

# ISOLATED DC/DC CONVERTERS

48 Vdc Input 3.3 Vdc - 24 Vdc/7 A - 1.25 A Output



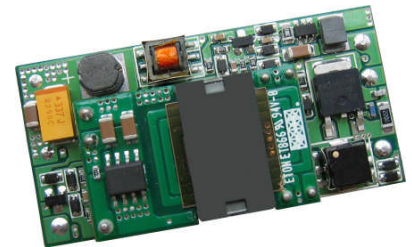
Nov. 29, 2010

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

0RLC-25T Series RoHS Compliant Rev.B

## Features

- Isolated
- High Efficiency
- High Power Density
- Fixed Frequency (230 KHz)
- Low Cost
- Input Under Voltage Lockout
- Class 1, Category 2, Isolated DC/DC Converter (refer to IPC-9592)
- Output Over Voltage Shutdown
- Output Voltage Trim
- OCP/SCP
- Over Temperature Protection
- Remote On/Off
- Remote On/Off Logic (Optional)



## Applications

- Networking
- Computers and peripherals
- Telecommunications

## Description

The 0RLC-25T series are isolated dc/dc converters that operate from a nominal 48 Vdc source. These units will provide up to 30 W of output power. These units are designed to be high efficient and very low cost. Features include remote on/off, over current protection, and under voltage lockout. These converters are provided in an industry standard package.

## Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Model Number Active High	Model Number Active Low
3.3 Vdc	36 Vdc - 75 Vdc	7 A	23 W	88%	0RLC-25T033	0RLC-25T03L
5.0 Vdc	36 Vdc - 75 Vdc	5 A	25 W	90%	0RLC-25T050	0RLC-25T05L
12.0 Vdc	36 Vdc - 75 Vdc	2.5 A	30 W	90%	0RLC-25T120	0RLC-25T12L
15.0 Vdc	36 Vdc - 75 Vdc	2.0 A	30 W	90%	0RLC-25T150	0RLC-25T15L
24.0 Vdc	36 Vdc - 75 Vdc	1.25 A	30 W	89%	0RLC-25T240	0RLC-25T24L

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

## Part Number Explanation

$\frac{0}{1} \frac{R}{2} \frac{LC}{3} - \frac{25}{4} \frac{T}{5} \frac{xx}{6} \frac{x}{7}$

1---Through hole mount

2---RoHS 6, change "R" to "7" means RoHS 5

3---Series name

4---Series code

5---Input range (36-75V)

6---Output voltage

7---Enable, "0" or "3" mean active high, and "L" means active low

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## Absolute Maximum Ratings

Parameter	Min	Typ	Max	Unit	Notes
Input Voltage (continuous)	-0.3	-	80	V	
Remote On/Off	-0.3	-	12	V	
Ambient Temperature	-40	-	85	°C	
Storage Temperature	-55	-	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	Unit	Notes
Input Voltage	36	-	75	V	
Input Current (full load)	-	-	1.1	A	
Input Current (no load)	-	25	40	mA	
Remote Off Input Current	-	3	10	mA	
Input Reflected Ripple Current (rms)	-	10	20	mA	With simulated source impedance of 10 uH, 5 Hz to 20 MHz. And use a 100 uF/ 100 V electrolytic capacitor with ESR=1 ohm max, at 200 kHz.
Input Reflected Ripple Current (pk-pk)	-	40	60	mA	
I <sup>2</sup> t Inrush Current Transient	-	0.1	0.5	A <sup>2</sup> s	
Turn-on Voltage Threshold	31	34	36	V	
Turn-off Voltage Threshold	30	33	35	V	

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

## Output Specifications

Parameter	Min	Typ	Max	Unit	Notes
Output Voltage Set Point					Test condition: V <sub>in</sub> =48 V, I <sub>o</sub> =50% load at the output.
V <sub>o</sub> =3.3 V	3.234	3.3	3.366	V	
V <sub>o</sub> =5.0 V	4.900	5.0	5.100	V	
V <sub>o</sub> =12.0 V	11.76	12.0	12.240	V	
V <sub>o</sub> =15.0 V	14.70	15.0	15.300	V	
V <sub>o</sub> =24.0 V	23.52	24.0	24.480	V	
Line Regulation					
V <sub>o</sub> =3.3 V	-	±1	±3	mV	
V <sub>o</sub> =5.0 V	-	±2	±5	mV	
V <sub>o</sub> =12.0 V	-	±5	±10	mV	
V <sub>o</sub> =15.0 V	-	±8	±15	mV	
V <sub>o</sub> =24.0 V	-	±10	±20	mV	
Load Regulation					
V <sub>o</sub> =3.3 V	-	±2	±5	mV	
V <sub>o</sub> =5.0 V	-	±4	±8	mV	
V <sub>o</sub> =12.0 V	-	±9	±18	mV	
V <sub>o</sub> =15.0 V	-	±10	±20	mV	
V <sub>o</sub> =24.0 V	-	±15	±30	mV	

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## Output Specifications (continued)

Parameter	Min	Typ	Max	Unit	Notes
Regulation Over Temperature (-40 °C to +85 °C)					
Vo=3.3 V	-	30	50	mV	
Vo=5.0 V	-	40	70	mV	
Vo=12.0 V	-	100	170	mV	
Vo=15.0 V	-	120	200	mV	
Vo=24.0 V	-	150	240	mV	
Total Regulation					
Vo=3.3 V	-	33	58	mV	
Vo=5.0 V	-	46	83	mV	
Vo=12.0 V	-	114	198	mV	
Vo=15.0 V	-	140	250	mV	
Vo=24.0 V	-	150	330	mV	
Ripple and Noise (pk-pk)					
Vo=3.3 V	-	40	75	mV	Test condition of the output ripple and noise: 0-20 MHz BW, with a 1 µF ceramic capacitor and a 10 µF/35 V electrolytic capacitor at the output.
Vo=5.0 V	-	40	75	mV	
Vo=12.0 V	-	40	75	mV	
Vo=15.0 V	-	80	120	mV	
Vo=24.0 V	-	85	150	mV	
Ripple and Noise (rms)					
Vo=3.3 V	-	10	20	mV	
Vo=5.0 V	-	10	20	mV	
Vo=12.0 V	-	10	20	mV	
Vo=15.0 V	-	15	30	mV	
Vo=24.0 V	-	20	40	mV	
Output Current Range					
Vo=3.3 V	0	-	7.0	A	
Vo=5.0 V	0	-	5.0	A	
Vo=12.0 V	0	-	2.5	A	
Vo=15.0 V	0	-	2.0	A	
Vo=24.0 V	0	-	1.25	A	
Output DC Current Limit					
Vo=3.3 V	7.7	-	12.0	A	
Vo=5.0 V	5.5	-	8.0	A	
Vo=12.0 V	3.0	-	4.2	A	
Vo=15.0 V	2.2	-	3.4	A	
Vo=24.0 V	1.5	-	2.2	A	
Short Circuit Surge Transient	-	0.5	1	A <sup>2</sup> s	
Turn on Time	-	10	25	mS	
Overshoot at Turn on	-	0	5	%	
Output Capacitance					
Vo=3.3 V	0	-	3300	µF	
Vo=5.0 V	0	-	2200		
Vo=12.0 V	0	-	330		
Vo=15.0 V	0	-	330		
Vo=24.0 V	0	-	330		

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## Output Specifications (continued)

Parameter		Min	Typ	Max	Unit	Notes
<b>Transient Response</b>						
50% ~ 75% Max Load	Overshoot	Vo= 3.3 V	-	75	100	mV
	Settling Time		-	150	200	uS
25% ~ 50% Max Load	Overshoot	Vo= 5.0 V	-	75	100	mV
	Settling Time		-	150	200	uS
50% ~ 75% Max Load	Overshoot	Vo= 12.0 V	-	100	150	mV
	Settling Time		-	150	200	uS
25% ~ 50% Max Load	Overshoot	Vo= 15.0 V	-	100	150	mV
	Settling Time		-	150	200	uS
50% ~ 75% Max Load	Overshoot	Vo= 24.0 V	-	150	200	mV
	Settling Time		-	150	200	uS
25% ~ 50% Max Load	Overshoot	Vo= 3.3 V	-	150	200	mV
	Settling Time		-	150	200	uS
50% ~ 75% Max Load	Overshoot	Vo= 5.0 V	-	100	150	mV
	Settling Time		-	150	200	uS
25% ~ 50% Max Load	Overshoot	Vo= 12.0 V	-	100	150	mV
	Settling Time		-	150	200	uS
50% ~ 75% Max Load	Overshoot	Vo= 15.0 V	-	100	200	mV
	Settling Time		-	200	300	uS
25% ~ 50% Max Load	Overshoot	Vo= 24.0 V	-	100	200	mV
	Settling Time		-	200	300	uS
50% ~ 75% Max Load	Overshoot	Vo= 3.3 V	-	150	300	mV
	Settling Time		-	300	500	uS
25% ~ 50% Max Load	Overshoot	Vo= 5.0 V	-	150	300	mV
	Settling Time		-	300	500	uS

Test condition of the transient response: di/dt=0.1 A/us, Vin=48 V, with a 220 uF/35 V electrolytic capacitor at the output.

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

## General Specifications

Parameter	Min	Typ	Max	Unit	Notes
Efficiency					Measured at Vin=48 V, Io=Io, max
Vo=3.3 V	85	88	-	%	
Vo=5.0 V	87	90	-	%	
Vo=12.0 V	87	90	-	%	
Vo=15.0 V	87	90	-	%	
Vo=24.0 V	86	89	-	%	
Switching Frequency	200	230	260	kHz	
I/O Isolation Voltage	1500	-	-	V	
Isolation Capacitance	-	1500	-	pF	
Output Voltage Trim Range	90	-	110	%	
Over Temperature Protection	-	110	-	°C	
Over Voltage Protection					Test condition of Over Voltage Protection: Vin=48 V, Io=100% load at 25 °C ambient.
Vo=3.3 V	3.90	-	5.0	V	
Vo=5.0 V	5.70	-	7.0	V	
Vo=12.0 V	13.60	-	14.2	V	
Vo=15.0 V	17.25	-	22.5	V	
Vo=24.0 V	27.60	-	36.0	V	
Weight	-	20	-	g	
MTBF	2,602,427			hours	Calculated Per Bell Core SR-332 (Io = 80% load; Vin=48 V; Vo=3.3 V, Ta = 25 °C)
Dimensions					
Inches (L x W x H)	2.0 x 1.0 x 0.438			-	
Millimeters (L x W x H)	50.8 x 25.4 x 11.14				

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

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## Remote On/Off

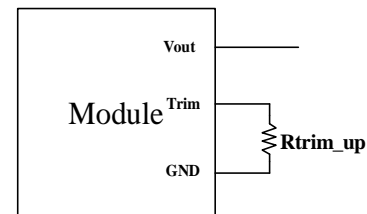
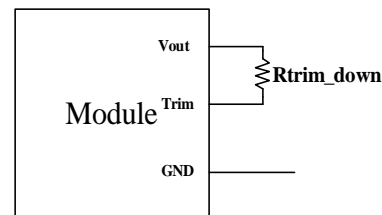
Parameter		Min	Typ	Max	Unit	Notes
Signal Low (Unit On)	Active Low	-0.3	-	0.8	V	The remote on/off pin open, Unit off
Signal High (Unit Off)		3.5	-	12	V	
Signal Low (Unit Off)	Active High	-0.3	-	0.8	V	The remote on/off pin open, Unit on
Signal High (Unit On)		3.5	-	12	V	
Current Sink		0.3	-	0.75	mA	

## Output Trim Equations

Equations for calculating the trim resistor (in kΩ) given the desired adjusted voltage ( $V_{adj}$ ) and the nominal output voltage of the converter ( $V_{nom}$ ) are shown below. The Trim Down resistor should be connected between the Trim pin and  $V_{out}$ . The Trim Up resistor should be connected between the Trim pin and Ground. Only one of the resistors should be used for any given application.

$$R_{trim\_down} = \frac{A}{V_{nom} - V_{adj}} - B$$

$$R_{trim\_up} = \frac{C}{V_{adj} - V_{nom}} - D$$



Vnom	A	B	C	D
24.0	272.305	15.664	31.634	3.010
15.0	92.125	9.360	18.400	2.000
12.0	53.320	9.260	14.025	3.650
5.0	19.300	15.120	6.350	10.000
3.3	21.711	40.610	13.032	30.100

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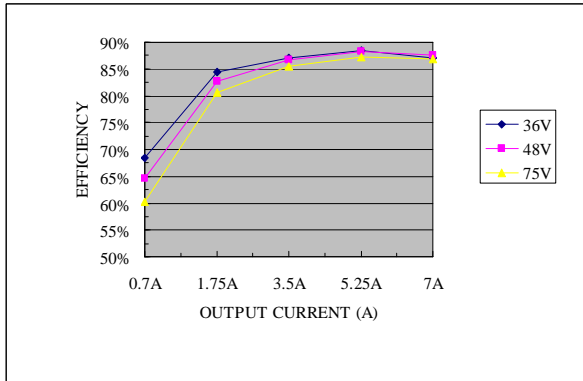
48 Vdc Input 3.3 Vdc - 24 Vdc/7 A - 1.25 A Output



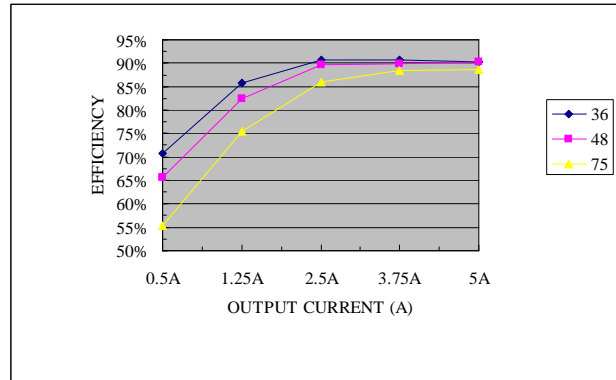
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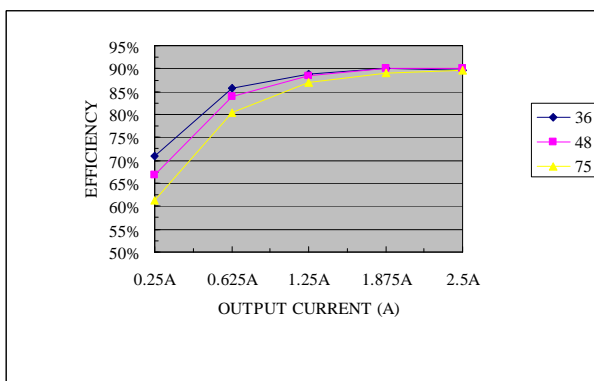
## Efficiency Data



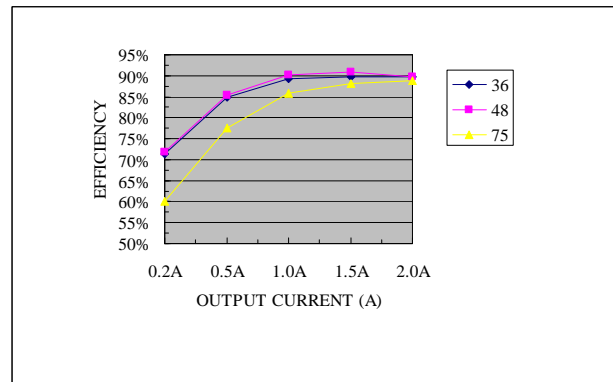
ORLC-25T033



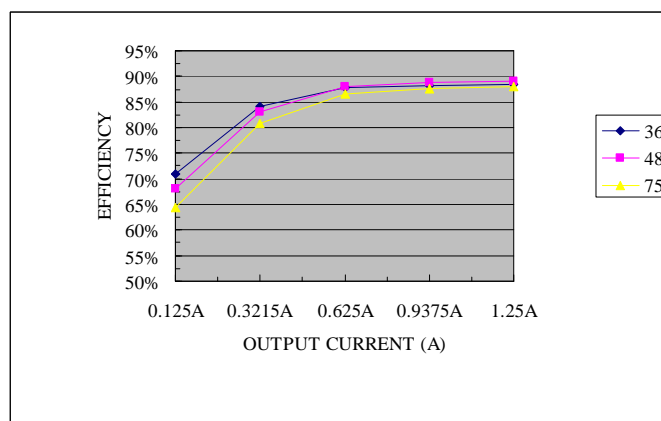
ORLC-25T050



ORLC-25T120



ORLC-25T150



ORLC-25T240

# ISOLATED DC/DC CONVERTERS

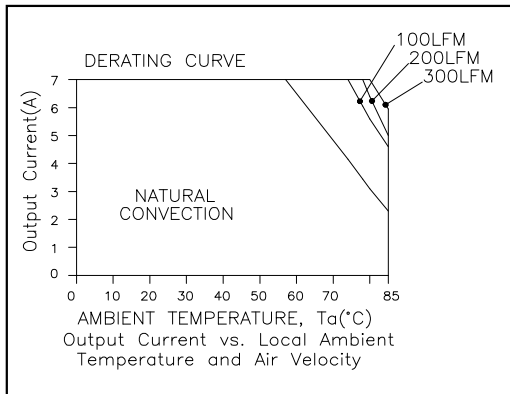
48 Vdc Input 3.3 Vdc - 24 Vdc/7 A - 1.25 A Output



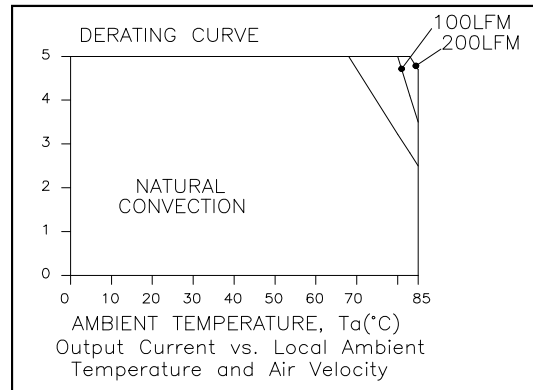
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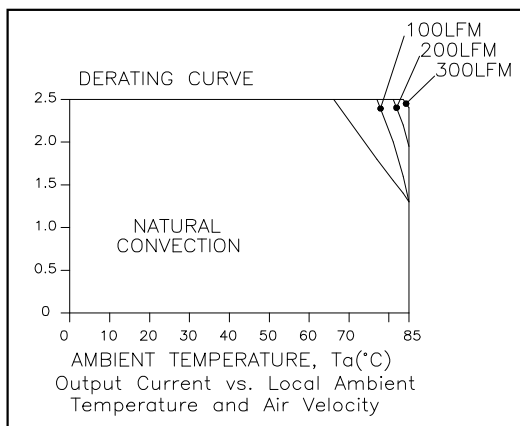
## Thermal Derating Curves



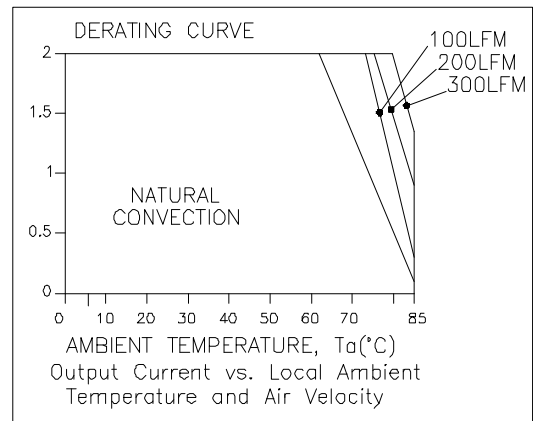
ORLC-25T033



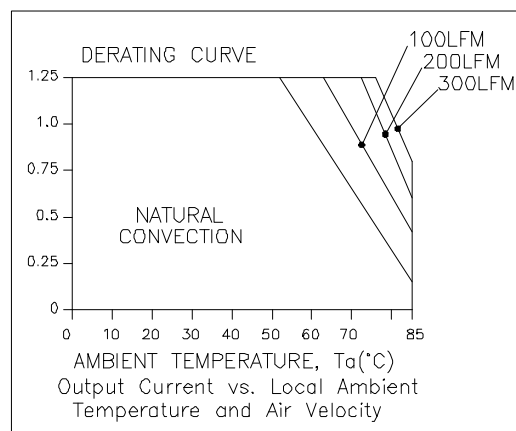
ORLC-25T050



ORLC-25T120



ORLC-25T150



ORLC-25T240

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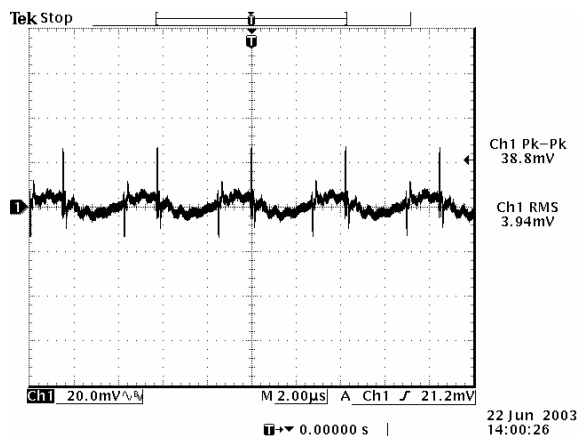
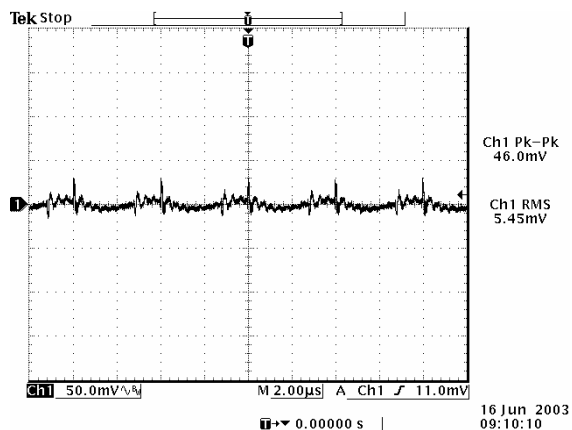
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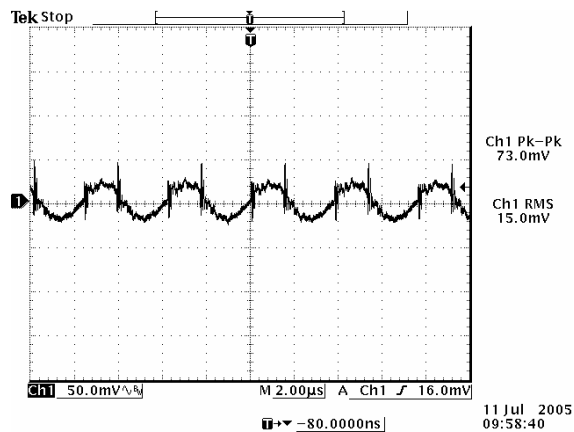
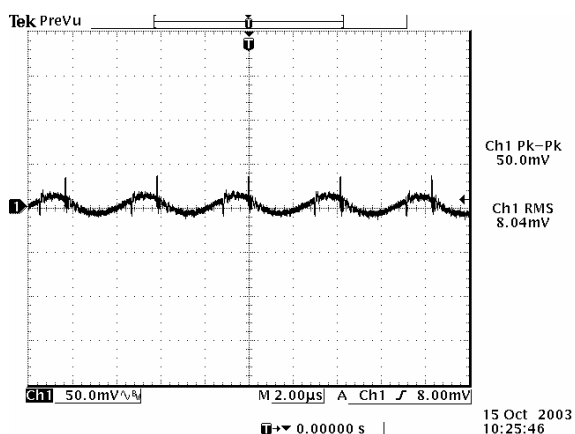
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## Ripple and Noise Waveforms



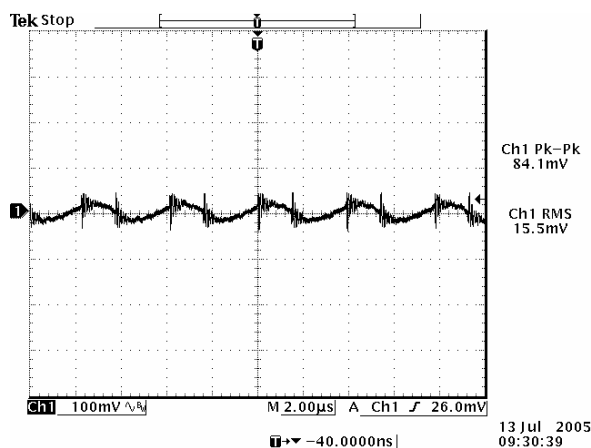
Ripple and noise at full load, 3.3 Vdc/7 A output

Ripple and noise at full load, 5.0 Vdc/5 A output



Ripple and noise at full load, 12 Vdc/2.5 A output

Ripple and noise at full load, 15 Vdc/2 A output



Ripple and noise at full load, 24 Vdc/1.25 A output

**Note:** Ripple and noise at 48 Vdc input, with a 0.47 µF ceramic cap at the output, Ta=25 deg C.



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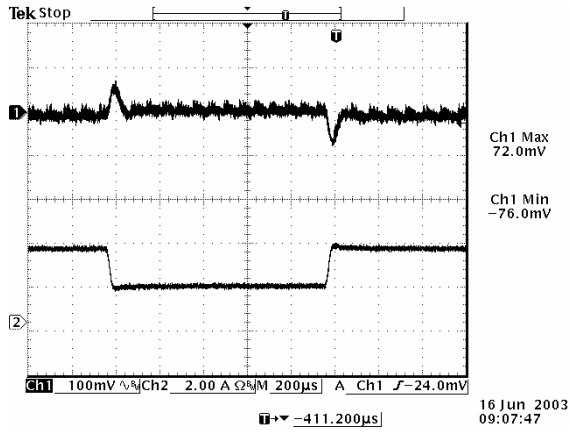
48 Vdc Input 3.3 Vdc - 24 Vdc/7 A - 1.25 A Output



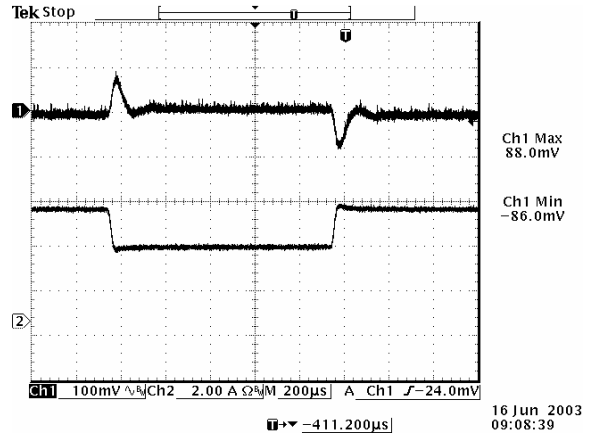
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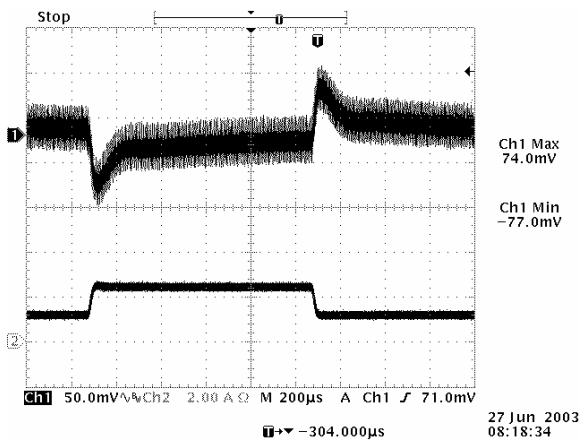
## Transient Response Waveforms



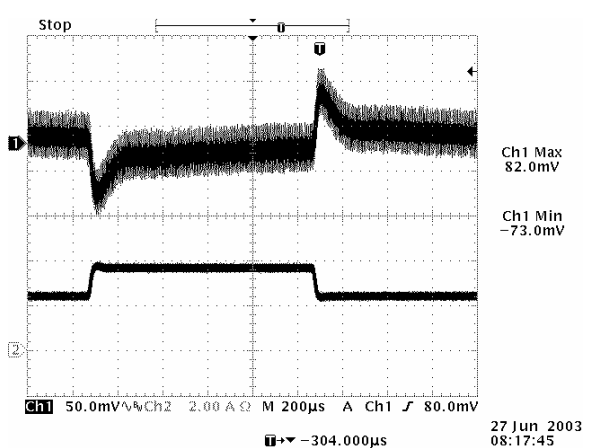
Transients 25% to 50% load 3.3 Vdc output



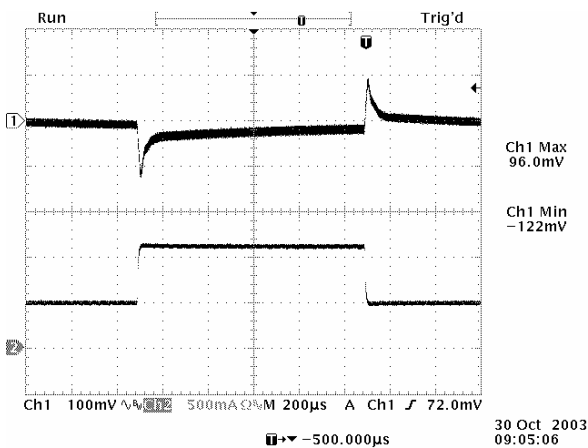
Transients 50% to 75% load 3.3 Vdc output



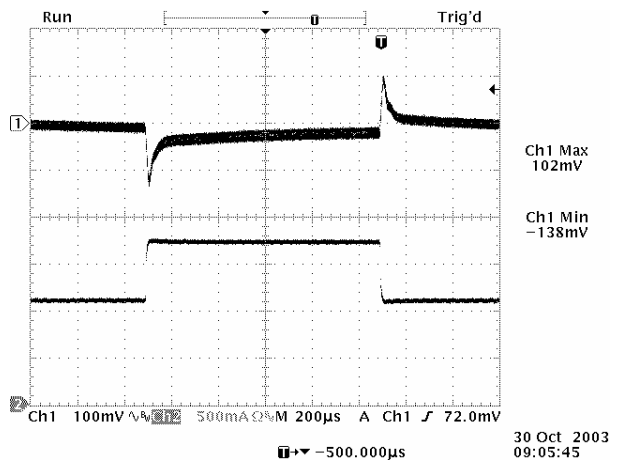
Transients 25% to 50% load 5.0 Vdc output



Transients 50% to 75% load 5.0 Vdc output



Transients 25% to 50% load 12 Vdc output



Transients 50% to 75% load 12 Vdc output

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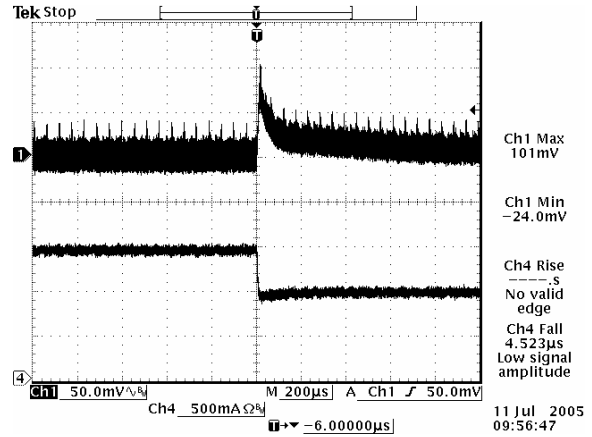
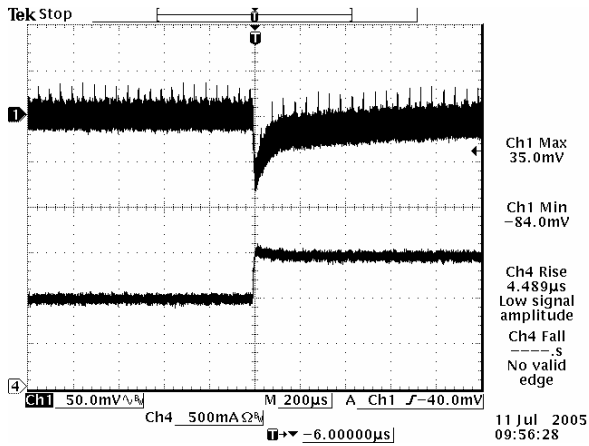
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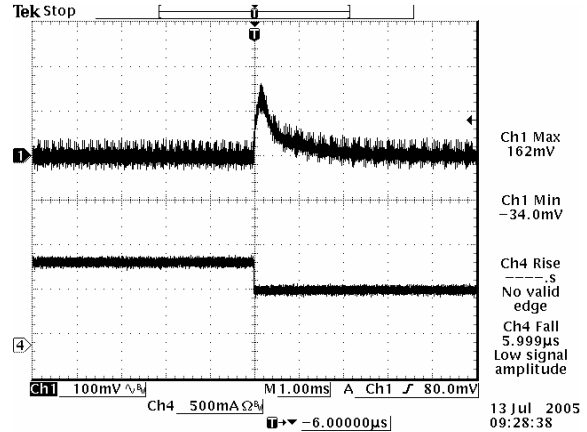
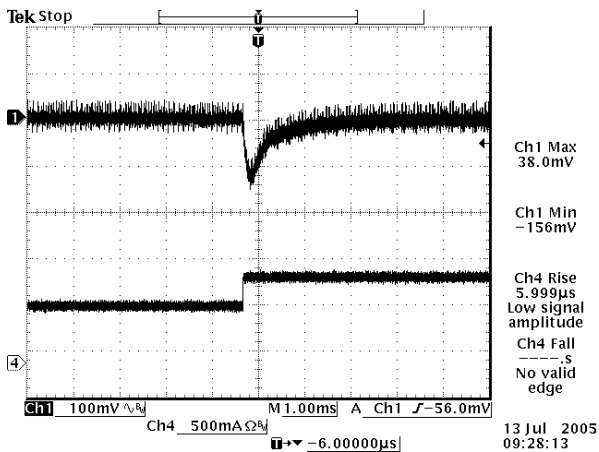
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## Transient Response Waveforms (continued)



Transients 25% to 50% load 15 Vdc output

Transients 50% to 75% load 15 Vdc output



Transients 25% to 50% load 24 Vdc output

Transients 50% to 75% load 24 Vdc output

**Note:** Transient response at 48 Vdc input,  $di/dt=0.1$  A/ $\mu$ S, with external 220  $\mu$ F electrolytic cap and 0.47  $\mu$ F ceramic cap at the output, and  $T_a=25$  deg C.

# ISOLATED DC/DC CONVERTERS

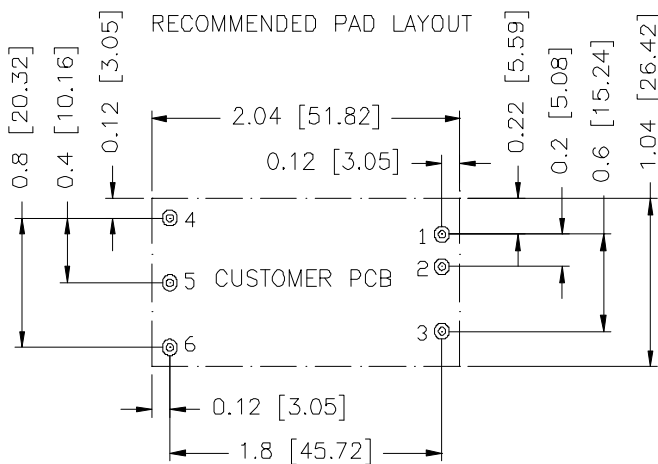
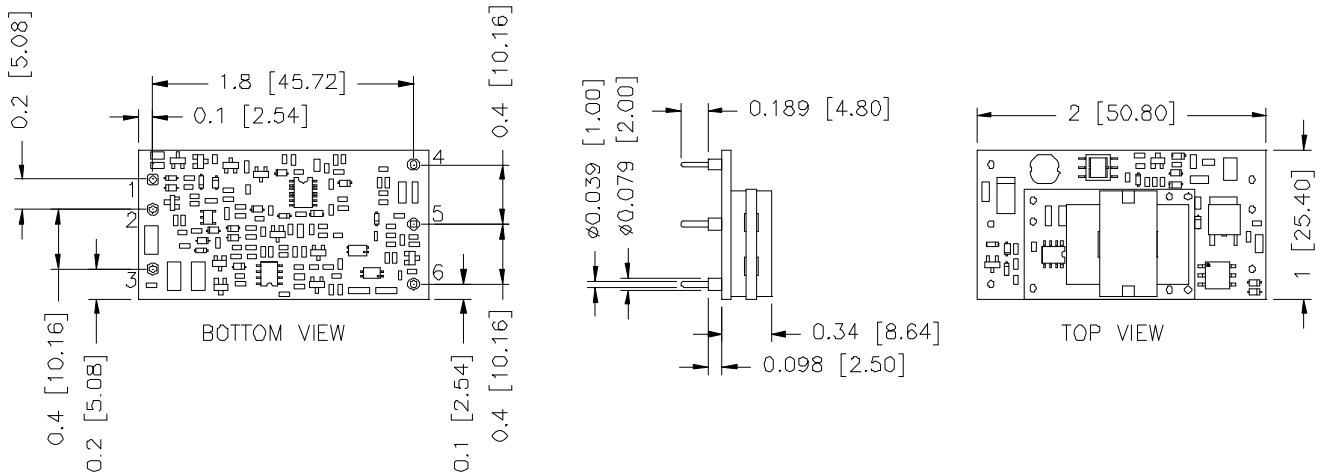
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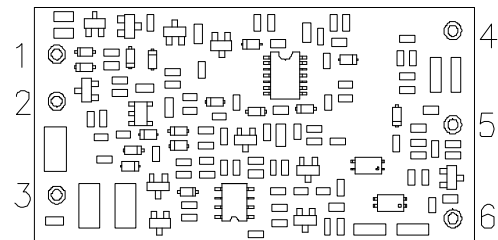
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## Mechanical Outline



HOLE SIZE:  $\phi 0.047$  [1.19]  
 PAD SIZE:  $\phi 0.1$  [2.54] BOTH SIDE



### Pin Connections

Pin	Function
1	Vin+
2	Vin-
3	CNT
4	Vo+
5	Vo-
6	Trim

**Note:** This module is recommended and compatible with Pb-Free Wave Soldering and must be soldered using a peak solder temperature of no more than 260 °C for less than 5 seconds.

#### Note:

- 1) All Pins: Material - Copper Alloy;  
 Finish – 3 micro inches minimum Gold over 50 micro inches minimum Nickel plate.
- 2) Undimensioned components are shown for visual reference only.
- 3) 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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### Revision History

Date	Revision	Changes Detail	Approval
2007-03-02	A	First Release.	XF Jiang
2010-11-29	B	Update the notes in Remote On/Off.	XF Jiang

### 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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#### CORPORATE

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