# SRBC-16A1A

## Non-Isolated DC-DC Converter

The Bel SRBC-16A1A modules are a series of non-isolated DC/DC converters that deliver up to 16 A of output current with full load efficiency of 92% at 3.3 VDC output. These modules provide precisely regulated voltage programmable via external resistor from 0.75 VDC to 5.0 VDC over a wide range of input voltage (8.4 -14 VDC).

The open-frame construction and small footprint enable designers to develop cost and space-efficient solutions. Standard features include remote on/off, remote sense, over current protection, short current protection, and programmable output voltage.

RoHS Compliant

### Key Features & Benefits

- Non-Isolated
- High Efficiency
- High Power Density
- Excellent Thermal Performance
- Low Cost
- Flexible Output Voltage
- Remote Sense
- Able to Sink/Source Current
- Under-voltage Lockout (UVLO)
- Over Temperature Protection
- OCP/SCP
- Wide Input
- Wide Trim
- Remote On/Off
- Active Low/High (option)
- Industrial Temperature Range
- Approved to IEC/EN 62368-1
- Approved to CSA/UL 62368-1

### Applications

- Networking
- Computers and Peripherals
- Telecommunications

## 1. MODEL SELECTION

| MODEL NUMBER | OUTPUT VOLTAGE | INPUT VOLTAGE | MAX. OUTPUT CURRENT | MAX. OUTPUT POWER | TYPICAL EFFICIENCY |
|---|---|---|---|---|---|
| SRBC-16A1ALG<br>SRBC-16A1A0G<br>SRBC-16A1ALR<br>SRBC-16A1A0R | 0.75 - 5.0 V | 8.3 - 14 V | 16 A | 80 W | 94% |

### PART NUMBER EXPLANATION

| S | R | BC | - | 16 | A | 1A | x | y |
|---|---|---|---|---|---|---|---|---|
| Mounting Type | RoHS Status | Series Name | | Output Current | Input Range | Output Voltage | Active Logic | Package Type |
| Surface Mount | RoHS | Bobcat | | 16 A | 8.3 - 14 V | 0.75 - 5.0 V | L – Active Low<br>0 – Active High | G - Tray Package<br>R - Tape & Reel Package |

## 2. ABSOLUTE MAXIMUM RATINGS

| PARAMETER | DESCRIPTION | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|
| Input Voltage (Continuous) | | -0.3 | - | 15 | V |
| Output Enable Terminal Voltage | | -0.3 | - | 15 | V |
| Ambient Temperature | | -40 | - | 85 | °C |
| Storage Temperature | | -55 | - | 125 | °C |
| Altitude | | - | - | 2000 | m |

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

## 3. INPUT SPECIFICATIONS

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

| PARAMETER | DESCRIPTION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|
| Input Voltage | Vo, set ≤ 3.63 V | 8.3 | 12 | 14 | V |
| | Vo, set > 3.63 V | 8.3 | 12 | 13.2 | V |
| Input Current (full load) | This power module is not internally fused. An input line fuse must always be used. | - | - | 11 | A |
| Input Current (no load) | | - | 100 | - | mA |
| Remote Off Input Current | | - | 2 | - | mA |
| Input Reflected Ripple Current (pk-pk) | Tested with one 1000 µF/25 V AL input capacitor with ESR = 0.03 Ω max and 6 × 47 µF/16 V tantalum capacitors with ESR = 0.013 Ω max at 100 kHz, & simulated source impedance of 1000 nH, 5 Hz to 20 MHz. | - | 70 | 200 | mA |
| Input Reflected Ripple Current (rms) | | - | - | 150 | mA |
| $I^2t$ Inrush Current Transient | | - | 0.2 | 0.4 | $A^2s$ |
| Turn-on Voltage Threshold | | - | 8.0 | - | V |
| Turn-off Voltage Threshold | | - | 7.5 | - | V |

## 4. OUTPUT SPECIFICATIONS

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

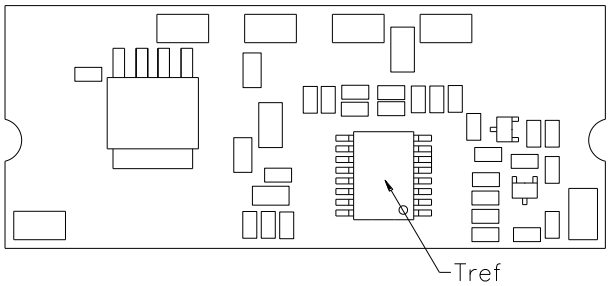
| PARAMETER | DESCRIPTION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|
| Output Voltage Set Point | Vin = 12 V, full load. | -2% | - | 2% | Vo,set |
| Output Voltage Set Point | Over entire operating input voltage range, resistive load, and temperature conditions. | -3% | - | 3% | Vo,set |
| Load Regulation | Io = Io, min to Io, max | - | 0.1% | - | Vo,set |
| Line Regulation | Vin = Vin, min to Vin, max | - | 0.1% | - | Vo,set |
| Regulation Over Temperature (-40 °C to +85 °C) | Tref = Ta,min to Ta,max | - | 0.3% | - | Vo,set |
| Output Current Range | | 0 | - | 16 | A |
| Current Limit Threshold | | - | 180% Io | - | A |
| Short Circuit Surge Transient | | - | 1 | 3 | $A^2s$ |
| Ripple and Noise (Pk-Pk) | Tested with 0-20 MHz, 10 µF tantalum capacitor & 1 µF TDK ceramic capacitor at the output | - | 75 | 100 | mV |
| Ripple and Noise (RMS) | | - | 30 | 45 | mV |
| Turn on Time | | - | 6 | 10 | ms |
| Overshoot at Turn on | | - | - | 1% | Vo,set |
| Output Capacitance | ESR ≥ 10 mΩ | 0 | - | 5000 | µF |
| ***Transient Response*** | | | | | |
| △V 50%~100% of Max Load | Vo = 0.75 - 5 V; di/dt = 2.5 A/µs; Vin = 12 V; and with 2 × 150 µF polymer capacitors at the output | - | 100 | - | mV |
| Settling Time | | - | 50 | - | µs |
| △V 100%~50% of Max Load | | - | 100 | - | mV |
| Settling Time | | - | 50 | - | µs |

## 5. GENERAL SPECIFICATIONS

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

| PARAMETER | | DESCRIPTION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Efficiency | Vo = 5.0 V | Measured at Vin = 12 V, full load | - | 94% | - | - |
| | Vo = 3.3 V | | - | 92% | - | |
| | Vo = 2.5 V | | - | 90% | - | |
| | Vo = 1.8 V | | - | 88% | - | |
| | Vo = 1.5 V | | - | 87% | - | |
| | Vo = 1.2 V | | - | 85% | - | |
| | Vo = 0.75 V | | - | 79% | - | |
| Switching Frequency | | | 265 | 300 | 335 | kHz |
| Over Temperature Shutdown [1] | | | - | 130 | - | °C |
| Output Trim Range (Wide Trim) | | | 0.7525 | - | 5.0 | V |
| Remote Sense Compensation | | | - | - | 0.5 | V |
| MTBF | | Calculated Per Bell Core SR-332 (Io = Nominal; Ta = 25°C) | - | 2,666,488 | - | hour |
| Weight | | | - | 8 | - | g |
| Dimensions (L × W × H) | | | 1.30 x 0.53 x 0.315<br>33.02 x 13.46 x 8.00 | | | inch<br>mm |

**NOTE:** [1] The Tref temperature measurement location:




## 6. CONTROL SPECIFICATIONS

| PARAMETER | DESCRIPTION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|
| ***Remote on/off*** | | | | | |
| Signal Low (Unit Off) | SRBC-16A1A0; Remote On/Off pin open, Unit on. | -0.2 | - | 0.3 | V |
| Signal High (Unit On) | | 1.0 | - | Vin, max | V |
| Signal Low (Unit On) | SRBC-16A1AL; Remote On/Off pin open, Unit on. | -0.2 | - | 0.3 | V |
| Signal High (Unit Off) | | 2.5 | - | Vin, max | V |

## 7. REMOTE ENABLE SPECIFICATIONS

The SRBC-16A1AL modules feature an enable pin with negative logic. If not using the enable pin, leave the pin open (the module will be on). During logic_high, the module is turned off, during logic_low, the module is turned on. Its inner circuit impedance is showed as figure.

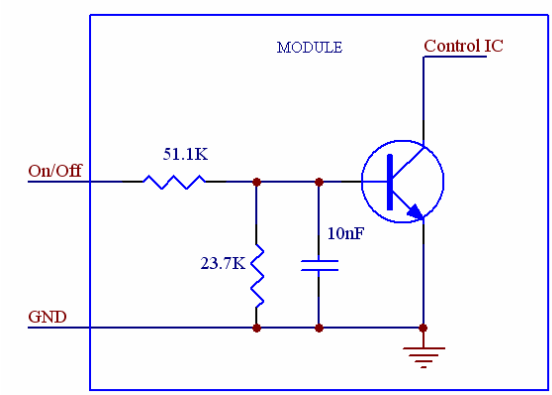



*Figure 1. SRBC-16A1AL*

The SRBC-16A1A0 modules feature an enable pin with Positive logic. If not using the enable pin, leave the pin open (the module will be on). During logic_high, the module is turned on, during logic_low, the module is turned off. Its inner circuit impedance is showed as figure.

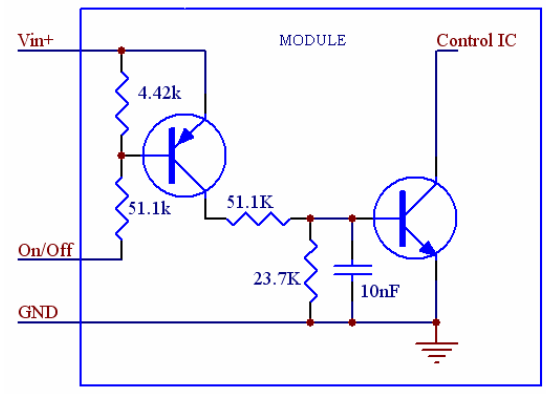



*Figure 2. SRBC-16A1A0*



## 8. EFFICIENCY DATA

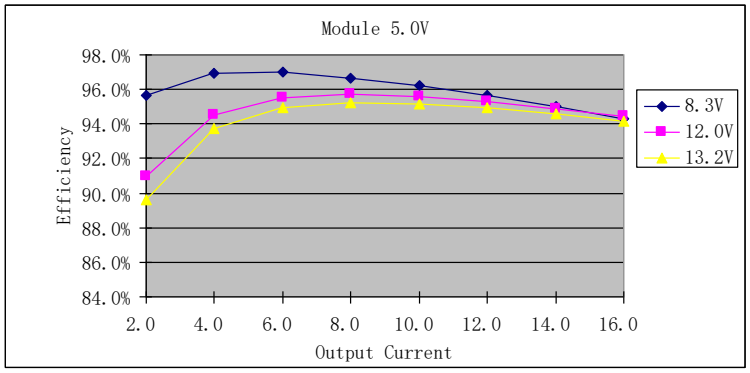



*Figure 3. Vo = 5.0 V*

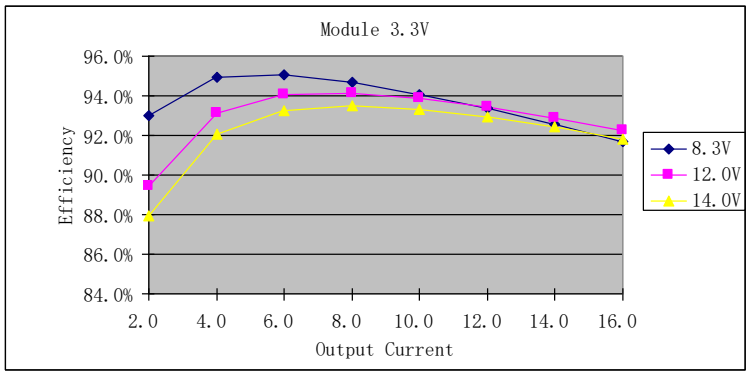



*Figure 4. Vo = 3.3 V*

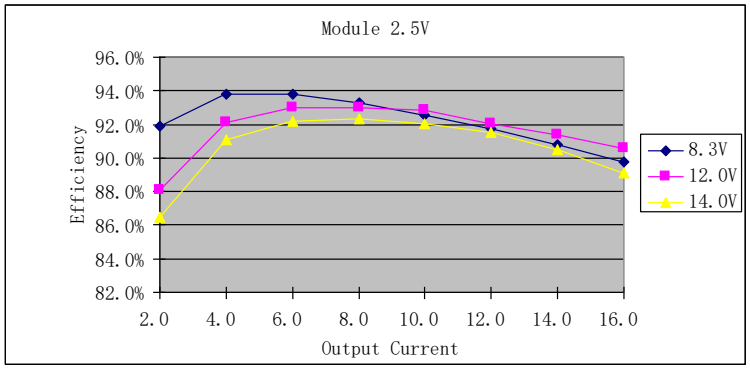



*Figure 5. Vo = 2.5 V*

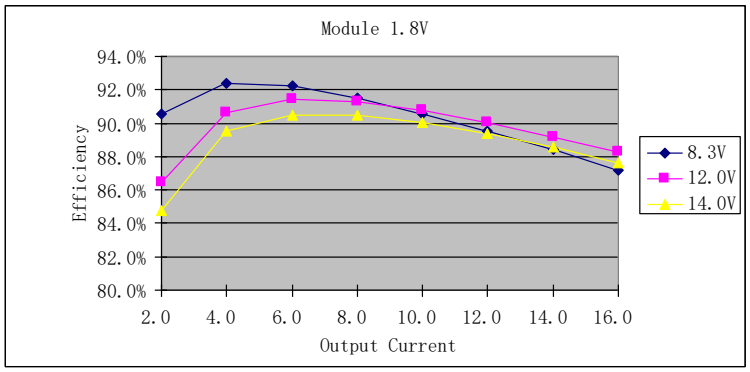



*Figure 6. Vo = 1.8 V*

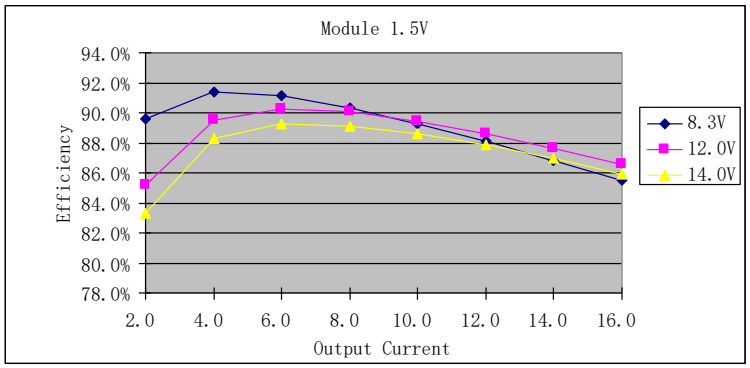



*Figure 7. Vo = 1.5 V*

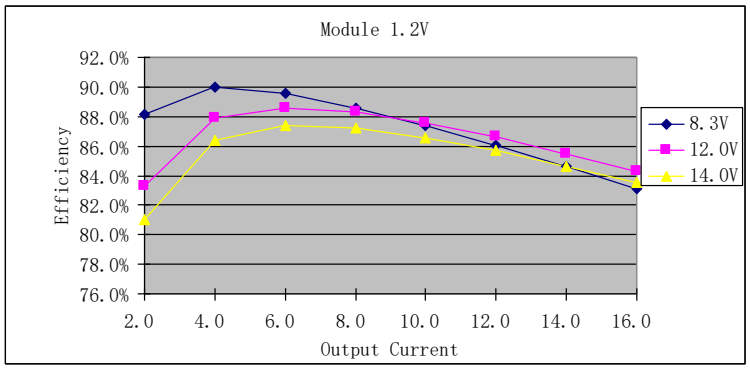



*Figure 8. Vo = 1.2 V*

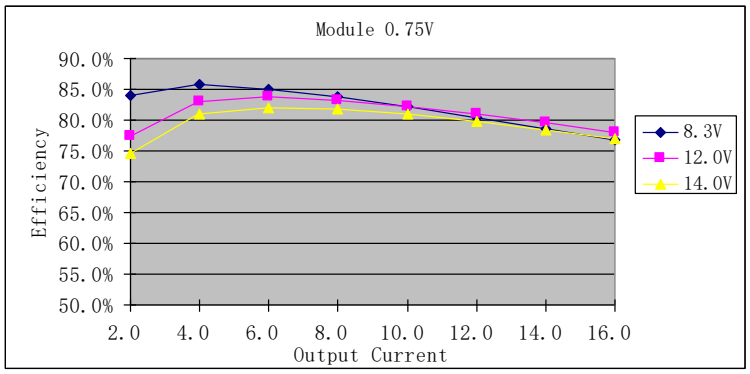



*Figure 9. Vo = 0.75 V*

## 9. OUTPUT TRIM EQUATIONS

Equation for calculating the trim resistor (in Ω) given the desired adjusted voltage (Vadj) is shown below. The Trim Up resistor should be connected between the Trim pin and Ground.

$$R_{trimup} = \frac{10500}{V_{adj} - 0.7525} - 1000$$

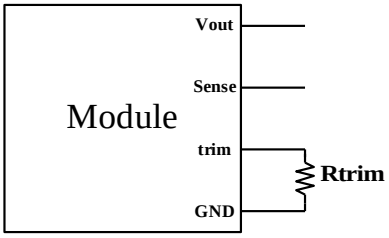



*Figure 10. Trim up circuit-1*

Equation for calculating the trim voltage (in V) given the desired adjusted voltage (Vadj) is shown below. The Trim Up voltage should be connected between the Trim pin and Ground.

$$V_{trimup} = 0.7 - 0.0667 \times (V_{adj} - 0.7525)$$

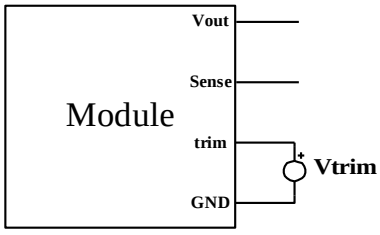



*Figure 11. Trim up circuit-2*

## 10. RIPPLE AND NOISE WAVEFORMS

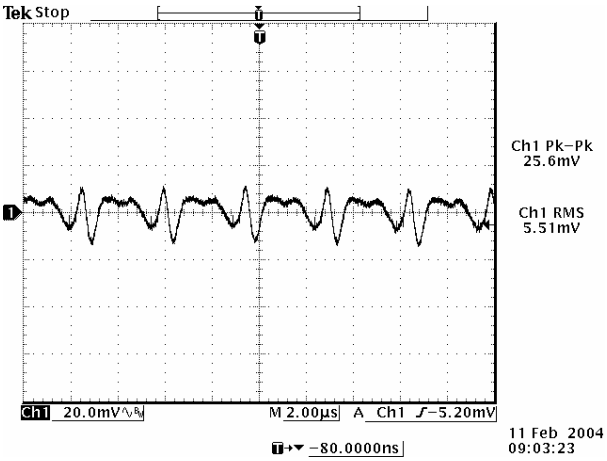



*Figure 12. Ripple and noise at max load 0.75 VDC output*

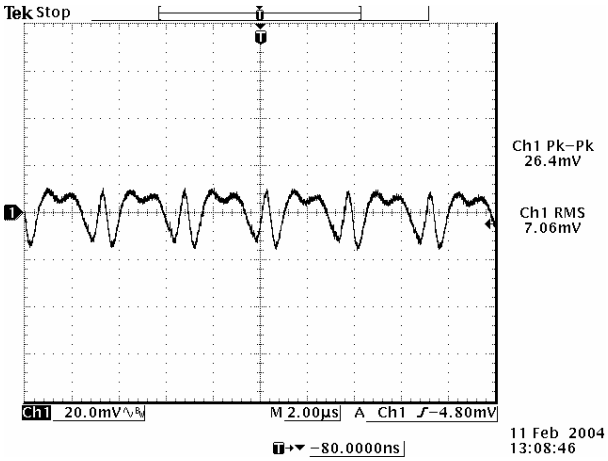



*Figure 13. Ripple and noise at max load 1.2 VDC output*

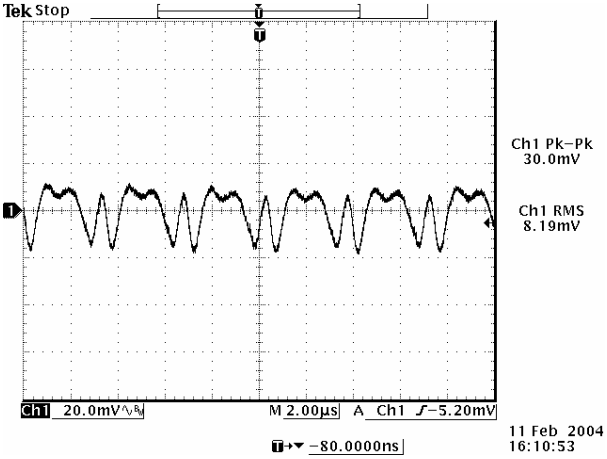



*Figure 14. Ripple and noise at max load 1.5 VDC output*

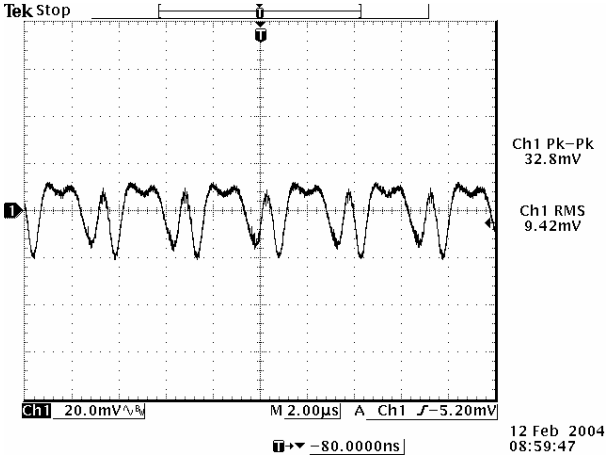



*Figure 15. Ripple and noise at max load 1.8 VDC output*



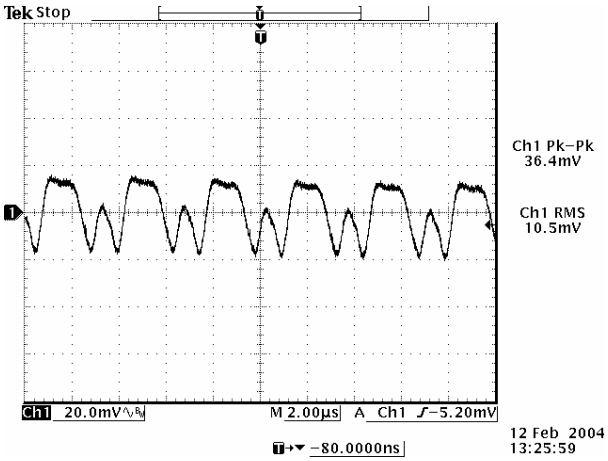



*Figure 16. Ripple and noise at max load 2.5 VDC output*

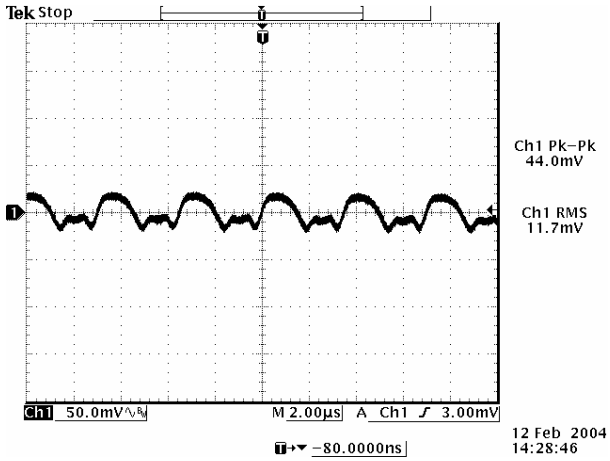



*Figure 17. Ripple and noise at max load 3.3 VDC output*

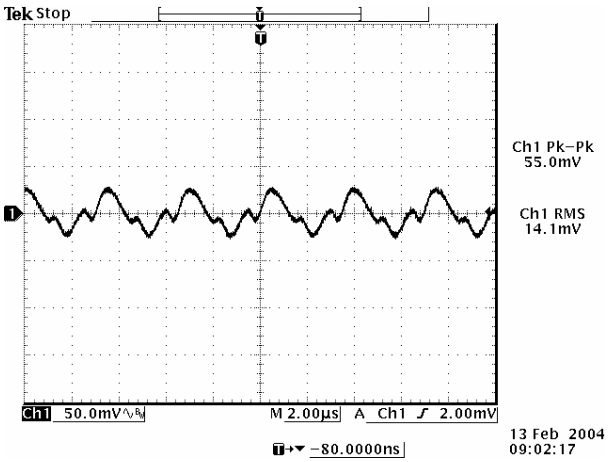



*Figure 18. Ripple and noise at max load 5.0 VDC output*

**Note:** Ripple and Noise at 12 V input, with 10 µF tantalum capacitor and 1 µF ceramic capacitor at the output, and Ta = 25°C.

## 11. TRANSIENT RESPONSE WAVEFORMS

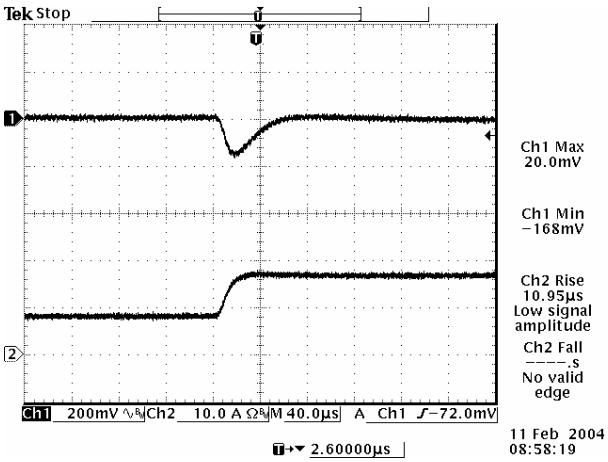



*Figure 19. Transients 50% to 100% load 0.75 VDC output*

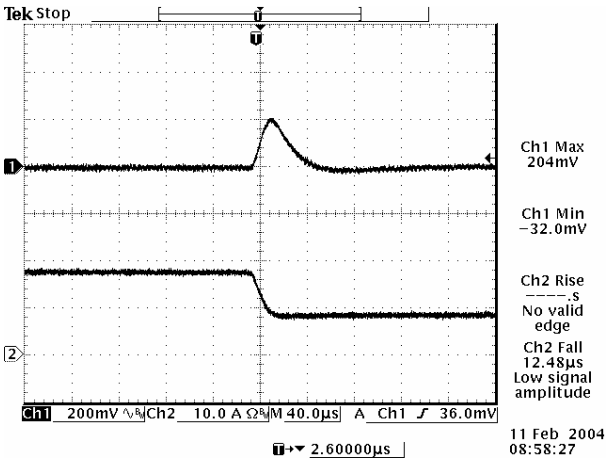



*Figure 20. Transients 100% to 50% load 0.75 VDC output*

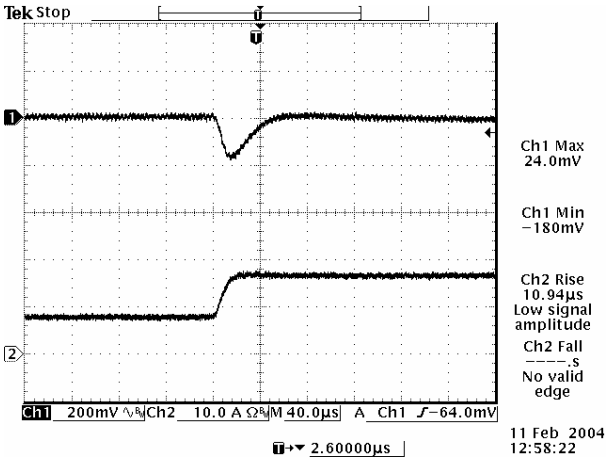



*Figure 21. Transients 50% to 100% load 1.2 VDC output*

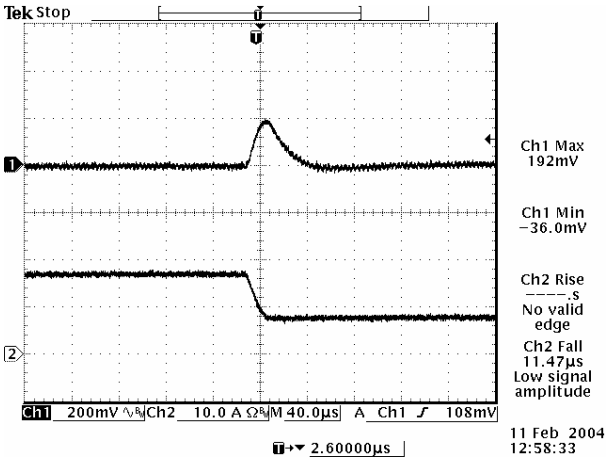



*Figure 22. Transients 100% to 50% load 1.2 VDC output*



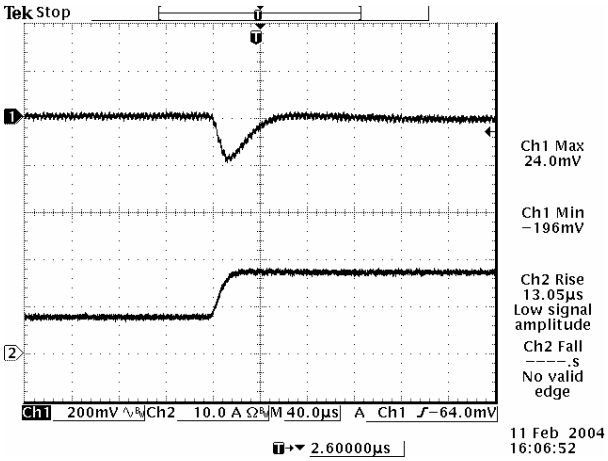



*Figure 23. Transients 50% to 100% load 1.5 VDC output*

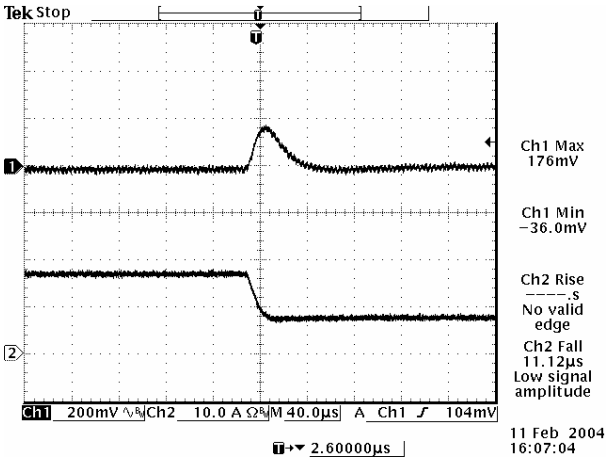



*Figure 24. Transients 100% to 50% load 1.5 VDC output*

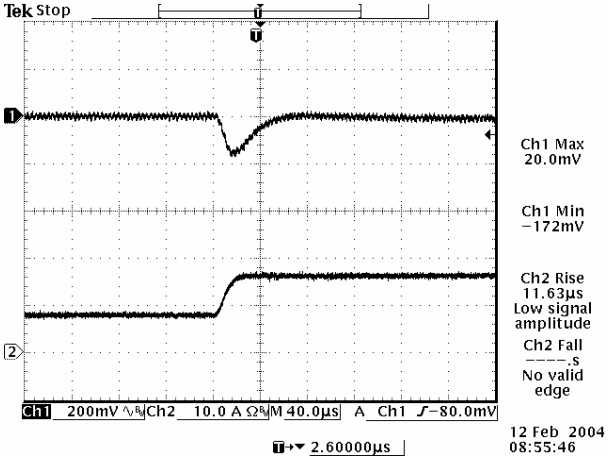



*Figure 25. Transients 50% to 100% load 1.8 VDC output*

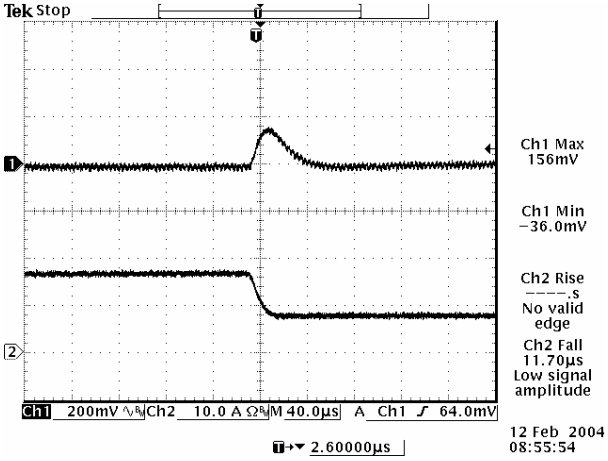



*Figure 26. Transients 100% to 50% load 1.8 VDC output*

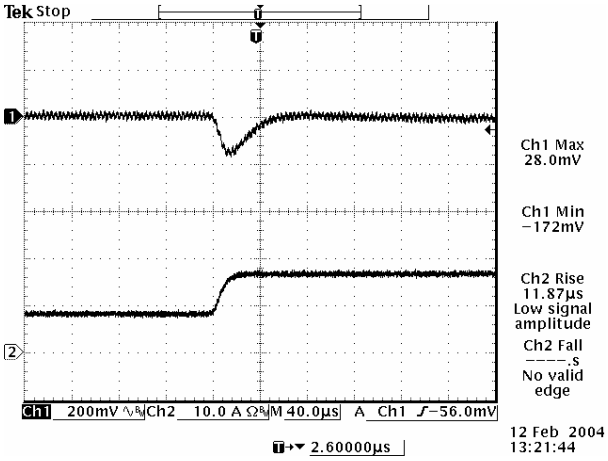



*Figure 27. Transients 50% to 100% load 2.5 VDC output*

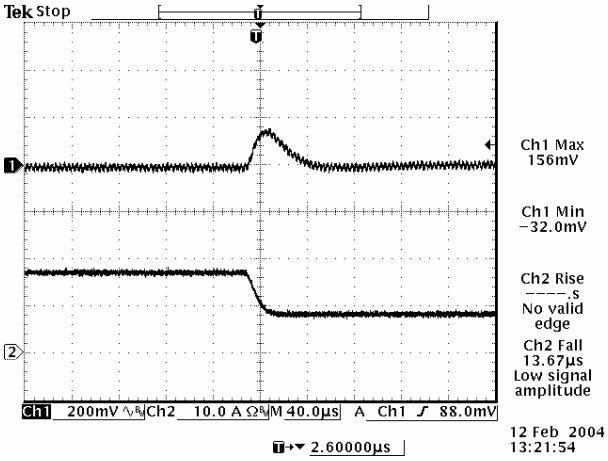



*Figure 28. Transients 100% to 50% load 2.5 VDC output*

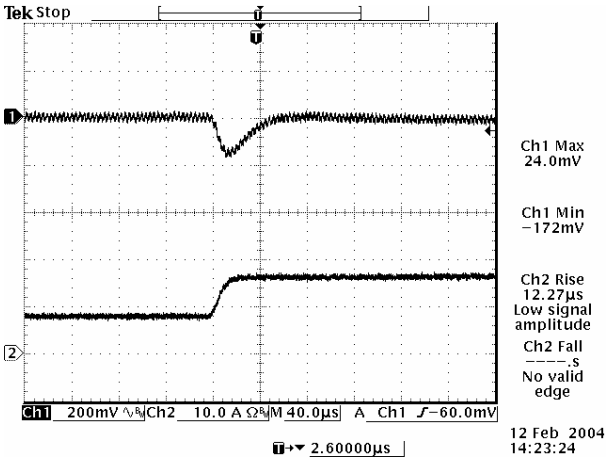



*Figure 29. Transients 50% to 100% load 3.3 VDC output*

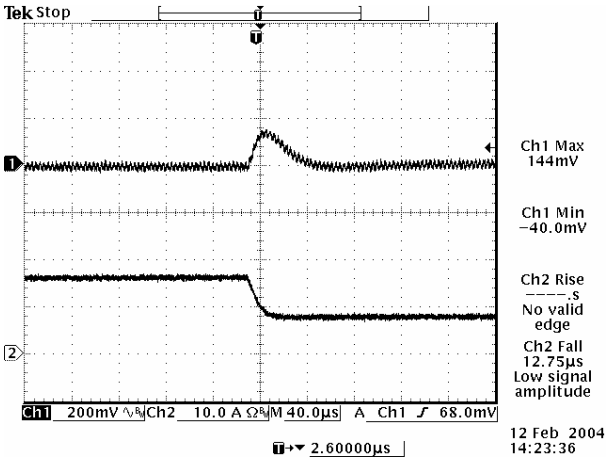



*Figure 30. Transients 100% to 50% load 3.3 VDC output*

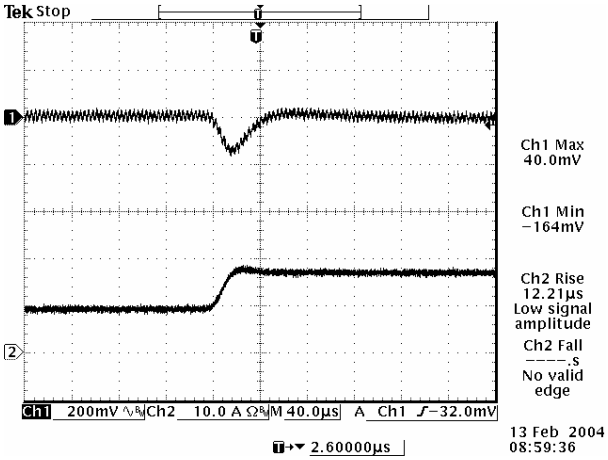



*Figure 31. Transients 50% to 100% load 5.0 VDC output*

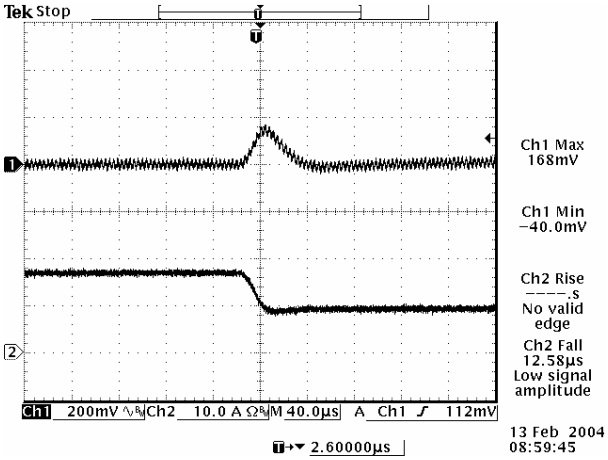



*Figure 32. Transients 100% to 50% load 5.0 VDC output*

**Note:** Transient response at 12 V input, di/dt = 2.5 A/µs, with external 2 x 150 µF polymer capacitor at the output, Ta = 25°C.

## 12. THERMAL DERATING CURVE

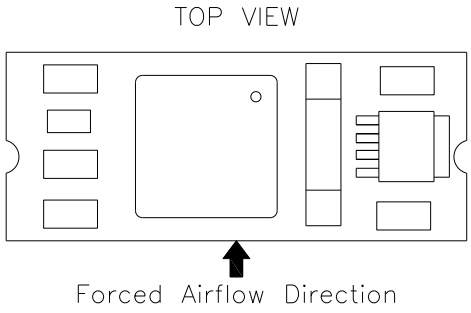



*Figure 33. Airflow direction*

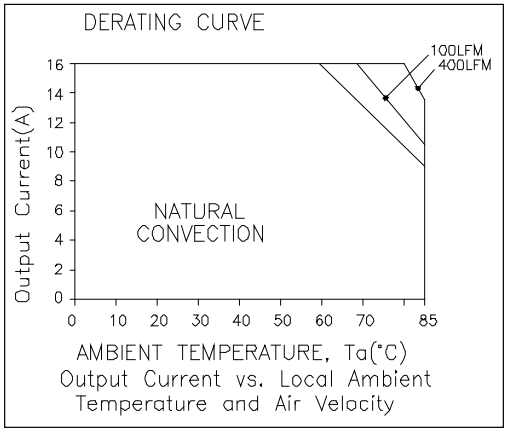



*Figure 34. Vo = 0.75 V*

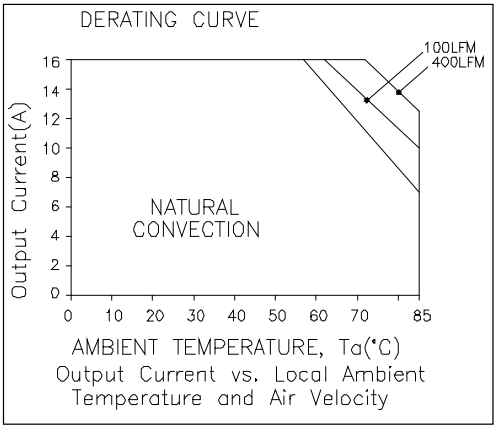



*Figure 35. Vo = 1.8 V*

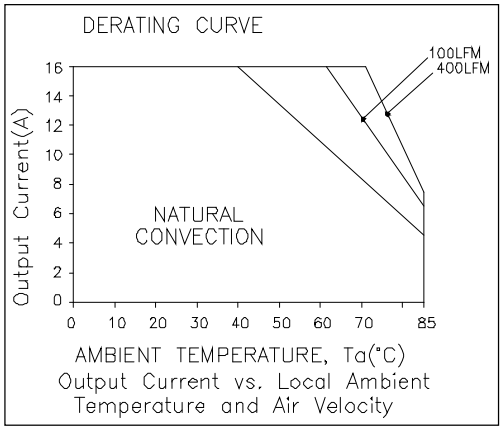



*Figure 36. Vo = 3.3 V*

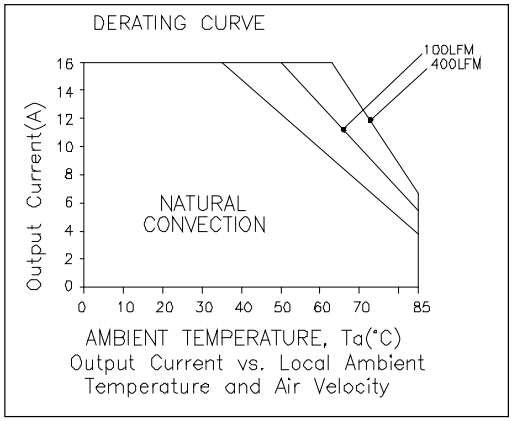



*Figure 37. Vo = 5.0 V*



## 13. MECHANICAL DIMENSIONS

### OUTLINE

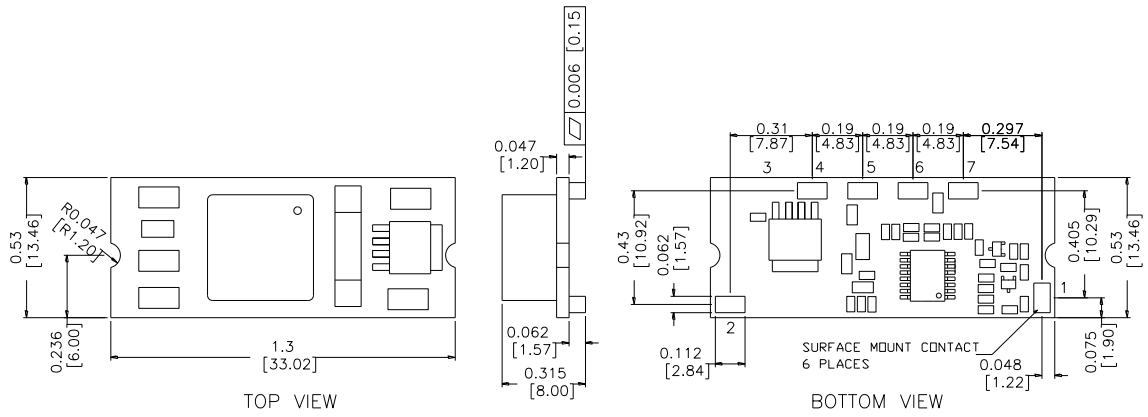


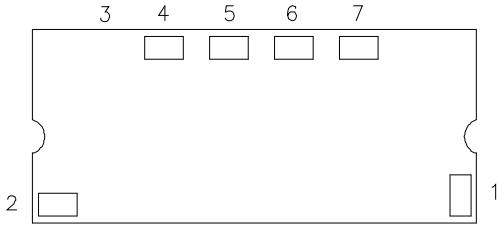

*Figure 38. Outline*

**Note:** These parts are not however compatible with the higher temperatures associated with lead free solder processes and must be soldered using a reflow profile with a peak temperature of no more than 245°C.

**Notes:**

1) All Pins: Material - Copper Alloy;
   Finish - Gold plated.
2) Un-dimensioned components are shown for visual reference only.
3) All dimensions in inch [mm]; Tolerances: x.xx +/-0.02 inch [0.51 mm]. x.xxx +/-0.010 inch [0.25 mm].

## PIN DEFINITIONS

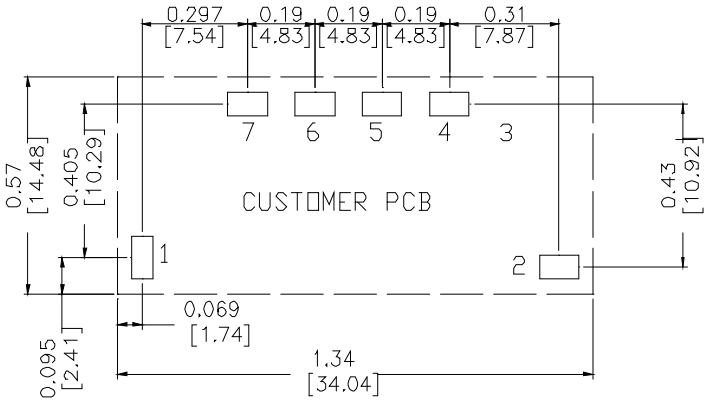



BOTTOM VIEW

*Figure 39. Pins*

| PIN | FUNCTION | PIN | FUNCTION |
|---|---|---|---|
| 1 | Remote On/Off | 5 | Vout (+) |
| 2 | Vin (+) | 6 | Trim |
| 3 | N/A | 7 | Remote Sense |
| 4 | Ground | | |

## RECOMMENDED PAD LAYOUT




PAD SIZE:
MIN: 0.14"* 0.095" (3.56mm * 2.41mm)
MAX: 0.165"* 0.11" (4.19mm * 2.79mm)

*Figure 40. Recommended pad layout*



## 14. REVISION HISTORY

| DATE | REVISION | CHANGES DETAIL | APPROVAL |
|---|---|---|---|
| 2007-01-05 | AA | First release. | Lynn |
| 2007-12-13 | AB | Add Total Regulation. | XP.Chen / HL.Lu |
| 2011-08-25 | AC | Update the reflow solder temperature. | HL.Lu |
| 2013-01-25 | AD | Update UL. | HL.Lu |
| 2015-05-11 | AE | Update Package. | XF.Jiang |
| 2021-07-30 | AF | Add object ID and thermal test airflow direction. Update to new form. Update safety certificate. | XF.Jiang |