THE DATASHEET OF

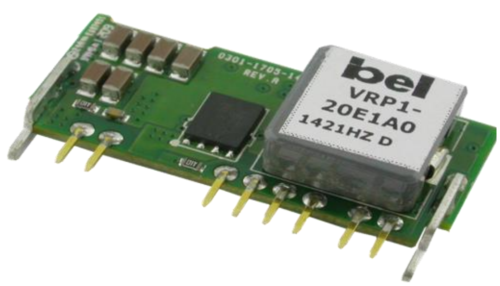
VRP1-20E1A0G

VRP1-20E1A0

Non-Isolated DC-DC Converter

The VRP1-20E1A0 is a non-isolated DC-DC converter that operates over a wide range of input voltage (Vin = 4.5 - 13.8 VDC). This unit can provide a precisely regulated output voltage from 0.591 VDC to 5.1 VDC and can deliver up to 20 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

- 4.5 - 13.8 VDC Input
- 0.591 - 5.1 VDC @ 20 A Output
- Non-Isolated
- High Efficiency
- High Power Density
- Fixed Switching Frequency
- Low Cost
- Excellent Thermal Performance
- Wide Input Voltage Range
- Wide Output Trim Range
- Output Over-Voltage Shutdown
- Power Good Signal
- Remote On/Off
- OCP/SCP
- 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
VRP1-20E1A0G	0.591 - 5.1 VDC	4.5 - 13.8 VDC	20 A	100 W	94%

PART NUMBER EXPLANATION

V	R	P1	-	20	E	1A	0	G
Mounting Type	RoHS Status	Series Name		Output Current	Input Range	Output Voltage	Active Logic	Package Type
Vertical Mount	RoHS	SIP		20 A	4.5 - 13.8 V	0.591 - 5.1 V	Active High	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	-	5.5	V
Ambient temperature		0	-	85	°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.

3. INPUT SPECIFICATIONS

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

PARAMETER		DESCRIPTION	MIN	TYP	MAX	UNIT
Operating Input Voltage	Vo < 3.45 V		4.5	12	13.8	V
	Vo ≥ 3.45 V		1.3*Vo	12	13.8	V
Input Current (full load)		An input line fuse must always be used.	-	-	20	A
Input Current (no load)			-	150	300	mA
Remote Off Input Current			-	50	-	mA
Input Reflected Ripple Current (pk-pk)		Use a 1000 μF AL-Cap on the input.	-	50	100	mA
Input Reflected Ripple Current (rms)			-	20	40	mA
I^2t Inrush Current Transient			-	-	1	A^2s
Turn-on Voltage Threshold			-	4.2	-	V
Turn-off Voltage Threshold		A 30.1 k resistor is connected from Enable to Vin	-	3.9	-	V

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

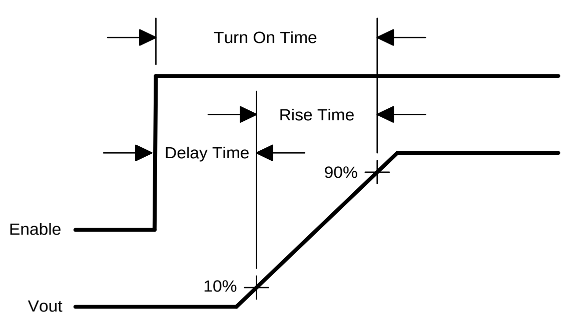
4. OUTPUT SPECIFICATIONS

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 Accuracy	Setpoint test condition: Vin = 12 V, Iout = half load.	-1.5	-	1.5	% Vo.set
Load Regulation		-	-	1	% Vo.set
Line Regulation		-	-	0.5	% Vo.set
Regulation Over Temperature (0°C to 85°C)		-	-	1	% Vo.set
Output Current Range		0	-	20	A
Output DC Current Limit		-	150	-	% Iout
Output Ripple and Noise (pk-pk)	Test condition: 0-20MHz BW, with a 1 µF ceramic capacitor and a 10 µF Tantalum cap at output.	-	40	80	mV
Output Ripple and Noise (rms)		-	20	40	mV
Output Short-Circuit Current		-	1	3	A^2s
Turn On Time[2]	Vout = 5.0V; time from enable going high to 90% of Vout	1	-	3	ms
	Vout = 3.3V; time from enable going high to 90% of Vout	1	-	3	ms
	Vout = 1.8V; time from enable going high to 90% of Vout	1	-	3	ms
	Vout = 0.9V; time from enable going high to 90% of Vout	1	-	3	ms
Rise Time[2]	Vout = 5.0V; time from 10% to 90% of Vout	-	1.08	1.58	ms
	Vout = 3.3V; time from 10% to 90% of Vout	-	0.99	1.49	ms
	Vout = 1.8V; time from 10% to 90% of Vout	-	093	1.43	ms
	Vout = 0.9V; time from 10% to 90% of Vout	-	0.90	1.40	ms
Overshoot at Turn on and off		-	-	5	%
Output Capacitance		0	-	1000	µF
Transient Response					
50% ~ 75% Max Load	Vo = All; Test condition：di/dt = 2.5 A/µs; Vin =12 V; with 10 µF tantalum cap and 1 µF ceramic at the output, Ta=25 °C	-	200	300	mV
Settling Time		-	-	50	µs
75% ~ 50% Max Load		-	200	300	mV
Settling Time		-	-	50	µs

NOTE: 1. All specifications are typical at normal input, full load at Ta=25°C unless otherwise stated.

2. The turn on time is guaranteed to be in between the minimum and maximum limits specified over entire operating temperatures. Output capacitance used was 4 x 470 µF polymer and 4 x 47 µF ceramic. The turn on waveform with parameter measurement locations is shown below.



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5. GENERAL SPECIFICATIONS

PARAMETER		DESCRIPTION	MIN	TYP	MAX	UNIT
Efficiency	Vo = 5.0 V	The efficiency is measured at Vin = 12 V, full load.	-	94	-	%
	Vo = 3.3 V		-	92	-	%
	Vo = 2.5 V		-	90	-	%
	Vo = 1.5 V		-	85	-	%
	Vo = 0.591 V		-	70	-	%
Switching Frequency			-	500	-	kHz
Output Voltage Trim Range			0.591	-	5.1	V
Remote Sense Compensation		Vin=12 V, full load.	-	-	0.2	V
MTBF		Calculated Per Bell Core SR-332 (Io = 80% Iomax; Vin = 12 V; Ta = 25 °C)	-	19310000	-	hrs
Weight			-	9.7	-	g
Dimensions (L × W × H)			1.45 x 0.40 x 0.61			inch
			36.83 x 10.16 x 15.49			mm

6. CONTROL SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Remote On/Off (Active High)					
Turn On Voltage Threshold	Unit is on when voltage on enable pin is driven above the turn on threshold. When enable pin is floating, unit is off.	0.492	0.510	0.526	V
Maximum Enable Voltage	Maximum voltage that should be applied to the enable pin.	-	-	5.5	V
Hysteresis Source Current	A 10 uA current source to GND (IEN_HYS) is active when unit is off and inactive when unit is on (see figure below).	7.5	10	11.5	μA
PwGood (PowerGood)[1]					
PwGood = High = Power Good		2.4	-	6	V
		-	-	2	mA
PwGood = Low = Power Not Good		0	-	0.35	V
		-	-	5	mA

Note 1: PwGood is an open drain output signal. An external pull up is required. Pull up voltage should not exceed 6 V.

7. EFFICIENCY DATA

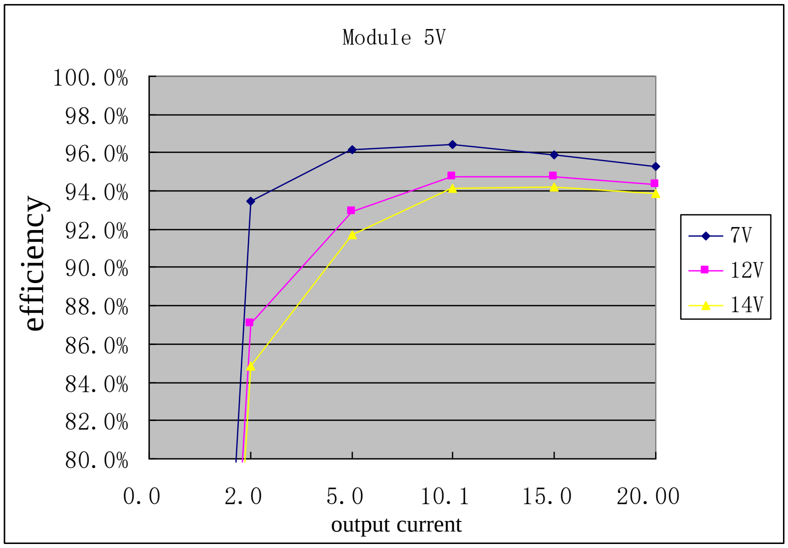

Figure 1. Efficiency data at Vo = 5 V

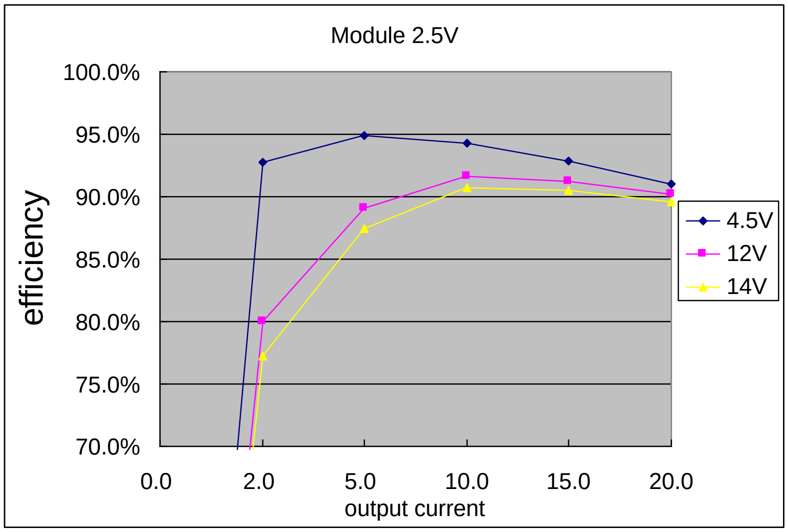

Figure 2. Efficiency data at Vo = 2.5 V

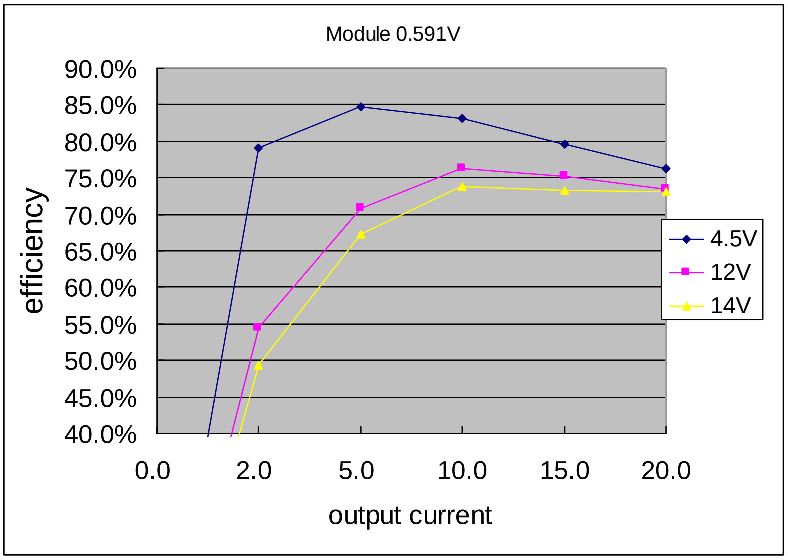

Figure 3. Efficiency data at Vo = 0.591 V

8. OUTPUT TRIM EQUATION

The Rtrim resistor should be connected between the Trim pin and GND pin.

$$R\ trim = \left[\frac{1.182}{Vo - 0.591} \right]$$

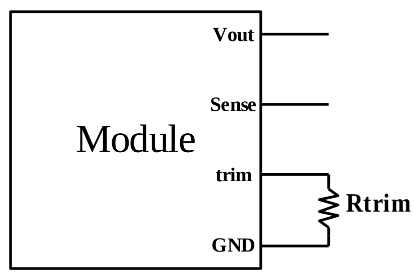

Figure 4. Trim circuit

9. THERMAL DERATING CURVE

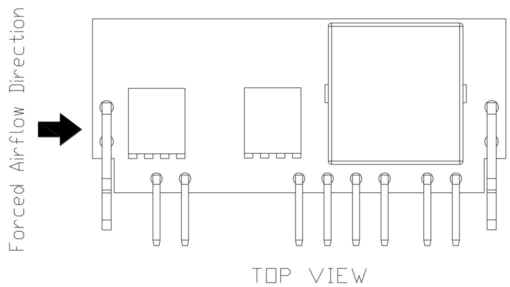

Figure 5. Airflow direction

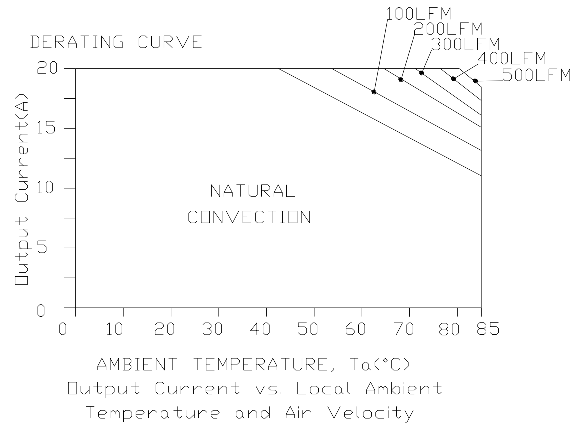

Figure 6. Vout = 0.591 V

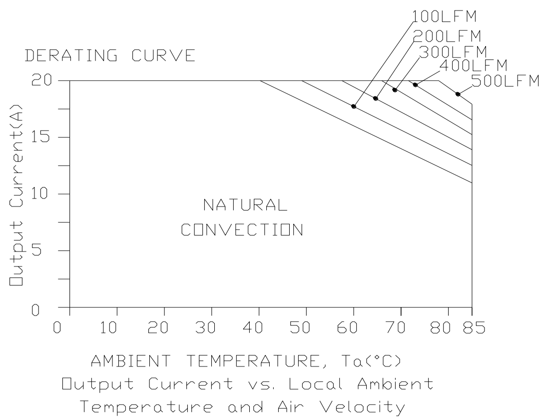

Figure 7. Vout = 1.2 V

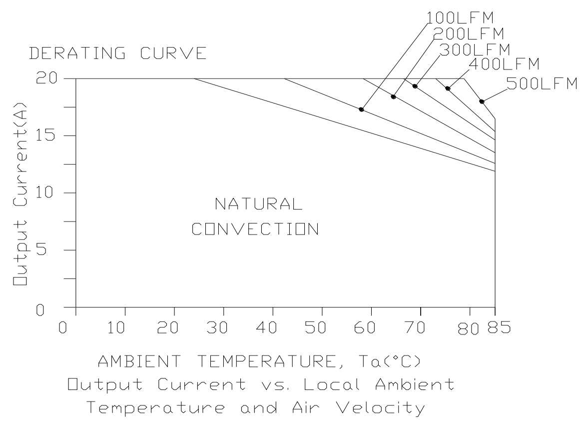

Figure 8. Vout = 2.5 V

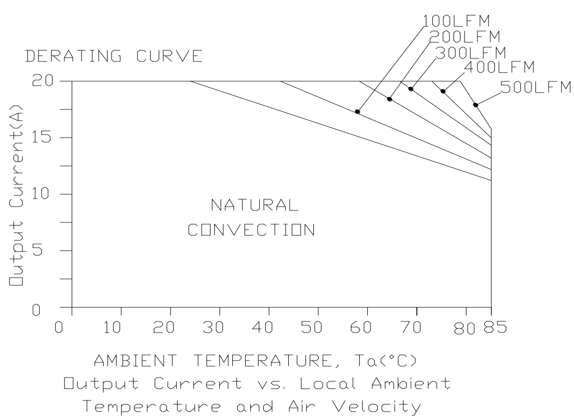

Figure 9. Vout = 3.3 V

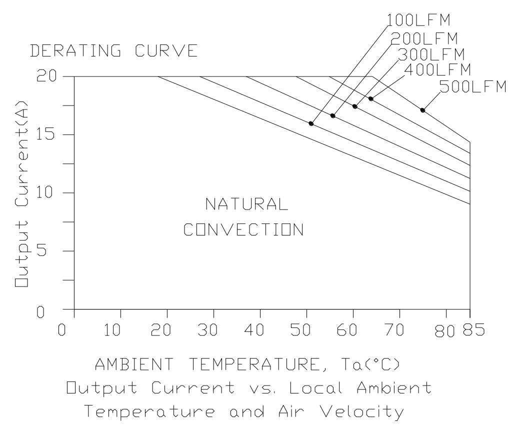

Figure 10. Vout = 5 V

10. TRANSIENT RESPONSE WAVEFORMS

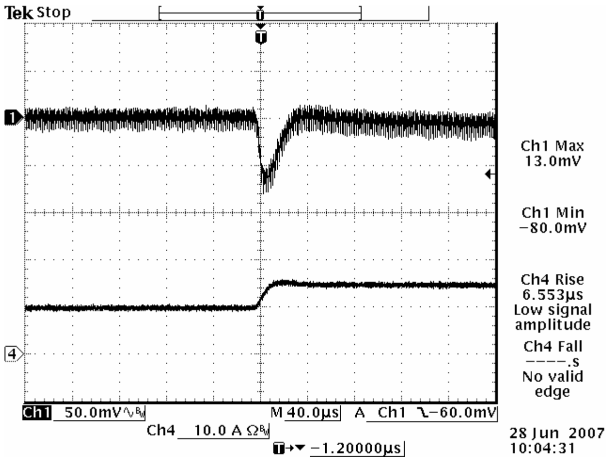

Figure 11. Vout= 2.5 V, 50%-75% Load Transients

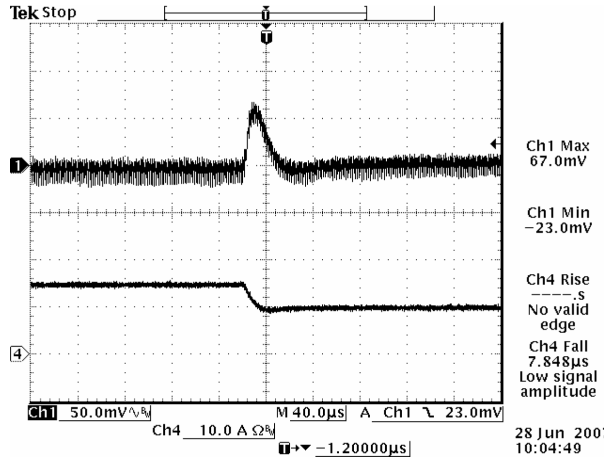

Figure 12. Vout = 2.5 V, 75%-50% Load Transients

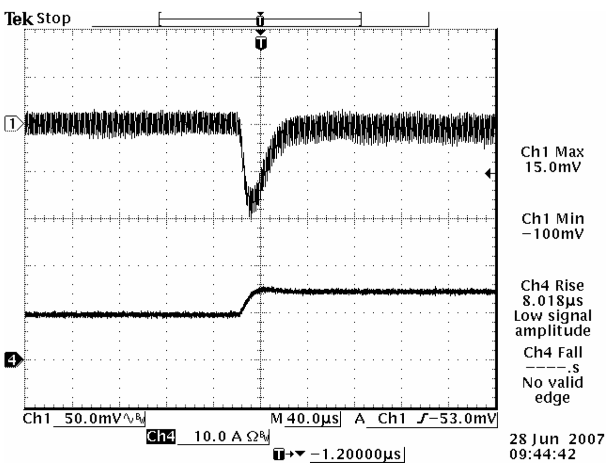

Figure 13. Vout = 5 V, 50%-75% Load Transients

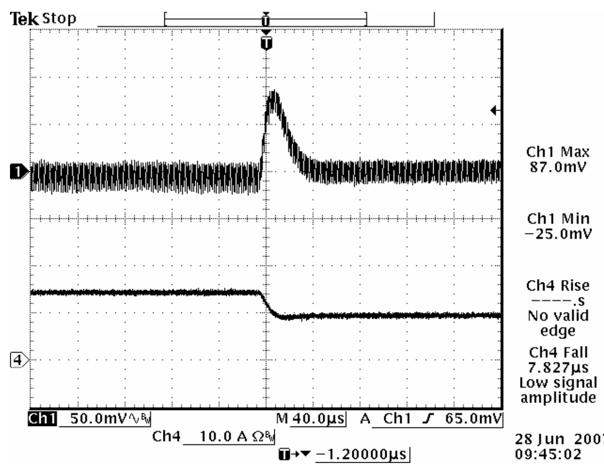

Figure 14. Vout = 5 V, 75%-50% Load Transients

Note: Transient response at di/dt = 2.5 A/us, with 1 µF ceramic capacitor at the output, and Ta = 25°C.

11. RIPPLE AND NOISE

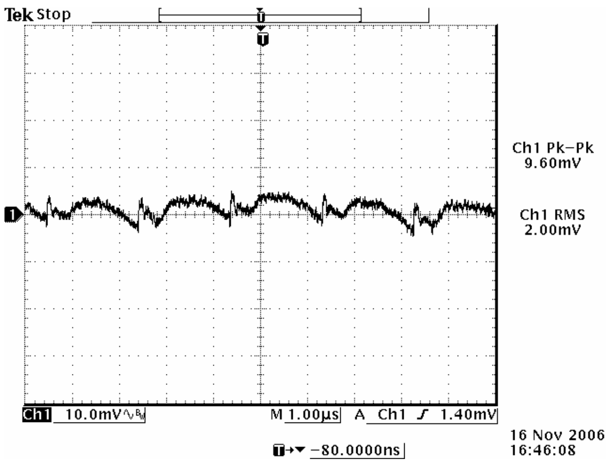

Figure 15. 12 VDC input, 0.591 VDC output

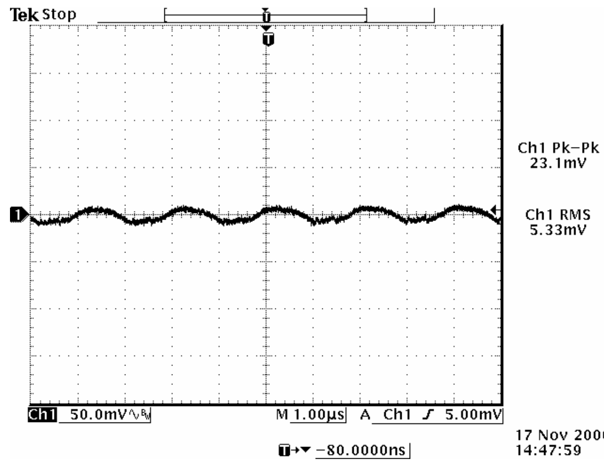

Figure 16. 12 VDC input, 2.5 VDC output

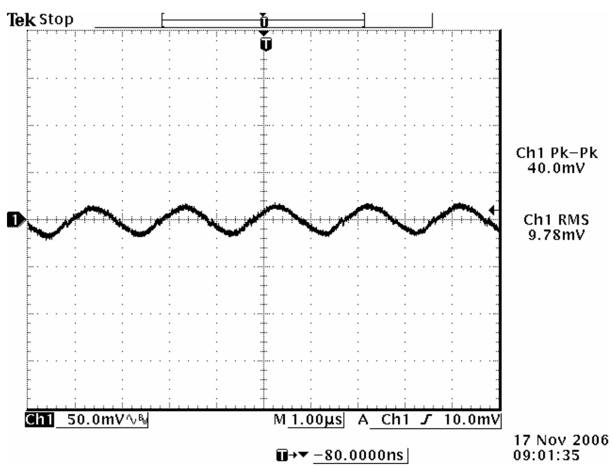

Figure 17. 12 VDC input, 5 VDC output

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

12. MECHANICAL DIMENSIONS

OUTLINE

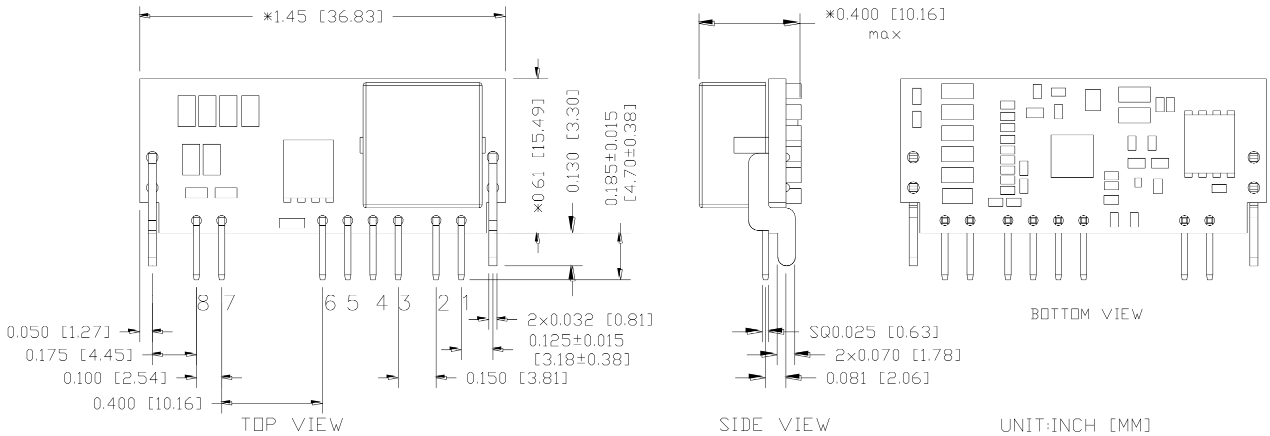

Figure 18. Outline

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

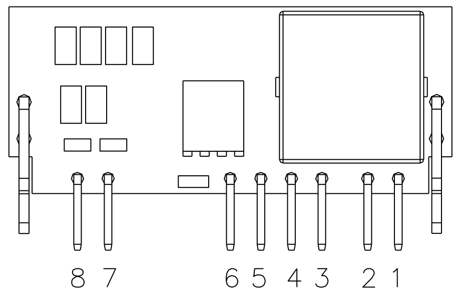

Figure 19. Pins

PIN	FUNCTION	PIN	FUNCTION
1	Vout	5	Enable
2	Trim	6	Vin
3	GND	7	Sense+
4	PwGOOD	8	Sense-

RECOMMENDED PAD LAYOUT

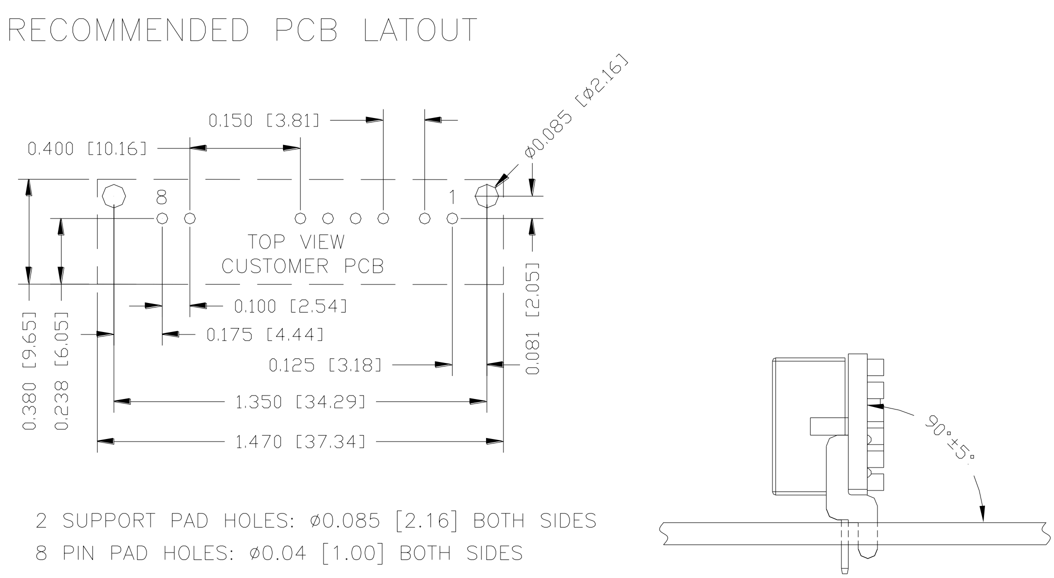

Figure 20. Recommended pad layout

13. REVISION HISTORY

DATE	REVISION	CHANGES DETAIL	APPROVAL
2010-04-16	I	Add part number 0RP1-20E1A0.	J.Fan
2013-04-11	J	Update Output Spec and Control Spec.	J.Fan
2014-06-09	K	Update MD.	J.Fan
2014-09-02	L	Update MTBF.	XF.Jiang
2016-01-05	M	Add Assembly Note. Update mechanical drawing.	XF.Jiang
2018-03-12	AN	Update the form and TD.	XF.Jiang
2018-05-23	AO	Add Control Specs Note.	XF.Jiang
2021-08-02	AP	Add object ID and thermal test airflow direction.	XF.Jiang