ISOLATED DC/DC CONVERTERS

48 Vdc Input 12 Vdc/12 A, 3.3 Vdc/46 A, 5 Vdc/30 A, 1.2-2.5 Vdc/50 A Outputs

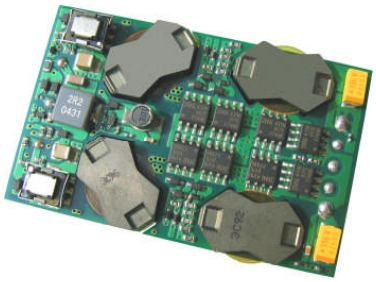
May 17, 2011

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

0RQB-C5T Series RoHS Compliant Rev.C

Features

- Isolated
- High Efficiency
- High Power Density
- Low Cost
- Input Under Voltage Lockout
- Fixed Frequency (330 kHz)
- Active Low/High (Option)
- UL60950-1 Recognized (UL/cUL)
- Output Over Voltage Shutdown
- OCP/SCP
- Over Temperature Protection
- Remote On/Off
- Output Voltage Trim
- Positive/Negative Remote Sense
- Input Over Voltage Lockout
- Basic Isolation



Applications

- Networking
- Computers and peripherals
- Telecommunications

Description

The 0RQB-C5T Series are isolated dc/dc converters that operate from a nominal 48 Vdc source. These units will provide up to 150 W of output power from a nominal 48 Vdc input. These units are designed to be highly efficient and low cost. Typical efficiency of 12 Vdc output at 48 Vdc input at full load is 93%. Features include remote on/off, over current protection and under-voltage lockout. These converters are provided in an industry standard quarter brick package.

Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Model Number Active High	Model Number Active Low
12 V	36 V - 75 V	12 A	144 W	93.0%	0RQB-C5T120	0RQB-C5T12L
5.0 V	36 V - 75 V	30 A	150 W	92.5%	0RQB-C5T050	0RQB-C5T05L
3.3 V	36 V - 75 V	46 A	152 W	91.0%	0RQB-C5T033	0RQB-C5T03L
2.5 V	36 V - 75 V	50 A	125 W	90.5%	0RQB-C5T025	0RQB-C5T02L
1.8 V	36 V - 75 V	50 A	90 W	88.0%	0RQB-C5TV80	0RQB-C5TV8L
1.5 V	36 V - 75 V	50 A	75 W	85.0%	0RQB-C5TV50	0RQB-C5TV5L
1.2 V	36 V - 75 V	50 A	60 W	83.0%	0RQB-C5TV20	0RQB-C5TV2L

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

Part Number Explanation

0 R QB – C5 T xx x
1 2 3 4 5 6 7

1---Through hole
2---RoHS 6, change "R" to "7" means RoHS 5
3---Series name, 1/4 Brick
4---Series code
5---Input range 48V wide (36-75V)
6---Output voltage
7---Option, "x" of the model part number to be 0-9, A-Z, which will represent the special request of customer.

Absolute Maximum Ratings

Parameter	Min	Typ	Max	Unit	Notes
Input Voltage (continuous)	-0.3	-	80	V	
Remote On/Off	-0.3	-	18	V	
I/O Isolation Voltage	-	-	2000	V	
Ambient Temperature	-40	-	85	°C	
Storage Temperature	-55	-	125	°C	

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

Input Specifications

Parameter	Min	Typ	Max	Unit	Notes
Input Voltage	36	48	75	V	
Input Current (full load) Vo=12 V Vo=5.0 V Vo=3.3 V Vo=2.5 V Vo=1.8 V Vo=1.5 V Vo=1.2 V	 - - - - - - -	 - - - - - - -	 4.5 4.9 4.9 4.1 3.0 2.6 2.1	 A A A A A A A	
Input Current (no load)	-	120	180	mA	
Remote Off Input Current		10	15	mA	
Input Reflected Ripple Current (pk-pk)	-	10	15	mA	Tested with simulated source impedance of 10 uH, 5 Hz to 20 MHz; use a 100 uF /100 V electrolytic capacitor with ESR = 1 ohm max. at 200 kHz at 25 °C.
Input Reflected Ripple Current (rms)	-	1.5	3	mA	
I^2t Inrush Current Transient	-	0.05	0.1	A^2s	
Turn-on Voltage Threshold	32	34	35	V	
Turn-off Voltage Threshold	30	32	34	V	
Input over voltage Lockout	76	78	80	V	

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

Output Specifications

Parameter	Min	Typ	Max	Unit	Notes
Output Voltage Set Point					
Vo=12 V	11.790	12.030	12.270	V	Vin=48V, Io=50% load
Vo=5.0 V	4.925	5.004	5.075	V	
Vo=3.3 V	3.260	3.308	3.360	V	
Vo=2.5 V	2.450	2.503	2.550	V	
Vo=1.8 V	1.770	1.808	1.844	V	
Vo=1.5 V	1.477	1.500	1.523	V	
Vo=1.2 V	1.176	1.200	1.224	V	
Output Voltage Set Point	-3.5	-	3.5	%Vo,set	Over all operating input voltage, resistive load, and temperature conditions.
Line Regulation					
Vo=12 V	-	±8	±15	mV	
Vo=5.0 V	-	±5	±15	mV	
Vo=1.2 V-3.3 V	-	±3	±6	mV	
Load Regulation					
Vo=5.0 V-12 V	-	±10	±20	mV	
Vo=2.5 V-3.3 V	-	±5	±10	mV	
Vo=1.2 V-1.8 V	-	±2	±5	mV	
Regulation Over Temperature (-40 °C to +85 °C)					
Vo=12 V	-	±60	±100	mV	
Vo=5.0 V	-	±40	±65	mV	
Vo=3.3 V	-	±30	±50	mV	
Vo=2.5 V	-	±20	±40	mV	
Vo=1.8 V-1.2 V	-	±15	±30	mV	
Output Current					
Vo=12 V	0	-	12	A	
Vo=5.0 V	0	-	30	A	
Vo=3.3 V	0	-	46	A	
Vo=1.2 V-2.5 V	0	-	50	A	
Current Limit Threshold					
Vo=12 V	14	15.5	18	A	
Vo=5.0 V	35	40	45	A	
Vo=3.3 V	50	60	65	A	
Vo=1.2 V-2.5 V	55	60	65	A	
Short Circuit Surge Transient	-	3	5	A^2s	
Ripple and Noise (rms)					
Vo=12 V	-	25	30	mV	
Vo=5.0 V	-	20	25	mV	
Vo=3.3 V	-	20	20	mV	
Vo=1.2 V-2.5 V	-	15	20	mV	
Ripple and Noise (pk-pk)					Test conditions: 0-20 MHz BW, with a 1 uF ceramic capacitor and a 10 uF Tantalum capacitor at the output.
Vo=12 V	-	70	90	mV	
Vo=5.0 V	-	60	80	mV	
Vo=3.3 V	-	50	70	mV	
Vo=1.8 V	-	45	60	mV	
Vo=2.5 V	-	40	60	mV	
Vo=1.5 V	-	55	70	mV	
Vo=1.2 V	-	40	60	mV	
Turn on Time	10	-	100	mS	
Overshoot at Turn on	-	0	5	%	

Output Specifications (continued)

Parameter			Min	Typ	Max	Unit	Notes
Output Capacitance							
		Vo=12.0 V	0	-	2200	uF	
		Vo=5.0 V	0	-	10000	uF	
		Vo=1.2 V-3.3 V	0	-	20000	uF	
Transient Response							
50% ~ 75% Max Load	Overshoot	Vo=12.0 V	-	600	800	mV	Test conditions: di/dt = 0.1 A/uS, Vin=48 V, with a 1 uF ceramic capacitor and a 10 uF Tantalum capacitor at the output.
	Settling Time		-	200	300	uS	
75% ~ 50% Max Load	Overshoot		-	600	800	mV	
	Settling Time		-	200	300	uS	
50% ~ 75% Max Load	Overshoot	Vo=5.0 V	-	250	375	mV	
	Settling Time		-	100	200	uS	
75% ~ 50% Max Load	Overshoot		-	250	375	mV	
	Settling Time		-	100	200	uS	
50% ~ 75% Max Load	Overshoot	Vo=3.3 V	-	100	200	mV	
	Settling Time		-	200	300	uS	
75% ~ 50% Max Load	Overshoot		-	100	200	mV	
	Settling Time		-	200	300	uS	
50% ~ 75% Max Load	Overshoot	Vo=2.5 V	-	100	200	mV	
	Settling Time		-	300	400	uS	
75% ~ 50% Max Load	Overshoot		-	100	200	mV	
	Settling Time		-	300	400	uS	
50% ~ 75% Max Load	Overshoot	Vo=1.8 V Vo=1.5 V	-	100	140	mV	
	Settling Time		-	200	300	uS	
75% ~ 50% Max Load	Overshoot		-	100	140	mV	
	Settling Time		-	200	300	uS	
50% ~ 75% Max Load	Overshoot	Vo=1.2 V	-	100	120	mV	
	Settling Time		-	200	300	uS	
75% ~ 50% Max Load	Overshoot		-	100	120	mV	
	Settling Time		-	200	300	uS	

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

General Specifications

Parameter	Min	Typ	Max	Unit	Notes
Efficiency					
Vo=12 V	90	93	-	%	Vin=48V, full load
Vo=5.0 V	89	92.5	-	%	
Vo=3.3 V	88	91	-	%	
Vo=2.5 V	87	90.5	-	%	
Vo=1.8 V	85	88	-	%	
Vo=1.5 V	82	85	-	%	
Vo=1.2 V	80	83	-	%	
Switching Frequency	280	330	380	kHz	
Isolation capacitance	-	1500	-	pF	
Input to Output Isolation Voltage	-	-	2000	V	
Remote Sense Compesation	-	-	10	% Vo	The total voltage increased by trim and remote sense should not exceed 10%Vo.
Output Voltage Trim Range	80	-	110	% Vo	
Over Temperature Protection	-	125	-	°C	
Over Voltage Protection	-	130	-	% Vo	Vin=48V, full load, Hiccup mode
MTBF	1,109,917			Hours	Calculated Per Bell Core SR-332 (Io =80% load, Vin=48 V, Vo=3.3 V; Ta = 25 °C)
Dimensions					
Inches (L × W × H)	2.30 x 1.45 x 0.395			-	
Millimeters (L × W × H)	58.42 x 36.83 x 10.03				
Weight	-	41	-	g	

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

Remote On/Off

Parameter		Min	Typ	Max	Unit	Notes
Signal Low (Unit On)	Active Low	-0.3	-	0.8	V	0RQB-C5TxxL. The remote on/off pin open, Unit off.
Signal High (Unit Off)		2.4	-	18	V	
Signal Low (Unit Off)	Active High	-0.3	-	0.8	V	0RQB-C5Txx0. The remote on/off pin open, Unit on.
Signal High (Unit On)		2.4	-	18	V	
Current Sink		0	-	0.75	mA	

Output Trim Equations

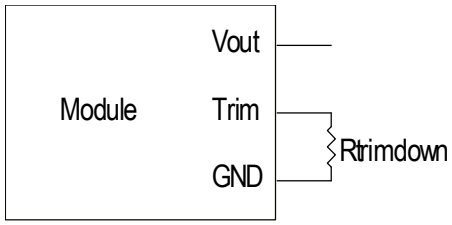
Trim Resistor Calculate

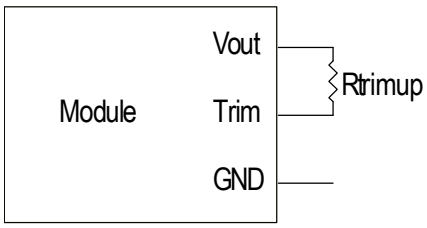
Equations for calculating the trim resistor are shown below (Unit: kΩ). The Trim Down resistor should be connected between the Trim pin and Ground pin. The Trim Up resistor should be connected between the Trim pin and the Vout. Only one of the resistors should be used for any given application.

1) For Vo=1.5 V – 12 V:

$$Rtrimdown = \frac{511}{|delta|} - 10.22$$

$$Rtrimup = \frac{(100 + delta) \cdot Vo \cdot 5.11 - 626}{1.225 \cdot delta} - 10.22$$





Note:

$$delta = \frac{(Vo\_req - Vo)}{Vo} \times 100[\%]$$

Vo_req=Desired (trimmed) output voltage [V]; Vo=output voltage
Vo=12.006 V for 12 V output; Vo=5.000 V for 5 V output; Vo=3.308 V for 3.3 V output; Vo=2.505 V for 2.5 V output; Vo=1.804 V for 1.8 V output; Vo=1.503 V for 1.5 V output

2) For Vo=1.2 V:

$$Rtrimdown = \frac{511}{|delta|} - 10.22$$

$$Rtrimup = \frac{(100 + delta) \cdot Vo \cdot 5.11 - 313}{0.6125 \cdot delta} - 10.22$$

Note:

$$delta = \frac{(Vo\_req - Vo)}{Vo} \times 100[\%]$$

Vo_req=Desired (trimmed) output voltage [V]; Vo=output voltage
Vo=1.202 V for 1.2 V output

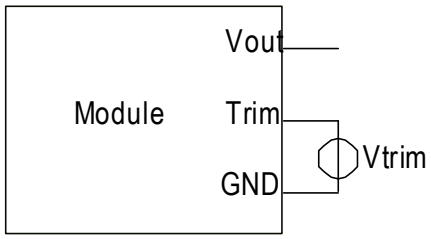
Output Trim Equations (continued)

Trim Voltage Calculate

Equations for calculating the external trim voltage are shown below (Unit: V).

1) For Vo=1.5 V – 12 V:

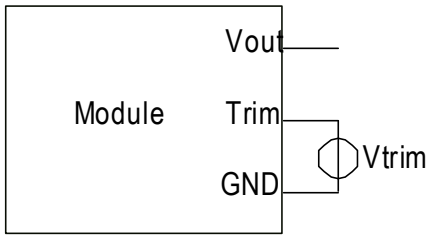
$$Vtrim = \frac{2.45}{Vo} \cdot Vo\_req - 1.225 \quad [V]$$



Note:
Vo_req=Desired (trimmed) output voltage [V]; Vo=output voltage
Vo=12.006 V for 12 V output; Vo=5.000 V for 5 V output; Vo=3.308 V for 3.3 V output; Vo=2.505 V for 2.5 V output; Vo=1.804 V for 1.8 V output; Vo=1.503 V for 1.5 V output

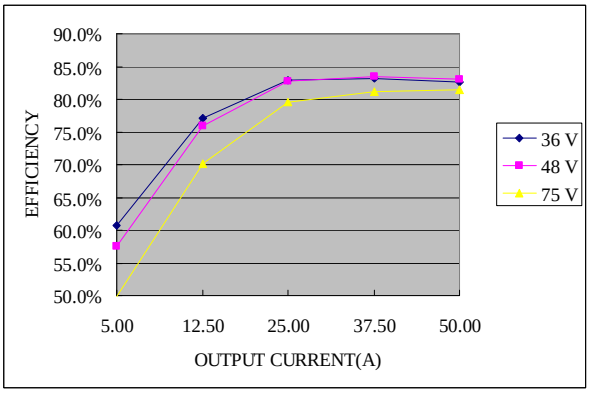
2) For Vo=1.2 V:

$$Vtrim = \frac{1.226}{Vo} \cdot Vo\_req - 0.614 \quad [V]$$

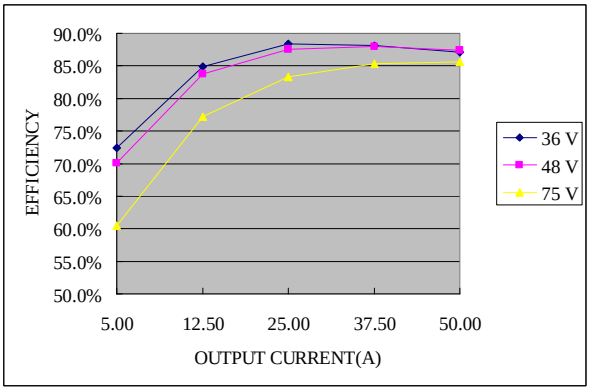


Note:
Vo_req=Desired (trimmed) output voltage [V]; Vo=output voltage
Vo=1.202 V for 1.2 V output

Efficiency Data



0RQB-C5TV2x



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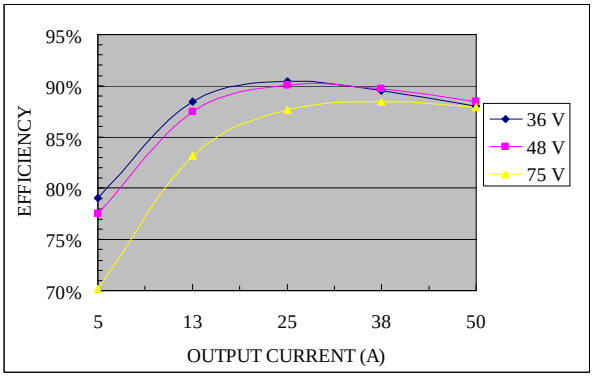

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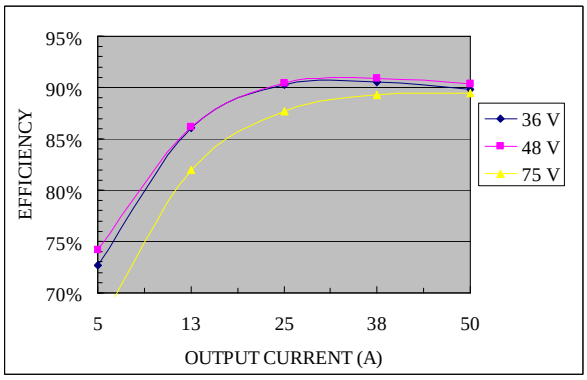

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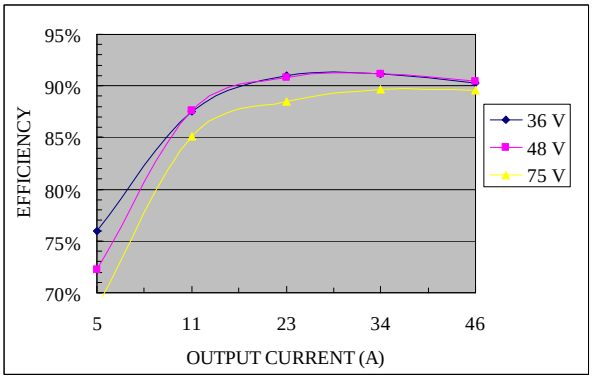

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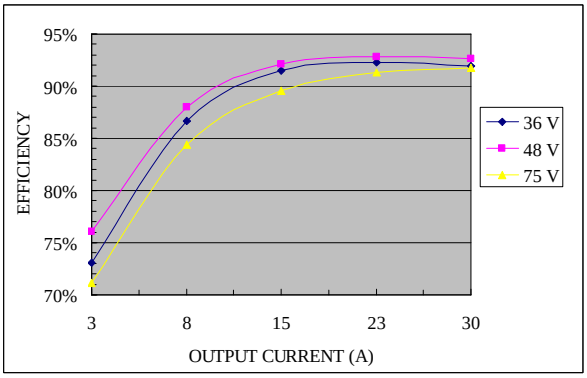
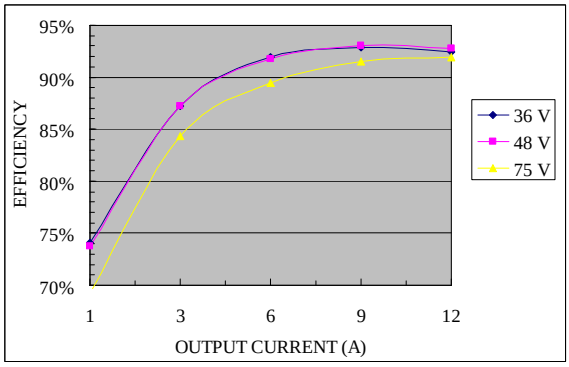


0RQB-C5T05x

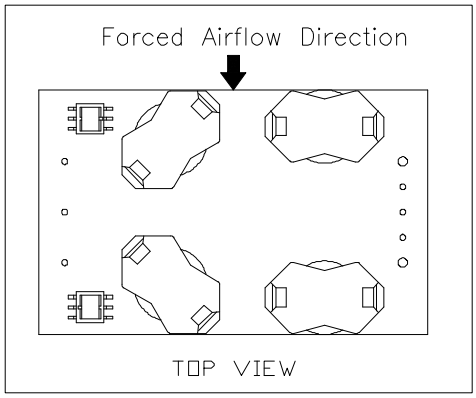
Efficiency Data (continued)



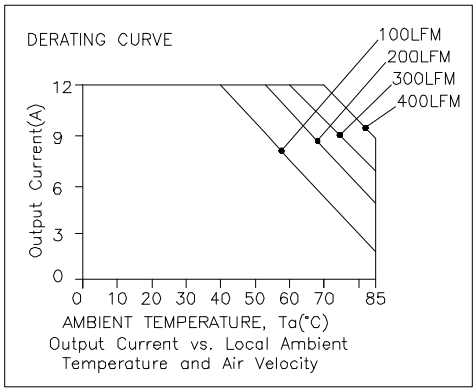
0RQB-C5T12x

Thermal Derating Curves

Vin=48V, with maximum junction temperature of semiconductors derated to 120 degree C.



0RQB-C5Txxx



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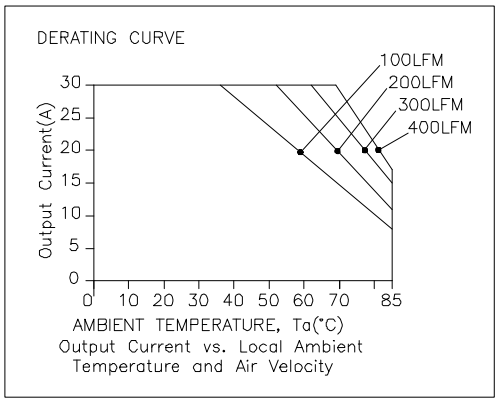

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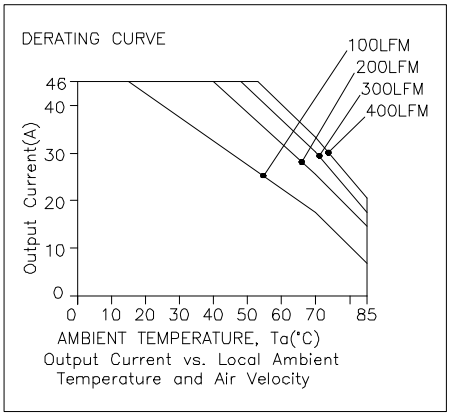

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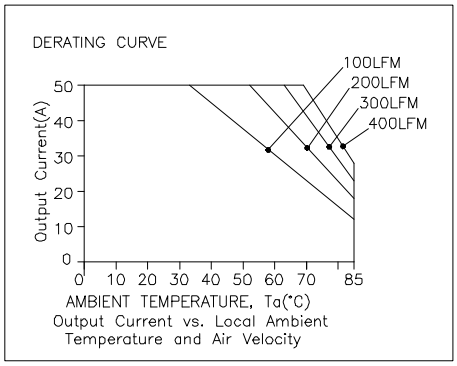
Thermal Derating Curves (continued)



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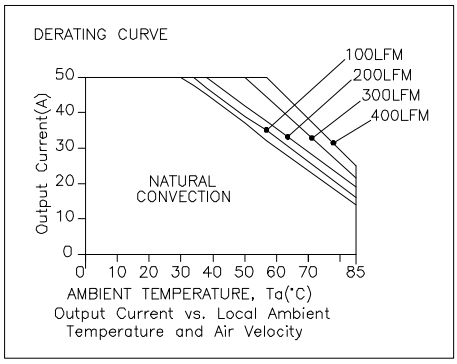

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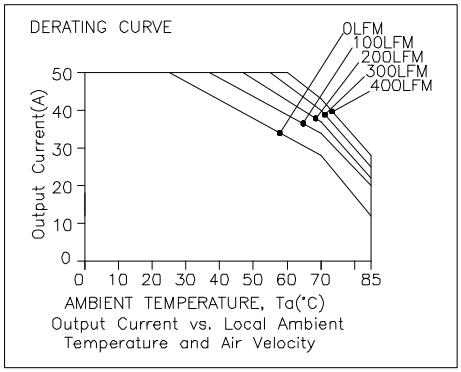

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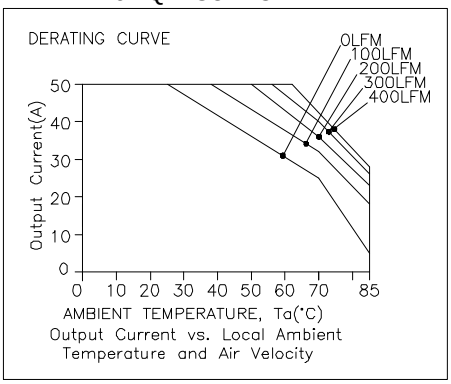
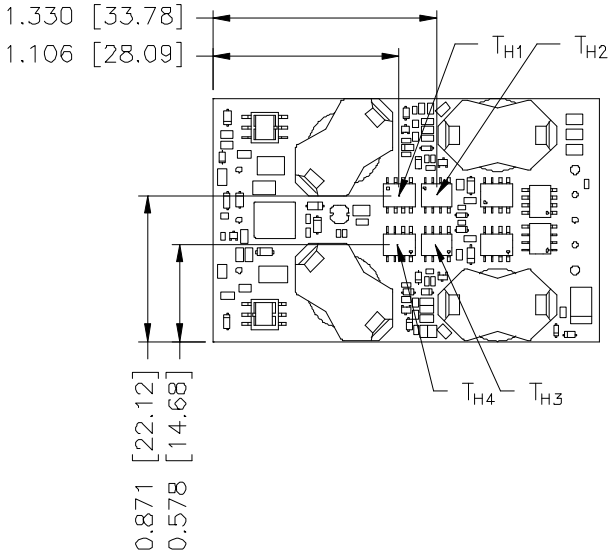


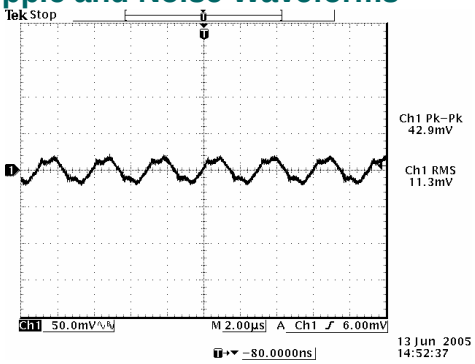
0RQB-C5TV2x

Thermal Reference

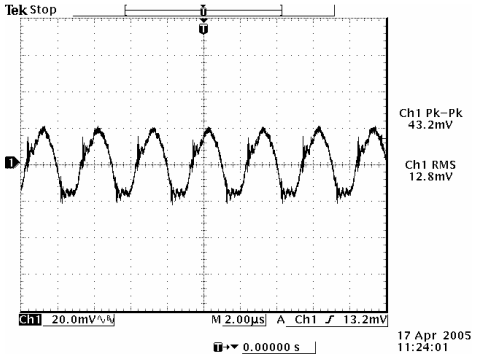


Note: T_{H1}, T_{H2}, T_{H3} and T_{H4} are hot spots which should not exceed 115 degree C.

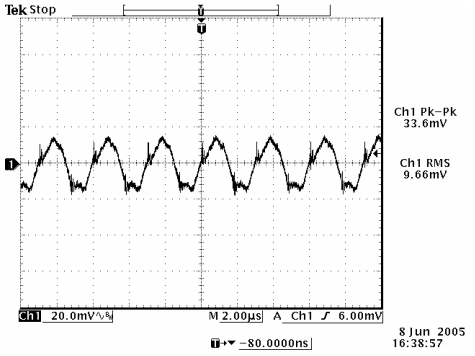
Ripple and Noise Waveforms



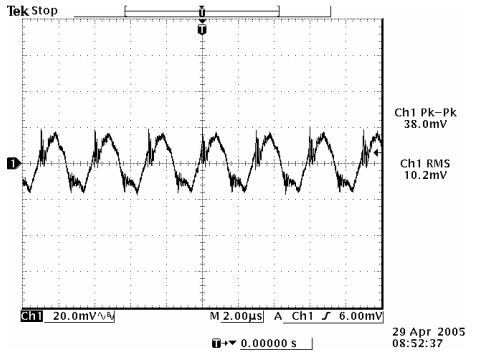
Ripple and noise at full load, 1.2 V/50 A output



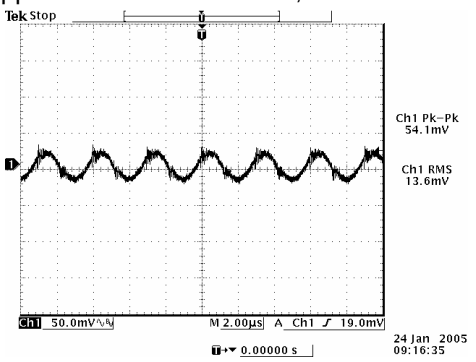
Ripple and noise at full load, 1.5 V/50 A output



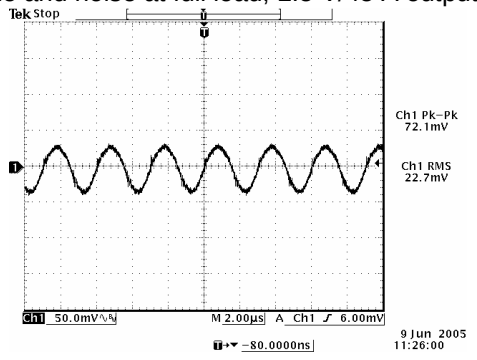
Ripple and noise at full load, 1.8 V/50 A output



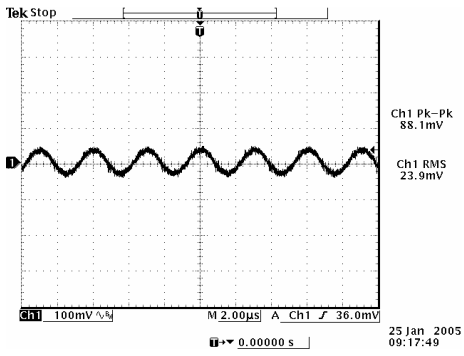
Ripple and noise at full load, 2.5 V/45 A output



Ripple and noise at full load, 3.3 V/46 A output



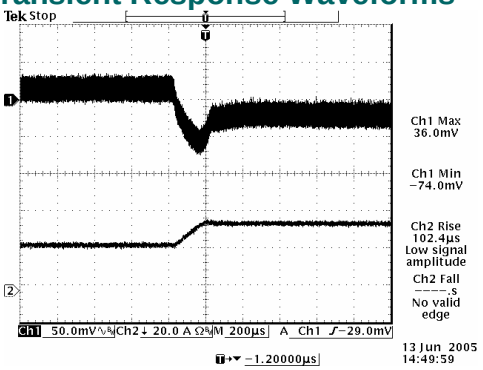
Ripple and noise at full load, 5.0 V/30 A output



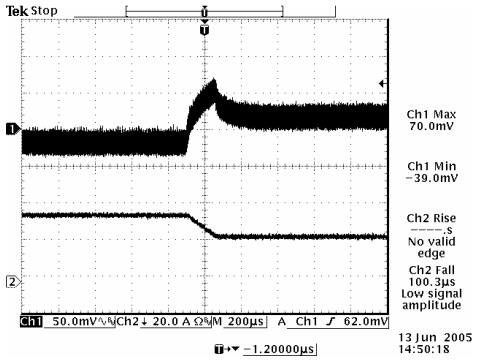
Ripple and noise at full load, 12 V/12 A output

Note: Ripple and noise is tested with a 1 uF ceramic cap and a 10 uF tantalum capat output, Ta=25 deg C.

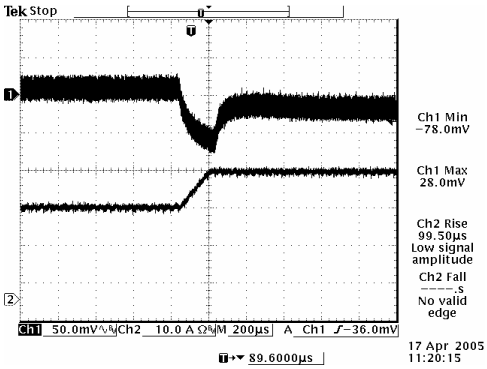
Transient Response Waveforms



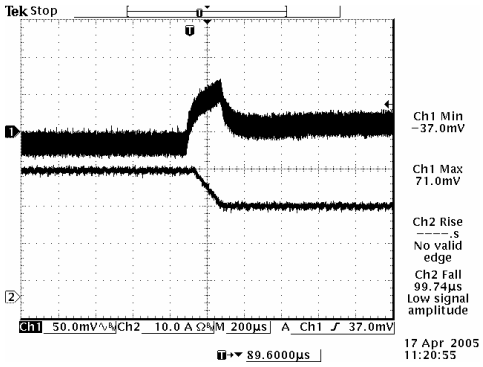
Vout= 1.2 V 50%-75% Load Transients



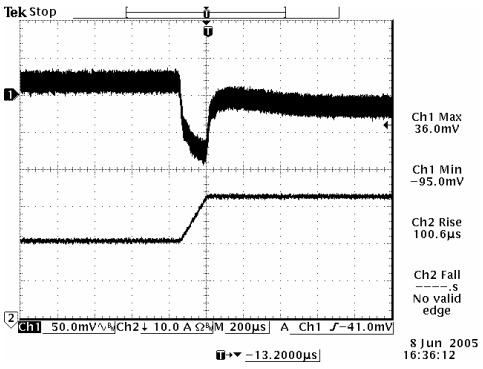
Vout= 1.2 V 75%-50% Load Transients



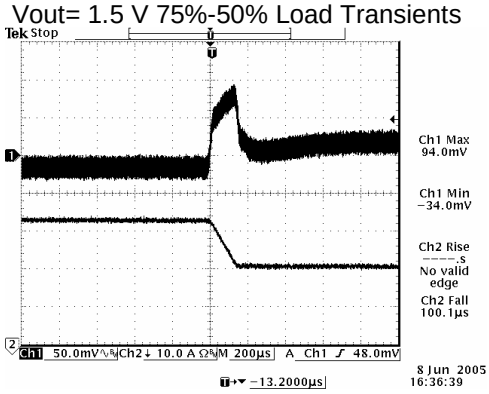
Vout= 1.5 V 50%-75% Load Transients



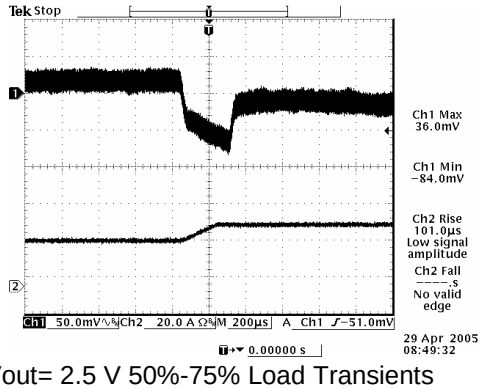
Vout= 1.5 V 75%-50% Load Transients



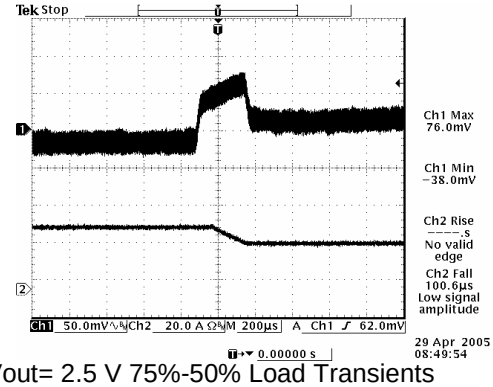
Vout= 1.8 V 50%-75% Load Transients



Vout= 1.8 V 75%-50% Load Transients

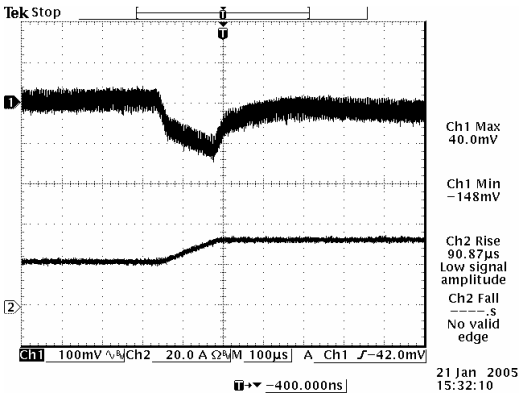


Vout= 2.5 V 50%-75% Load Transients

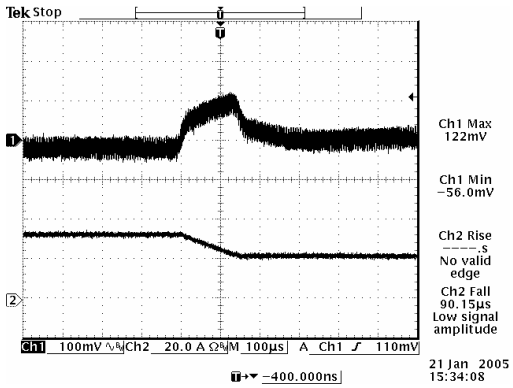


Vout= 2.5 V 75%-50% Load Transients

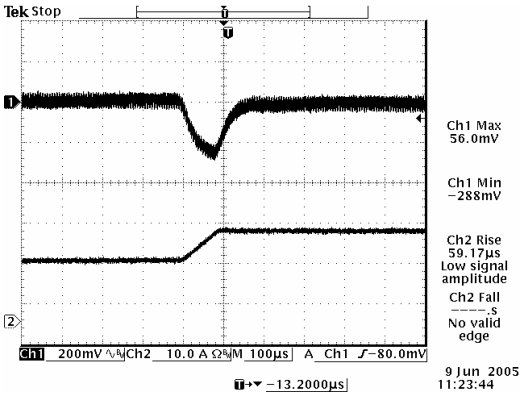
Transient Response Waveforms (continued)



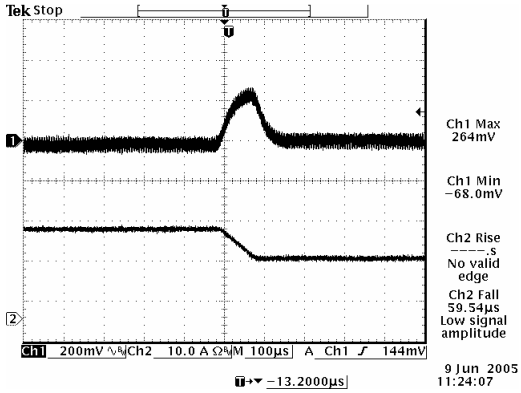
Vout= 3.3 V 50%-75% Load Transients



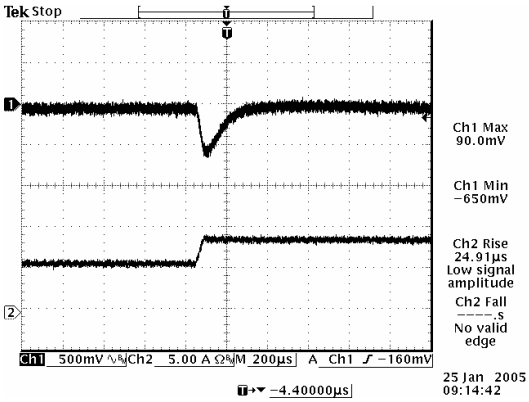
Vout= 3.3 V 75%-50% Load Transients



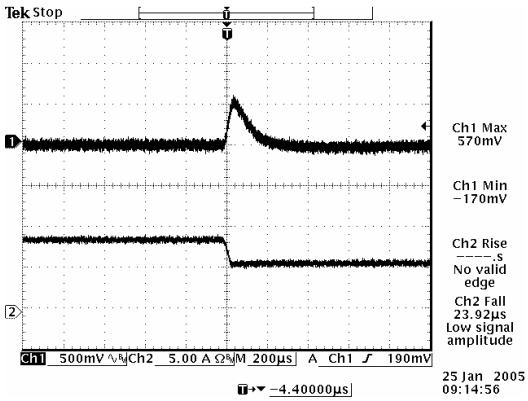
Vout= 5.0 V 50%-75% Load Transients



Vout= 5.0 V 75%-50% Load Transients



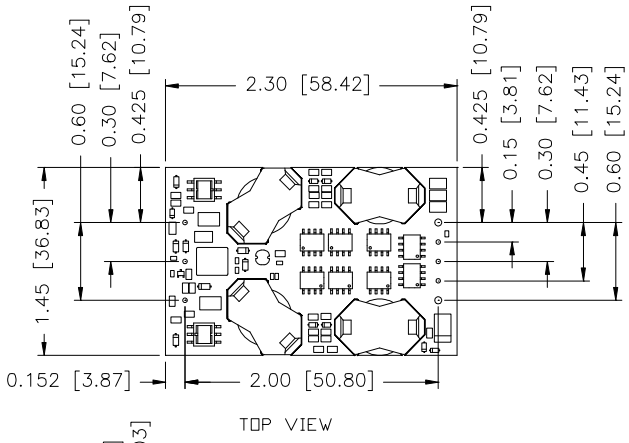
Vout= 12 V 50%-75% Load Transients

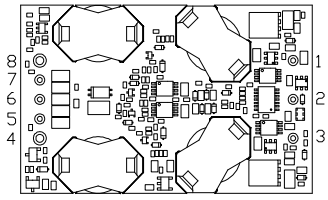


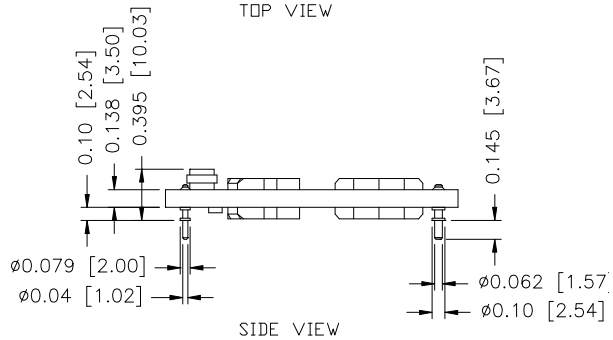
Vout= 12 V 75%-50% Load Transients

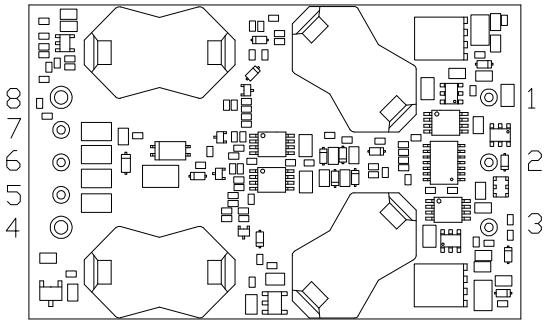
Note: Transient response at Vin=48 V, di/dt = 0.1 A/uS, with a 1 uF ceramic capacitor and a 10 uF Tantalum capacitor at the output, Ta=25 deg C.

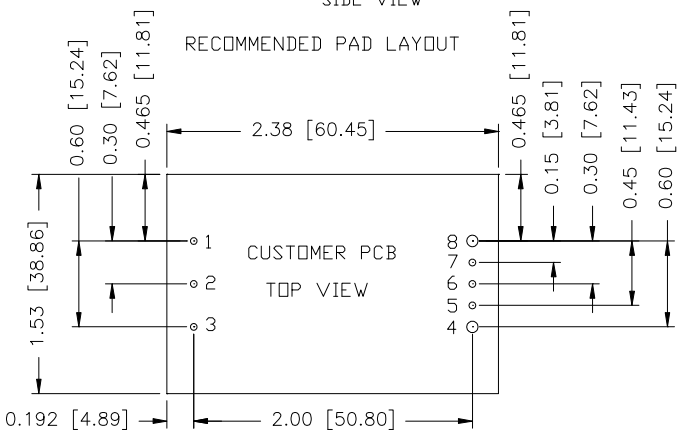
Mechanical Outline











1,2,3,5,6,7 ø0.047 HOLE SIZE, ø0.08 min PAD SIZE
4,8 ø0.07 HOLE SIZE, ø0.10 min PAD SIZE

Pin Connections

Pin	Function	Pin Size
1	Vin (+)	0.04"
2	Remote On/Off	0.04"
3	Vin (-)	0.04"
4	Vout (-)	0.062"
5	Remote Sense (-)	0.04"
6	Trim	0.04"
7	Remote Sense (+)	0.04"
8	Vout (+)	0.062"

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 ºC 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).

Revision History

Date	Revision	Changes Detail	Approval
2011-05-17	C	Add trim equation for external trim voltage.	JZ Wang

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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