NON-ISOLATED DC/DC CONVERTERS

7.5 Vdc – 13.2 Vdc Input 0.6 Vdc – 2.0 Vdc/50 A Output

May. 12 2016

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

SRPE-50E1A0 RoHS Compliant Rev.H

Features

- Non-Isolated
- Fixed frequency
- High efficiency
- High Power Desity
- Overtemperature Shutdown
- Wide Input Voltage Range
- Low Cost
- Wide Output Trim Range
- Output Over-Voltage Shutdown
- OCP/SCP
- Power Good Signal
- Remote Sense
- Remote On/Off
- Undervoltage lockout
- Wide Operating Temperature Range (0 °C - 50 °C)
- Class 2, Category 2, Non-Isolated DC/DC Converter (refer to IPC-9592B)

Applications

- Networking
- Computers and peripherals
- Telecommunications

Description

The Bel SRPE-50E1A0 is part of the non-isolated dc to dc converter Power Module series. The modules use a Vertical SMT package. These converters are available in a range of output voltages from 0.6 Vdc to 2.0 Vdc over a wide range of input voltage (Vin = 7.5 – 13.2 Vdc).

Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Model Number Active High
0.6 Vdc – 2.0 Vdc	7.5 Vdc - 13.2 Vdc	50 A	100 W	91%	SRPE-50E1A0

Notes: 1.Add “G” or “R” suffix at the end of the model number to indicate packaging.

Ordering Part Number

S	R	PE	–	50	E	1A	0	x
1	2	3		4	5	6	7	8

1---Mounting type, **S –Surface mount**
2---RoHS Status, **R – RoHS 6**
3---Series name, **PE –SMD Series name**
4---Output power, **50 – 100W output**
5---Input range, **E – 7.5-13.2V input**
6---Output voltage, **1A – 0.6-2.0V output**
7---Active logic and HSK feature, **0 – active high, with HSK**
8---Package type, **G – Tray packaging**
R – Tape and Reel packaging

Absolute Maximum Ratings

Parameter	Min	Typ	Max	Unit	Notes
Continuous non-operating Input Voltage	-0.3	-	15	V	
Output Enable Terminal Voltage	-0.3	-	15	V	
Ambient Temperature	0	-	50	°C	
Storage Temperature	-40	-	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.

Input Specifications

Parameter	Min	Typ	Max	Unit	Notes
Input Voltage	7.5	12	13.2	V	
Input Current (full load)	-	9.3	10.3	A	Vin=12V, Vo=2V, Io=50A
	-	4.6	5.6	A	Vin=12V, Vo=0.9V, Io=50A
	-	3.3	4.3	A	Vin=12V, Vo=0.6V, Io=50A
Input Current (no load)	-	135	-	mA	Vin=12V, Vo=0.9V
	-	126	-	mA	Vin=12V, Vo=0.6V
	-	190	-	mA	Vin=12V, Vo=2V
Remote Off Input Current	-	20	-	mA	Vin=12V
Input Reflected Ripple Current (pk-pk)	-	45	-	mA	Vin=12V, Vo=0.9V 1uH inductor×1, 100uf/100V×1 @25°C.
Input Reflected Ripple Current (rms)	-	11	-	mA	
Turn-on Voltage Threshold	-	7.2	-	V	
Turn-off Voltage Threshold	-	6.4	-	V	

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

Output Specifications

Parameter	Min	Typ	Max	Unit	Notes
Output Voltage Set Point	-	±2	-	%Vo,set	Vin=12V, Iout=full load, Ta=25°C.
Load regulation	-	-	±2	%Vo,set	
Line Regulation	-	-	±2	%Vo,set	
Regulation Over Temperature	-	-	±2	%Vo,set	
Output Ripple and Noise (pk-pk)	-	15	30	mV	Vin=12V, Iout=full load, Ta=25°C.
Output Ripple and Noise (rms)	-	5	10	mV	
Output Current Range	0	-	50	A	
Output DC Current Limit	60	-	120	A	

Output Specifications (continued)

Parameter		Min	Typ	Max	Unit	Notes
Turn On Time		-	3.5	5	ms	
Output capcitance		-	1542	-	uF	6*22uF 0805, 6.3V ceramic caps 3*470uF 7mohm Polymer Caps
Transient Response						
△V50%~75% of Max Load	Overshoot	Vo=0.9	-	40	70	mV	di/dt=1A/us, Vin=12Vdc, Vo=0.9Vdc, Ta=25°C, with1*0.1uF+1*1uF+ 6*22uF ceramic capacitor and 3*470uF polymer cap at output.
	Settling Time		-	50	80	us	
△V75%~50% of Max Load	Overshoot		-	40	70	mV	
	Settling Time		-	50	80	us	

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

General Specifications

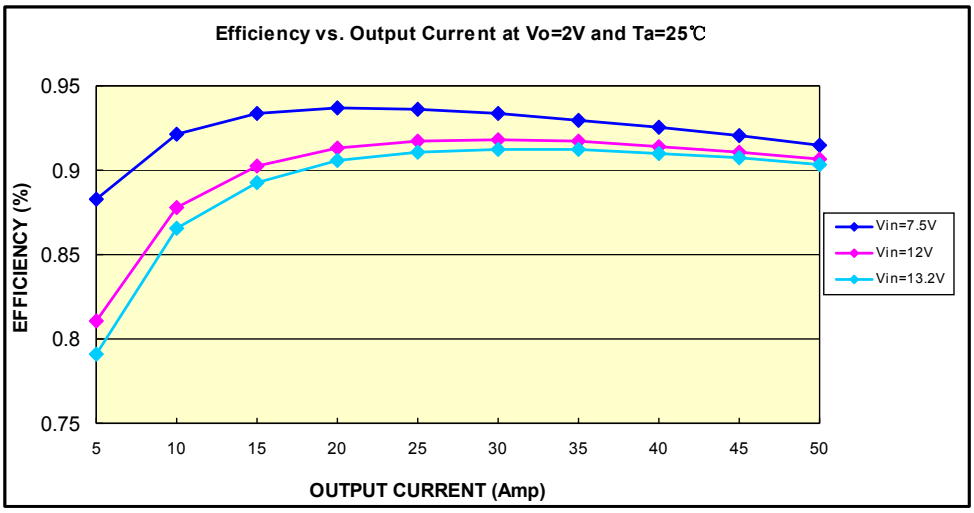
Parameter	Min	Typ	Max	Unit	Notes
Efficiency	-	90.5	-	%	The efficiency is measured at Vin=12V, Vout=2V, Iout=50A and Ta=25°C.
Switching Frequency	-	350	-	kHz	For per phase
Over Temperature Protection	-	-	-	°C	
Output Voltage Trim Range(Wide Trim)	0.6	-	2	V	This voltage is achieved by trimming up output slowly.
Weight	-	19	-	g	
MTBF	-	31.7	-	hours	Calculated Per Telcordia SR-332, Issue 3 （Vin=12V,Vo=0.9V,Io=50A,Ta=40C，with 300 LFM，FIT=10^9/MTBF）
FIT	-	31.5	-		
Dimensions Inches (L × W × H) Millimeters (L × W × H)	1.45 x 0.95 x 0.62 36.83 x 24.13 x 15. 75			-	

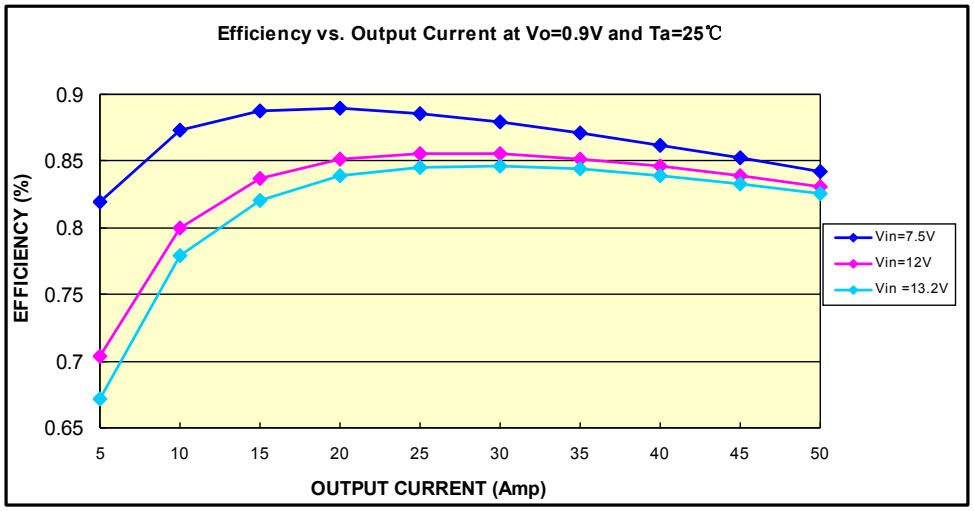
Note: All specifications are typical at 25 °C unless otherwise stated.

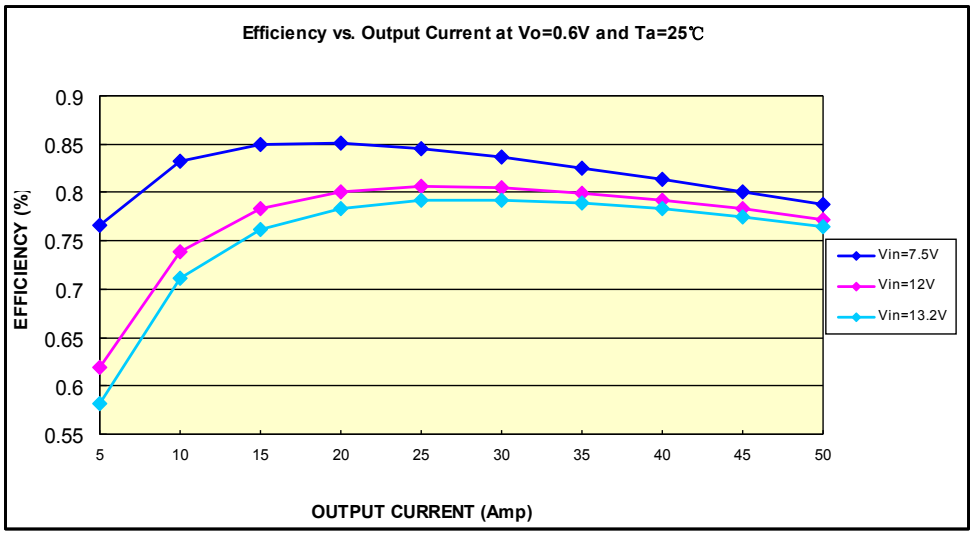
Control Specifications

Parameter	Min	Typ	Max	Unit	Notes
Remote On/Off					
Signal Low(Unit Off)	0	-	0.5	V	Remote On/Off pin open,unit off.
Signal High(Unit On)	1.8	-	15	V	

Efficiency Data

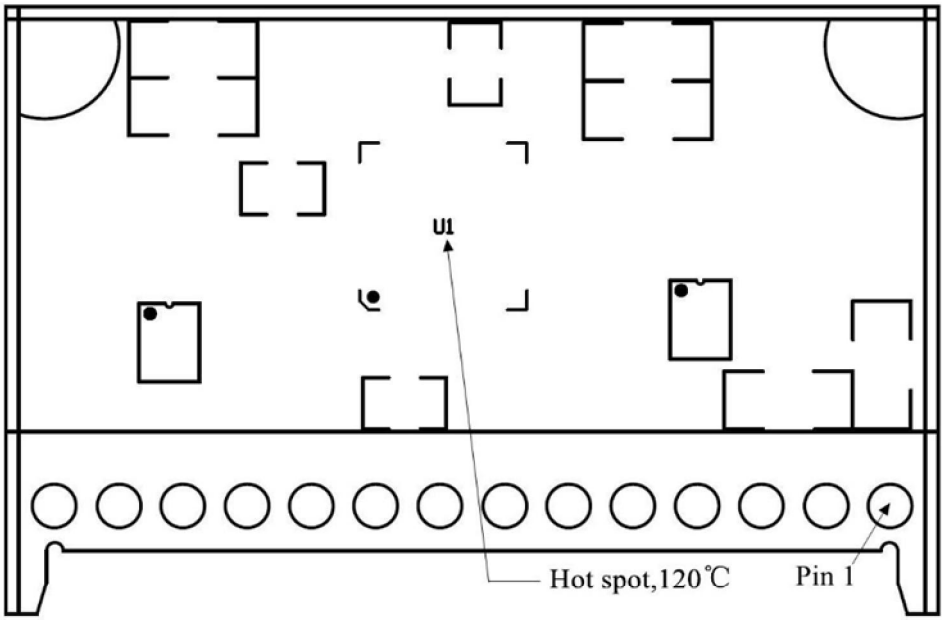


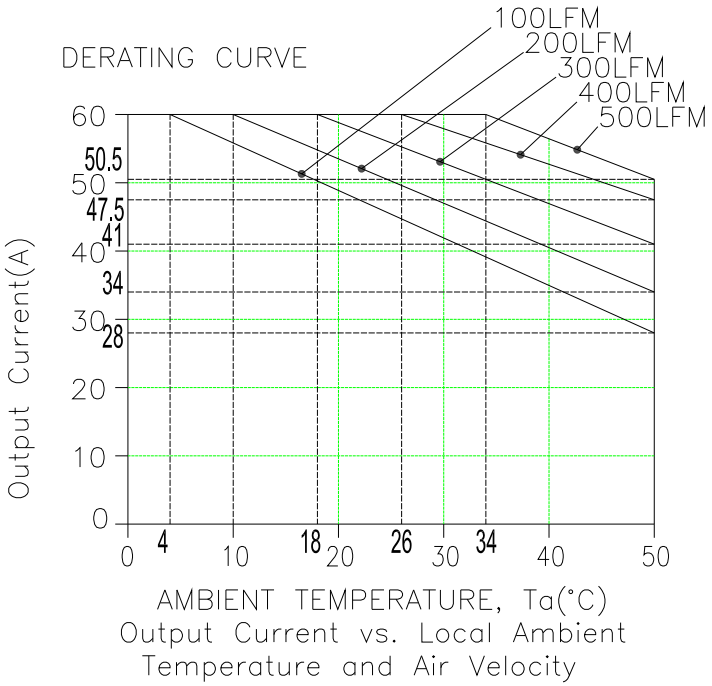




Thermal Derating Curves

Hot spot location and allowed maximum temperature

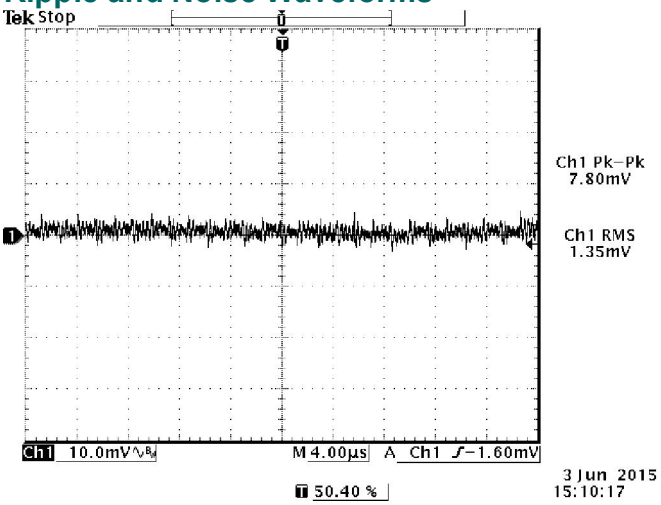




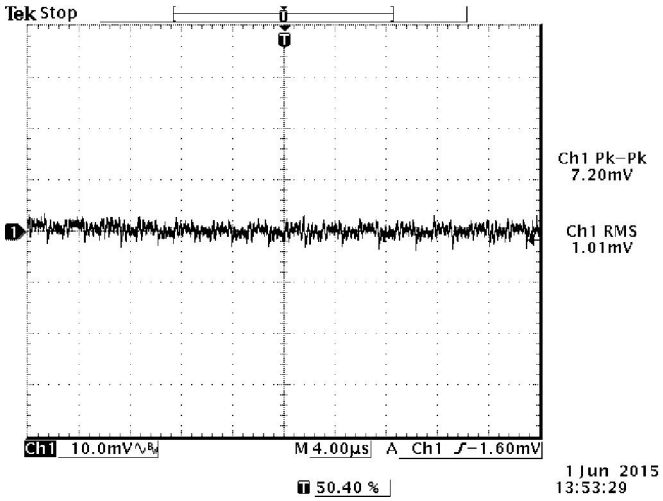
Output Current vs. Local Ambient Temperature and Air Velocity

Vin=12V, Vo=0.9V

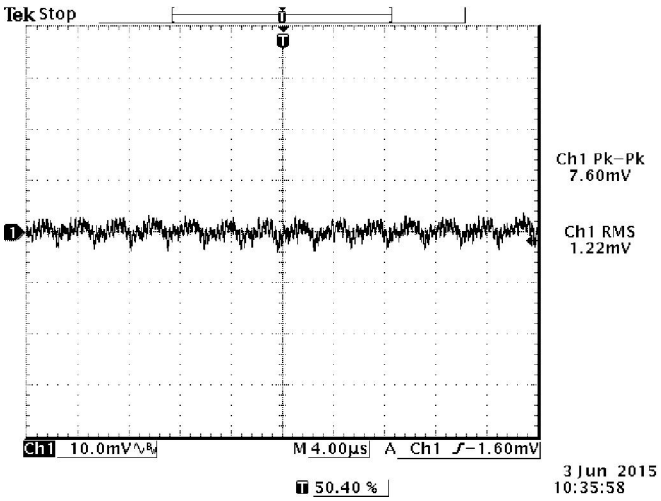
Ripple and Noise Waveforms



Vin=12V,Vo=0.6V,Io=50A



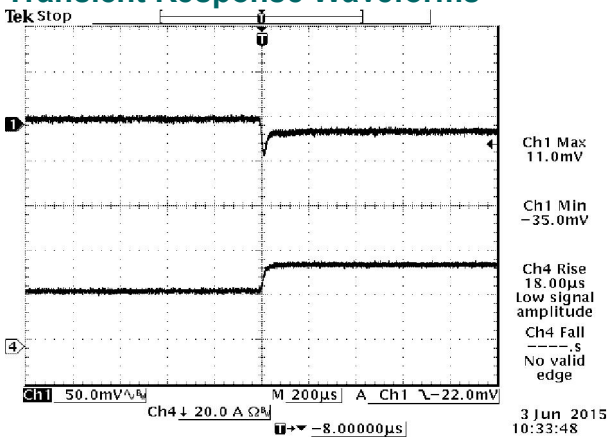
Vin=12V,Vo=0.9V,Io=50A



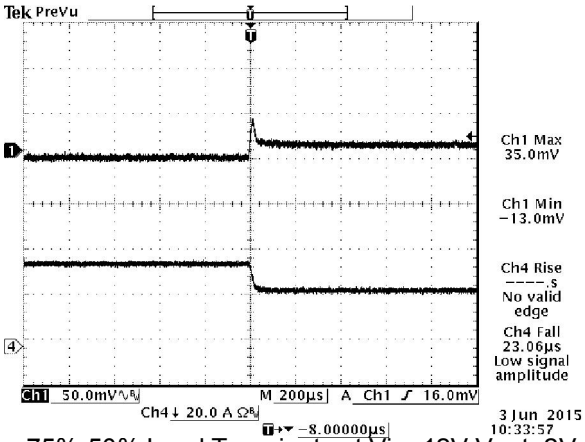
Vin=12V,Vo=2V,Io=50A

Note：Ripple and noise at full load, 0-20MHz BW, with 1*0.1uf+1*1uf+6*22uf ceramic and 3*470 uF polymer capacitor at the output, Ta=25 deg C.

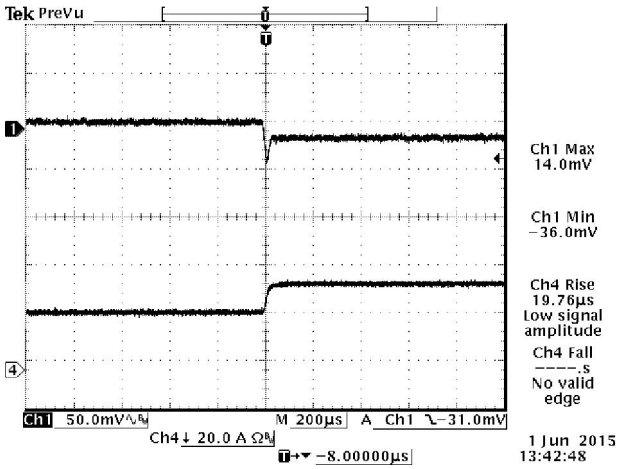
Transient Response Waveforms



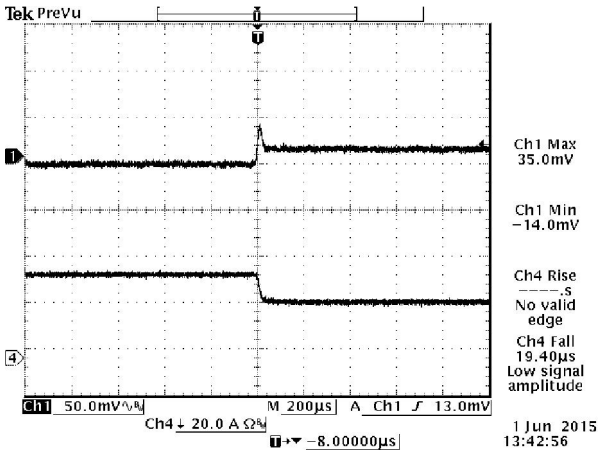
50%-75% Load Transients at Vin=12V,Vout=2V



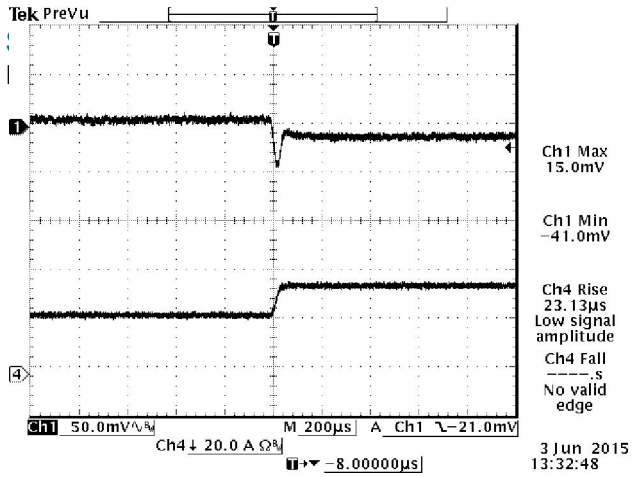
75%-50% Load Transients at Vin=12V,Vout=2V



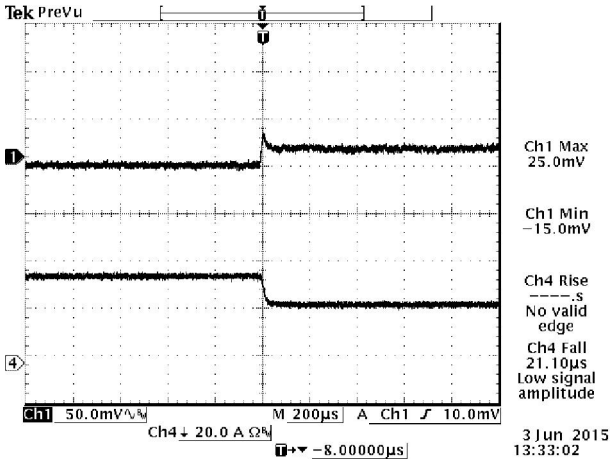
50%-75% Load Transients at Vin=12V,Vout=0.9V



75%-50% Load Transients at Vin=12V,Vout=0.9V



50%-75% Load Transients at Vin=12V,Vout=0.6V



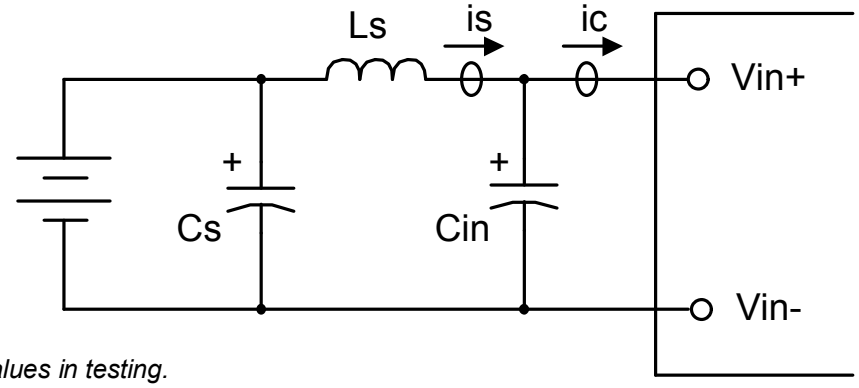
75%-50% Load Transients at Vin=12V,Vout=0.6V

Note：Transient response at di/dt=1A/uS, with 1*0.1uf+1*1uf+6*22uf ceramic and 3*470 uF polymer capacitor at the output, Ta=25 deg C.

Input noise

Input reflected ripple current

Testing setup



Notes and values in testing.

is: Input Reflected Ripple Current

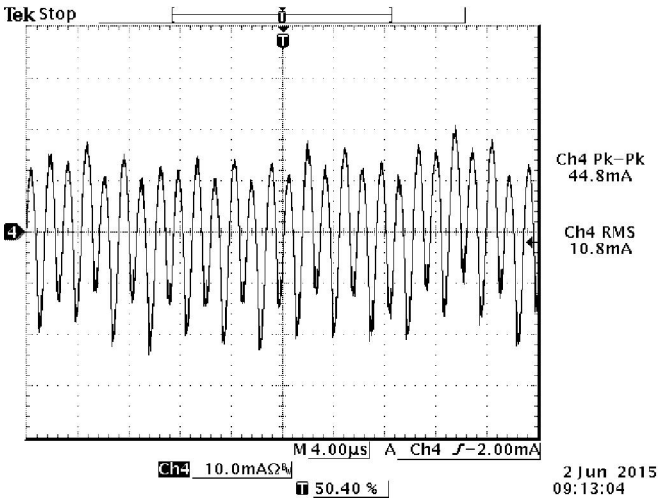
ic: Input Terminal Ripple Current

Ls: Simulated Source Impedence (1μH)

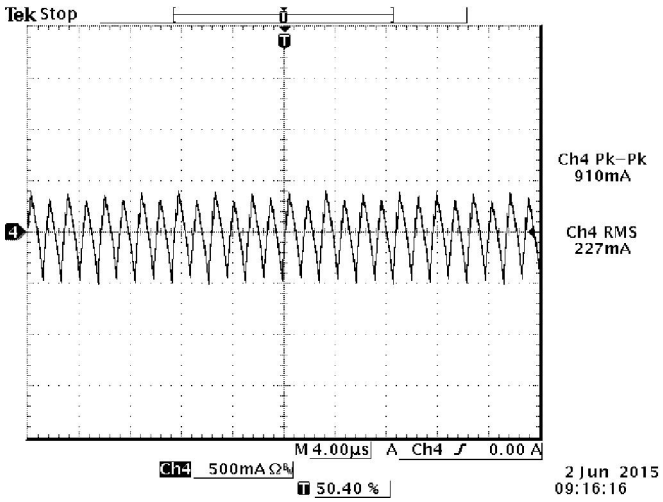
Cs: Offset possilbe source Impedence (100μF, ESR<0.2Ω @ 100kHz, 20C)

Cin: Electrolytic capacitor, should be as closed as possible to the power module to swallow ic ripple current and help with stability. Recommendation: 100μF, ESR<0.2Ω @ 100kHz, 20C.

Below measured waveforms are based on above simulated and recommended inductance and capacitance.



is (input reflected ripple current), AC component

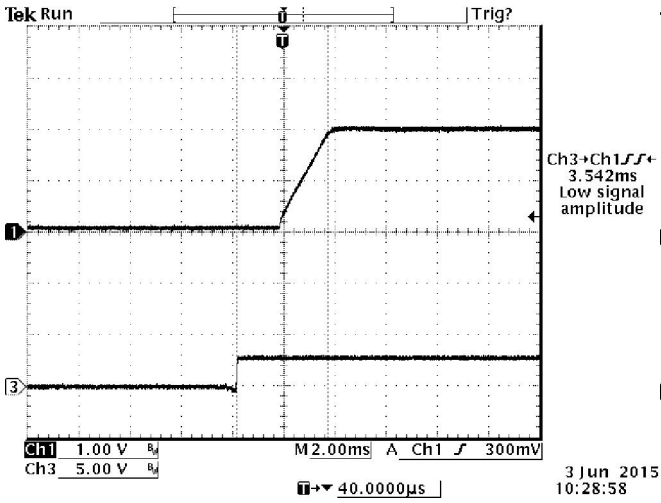


ic (input terminal ripple current), AC component

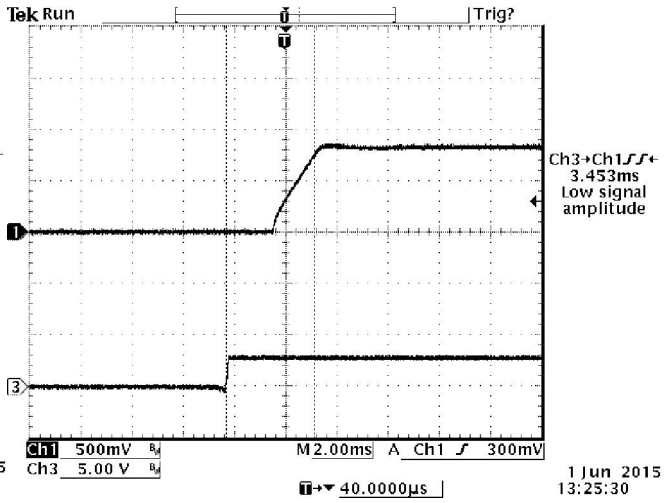
Note: Vin=12V, Vo=0.9V, Io=50A, with 1*0.1uf+1*1uf+6*22uf ceramic and 3*470 uF polymer capacitor at the output, Ta=25 deg C.

Startup&Shutdown

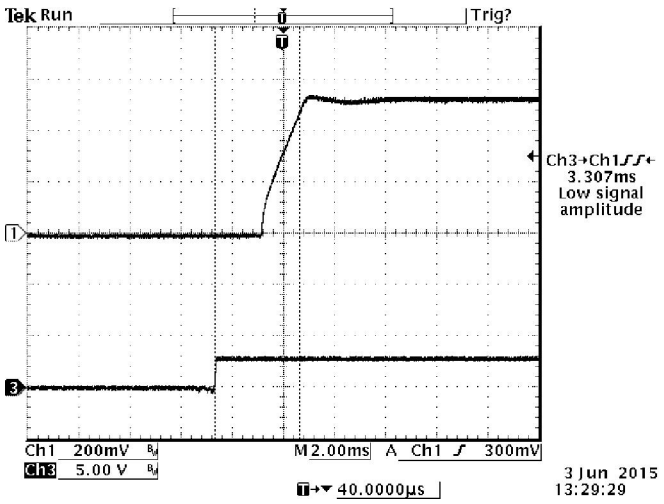
Rise time



Vin=12V,Vo=2V,Io=50A



Vin=12V,Vo=0.9V,Io=50A



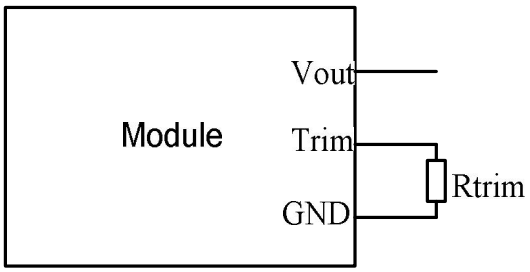
Vin=12V,Vo=0.6V,Io=50A

Note: With 1*0.1uf+1*1uf+6*22uf ceramic and 3*470 uF polymer capacitor at the output, Ta=25 deg C.

Trim

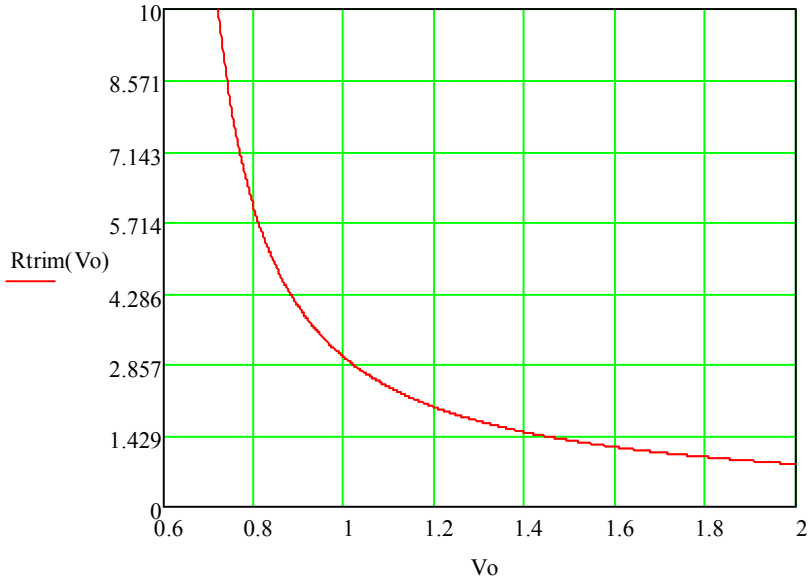
Output Voltage Set-Point Adjustment
Maximum trim up voltage is 2V.
Mimimum trim up voltage is 0.6V.
1.Trim up circuit (using an external resistor)
Equations for calculating the trim resistor are shown below.
The Trim Up resistor should be connected between the Trim pin and GND pin.

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



SRPE-50E1A0 Trim up Resistor Calculate Unit: KΩ

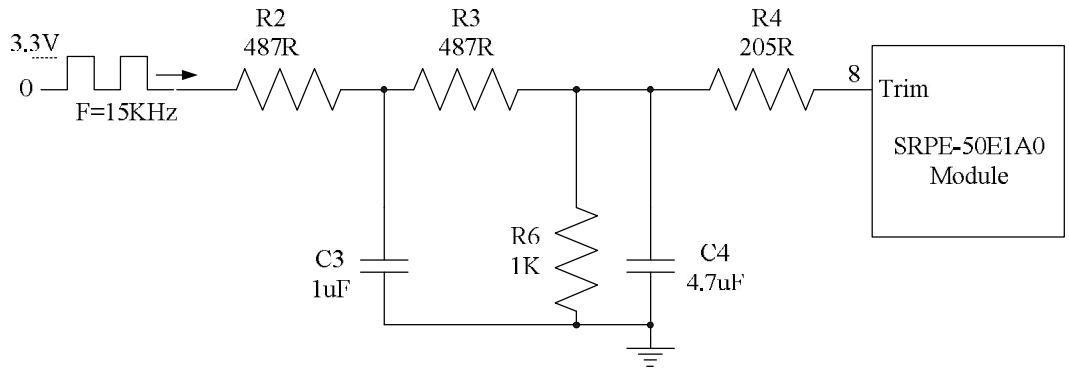
Vo is the desired output voltage
Rtrim is the required resistance between TRIM and GND



Trim(continued)

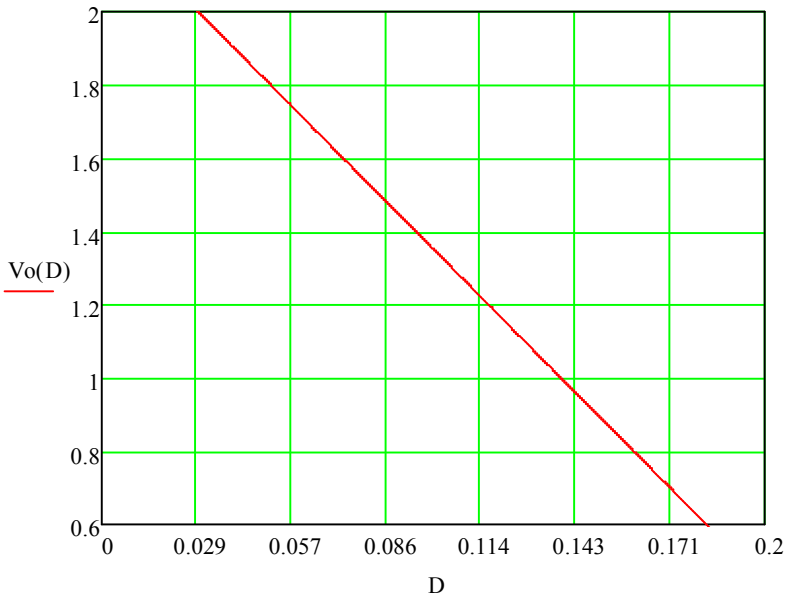
2.Trim up circuit (using external PWM signal)
Equations for calculating the duty cycle are shown below.

$$Vo(D) = 2.265 - 9.13D$$



SRPE-50E1A0 Trim up duty cycle Calculate

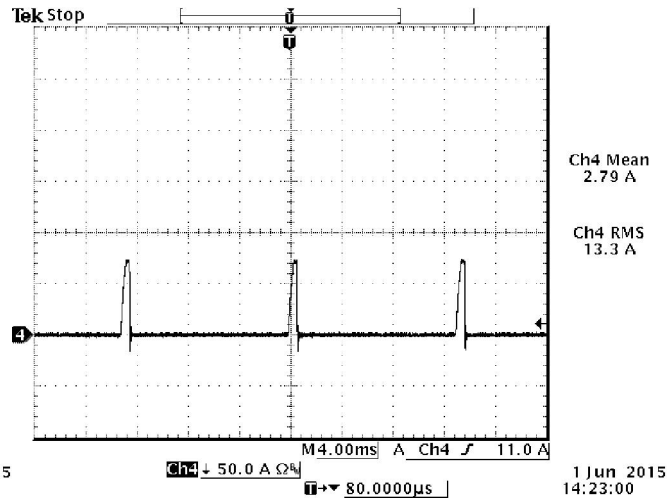
Vo is the desired output voltage
D is the external PWM signal duty cycle.



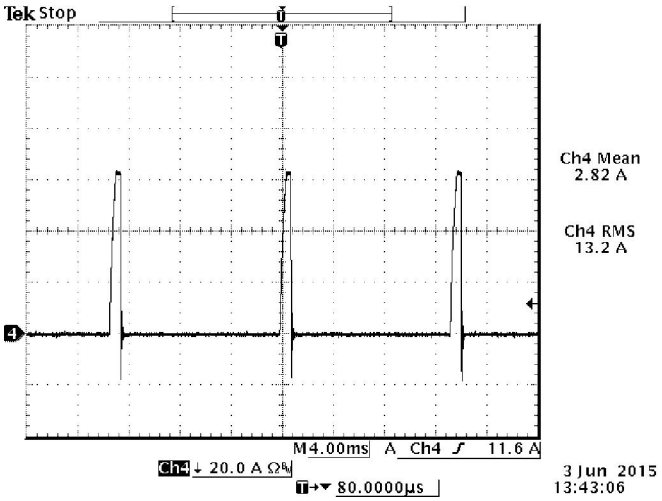
OCP

To provide protection in a fault output overload condition, the module is equipped with internal current-limiting circuitry and can endure current limiting for a few mili-seconds. If the overcurrent condition persists beyond a few milliseconds, the module will shut down into hiccup mode and restart once every 14mS. The module operates normally when the output current goes into specified range. The typical average output current is 3A during hiccup.

Vin=12V, Vo=2V

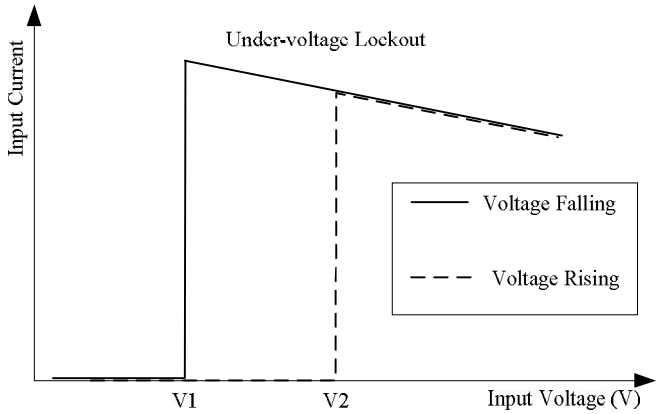


Vin=12V, Vo=0.9V



Vin=12V, Vo=0.6V

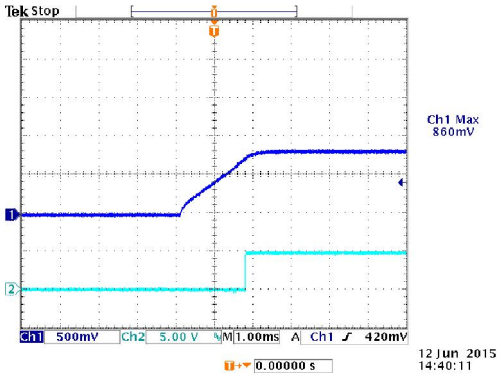
Input under-voltage lockout



V1=6.4V
V2=7.2V

Power Good

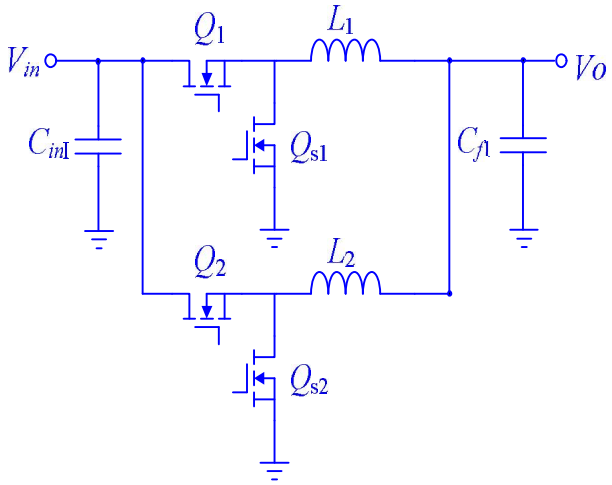
1. This module has a power good indicator output. Power good pin used positive logic and is open collector.
2. Maximum power good pin sinking current is 10mA.
3. The maximum voltage pulled up externally on Power Good pin should not exceed 5V.
4. When the output reaches 90% of the nominal set-point, the power good pin will be pulled high.



Typical Start-up Using Remote ON/OFF(Vin=12.0V, Vo=0.9V, Io=50A)
CH1=Vout CH2: PG

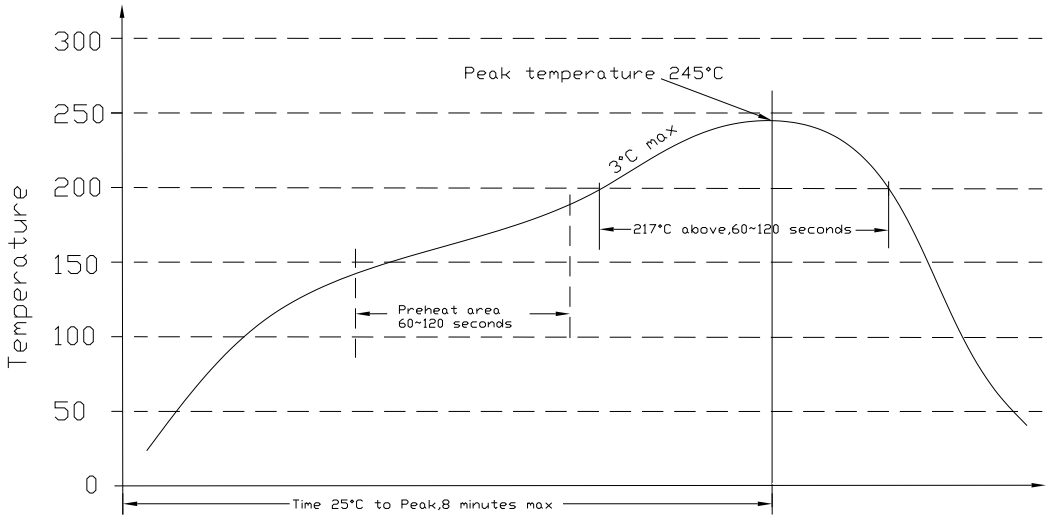
SCH

Fundamental Circuit Diagram



Soldering Information

The SRPE-50E1A0G modules are designed to be compatible with a Paste-In-Hole assembly process. The suggested Pb-free solder paste is Sn/Ag/Cu(SAC). The recommended reflow profile using Sn/Ag/Cu solder is shown in the following. Recommended reflow peak temperature is 245℃ while the part can withstand peak temperature of 260℃ maximum for 10seconds. This profile should be used only as a guideline. Many other factors influence the success of SMT reflow soldering. Since your production environment may differ, please thoroughly review these guidelines with your process engineers.



MSL Rating

The SRPE-50E1A0G modules have a MSL rating of 3.

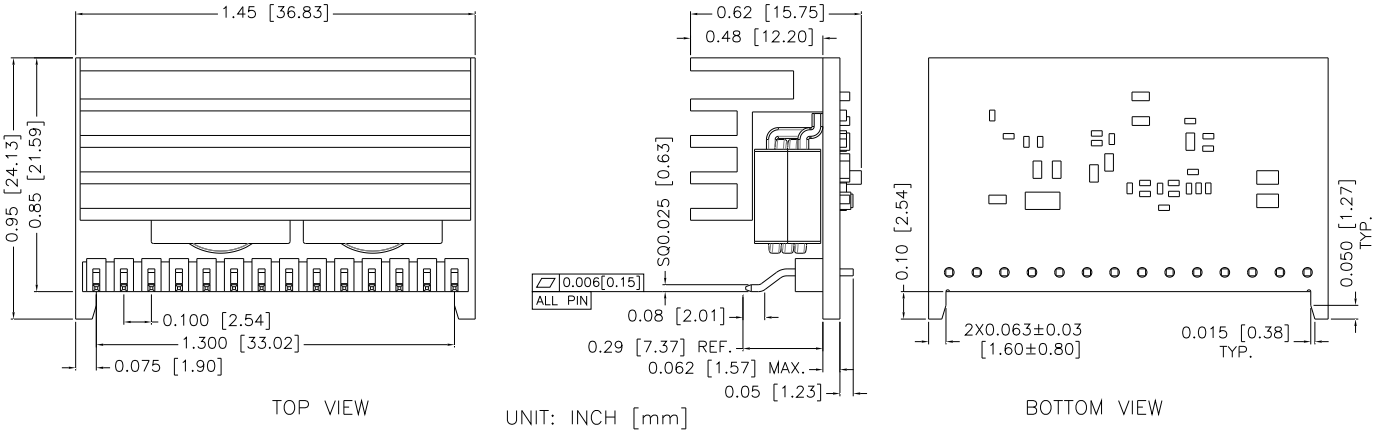
Storage and Handling

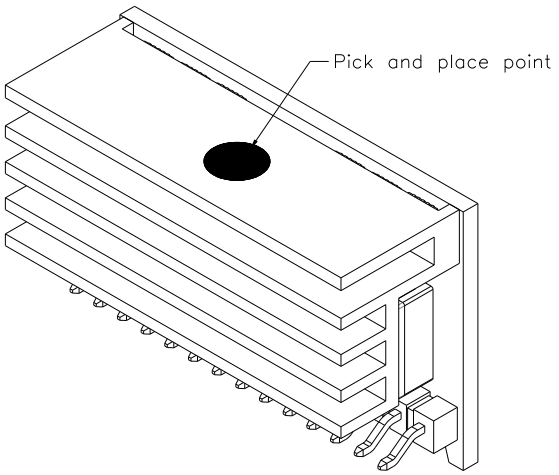
The SRPE-50E1A0G modules are designed to be compatible with J-STD-033 Rev:A (Handling, Packing, Shipping and Use of Moisture /Reflow Sensitive surface Mount devices). Moisture barrier bags (MBB) with desiccant are applied. The recommended storage environment and handling procedure is detailed in J-STD-033.

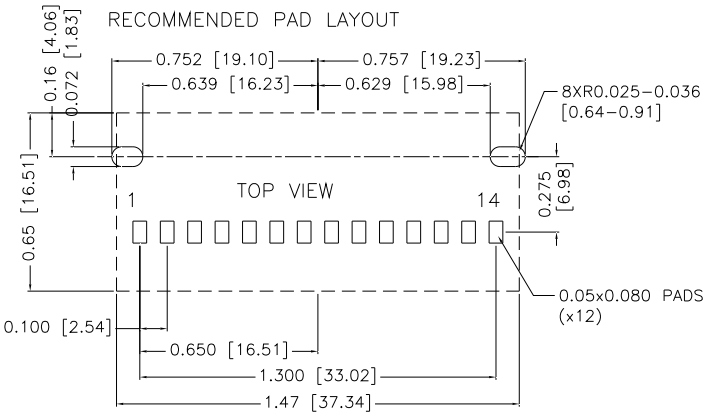
Pre-baking

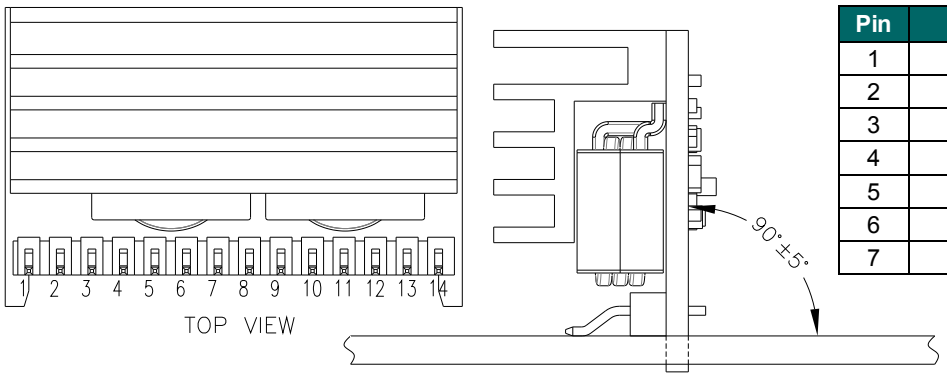
This component has been designed, handled, and packaged ready for pb-free reflow soldering. If the assembly shop follows J-STD-033 guidelines, no pre-bake of this component is required before being reflowed to a PCB. However, if the J-STD-033 guidelines are not followed by the assembler, Bel recommends that the modules should be pre-baked @ 120~125℃ for a minimum of 4 hours (preferably 24 hours) before reflow soldering.

Mechanical Outline









Pin Connections

Pin	Function	Pin	Function
1	Vout	8	Trim
2	Vout	9	PGOOD
3	Vout	10	Vsens+
4	Vout	11	Vsens-
5	GND	12	GND
6	GND	13	Vin
7	Enable	14	Vin

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[0.5mm]. x.xxx +/-0.010 in[0.25mm].

Datasheet Revision History

Date	Revision	Changes Detail	Approval
2014-01-13	PA	First release	Jessica
2014-7-3	PB	Update part number explanation, RoHS compliance，Add MD Note.	Jessica
2014-11-14	PC	Update Cover, Input Specs, Output Specs, General, Efficiency Data, NR, TR, Startup&Shutdown, Trim, OCP.	Jessica
2015-6-24	PD	Update Cover, Input Specs, Output Specs, General, Efficiency Data, Input Noise, TD, NR, TR, Startup&Shutdown, Trim, UVLO, OCP, MD, PG, SCH. • Updated Input Current (full load and no load) specs in Input Specifications (all conditions). • Updated Remote Off Input Current spec in Input Specifications. • Updated Input Reflected Ripple Current (pk-pk and rms) specs and test condition in Input Specifications. • Updated Turn-on and Turn-off Voltage Threshold specs in Input Specifications. • Updated Output Ripple and Noise (pk-pk and rms) specs in Output Specifications. • Updated Turn On Time typical spec in Output Specifications. • Updated Output Capacitance spec in Output Specifications. • Updated Transient Response specs in Output Specifications (all conditions). • Updated Switching Frequency in General Specifications. • Updated Weight and Dimensions specs in General Specifications. • Updated efficiency curves for Vo=0.6V, 0.9V, 2V in Efficiency Data. • Added derating graph for Vo = 0.9V in Thermal Derating Curves. • Updated ripple waveform for Vo=0.9V and added waveforms for Vo=0.6V, 2V in Ripple and Noise Waveforms. • Updated transient waveforms for Vo=0.9V and added waveforms for Vo=0.6V, 2V in Transient Response Waveforms. • Added Input Noise section to include Input Reflected Ripple Current waveforms and test setup. • Updated start-up waveform for Vo=0.9V and added waveforms for Vo=0.6V, 2V in Startup & Shutdown.	Jessica

Datasheet Revision History(continued)

Date	Revision	Changes Detail	Approval
2015-6-24	PD	• Updated resistor and PWM trim equations and graphs in Trim. • Updated OCP waveform for Vo=0.9V and added waveforms for Vo=0.6V, 2V in OCP. • Updated UVLO voltages in Input Under-Voltage Lockout. • Updated power good description and waveform in Power Good. • Updated mechanical drawing, including the dimensions: module height from customer board (0.85"), overall module height (0.95"), and length from PCB edge to heatsink edge (0.48”) in Mechanical Outline. • Added pin dimensions for coplanarity (0.006”) and length of pin that sits on the customer board (0.08”) in Mechanical Outline. • Updated recommended pad layout dimension for center of PCB standoff hole to back of keep out area (0.16”) in Mechanical Outline.	Jessica
2015-9-11	PE	Update thermal derating curves and output DC current limit.	Jessica
2016-01-22	PF	Update MTBF, FIT.	Jessica
2016-02-16	PG	Add 90+/-5 degree drawing and add 0.02" for the pin header out off the PCB	Jessica
2016-05-12	H	Add Hot spot location.	Jessica

RoHS Compliance

Complies with the European Directive 2011/65/EU, calling for the elimination of lead and other hazardous substances from electronic products.

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