VRP3-90E2AC

Non-Isolated DC-DC Converter

The VRP3-90E2AC is a non-isolated step-down DC-DC converter providing up to 90 A output current. Standard features include remote on/off, remote sense, a power good signal, over voltage and under voltage protection, over current protection. This product may be used almost anywhere low-voltage silicon is being employed and a nominal 12 VDC source is available. Typical applications include telecommunications, networking and other computing applications.

Key Features & Benefits

- Non-Isolated
- High Efficiency
- Fixed Frequency
- Wide Input (9 - 13.8 V)
- Open-Drain Power Good Output
- Over Voltage and Under Voltage Protection
- Over Current and Short Circuit Protection
- Two-Wire Remote Sense
- Remote On/Off
- Class II, Category 2, Isolated DC-DC Converter (refer to IPC-9592B)

RoHS Compliant

Applications

- Networking
- Computers and Peripherals
- Telecommunications

1. MODEL SELECTION

MODEL NUMBER	OUTPUT VOLTAGE	INPUT VOLTAGE	MAX. OUTPUT CURRENT	MAX. OUTPUT POWER	TYPICAL EFFICIENCY
VRP3-90E2ACG	0.6 - 1.8 VDC	9 - 13.8 VDC	90 A	162 W	86%

PART NUMBER EXPLANATION

V	R	P3	-	90	E	2A	C	G
Mounting Type	RoHS Status	Series Name		Output Current	Input Range	Output Voltage	Customer Option	Package Type
Vertical Mount	RoHS	SIP		90 A	9 - 13.8 V	0.6 - 1.8 V	C	Tray Package

2. ABSOLUTE MAXIMUM RATINGS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNITS
Continuous non-operating Input Voltage		-0.3	-	15	V
Remote On/Off		-0.3	-	5	V
Ambient Temperature		-40	-	85	°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
Operating Input Voltage		9	12	13.8	V
Input Current (full load)		-	-	25	A
Input Current (no load)	Vin = 12 V, Vo = 1.5 V	-	330	500	mA
Remote Off Input Current	The module is disabled	-	70	100	mA
Input Reflected Ripple Current (rms)	With simulated source impedance of 220 nH, 5 Hz to 20 MHz. Use 3 * 22 µF polymer capacitor and 3 * 4.7 µF ceramic capacitor.	-	20	40	mA
Input Reflected Ripple Current (pk-pk)		-	75	100	mA
I^2t Inrush Current Transient		-	-	1	A^2s
Input Capacitance (Internal)	Internal to the module	-	120	-	µF
Turn-on Voltage Threshold		8.3	8.5	8.7	V
Turn-off Voltage Threshold		7.4	7.6	7.8	V

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

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 Range			0.6	-	1.8	V
Set Point Regulation		The tolerance of the set point resistor is 0.1%	-1.2	-	1.2	%
Load Regulation			-	±0.3	-	%
Line Regulation			-	±0.2	-	%
Regulation Over Temperature (-40°C to 85°C)			-	0.3	-	%
Output Current Range			0	-	90	A
Output DC Current Limit		Before hiccup	90	-	130	A
Output Ripple and Noise (pk-pk)		0-20 MHz BW, with 4 * 22 µF ceramic capacitors and 2 * 470 µF polymer caps at output. Vo = 1.0 V.	-	-	20	mV
Output Ripple and Noise (rms)			-	-	3	mV
Turn on Delay Time			1.5	3.5	5	ms
Rise Time			1	2	3	ms
Power Good		The delay time is that soft start has completed and the output voltage is within the regulated range.	-	100	-	us
Overshoot at Turn on			-	-	1	%
Output Capacitance		2 x 470 µF/2.5 V polymer, 4 x 22 µF/4 V ceramic	-	1028	-	µF
Transient Response						
△V 50%~100% of Max Load	Overshoot	di/dt = 1 A/µs, Vin = 12 VDC, Vo = 1.0 V Ta=25°C, with 4 * 22 µF ceramic capacitors and 2 * 470 µF polymer caps at output.	-	50	100	mV
	Settling Time		-	50	100	µs
△V 100%~50% of Max Load	Overshoot		-	50	100	mV
	Settling Time		-	50	100	µs

5. GENERAL SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Efficiency	Vin = 12 V, Vout = 1.0 V, Iout = 90 A	84	86	-	%
Switching Frequency	Total frequency of ripple is 1.2 MHZ (±10%.)	360	400	440	kHz
Over Temperature Protection		100	-	120	°C
Over Voltage Protection		105	-	115	% Vo
Remote Sense	Sense- with a 100R resistor and sense+ resistor is NIL inside the module	-	10	-	% Vo
FIT	Calculated Per Telcordia SR-332, Issue 2 (Vin = 12 V, Vo = 1.8 V, Io = 72 A, Ta = 25°C, no forced air, FIT = 10^9/MTBF)	-	90.6	-	-
Weight		-	45.9	-	g
Dimensions (L × W × H)		2.05 x 0.80 x 1.10			inch
		52.07 x 20.32 x 27.94			mm

6. EFFICIENCY DATA

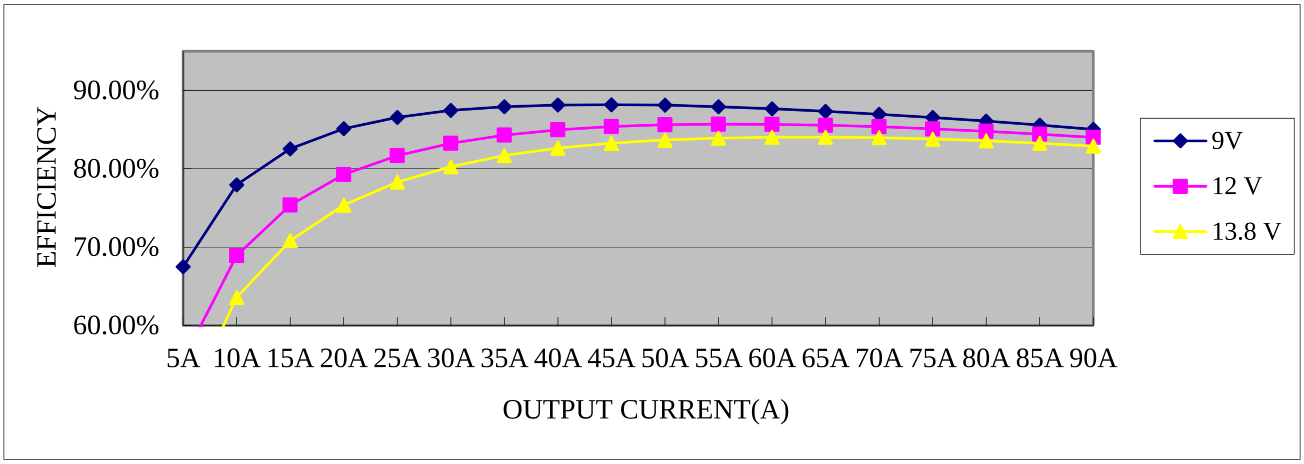

Figure 1. Efficiency data at Vo = 0.9 V

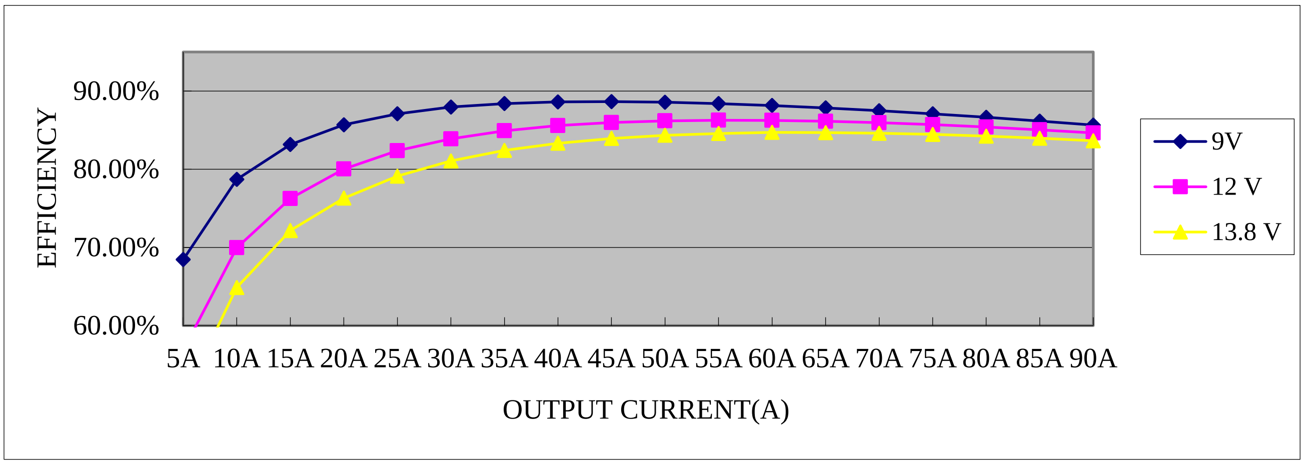

Figure 2. Efficiency data at Vo = 0.95 V

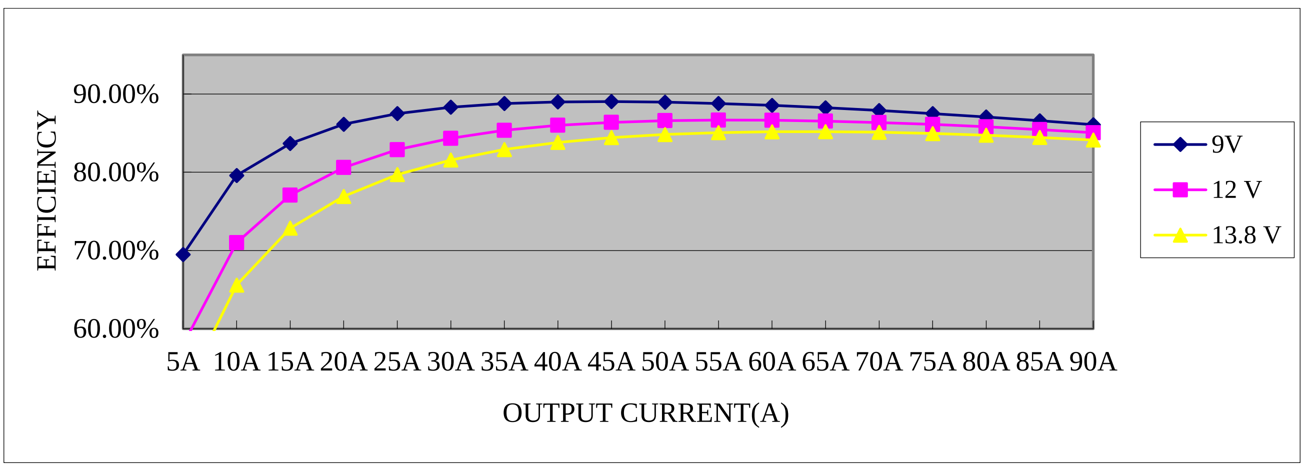

Figure 3. Efficiency data at Vo = 1.0 V

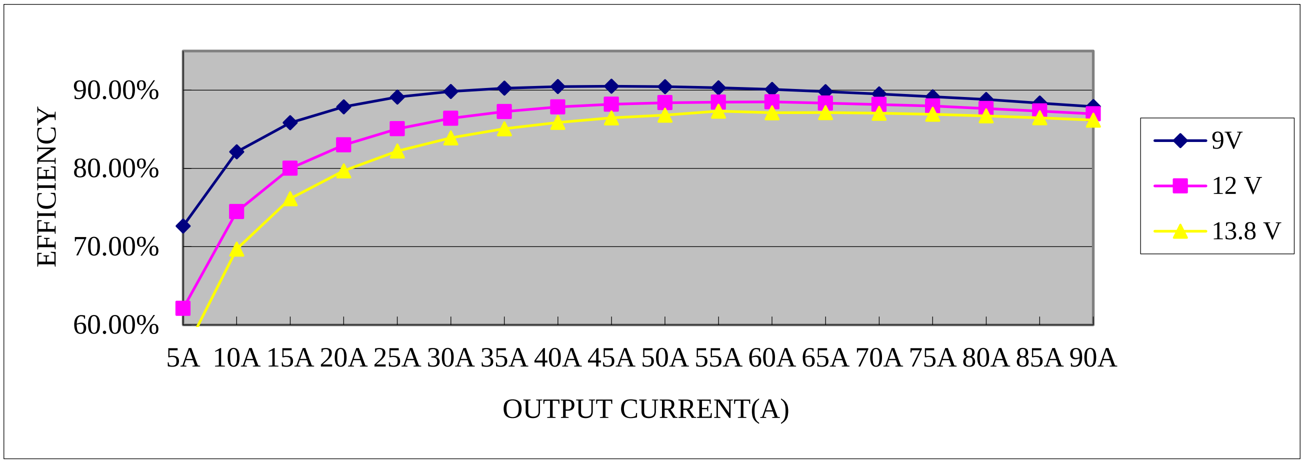

Figure 4. Efficiency data at Vo = 1.2 V

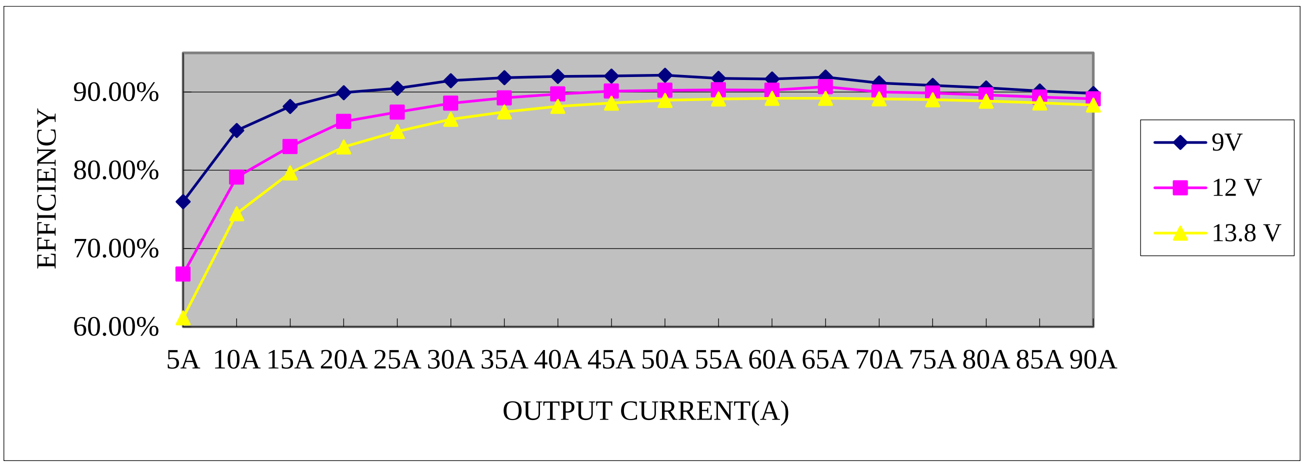

Figure 5. Efficiency data at Vo = 1.5 V

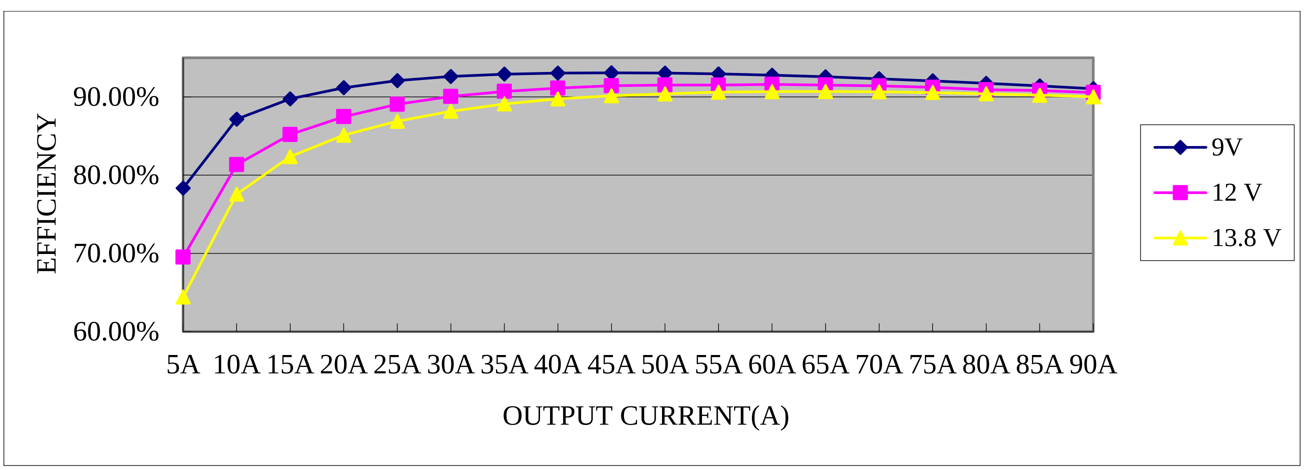

Figure 6. Efficiency data at Vo = 1.8 V

7. REMOTE ON/OFF

PARAMETER		DESCRIPTION	MIN	TYP	MAX	UNIT
Signal Low (Unit Off)	Active High	Remote on/off pin is open, Unit off.	-0.3	-	0.8	V
Signal High (Unit On)			2.4	-	5	V
Current Sink			0	-	1	mA

8. REMOTE SENSE

This module has remote sense compensation feature. It can minimize the effects of resistance between output and load in system layout and facilitate accurate voltage regulation at load terminals or other selected point.

1. The remote sense lines carry very little current and hence do not require a large cross-sectional area.

2. This module compensates for a maximum drop of 10% of the nominal output voltage.

3. If the unit is already trimmed up, the available remote sense compensation range should be correspondingly reduced. The total voltage increased by trim and remote sense should not exceed 10% of the nominal output voltage.

4. When using remote sense compensation, all the resistance, parasitic inductance and capacitance of the system are incorporated within the feedback loop of this module. It can make an effect on the module's compensation, affecting the stability and dynamic response. A 0.1 μF ceramic capacitor can be connected at the point of load to de-couple noise on the sense wires.

5. Recommend the connection of remote sense compensation as below figure. There are a resistor RS+ (NIL) from Vo+ to Sense+ and a resistor RS- (100 ohm)) from Vo- to Sense- inside of this module.

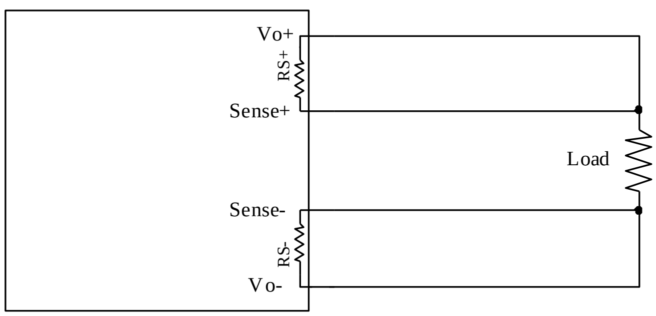

Figure 7.

6. If not using remote sense compensation, please connect sense directly to output at module's pin, that is, connect sense+ to Vo+ and sense- to Vo- at module's pin, the shorter the better. See below figure.

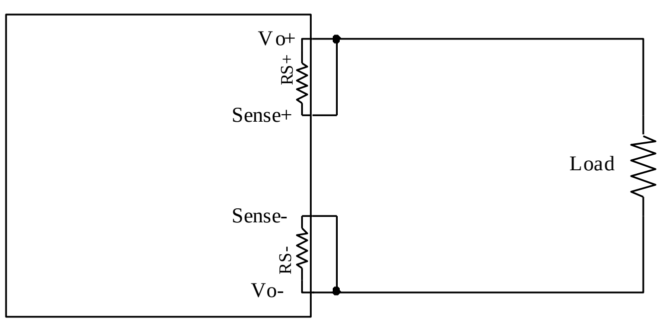

Figure 8.

9. OUTPUT TRIM EQUATIONS

Equations for calculating the trim resistor are shown below. The Trim Up resistor should be connected between the Trim pin and the Vsense-.

Maximum trim up voltage is 1.8 V.

The total voltage increased by trim and remote sense should not exceed 10% of the nominal output voltage.

Trim up test circuit:

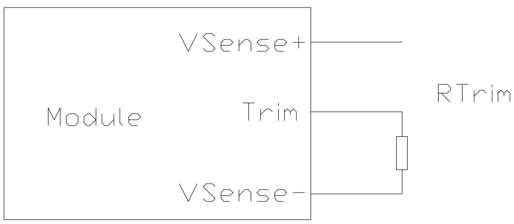

Figure 9. Trim up test circuit

$$R_{trim-up} = \frac{0.6}{Vo - 0.6006} (k\Omega)$$

10. INPUT UNDER-VOLTAGE LOCKOUT

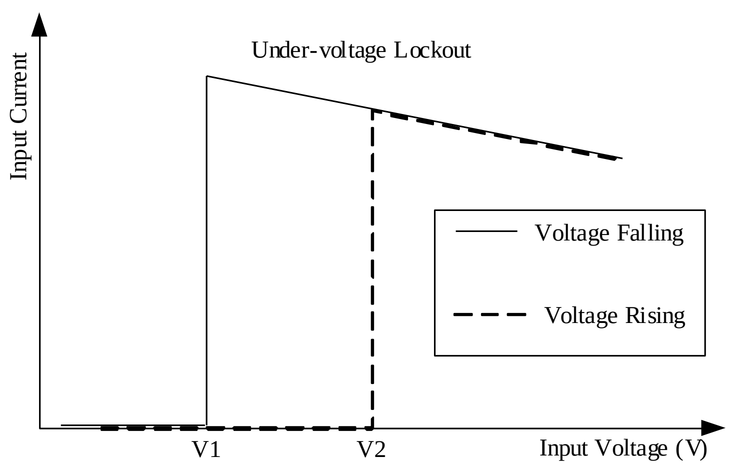

Figure 10. Input under-voltage lockout
V1 = 7.6 V
V2 = 8.5 V

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11. THERMAL DERATING CURVE

Maximum junction temperature of semiconductors derated to 120°C.
Below locations of the thermocouples for thermal testing.
Derating curve under normal input.

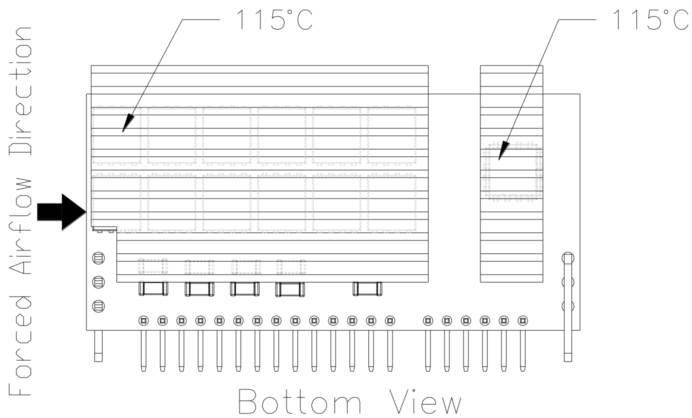

Figure 11. Airflow direction

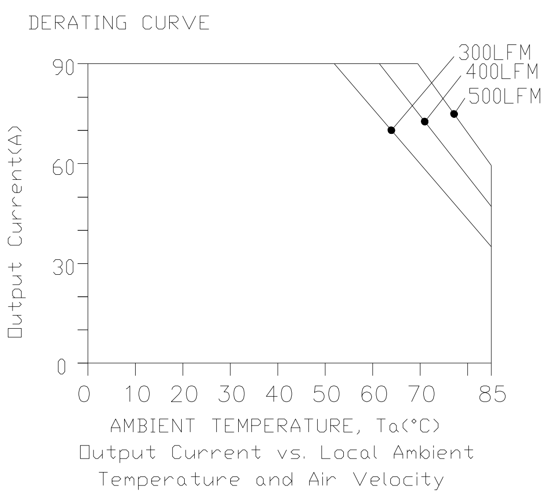

Figure 12. Vin = 12 V, Vo = 1.0 V

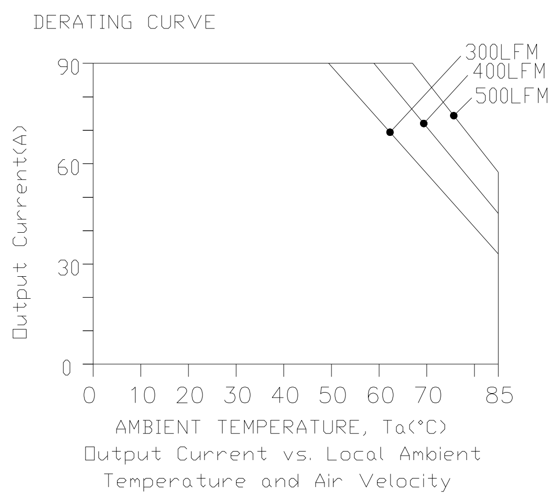

Figure 13. Vin = 12 V, Vo = 1.5 V

12. RIPPLE AND NOISE

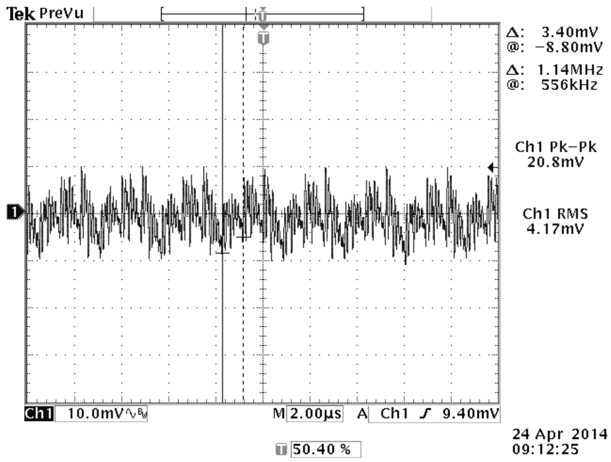

Figure 14.

Note: Ripple and noise at 12 VDC input, Vout = 1.0 V, Iout = 90 A and Ta = 25°C, with 4 * 22 µF ceramic capacitors and 2 * 470 µF polymer caps at output.

13. TRANSIENT RESPONSE WAVEFORMS

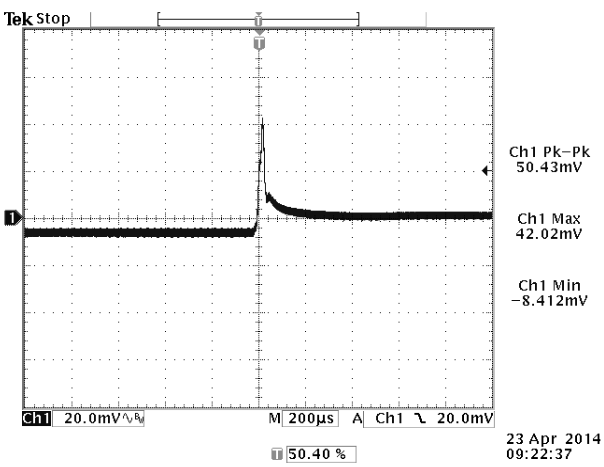

Figure 15.

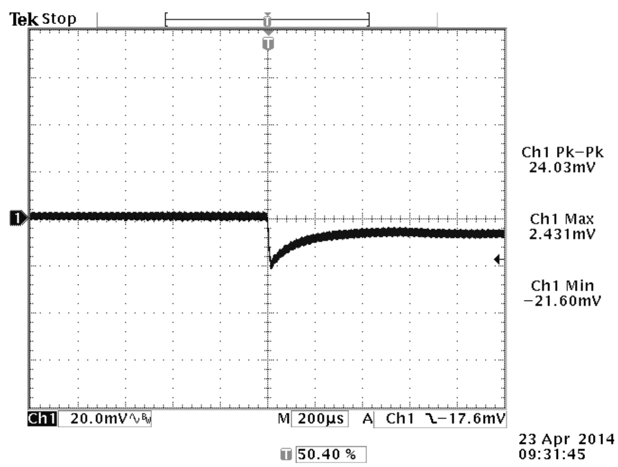

Figure 16.

Note: Vout = 1.0 V, Vin = 12 V@ Ta = 25°C, Io = 45 A→90 A→45 A, 1 A/us, with 4 * 22 µF ceramic capacitors and 2 * 470 µF polymer caps at output.

14. STARTUP & SHUTDOWN

Rise Time

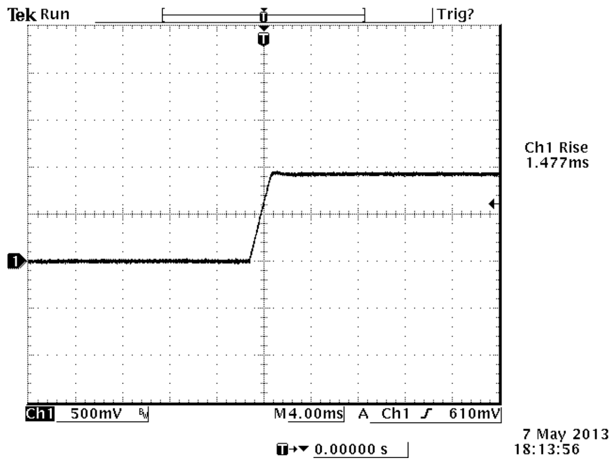

Figure 17.

Test Condition: 12 VDC input, Vout = 1.0 V, Iout = 90 A and Ta = 25°C, with 4 * 22 μF ceramic capacitors and 2 * 470 μF polymer caps at output.

Startup Time

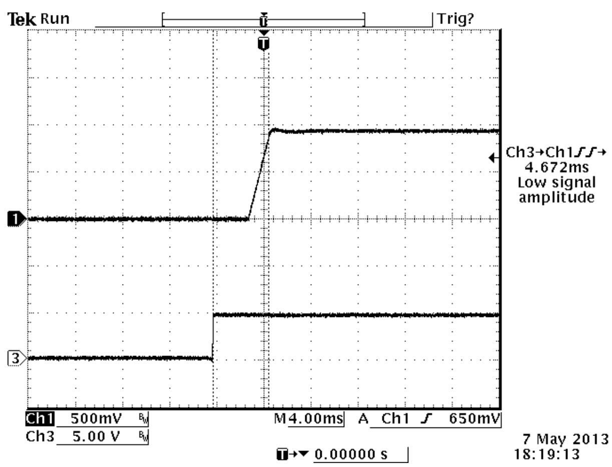

Figure 18. Startup from on/off
Ch1: Vo Ch3: on/off

Test Condition: 12 VDC input, Vout = 1.0 V, Iout = 90 A and Ta = 25°C, with 4 * 22 μF ceramic capacitors and 2 * 470 μF polymer and 5000 μF AL-cap.

Shutdown

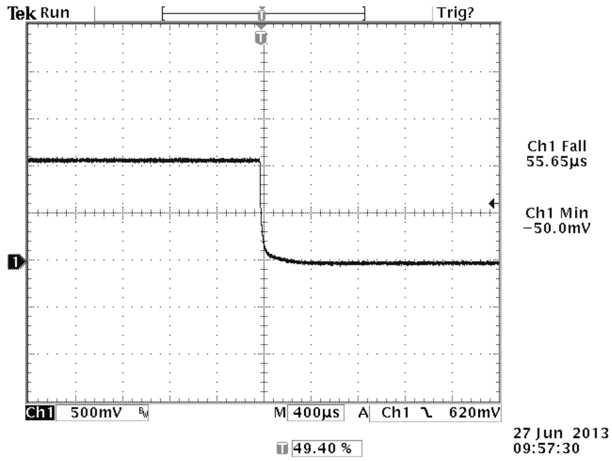

Figure 19.

Test Condition: 12 VDC input, Vout = 1.0 V, Iout = 90 A and Ta = 25°C, with 4 * 22 µF ceramic capacitors and 2 * 470 µF polymer caps at output

15. OVER CURRENT PROTECTION

To provide protection in a fault output overload condition, the module is equipped with internal current-limiting circuitry which can endure current limiting for a few milli-seconds. If the over current condition persists beyond a few milliseconds, the module will shut down into hiccup mode and restart once every 12 ms. The module operates normally when the output current goes into specified range. The typical average output current is 1.4 A during hiccup.

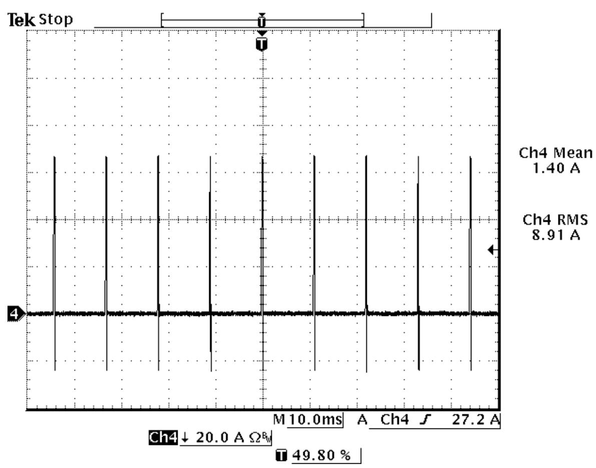

Figure 20.

Test Condition: 12 VDC input, Vout = 1.0 V, and Ta = 25°C, with 4 * 22 µF ceramic capacitors and 2 * 470 µF polymer caps at output.

16. OVER VOLTAGE PROTECTION

The output over-voltage protection consists of circuitry that monitors the voltage on the output terminals. If the voltage on the output terminals exceeds the over voltage protection threshold, the module will shut down into latch off mode. The over-voltage latch can be reset by either cycling the input power or toggling the on/off signal for one second at least.

17. POWER GOOD

1. This module has a power good indicator output. Power good pin used positive logic and is open collector.
2. Power good pin can sink 10 mA.
3. The maximum voltage pulled up externally on Power Good pin should not exceed 5.5 V.
4. When a successful soft start is completed, the power good pin will be pulled high.

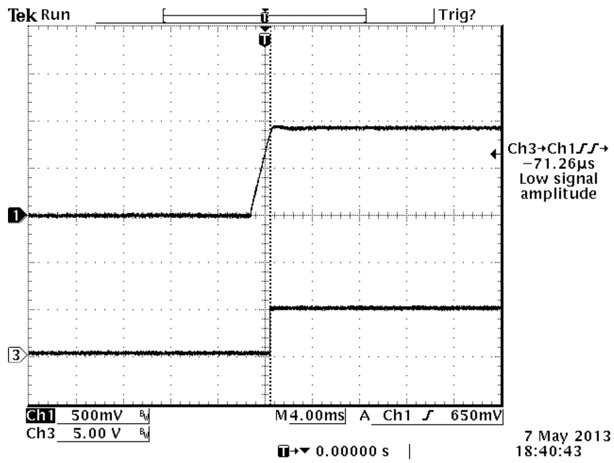

Figure 21. CH1: Remote ON/OFF CH3: PG
Typical Start-up Using Remote ON/OFF (Vin = 12.0 V, Vout = 1.0 V, Io = 90 A)

18. MECHANICAL DIMENSIONS

OUTLINE

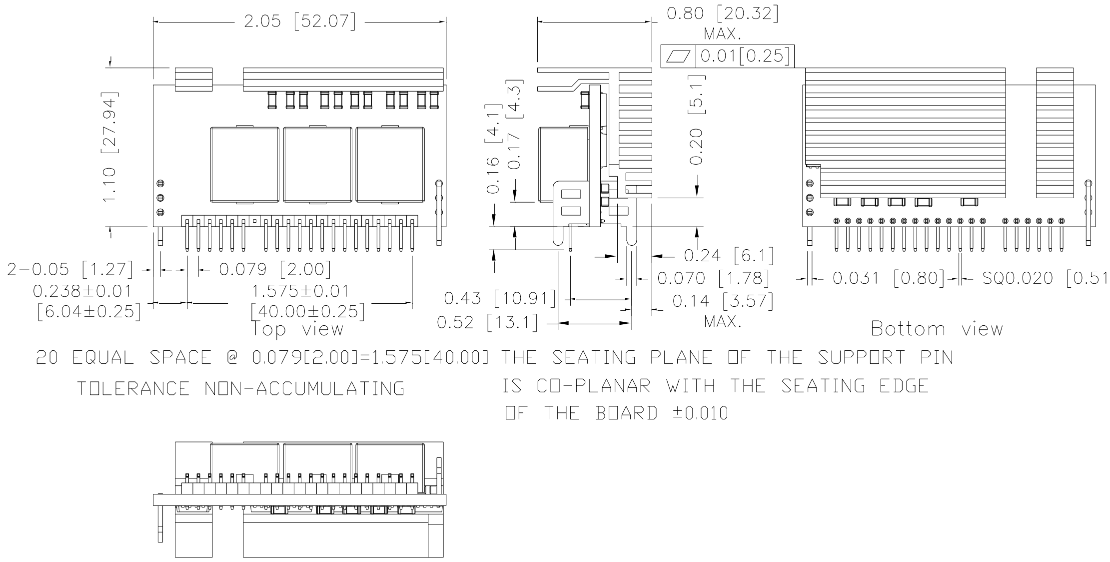

Figure 22. Outline

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 ºC 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 +/-0.01 inch [0.25 mm], x.xxx +/-0.005 inch [0.13 mm].

PIN DEFINITIONS

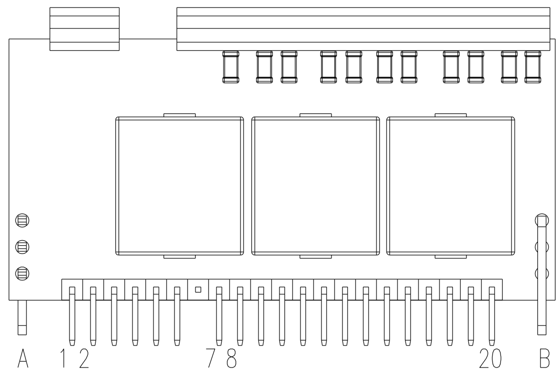

Figure 23. Pins

PIN	FUNCTION	PIN	FUNCTION
1	N/C	11	Vout
2	Enable	12	Vout
3	Vsense+	13	GND
4	Vsense-	14	GND
5	Trim	15	Vout
6	PGOOD	16	Vout
7	Vin	17	GND
8	Vin	18	GND
9	GND	19	Vout
10	GND	20	Vout
A	GND	B	GND

RECOMMENDED PAD LAYOUT

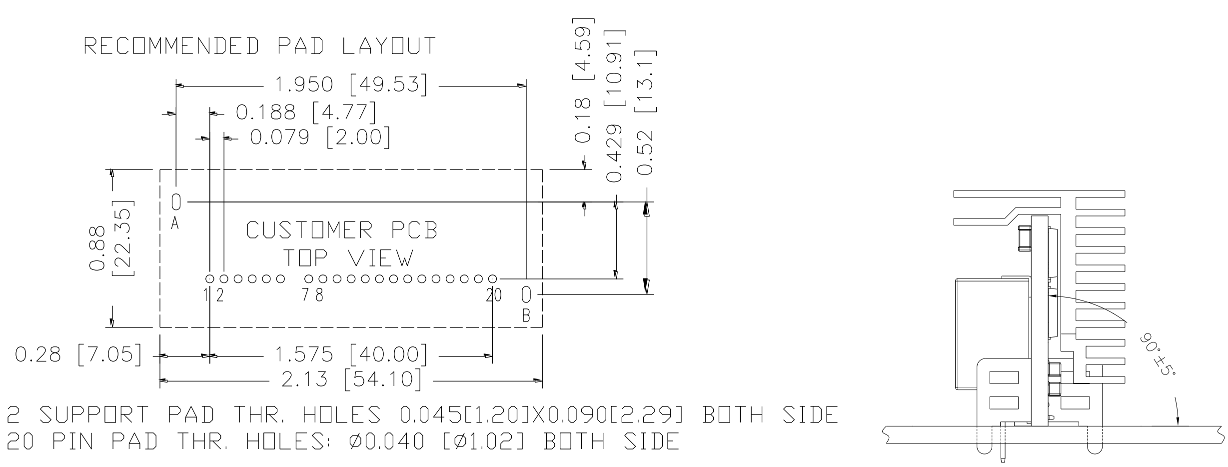

Figure 24. Recommended pad layout

19. REVISION HISTORY

DATE	REVISION	CHANGES DETAIL	APPROVAL
2014-04-23	A	First release.	XF.Jiang
2014-05-06	B	Update General Specifications, Output Specifications, SD.	XF.Jiang
2014-07-31	C	Update TD.	XF.Jiang
2014-09-04	D	Update TD.	XF.Jiang
2014-10-27	E	Update Efficiency Data.	XF.Jiang
2014-11-27	F	Update Output Specifications.	XF.Jiang
2015-03-18	G	Update Output Specifications.	XF.Jiang
2016-01-20	H	Add Assembly Note. Update mechanical drawing.	XF.Jiang
2021-08-04	I	Add object ID. Update to new form.	XF.Jiang

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

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