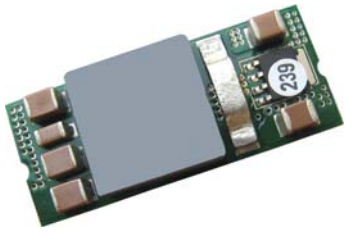
# NON-ISOLATED DC/DC CONVERTERS

**4.5 Vdc - 14 Vdc Input  0.75 Vdc - 3.63 Vdc/16 A Output**

**SRBC-16E2Ax  RoHS Compliant  Rev.A**

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



## Description

The Bel SRBC-16E2Ax is part of the non-isolated dc/dc converter series. The modules use a SMT package. These converters are available in a range of output voltages from 0.75 Vdc to 3.63 Vdc over a wide range of input voltage (Vin = 4.5 Vdc - 14 Vdc). The Bel SRBC-16E2Ax has a sequencing feature that enables designers to implement various types of output voltage sequencing when powering. The efficiency is typically 92% at 3.3 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 - 3.63 V | 4.5 V - 14 V | 16 A | 58 W | 92% | SRBC-16E2AL | SRBC-16E2A0 |

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

## 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 [1] | -0.3 V | - | Vin | |
| Ambient Temperature | -40 °C | - | 85 °C | |
| Storage Temperature | -55 °C | - | 125 °C | |

**Notes**: All specifications are typical at 25 °C unless otherwise stated.
1. SRBC-16E2Ax 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 not using the sequencing feature, either, tie the SEQ pin to Vin or leave it unconnected.

# NON-ISOLATED DC/DC CONVERTERS

**4.5 Vdc - 14 Vdc Input  0.75 Vdc - 3.63 Vdc/16 A Output**

bel POWER PRODUCTS

## Input Specifications

| Parameter | Min | Typ | Max | Notes |
|---|---|---|---|---|
| Input Voltage<br>Vo,set < 3.0 V<br>Vo,set ≥ 3.0 V | <br>4.5 V<br>Vo,set +1.5 V | <br>-<br>- | <br>14 V<br>14 V | |
| Input Current (full load) | - | - | 15 A | |
| Input Current (no load) | - | 100 mA | - | |
| Remote Off Input Current | - | 2 mA | - | |
| Input Reflected Ripple Current (pk-pk) | - | - | 400 mA | Tested with one 1000 uF/25 V AL input capacitor with ESR=0.03 ohm max and 6 × 47 uF/16 V tantalum 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) | - | - | 150 mA | |
| $I^2t$ Inrush Current Transient | - | 0.2 $A^2s$ | 0.4 $A^2s$ | |
| Turn-on Voltage Threshold | - | 4.2 V | - | |
| Turn-off Voltage Threshold | 3.7 V | - | 4.2 V | |

## Output Specifications

| Parameter | | Min | Typ | Max | Notes |
|---|---|---|---|---|---|
| Output Voltage Set Point | | -2% Vo,set | - | 2% Vo,set | Vin=12 V, full load |
| Load Regulation | | - | 0.1% Vo,set | - | Io=Iomin to Iomax |
| Line Regulation | | - | 0.1% Vo,set | - | Vin=Vinmin to Vinmax |
| Regulation Over Temperature (-40 °C to +85 °C) | | - | 0.3% Vo,set | - | Tref=Tamin to Tamax |
| Output Current | | 0 A | - | 16 A | |
| Current Limit Threshold | | - | 180% Io | - | |
| Short Circuit Surge Transient | | - | 1 $A^2s$ | 3 $A^2s$ | |
| Ripple and Noise (pk-pk) | | - | 30 mV | 75 mV | Tested with 0-20 MHz, 10 uF tantalum capacitor & 1 uF TDK ceramic capacitor at the output |
| Ripple and Noise (rms) | | - | 12 mV | 30 mV | |
| Turn on Time | | - | 12 mS | 20 mS | |
| Overshoot at Turn on | | - | - | 1% Vo,set | |
| Output Capacitance | | - | - | 5000 uF | |
| **Transient Response** | | | | | |
| 50% ~ 100% Max Load | All | - | 150 mV | - | di/dt=2.5 A/uS; Vin=12 V; and with 2 × 150 uF polymer capacitors at the output |
| Settling Time | | - | 50 uS | - | |
| 100% ~ 50% Max Load | | - | 150 mV | - | |
| Settling Time | | - | 50 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 | | | | |
| Vo=3.3 V | - | 92% | - | Measured at Vin=12 V, full load |
| 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% | - | |
| Efficiency | | | | |
| Vo=3.3 V | - | 92% | - | Measured at Vin=5 V, full load |
| Vo=2.5 V | - | 90% | - | |
| Vo=1.8 V | - | 87% | - | |
| Vo=1.5 V | - | 86% | - | |
| Vo=1.2 V | - | 83% | - | |
| Vo=0.75 V | - | 78% | - | |
| Switching Frequency | 200 kHz | 230 kHz | 260 kHz | |
| Over Temperature Shutdown[1] | - | 130 °C | - | |
| Output Trim Range (Wide Trim) | 0.7525 V | - | 3.63 V | |
| Remote Sense Compensation | - | - | 0.5 V | |
| MTBF | 2,666,488 hours | | | Calculated Per Bell Core SR-332 ($I_O$ =80% Iomax; Vo=3.3 V; Vin=12 V; $T_a$ = 25 °C) |
| Dimensions | | | | |
| Inches (L × W × H) | 1.30 x 0.53 x 0.315 | | | |
| Millimeters (L × W × H) | 33.02 x 13.46 x 8.00 | | | |
| Weight | - | 8 g | - | |

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

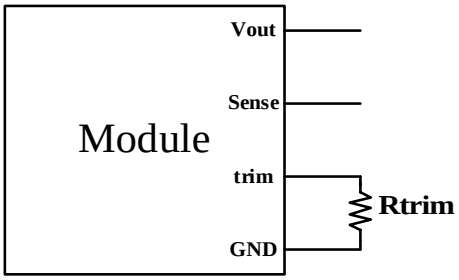
## Control Specifications

| Parameter | Min | Typ | Max | Notes |
|---|---|---|---|---|
| **Remote On/Off** | | | | |
| Signal Low (Unit Off) | -0.2 V | - | 0.3 V | SRBC-16E2A0; Remote On/Off pin open, Unit on. |
| Signal High (Unit On) | - | - | Vin, max | |
| Signal Low (Unit On) | -0.2 V | - | 0.3 V | SRBC-16E2AL; Remote On/Off pin open, Unit on. |
| Signal High (Unit Off) | 2.5 V | - | Vin, max | |
| **Voltage Sequencing** | | | | |
| Sequencing Delay Time | 25 mS | - | - | Delay from Vinmin 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 | |

## Output Trim Equations

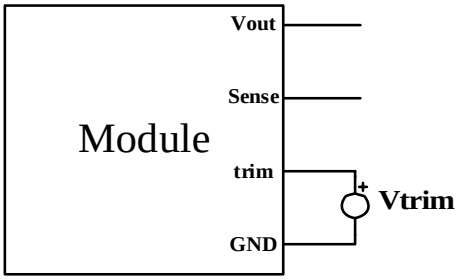
Equation for calculating the trim resistor (in Ω) given the desired output voltage (Vo) is shown below. The Trim Up resistor should be connected between the Trim pin and Ground.

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

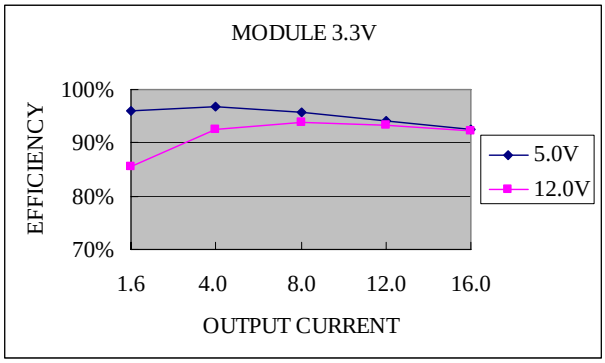


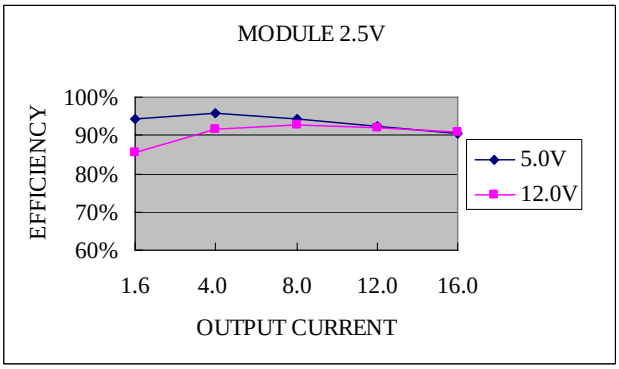

Equation for calculating the trim voltage (in V) given the desired output voltage (Vo) is shown below. The Trim Up voltage should be connected between the Trim pin and Ground.

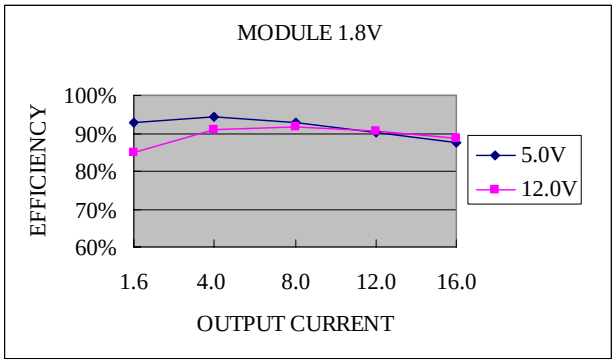
$$V_{trimup} = 0.7 - 0.0667 \times (Vo - 0.7525)$$

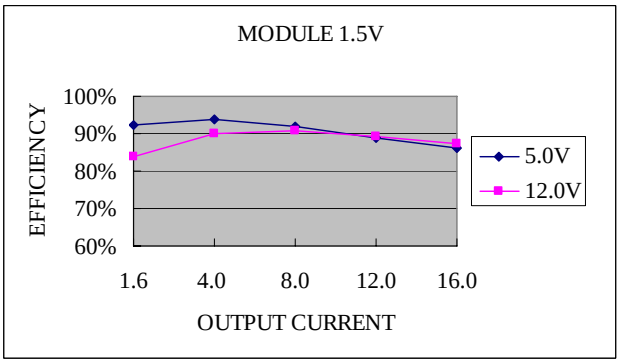


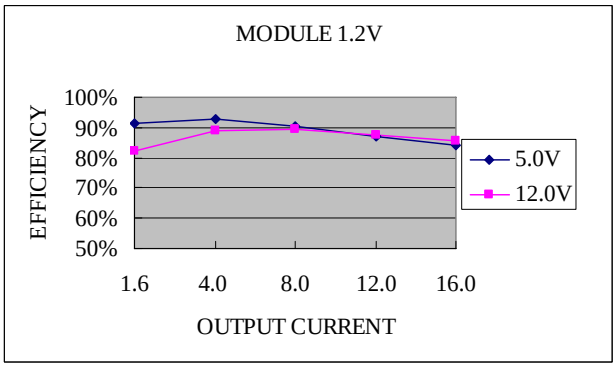
## Efficiency Data

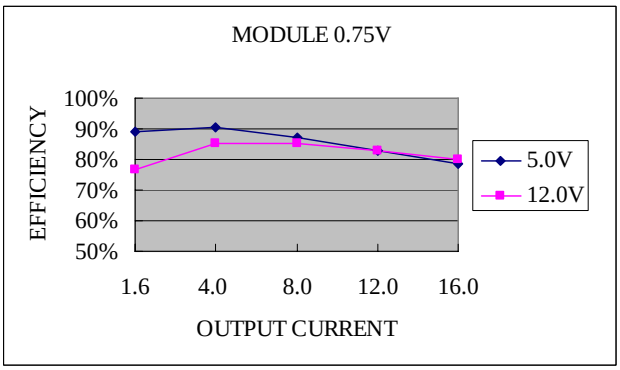


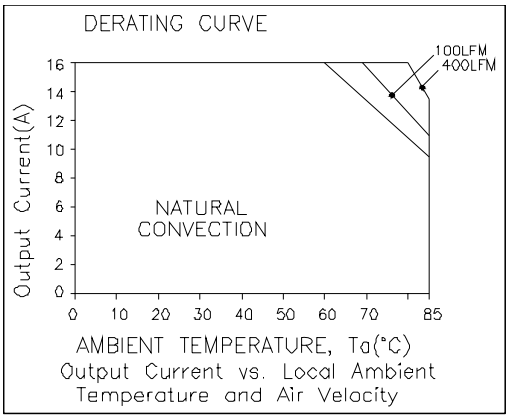



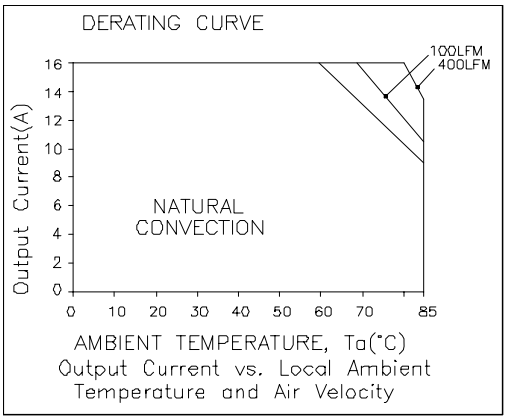



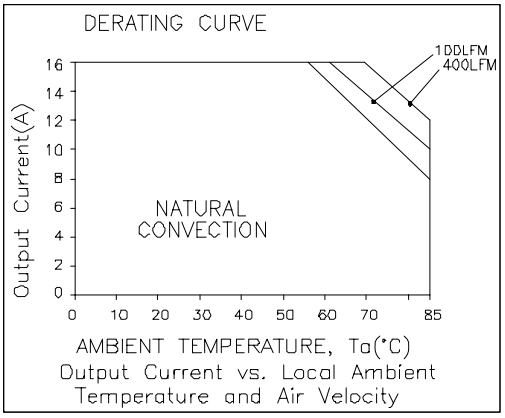
## Thermal Derating Curves



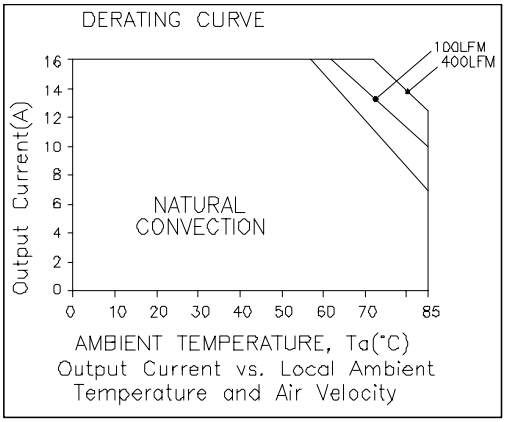

Vin=5 V, Vo=0.75 V



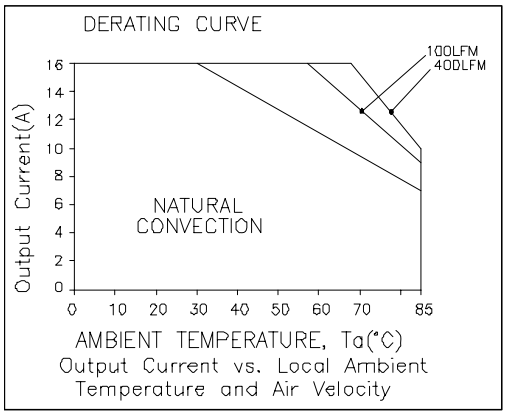

Vin=12 V, Vo=0.75 V



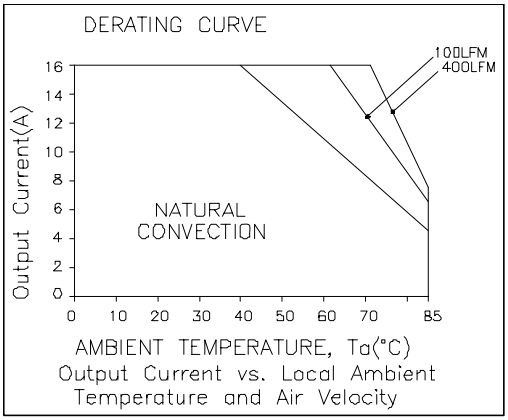

Vin=5 V, Vo=1.8 V




Vin=12 V, Vo=1.8 V

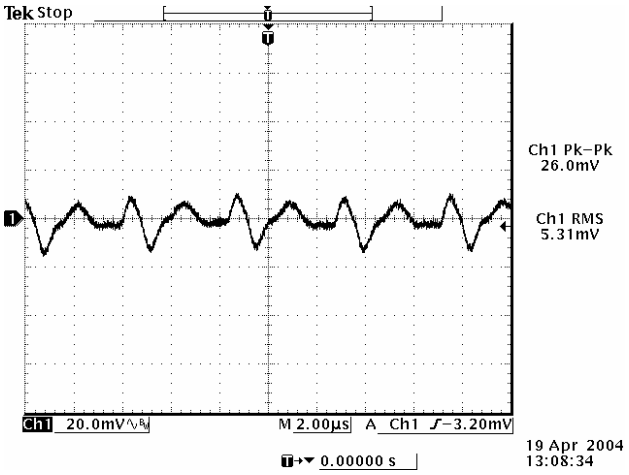



Vin=5 V, Vo=3.3 V

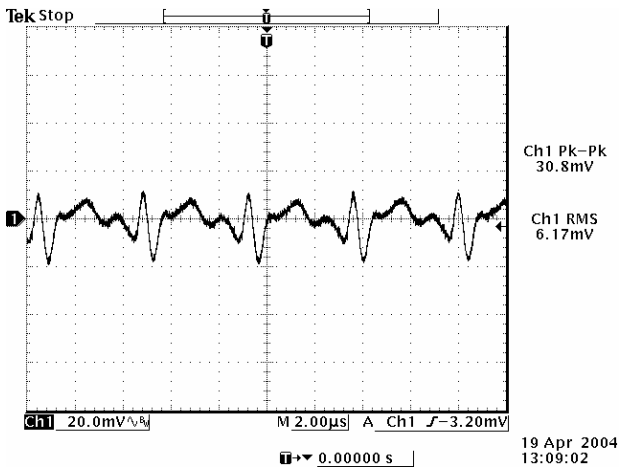



Vin=12 V, Vo=3.3 V

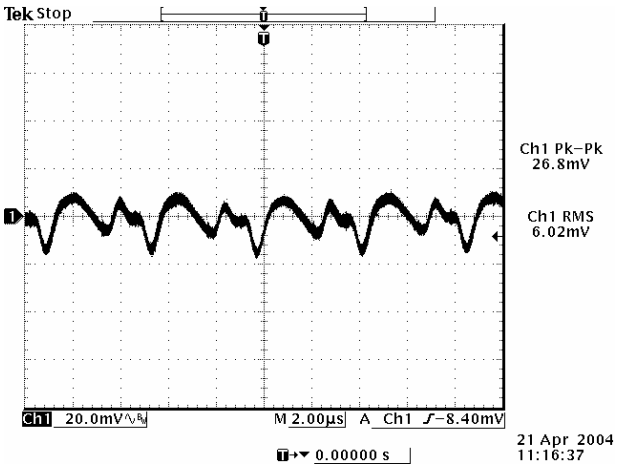
## Ripple and Noise Waveforms



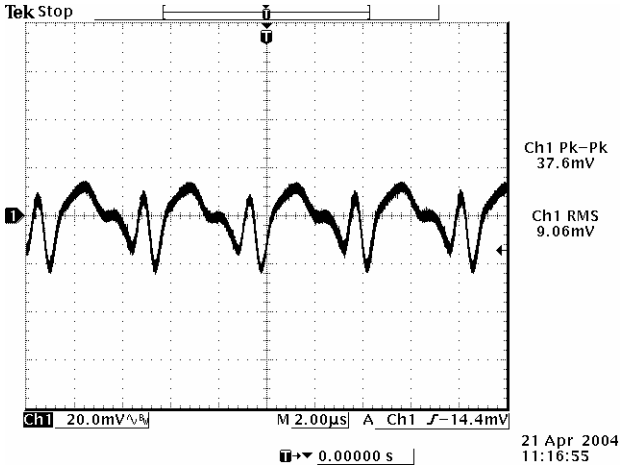

Vin=5 V, Vo=0.7525 V



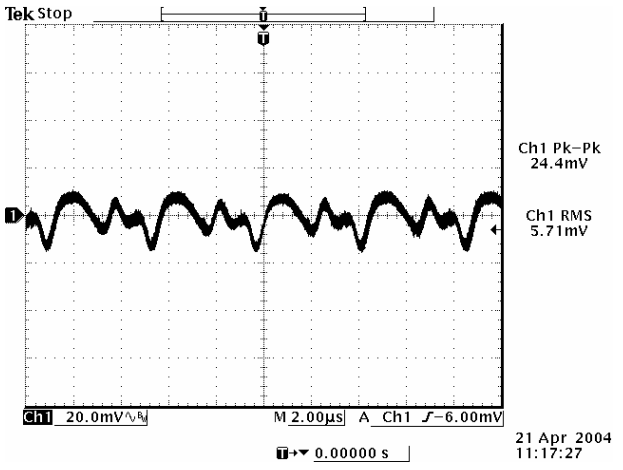

Vin=12 V, Vo=0.7525 V



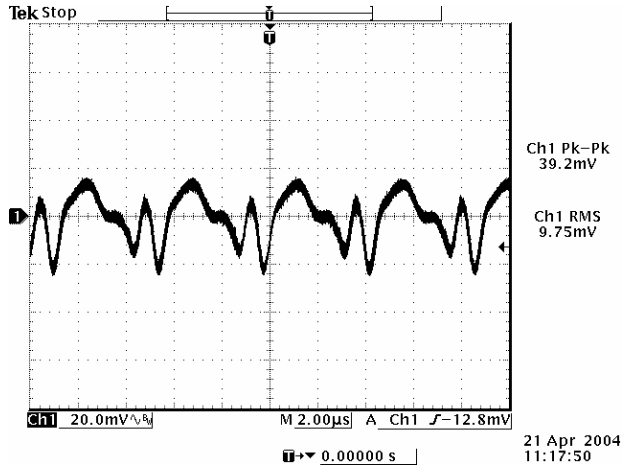

Vin=5 V, Vo=1.2 V




Vin=12 V, Vo=1.2 V

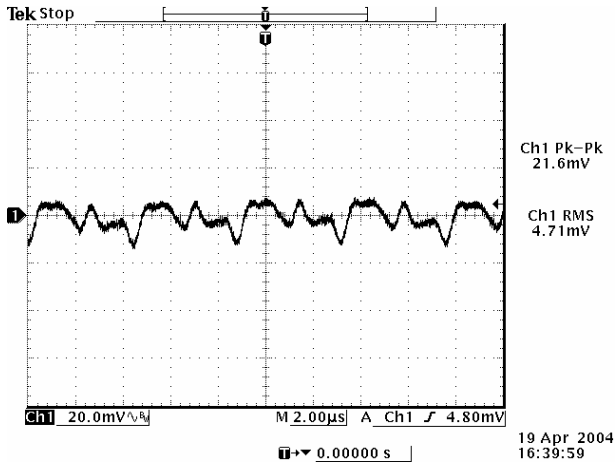



Vin=5 V, Vo=1.5 V

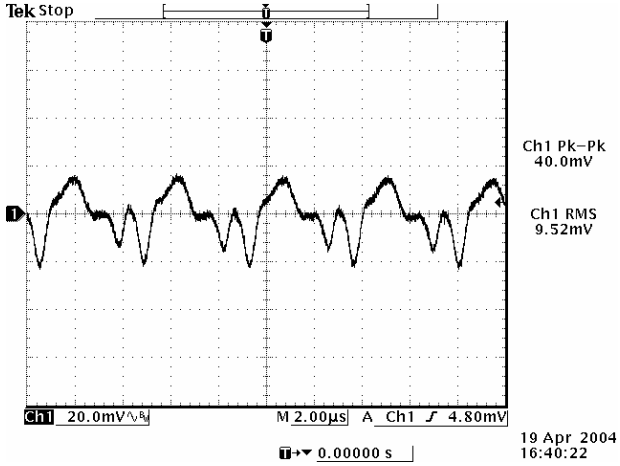



Vin=12 V, Vo=1.5 V

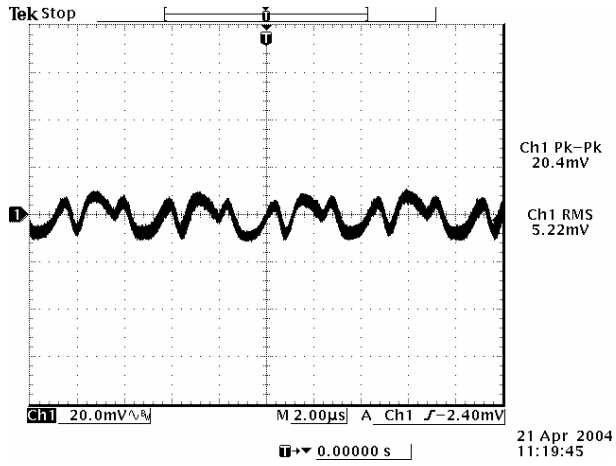
## Ripple and Noise Waveforms (continued)



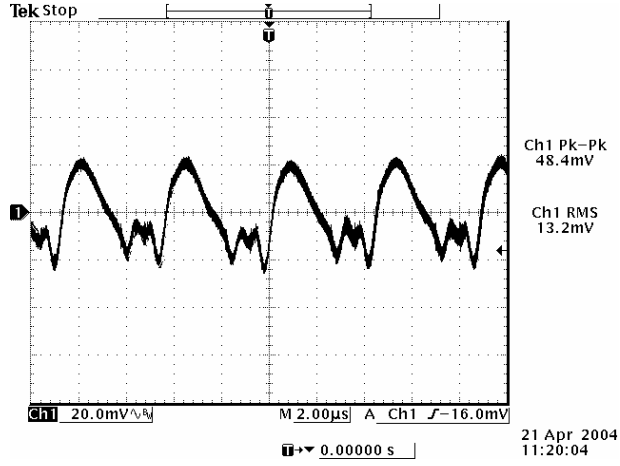

Vin=5 V, Vo=1.8 V



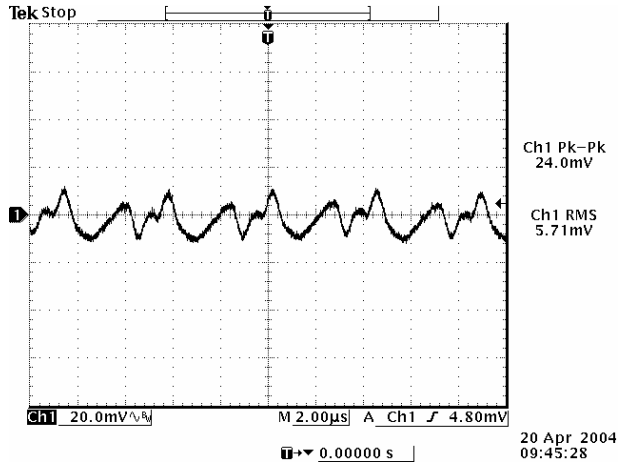

Vin=12 V, Vo=1.8 V



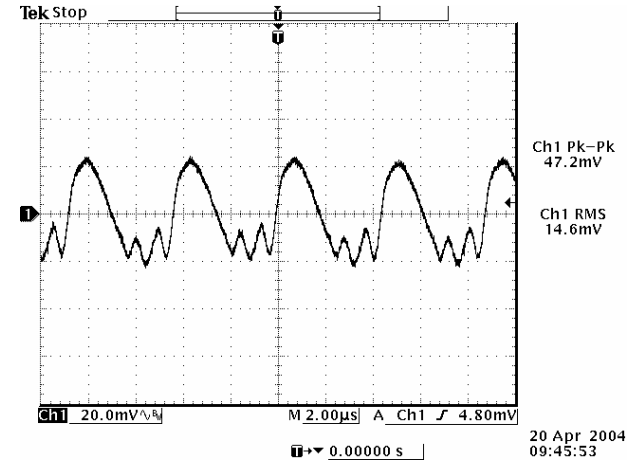

Vin=5 V, Vo=2.5 V




Vin=12 V, Vo=2.5 V



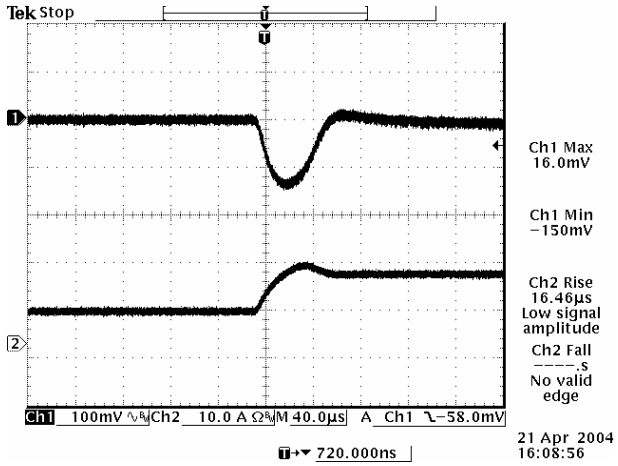

Vin=5 V, Vo=3.3 V



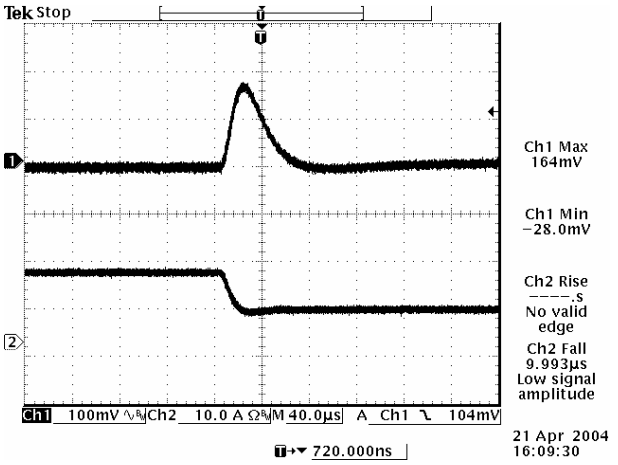

Vin=12 V, Vo=3.3 V

**Note:** Ripple and noise at full load, with 10uF tantalum capacitor and 1uF ceramic at the output, and Ta=25℃.

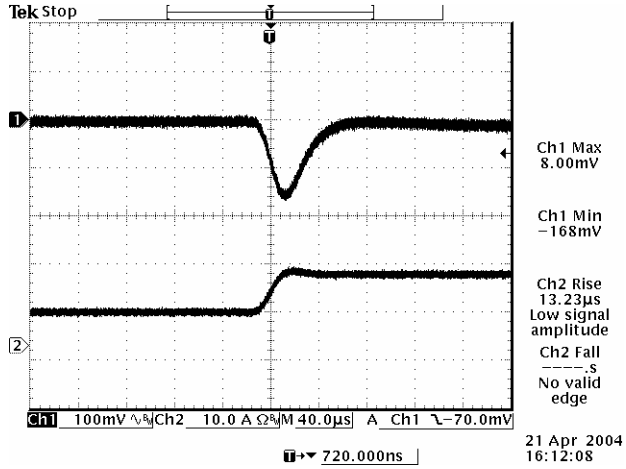
## Transient Response Waveforms



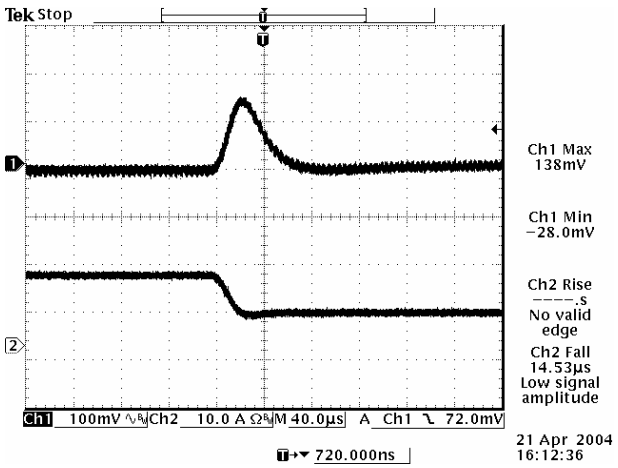

50% to 100% load Transient at Vin=5 V, Vo=0.75 V



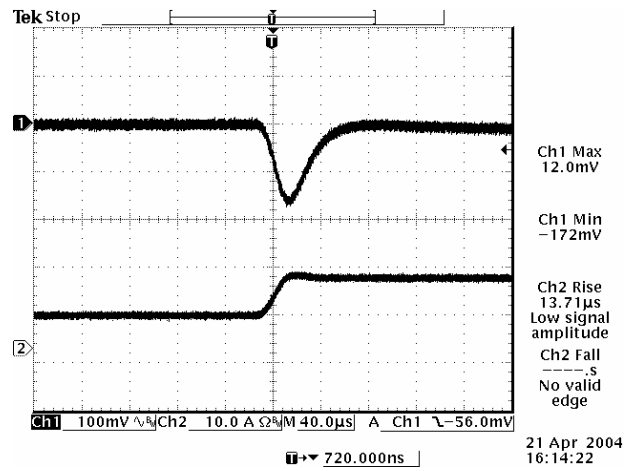

100% to 50% load Transient at Vin=5 V, Vo=0.75 V



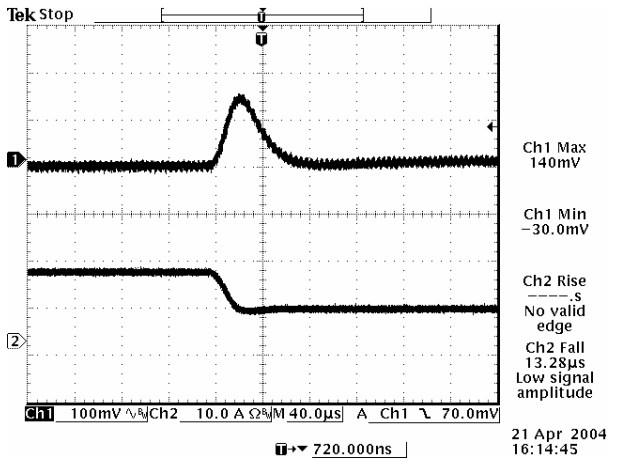

50% to 100% load Transient at Vin=5 V, Vo=1.2 V




100% to 50% load Transient at Vin=5 V, Vo=1.2 V

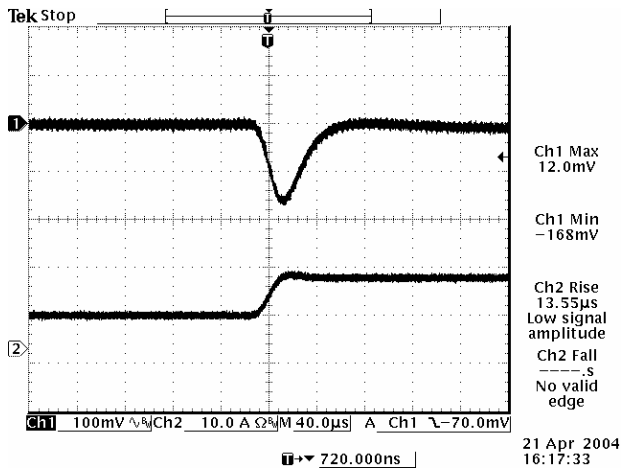



50% to 100% load Transient at Vin=5 V, Vo=1.5 V

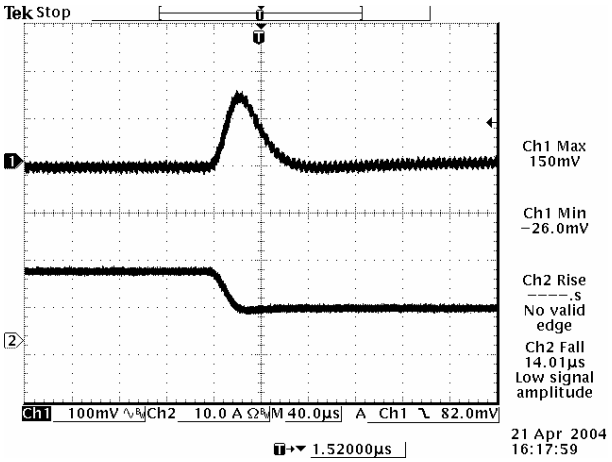



100% to 50% load Transient at Vin=5 V, Vo=1.5 V

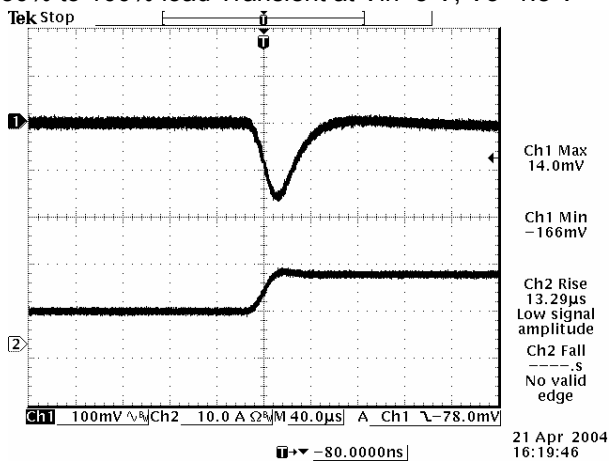
## Transient Response Waveforms (continued)



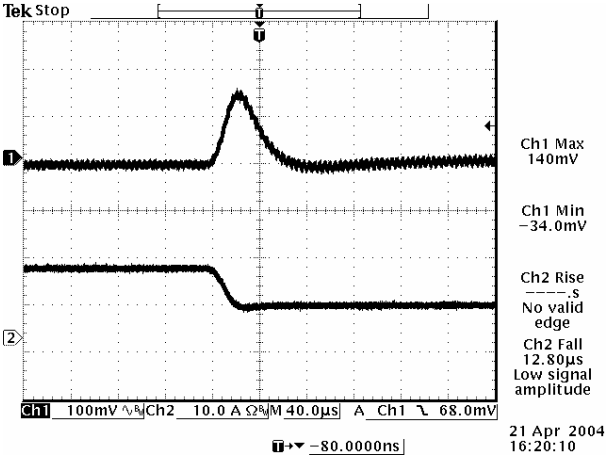

50% to 100% load Transient at Vin=5 V, Vo=1.8 V



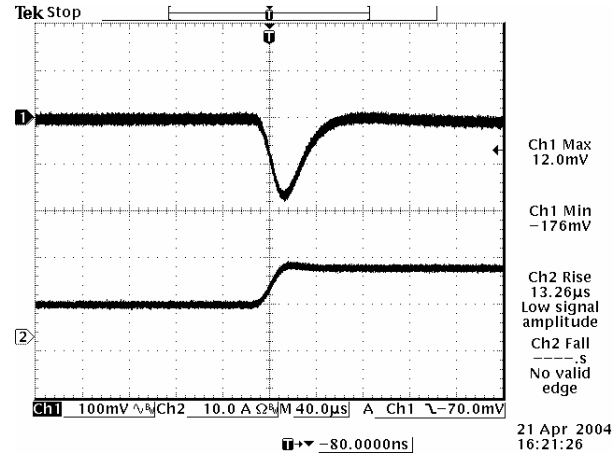

100% to 50% load Transient at Vin=5 V, Vo=1.8 V



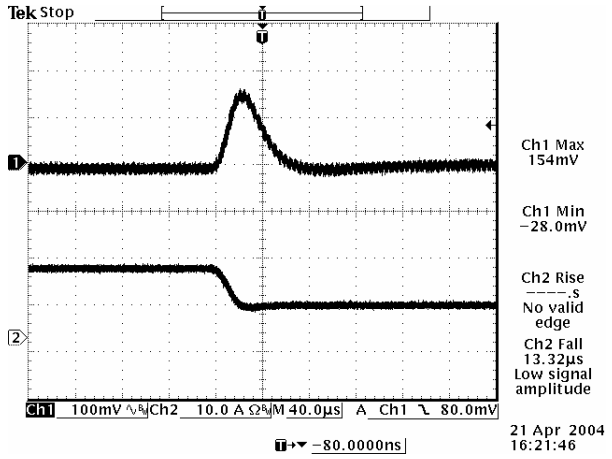

50% to 100% load Transient at Vin=5 V, Vo=2.5 V




100% to 50% load Transient at Vin=5 V, Vo=2.5 V

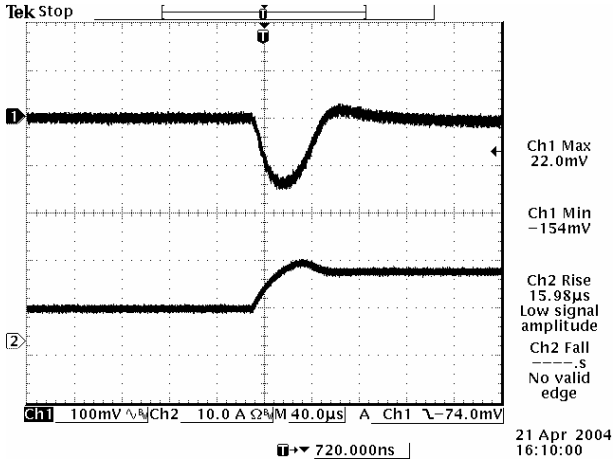



50% to 100% load Transient at Vin=5 V, Vo=3.3 V

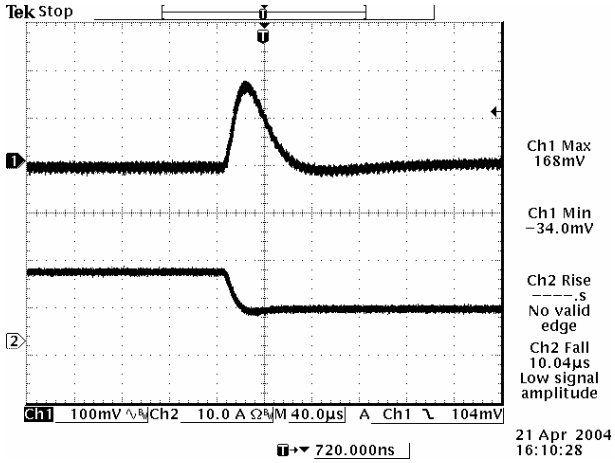



100% to 50% load Transient at Vin=5 V, Vo=3.3 V

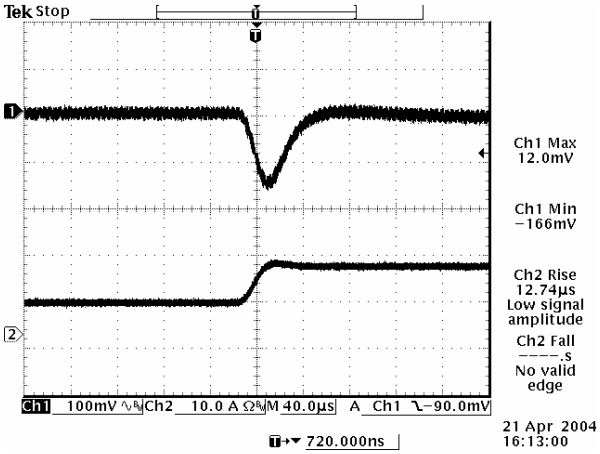
## Transient Response Waveforms (continued)



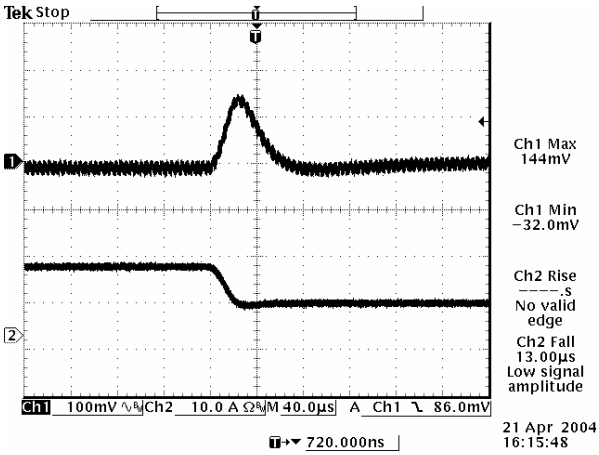

50% to 100% load Transient at Vin=12 V, Vo=0.75 V



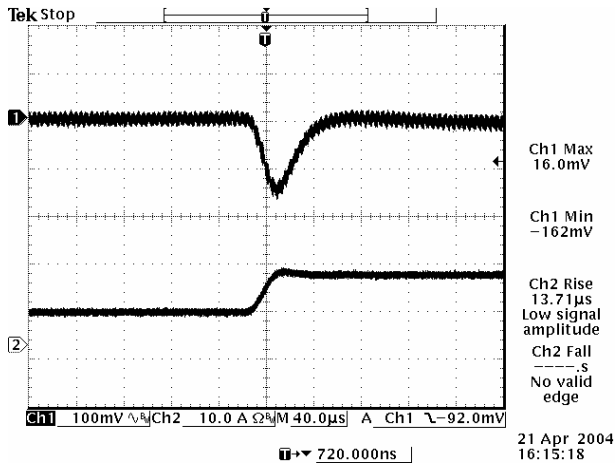

100% to 50% load Transient at Vin=12 V, Vo=0.75 V



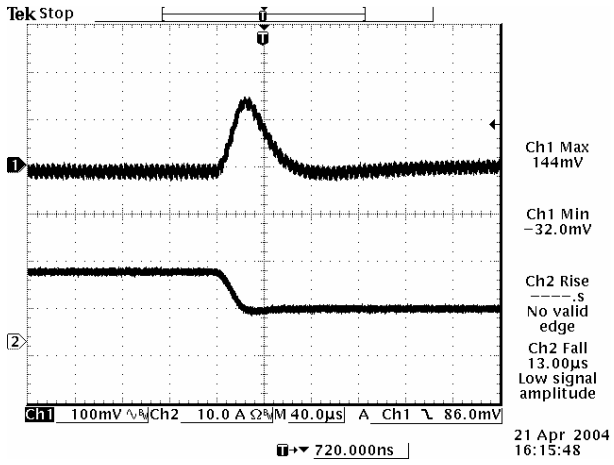

50% to 100% load Transient at Vin=12 V, Vo=1.2 V




100% to 50% load Transient at Vin=12 V, Vo=1.2 V

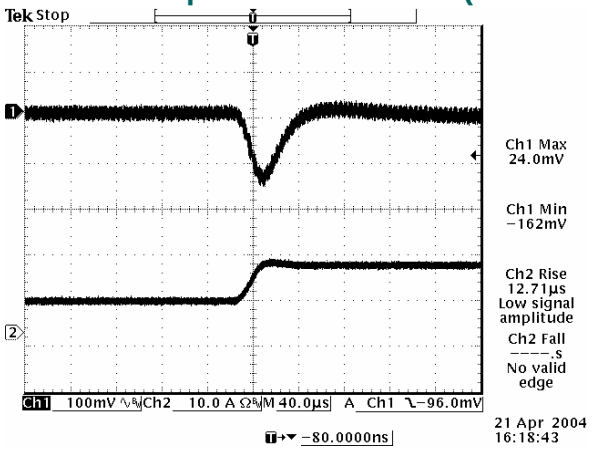



50% to 100% load Transient at Vin=12 V, Vo=1.5 V

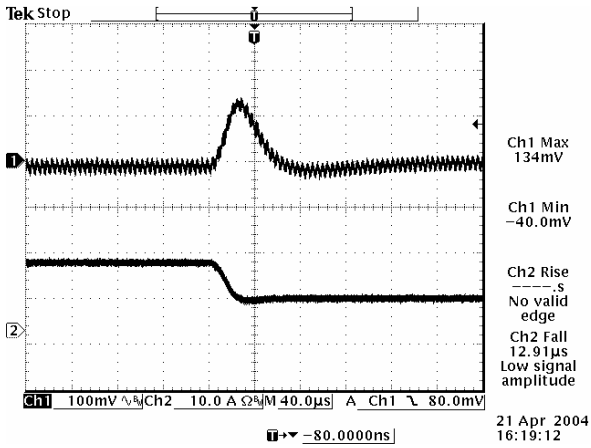



100% to 50% load Transient at Vin=12 V, Vo=1.5 V

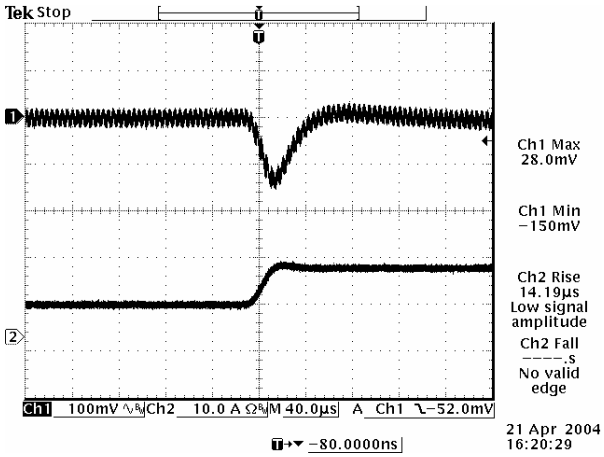
## Transient Response Waveforms (continued)



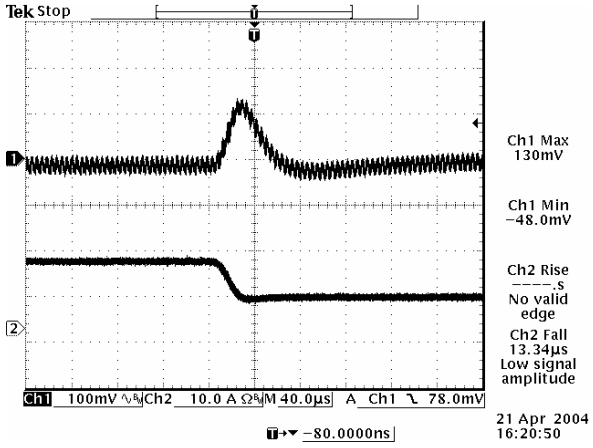

50% to 100% load Transient at Vin=12 V, Vo=1.8 V



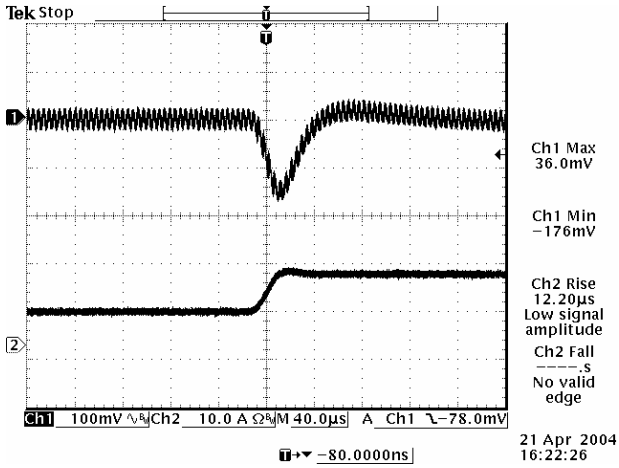

100% to 50% load Transient at Vin=12 V, Vo=1.8 V



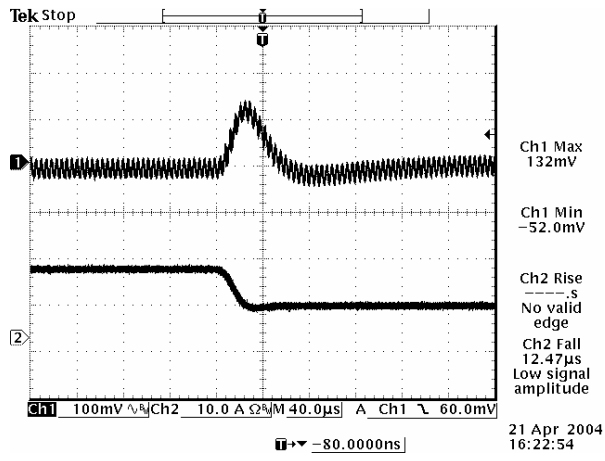

50% to 100% load Transient at Vin=12 V, Vo=2.5 V




100% to 50% load Transient at Vin=12 V, Vo=2.5 V




50% to 100% load Transient at Vin=12 V, Vo=3.3 V



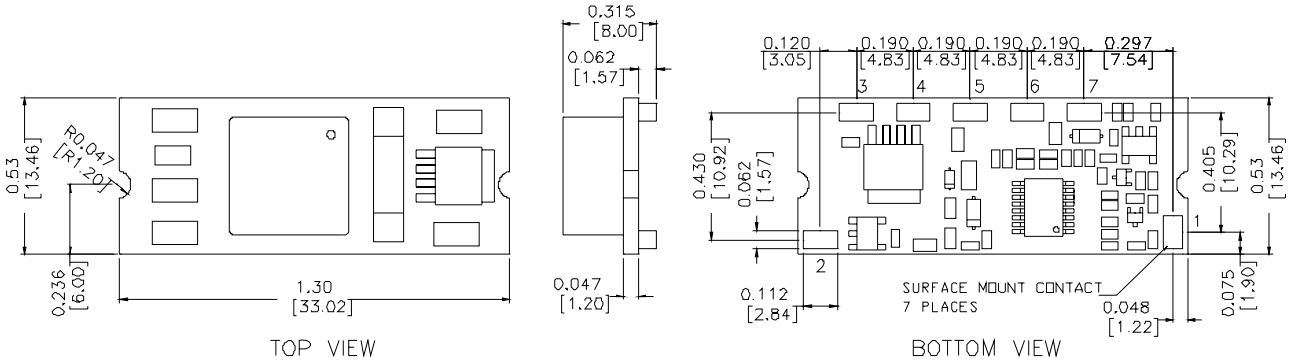

100% to 50% load Transient at Vin=12 V, Vo=3.3 V

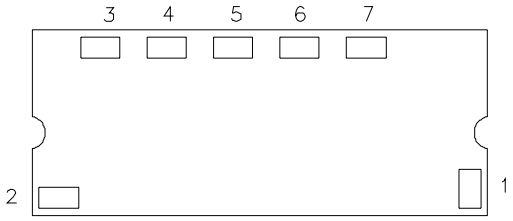
**Note:** Transient response with external load capacitance Cext=2x150uF (Polymer capacitors), and Ta=25℃.

# NON-ISOLATED DC/DC CONVERTERS

**4.5 Vdc - 14 Vdc Input  0.75 Vdc - 3.63 Vdc/16 A Output**

## Mechanical Outline

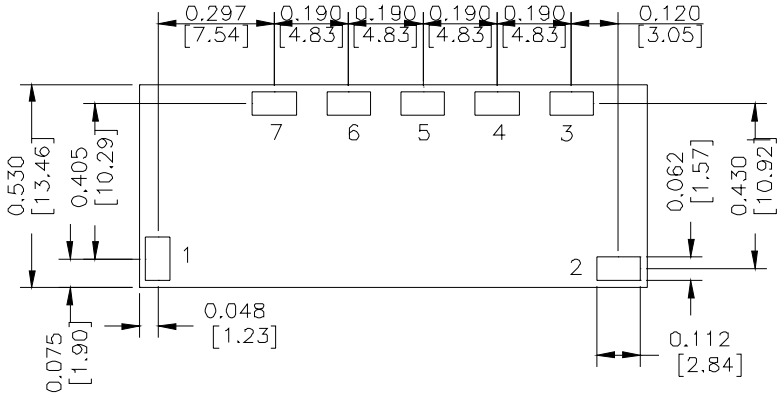



## Pin Connections

| Pin | Function |
|---|---|
| 1 | Remote On/Off |
| 2 | Vin |
| 3 | SEQ |
| 4 | Ground |
| 5 | Vout |
| 6 | Trim |
| 7 | Remote Sense |

RECOMMENDED PAD LAYOUT




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

## 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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# OCEAN CHIPS
## Океан Электроники
## Поставка электронных компонентов

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения «**JONHON**», а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов «**FORSTAR**».

AVIC JONHON

**«JONHON»** (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

**«FORSTAR»** (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).

FORSTAR®

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