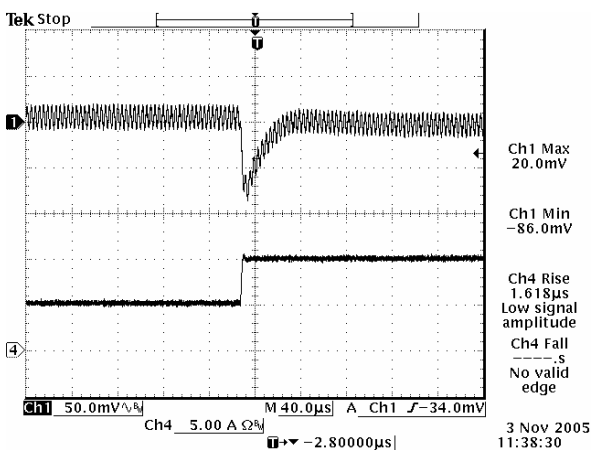
Transients 100% to 50% load 0.75 Vdc output



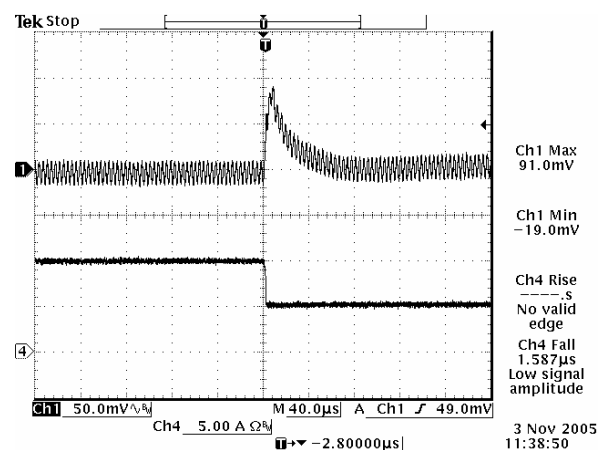
Transients 50% to 100% load 3.3 Vdc output



Transients 100% to 50% load 3.3 Vdc output



Transients 50% to 100% load 5.0 Vdc output



Transients 100% to 50% load 5.0 Vdc output

**Note:** Transient response at 12 V input,  $di/dt=2.5 A/\mu S$ , with external 470  $\mu F$  tantalum capacitor at the output,  $T_a=25$  deg C.

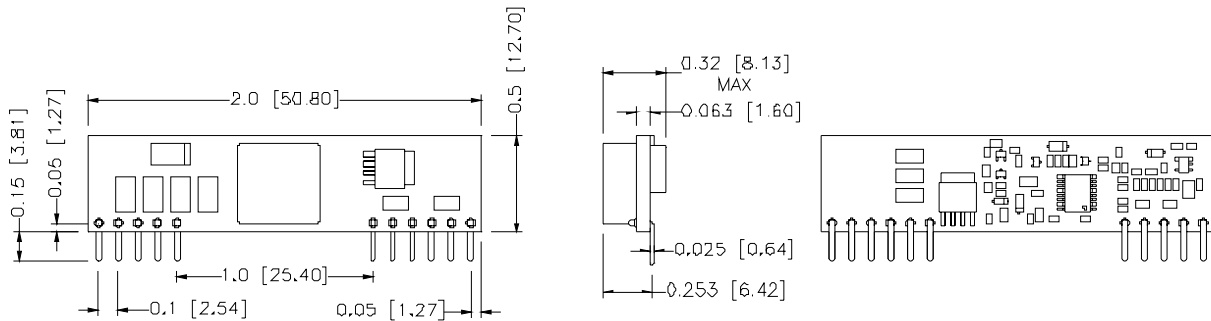
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## Mechanical Outline

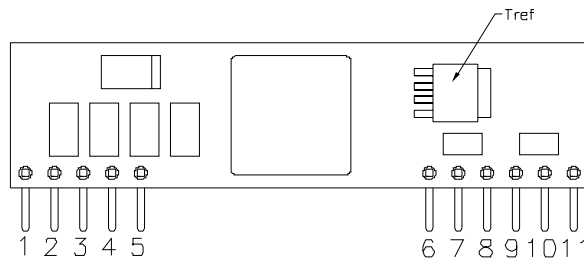


UNIT: INCH [MM]

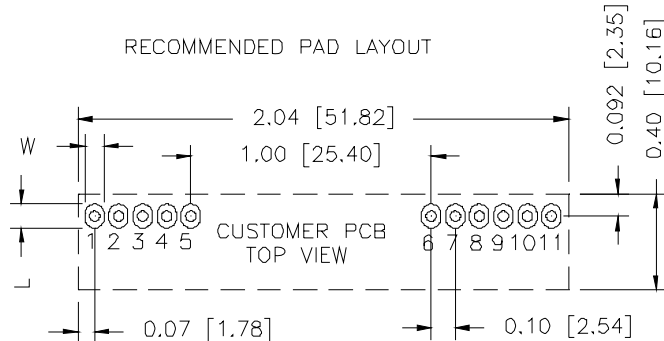
TOP VIEW

SIDE VIEW

BACK VIEW



RECOMMENDED PAD LAYOUT



HOLE SIZE:  $\varnothing 0.043 \pm 0.003$  [1.08  $\pm$  0.08]  
 PAD SIZE: W  $0.063 \pm 0.002$  [1.63  $\pm$  0.05]  
 L  $0.10 \pm 0.004$  [2.54  $\pm$  0.10] BOTH SIDE

## Pin Connections

| Pin | Function  |
|-----|-----------|
| 1   | Vo        |
| 2   | Vo        |
| 3   | Vo, sense |
| 4   | Vo        |
| 5   | GND       |
| 6   | GND       |
| 7   | Vin       |
| 8   | Vin       |
| 9   | SEQ       |
| 10  | TRIM      |
| 11  | On/Off    |

## 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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