VRP2-50E1A

Non-Isolated DC-DC Converter

The VRP2-50E1A are non-isolated DC-DC converters that operate over a wide range of input voltage (Vin = 5 - 13.8 VDC). This unit can provide a precisely regulated output voltage from 0.6 VDC to 5.0 VDC and can deliver up to 50 A of output current.
This unit is designed to be highly efficient and low cost. The converter is provided in an industry standard package.



Key Features & Benefits

- Non-Isolated
- High Efficiency
- Fixed Switching Frequency
- Low Cost
- Excellent Thermal Performance
- Wide Input Voltage Range
- Output Over-Voltage Shutdown
- OCP/SCP
- Low Output Ripple
- Power Good Signal
- Remote On/Off
- Wide Output Trim Range

RoHS Compliant

Applications

- Networking
- Computers and Peripherals
- Telecommunications

Please read our datasheet & drawing disclaimer here.

1. MODEL SELECTION

MODEL NUMBER	OUTPUT VOLTAGE	INPUT VOLTAGE	MAX. OUTPUT CURRENT	MAX. OUTPUT POWER	TYPICAL EFFICIENCY
VRP2-50E1A0G VRP2-50E1A1G	0.6 - 5.0 VDC	5.0 - 13.8 VDC	50 A	250 W	86%

PART NUMBER EXPLANATION

V	R	P2	-	50	E	1A	x	G
Mounting Type	RoHS Status	Series Name		Output Current	Input Range	Output Voltage	Option	Package Type
Vertical Mount	RoHS	SIP		50 A	5.0 - 13.8 V	0.6 - 5.0 V	0 – Model has a trim resistor equation 1 - Model has a trim voltage equation	Tray 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		0	-	70	°C
Storage Temperature		-55	-	125	°C
Altitude		-	-	2000	m

NOTE: Ratings used beyond the maximum ratings may cause a reliability degradation of the converter or may permanently damage the device.

3. INPUT SPECIFICATIONS

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

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Input Voltage	Vo ⩽ 2.8 V	5	12	13.8	V
	Vo > 2.8 V	1.8*Vo	12	13.8	V
Input Current (full load)		-	-	38	A
Input Reflected Ripple Current (pk-pk)	With simulated source impedance of 1 µH, 5 Hz to 20 MHz. Use a 1000 µF/16 V electrolytic capacitor with ESR = 0.1 ohm max, at 100 kHz at 25°C.	-	35	-	mA
Input Reflected Ripple Current (rms)		-	10	-	mA
I^2t Inrush Current Transient		-	-	1	A^2s
Turn-on Voltage Threshold		4.4	4.6	4.8	V
Under Voltage Threshold		4.0	4.3	4.6	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 Accuracy	Vo ⩾ 1 V	Vin = Vin min, Io = Io max	-1.5	-	1.5	%Vo
	Vo < 1 V		-10	-	10	mV
Load Regulation	Vo ⩾ 2.5 V		-	-	0.6	%Vo
	Vo < 2.5 V		-	-	12	mV
Line Regulation	Vo ⩾ 2.5 V		-	-	0.3	%Vo
	Vo < 2.5 V		-	-	9	mV
Regulation Over Temperature (0°C to 70°C)			-	-	0.02	%Vo/C
Output Current Range			0	-	50	A
Current Limit Threshold			105	130	180	%Io
Output Ripple and Noise (pk-pk)	Vo = 5.0 V	Test conditions: 0-20 MHz BW, with a 1 µF ceramic capacitor and a 10 µF Tantalum cap at output.	-	-	110	mV
	Vo = 3.3 V		-	-	100	mV
	Vo = 2.5 V		-	-	100	mV
	Vo = 1.5 V		-	-	80	mV
	Vo = 1.0 V		-	-	60	mV
	Vo = 0.6 V		-	-	60	mV
Output Ripple and Noise (rms)	Vo = 5.0 V	Test conditions: 0-20 MHz BW, with a 1 µF ceramic capacitor and a 10 µF Tantalum cap at output.	-	-	35	mV
	Vo = 3.3 V		-	-	35	mV
	Vo = 2.5 V		-	-	35	mV
	Vo = 1.5 V		-	-	30	mV
	Vo = 1.0 V		-	-	25	mV
	Vo = 0.6 V		-	-	25	mV
Turn on Time			-	-	10	ms
Rise Time			-	-	3	ms
Overshoot at Turn on and off			-	-	0.5	%
Output Capacitance		ESR ⩾ 1 mΩ	0	-	4700	µF
Transient Response						
△V 50%~100% of Max Load		Vo = All; Test conditions: di/dt = 10 A/µs; Vin =12 V; Co = 0 µF.	-	-	300	mV
Settling Time			-	-	100	µs
△V 100%~50% of Max Load			-	-	300	mV
Settling Time			-	-	100	µs

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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		-	93	-	%
	Vo = 3.3 V		-	91	-	%
	Vo = 2.5 V		-	88	-	%
	Vo = 1.8 V		-	86	-	%
	Vo = 1.5 V		-	84	-	%
	Vo = 1.2 V		-	82	-	%
	Vo = 1.0 V		-	75	-	%
	Vo = 0.6 V		-	68	-	%
Switching Frequency			-	330	-	kHz
Output Voltage Trim Range		Trim pin is open, Vo = 0.6 V.	0.6	-	5	V
Over Voltage Protection		Vin = 12 V, Io = full load.	110	115	130	%Vo,set
MTBF		Calculated Per Bell Core SR-332 (Io = 40 A, Vo = 1.92 V; Vin = 12 V; Ta = 25°C, 100 LFM forced air flow.)	-	3,361,100	-	hrs
Weight			-	28.5	-	g
Dimensions (L × W × H)			1.45 x 0.743 x 1.1			inch
			36.83 x 18.87 x 27.94			mm

6. EFFICIENCY DATA

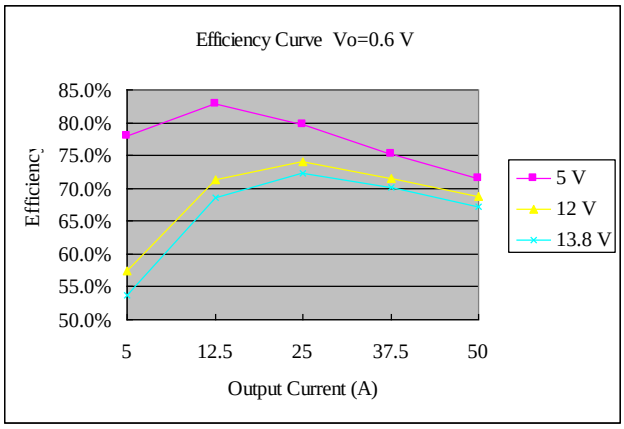


Figure 1. Efficiency data at Vo = 0.6 V

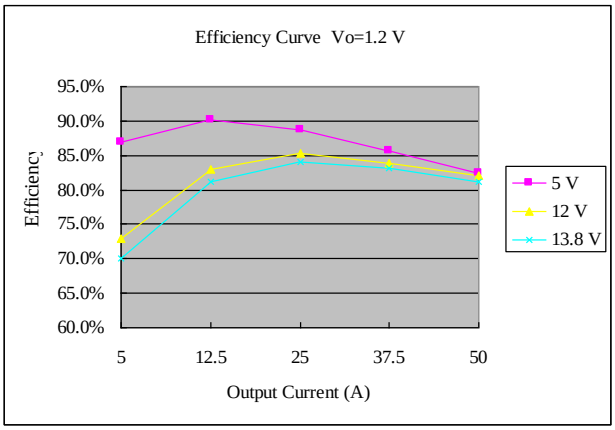


Figure 2. Efficiency data at Vo = 1.2 V

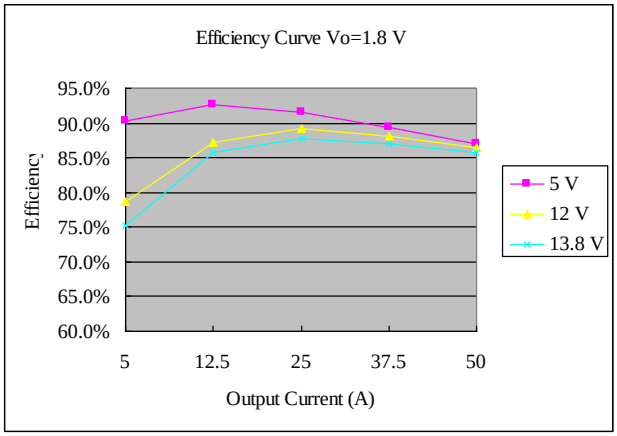


Figure 3. Efficiency data at Vo = 1.8 V

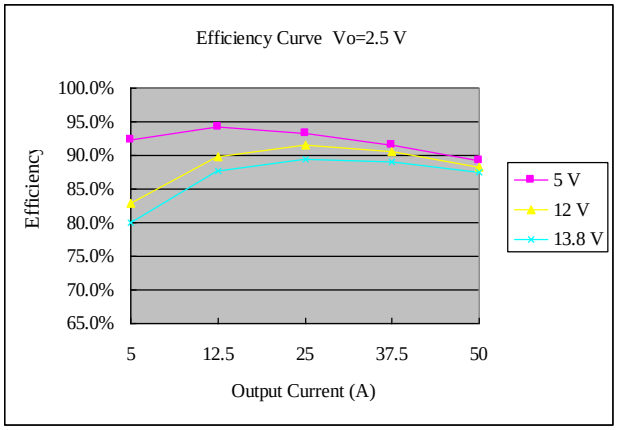


Figure 4. Efficiency data at Vo = 2.5 V

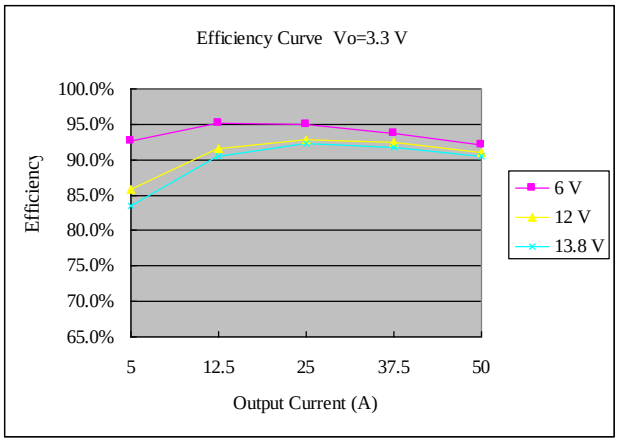


Figure 5. Efficiency data at Vo = 3.3 V

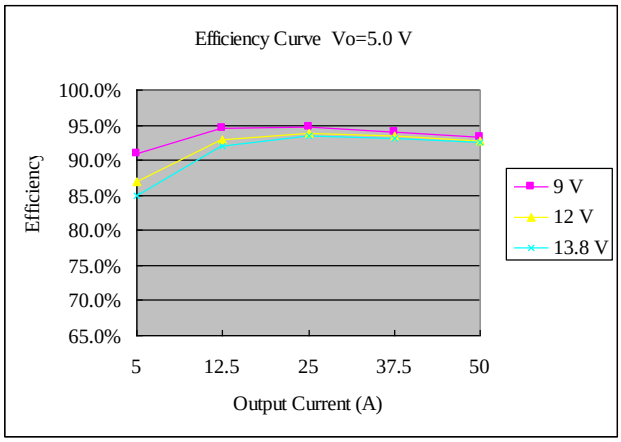


Figure 6. Efficiency data at Vo = 5.0 V

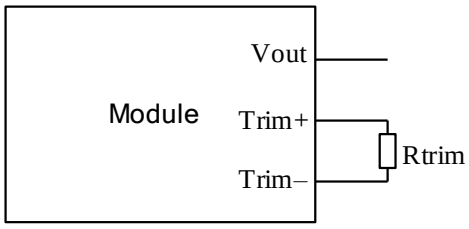
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7. CONTROL SPECIFICATIONS

PARAMETER		DESCRIPTION	MIN	TYP	MAX	UNIT
Remote On/Off						
Signal Low (Unit Off)	Active High	Remote On/Off pin is open, unit is off.	-0.3	-	0.8	V
Signal High (Unit On)			2	-	Vin,max	V
Current Source/Sink			0	-	3.3	mA
PwGood (PowerGood)						
PwGood = High = Power Good			2.4	-	5.25	V
			-	-	2	mA
PwGood = Low = Power Not Good			0	-	0.4	V
			-	-	4	mA

8. OUTPUT TRIM EQUATIONS

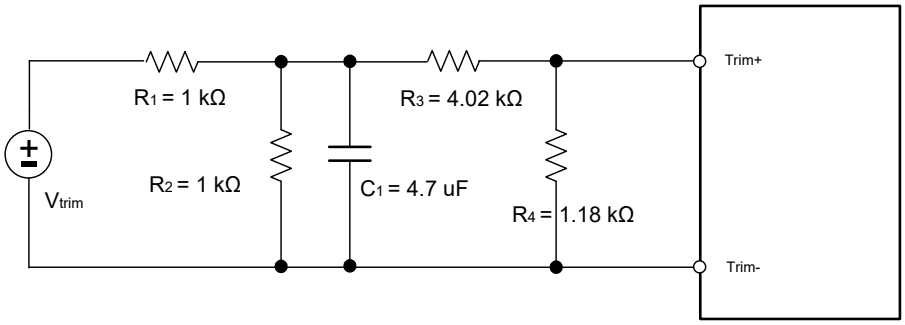
VRP2-50E1A0 --- Trim resistor equation.



$$R_{trim} = \frac{1.2}{Vo - 0.6}(K\Omega)$$

Figure 7. Trim resistor test circuit

VRP2-50E1A1 --- Trim voltage equation.



$$V_o = 1.8824 - 0.2212\ V_{trim}\ (V)$$

V_o= 1.847V when Vtrim is open.

Figure 8. Trim voltage test circuit

9. THERMAL DERATING CURVE

The thermal reference point Tref is shown above. For reliable operation this temperature should not exceed 115°C. The output power of the module should not exceed the rated power for the module.

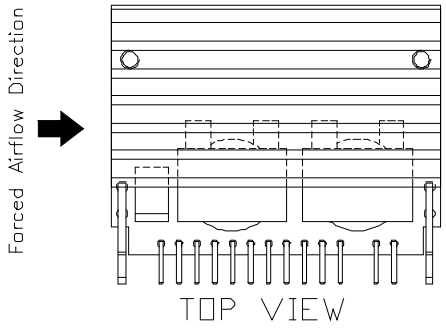


Figure 9. Airflow direction

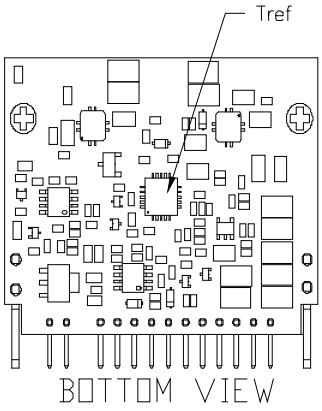


Figure 10. Tref in the bottom view

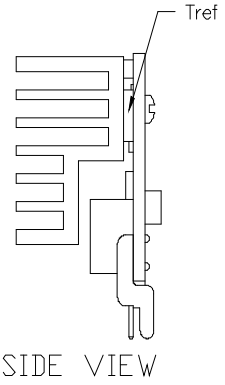


Figure 11. Tref in the side view

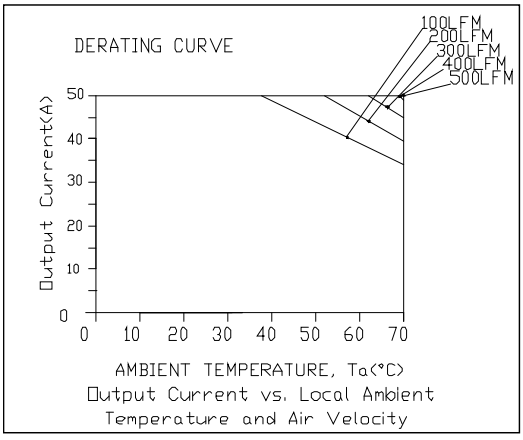


Figure 12. Vin = 12 V, Vo = 0.6 V

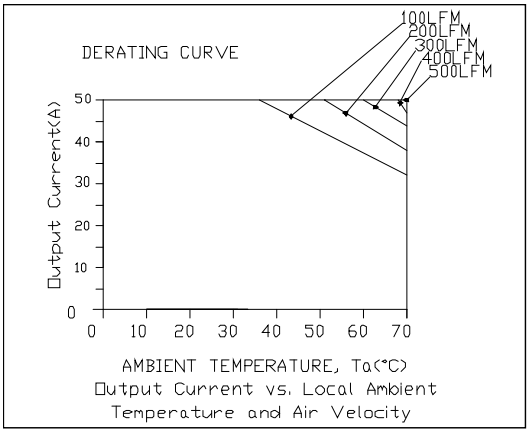


Figure 13. Vin = 12 V, Vo = 1.2 V

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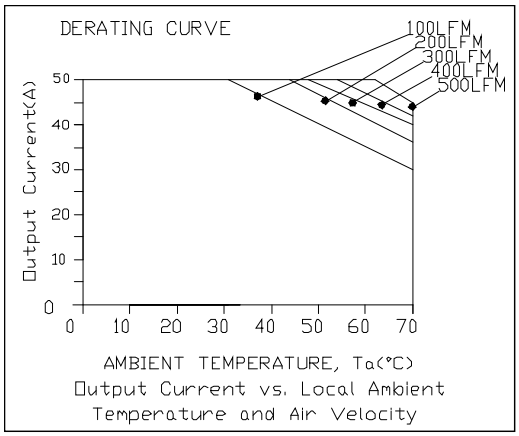


Figure 14. Vin = 12 V, Vo = 1.8 V

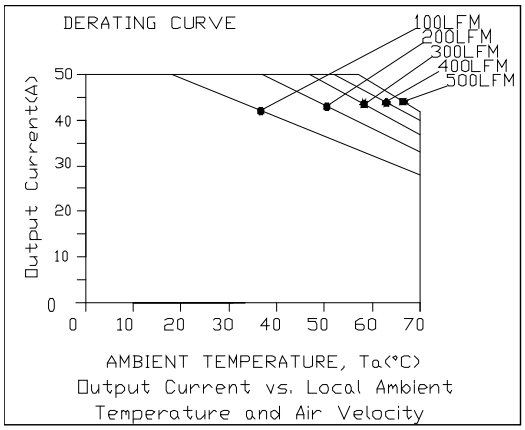


Figure 15. Vin = 12 V, Vo = 2.5 V

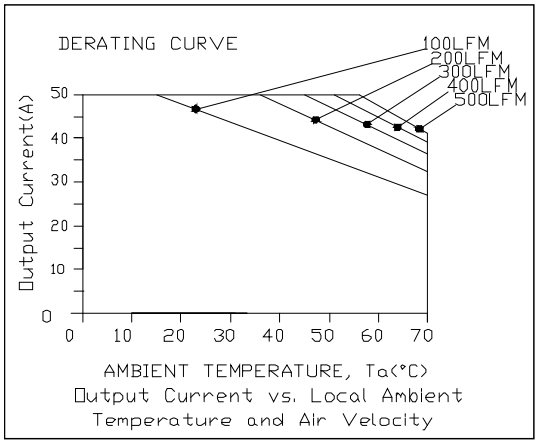


Figure 16. Vin = 12 V, Vo = 3.3 V

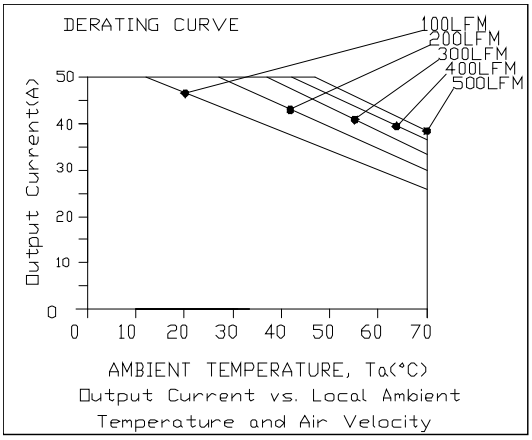


Figure 17. Vin = 12 V, Vo = 5.0 V

10. RIPPLE AND NOISE WAVEFORMS

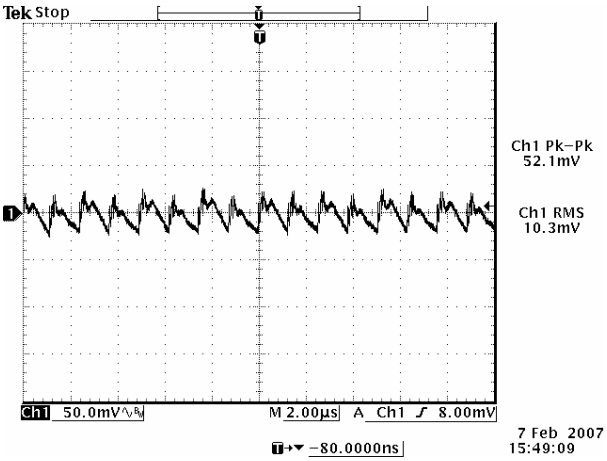


Figure 18. 12 VDC input, 0.6 VDC / 50 A output

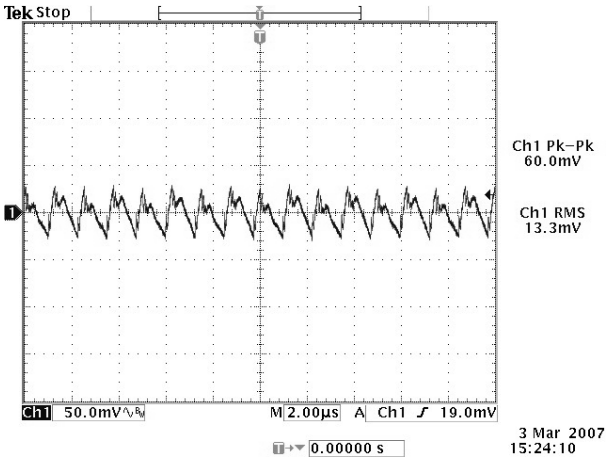


Figure 19. 12 VDC input, 1.2 VDC / 50 A output

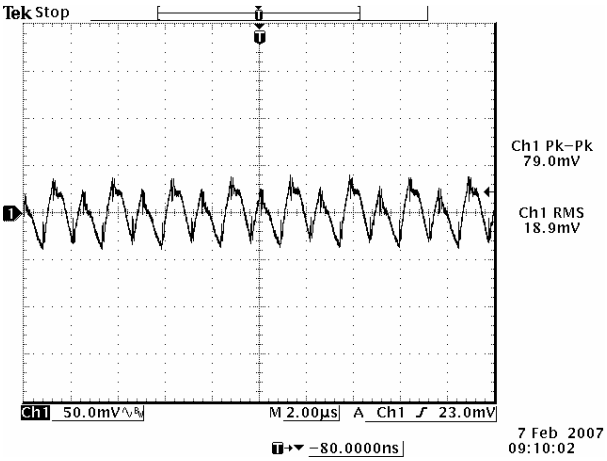


Figure 20. 12 VDC input, 1.8 VDC / 50 A output

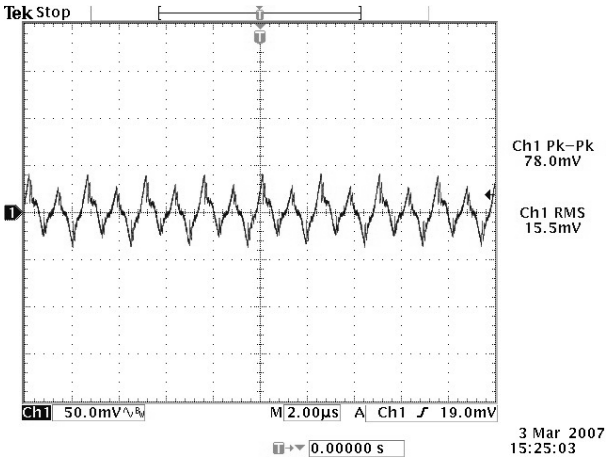


Figure 21. 12 VDC input, 2.5 VDC / 50 A output

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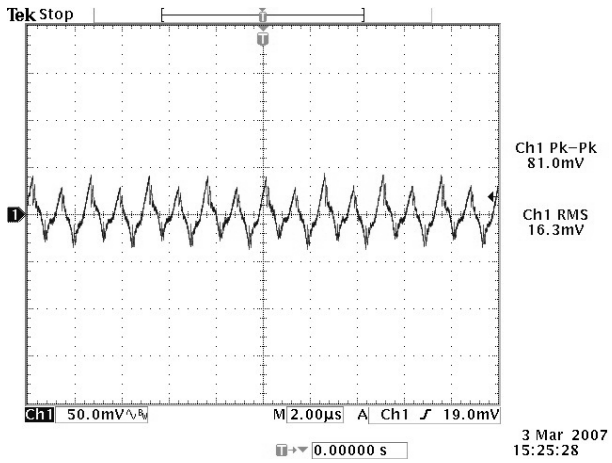


Figure 22. 12 VDC input, 3.3 VDC / 50 A output

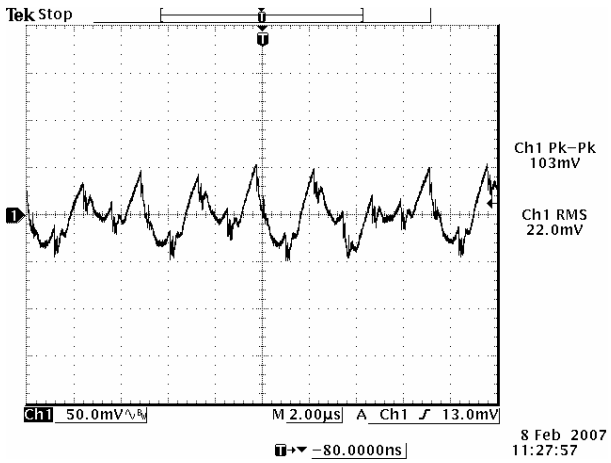


Figure 23. 12 VDC input, 5.0 VDC / 50 A output

Note: Ripple and noise at full load, 0-20 MHz BW, with a 10 µF and a 1 µF ceramic cap at the output, and Ta = 25°C.

11. TRANSIENT RESPONSE WAVEFORMS

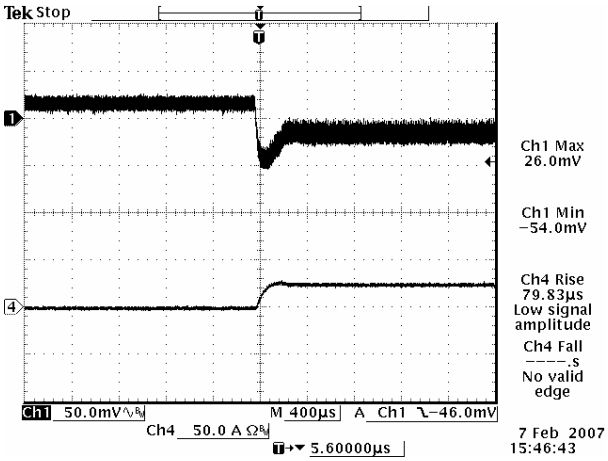


Figure 24. Vout = 0.6 V, 0%-50% Load Transient

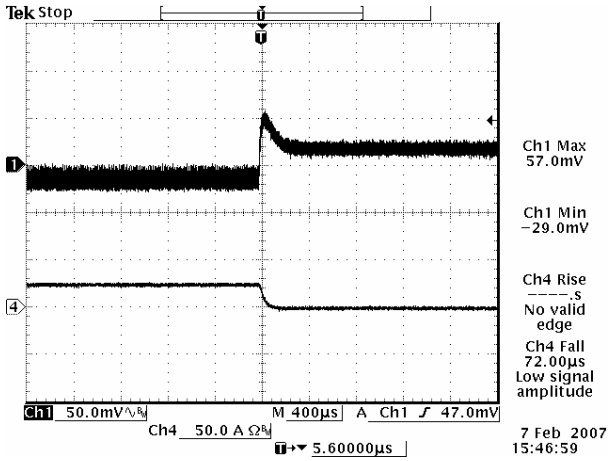


Figure 25. Vout = 0.6 V, 50%-0% Load Transient

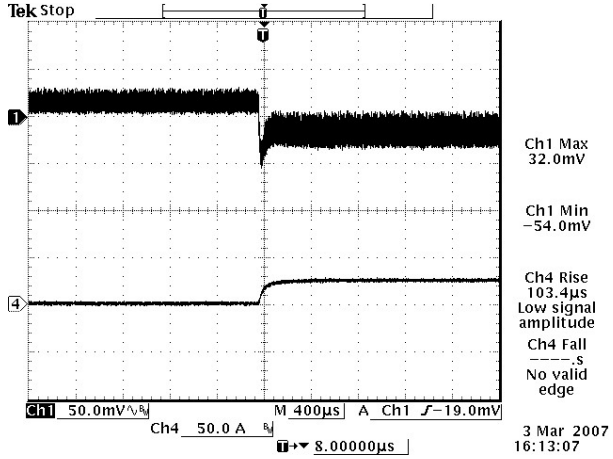


Figure 26. Vout = 1.2 V, 0%-50% Load Transient

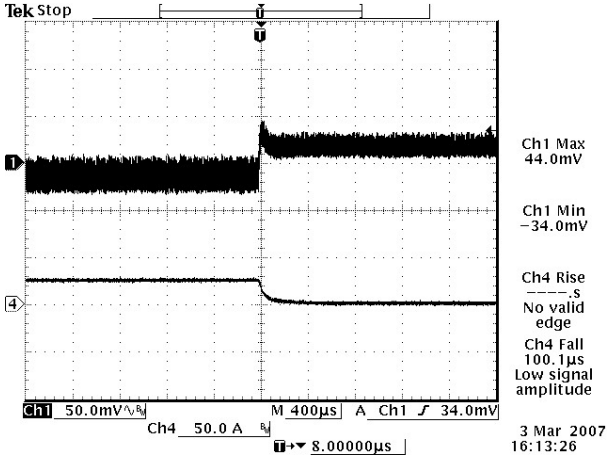


Figure 27. Vout = 1.2 V, 50%-0% Load Transient

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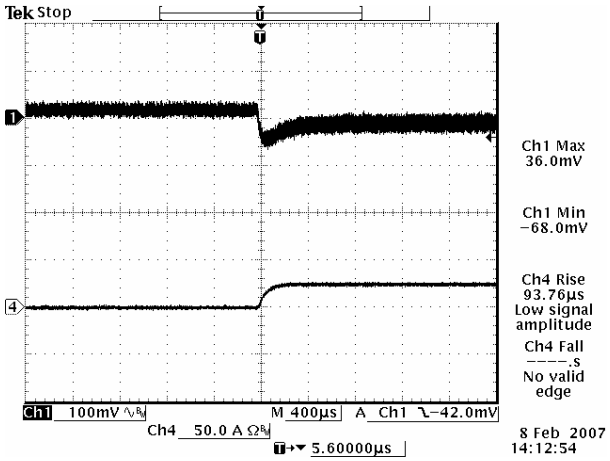


Figure 28. Vout = 1.8 V, 0%-50% Load Transient

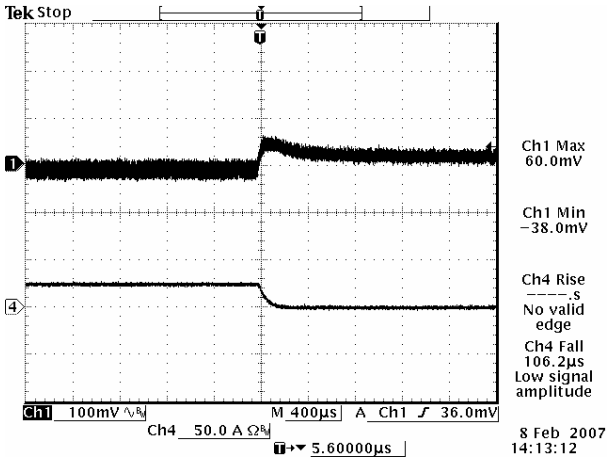


Figure 29. Vout = 1.8 V, 50%-0% Load Transient

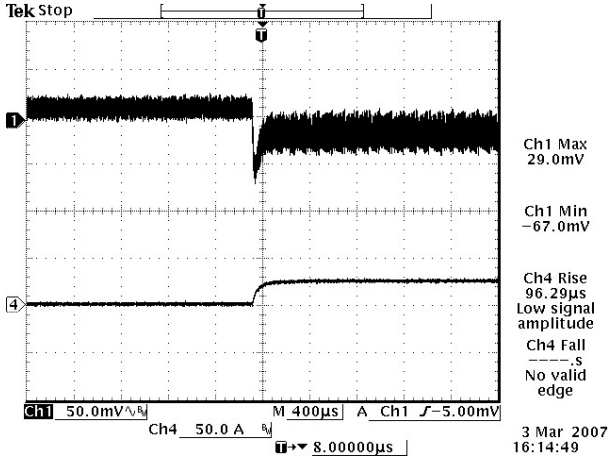


Figure 30. Vout = 2.5 V, 0%-50% Load Transient

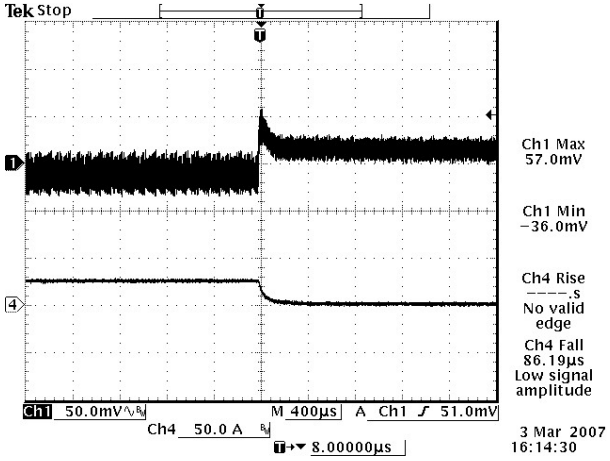


Figure 31. Vout = 2.5 V, 50%-0% Load Transient

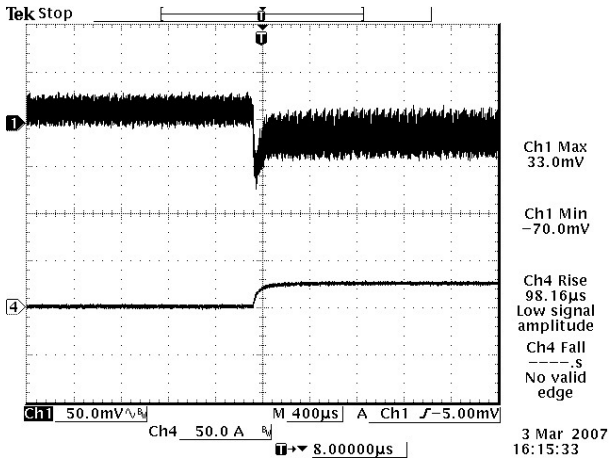


Figure 32. Vout = 3.3 V, 0%-50% Load Transient

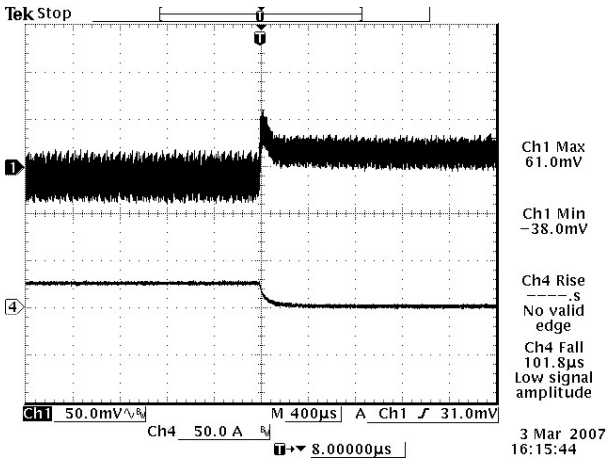


Figure 33. Vout = 3.3 V, 50%-0% Load Transient

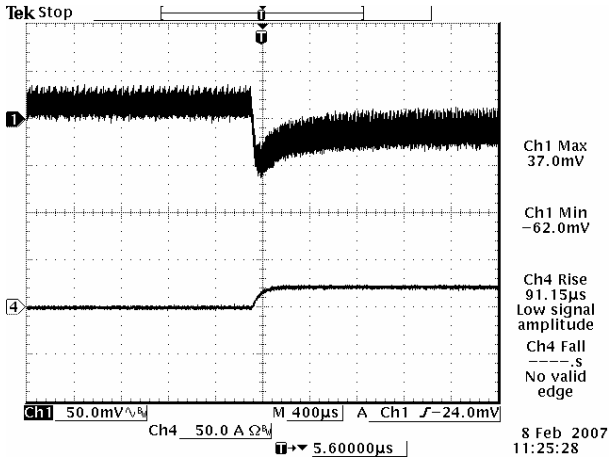


Figure 34. Vout = 5 V, 0%-50% Load Transient

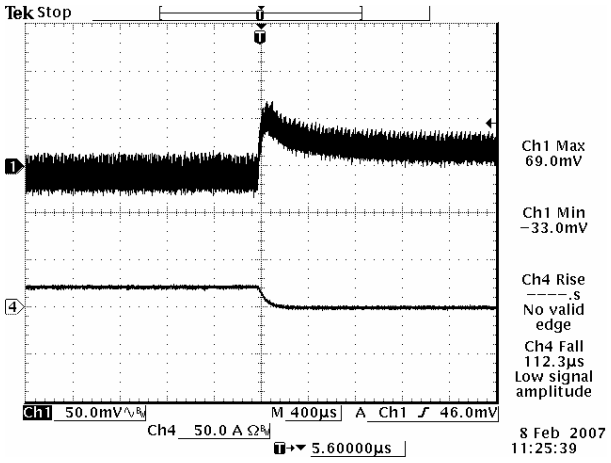


Figure 35. Vout = 5 V, 50%-0% Load Transient

Note: Transient response at di/dt = 10 A/us, with external electrolytic cap 4700 µF, and Ta = 25°C.

12. ASSEMBLY NOTE

Modules were designed for vertical insertion into host board. Experiments should be performed to make sure that the units meet the intended tilt specification. A fixture may be needed to make the module stand upright in assembly.

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13. MECHANICAL DIMENSIONS

OUTLINE

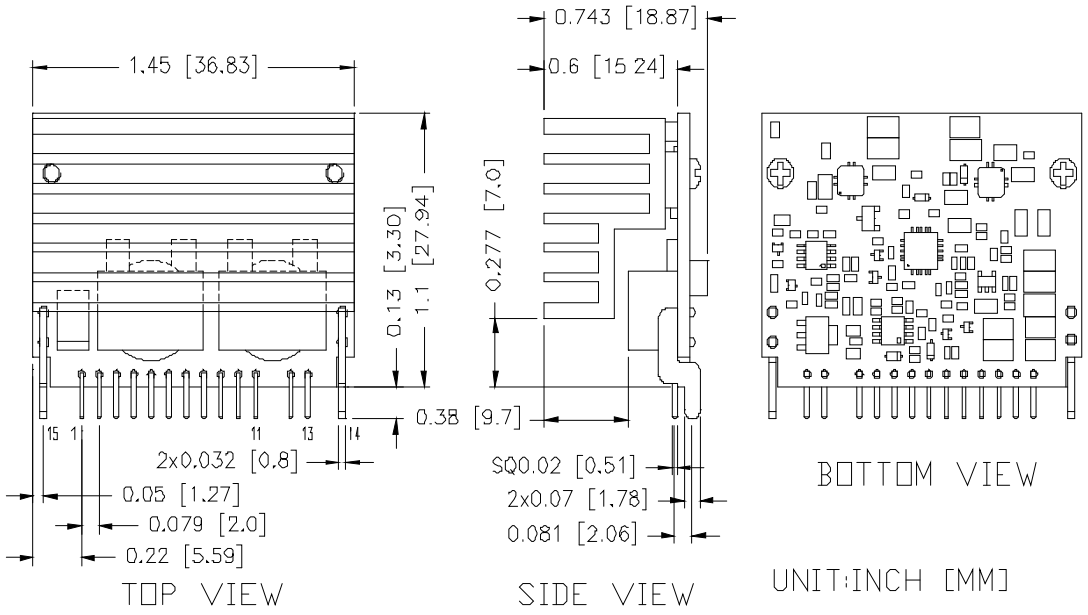


Figure 36. Outline

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.

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

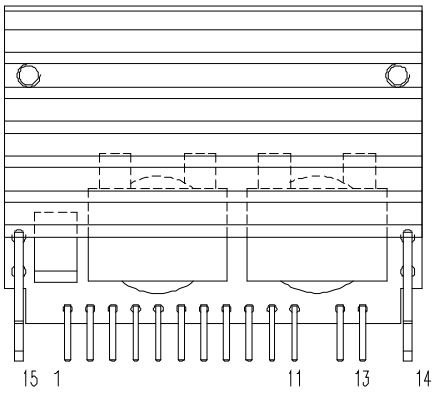


Figure 37. Pins

PIN	FUNCTION	PIN	FUNCTION
1	Vout	9	PwGOOD
2	Vout	10	Vsense-
3	Vout	11	Vsense+
4	GND	12	Vin
5	GND	13	Vin
6	Enable	14	GND
7	Trim-	15	GND
8	Trim+		

RECOMMENDED PAD LAYOUT

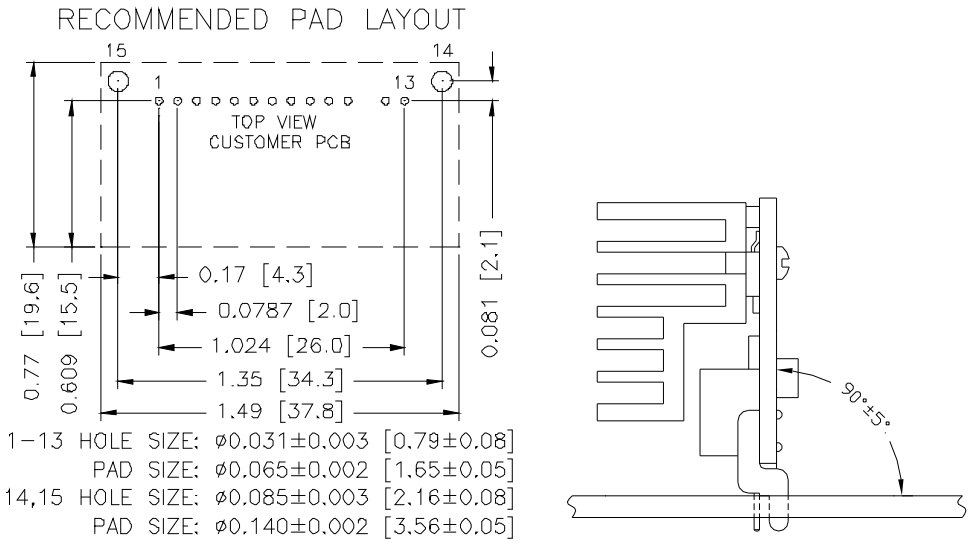


Figure 38. Recommended pad layout

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14. REVISION HISTORY

DATE	REVISION	CHANGES DETAIL	APPROVAL
2010-01-21	H	1. Change to Bel new datasheet format; 2. Add new part number “xRP2-50E1A1”.	YF.Sun
2016-01-19	I	Add Assembly Note. Update mechanical drawing.	F.Tao
2010-08-05	AJ	Add object ID. Update to new format. Delete 0RP2-50E1Ax.	XF.Jiang

For more information on these products consult: tech.support@psbel.com

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