0RCY-T0T12

Isolated DC-DC Converter

The 0RCY-T0T12 series are isolated DC-DC converters that operate from a nominal 48 V source. These units provide up to 300 W of output power from a nominal 48 V input.

These units are designed to be highly efficient. Features include remote on/off, short circuit protection, over current protection, under voltage lockout and over temperature protection.

The converters are provided in an industry standard eighth brick package.



Key Features & Benefits

- 36 - 72 VDC Input
- 12 VDC @ 25 A Output
- 1/8th Brick Converter
- Basic Isolated
- Fixed Frequency (350 kHz)
- High Efficiency
- High Power Density
- Input Under-Voltage Lockout
- OCP/SCP
- Output Over-Voltage Protection
- Over Temperature Protection
- Remote On/Off
- UL 94V-0 Flammability Compatible
- Approved to IEC/EN 62368-1
- Approved to UL/CSA 62368-1
- Class II, Category 2, Isolated DC/DC Converter (refer to IPC-9592B)

RoHS Compliant

Applications

- Networking
- Computers and Peripherals
- Telecommunications

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Please read our datasheet & drawing disclaimer here.

1. MODEL SELECTION

MODEL NUMBER	OUTPUT VOLTAGE	INPUT VOLTAGE	MAX. OUTPUT CURRENT	MAX. OUTPUT POWER	TYPICAL EFFICIENCY
0RCY-T0T12LG 0RCY-T0T120G 0RCY-T0T12AG 0RCY-T0T12BG 0RCY-T0T12C 0RCY-T0T12N	12 VDC	36 - 72 VDC	25 A	300 W	95.5%

PART NUMBER EXPLANATION

0	R	CY	-	T0	T	12	x
Mounting Type	RoHS Status	Series Name		Output Power	Input Range	Output Voltage	Option
Through hole mount	RoHS	1/8th Brick		300 W	36 - 72 V	12 V	LG – Active low, open frame, pin length 0.18'' 0G – Active high, open frame, pin length 0.18'' AG – Active high, with baseplate, pin length 0.18'' BG – Active low, with baseplate, pin length 0.18'' C – Active low, with baseplate, coating & 22000 µF max. ext. output capacitance, pin length 0.11'' N – Active low, with baseplate & 22000 µF max. ext. output capacitance, pin length 0.11''

2. ABSOLUTE MAXIMUM RATINGS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNITS
Continuous non-operating Input Voltage		-0.3	-	80	V
Input Transient Voltage	100 ms maximum	-	-	100	V
Remote On/Off		-0.3	-	18	V
I/O Isolation Voltage		-	-	1500	V
Ambient Temperature	The components on the Unit meet IPC-9592 derating guidelines	-40	-	85	°C
Storage Temperature	The component temperatures might exceed IPC-9592 derating guidelines but not exceed component temperature ratings	-55	-	125	°C
Altitude		-	-	5000	m
Relative Humidity, Operating, Non-Condensing		10	-	90	%

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		36	48	72	V
Input Current (full load)		-	-	9	A
Input Current (no load)		-	60	100	mA
Remote Off Input Current		-	3	6	mA
Input Reflected Ripple Current (pk-pk)	Detail conditions please refer to input reflected ripple current section.	-	-	20	mA
I^2t Inrush Current Transient	Vin = 50 V, with a 100 µF/100 V input electrolytic capacitor	-	-	2	A^2s
Turn-on Voltage Threshold		34	-	35	V
Turn-off Voltage Threshold		32	-	33	V
Lockout Hysteresis Voltage		2	-	-	V

CAUTION: This converter is not internally fused. An input line fuse must be used in application. Recommend a fast-acting fuse with maximum rating of 20 A on system board. Refer to the fuse manufacture's datasheet for further information.

4. OUTPUT PLOT VS INPUT

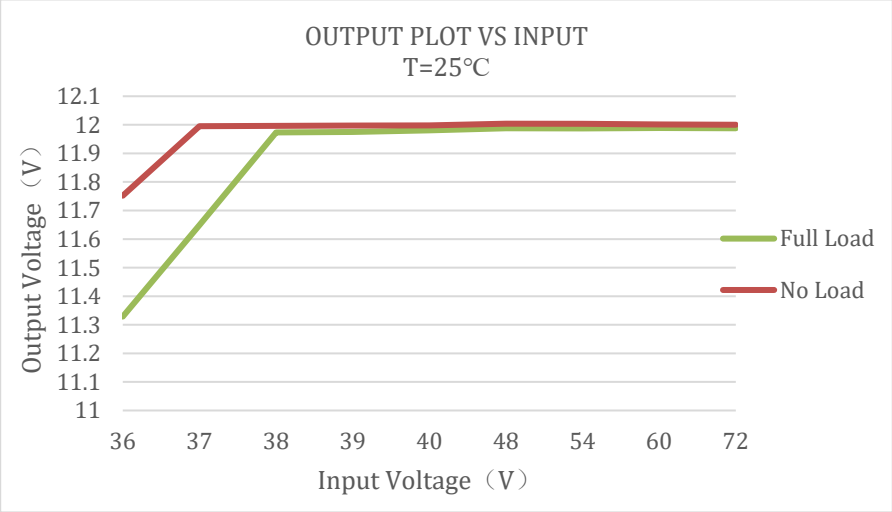


Figure 1. Output plot vs input

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5. 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	Vin = 48 V, Io = 50% load at 25°C	11.94	12.00	12.06	V
Total Output Range (Static) (-40 ~ 85°C)	Vin = 36 – 40 V	11.15	-	12.18	V
	Vin = 40 – 75 V	11.82	-	12.18	V
Load Regulation	Vin = 36 – 40 V, Io = 0~100% load at 25°C	-	500	600	mV
	Vin = 40 – 75 V, Io = 0~100% load at 25°C	-	20	60	mV
Line Regulation	Vin = 36 – 40 V, Io = 100% load at 25°C	-	300	400	mV
	Vin = 40 – 75 V, Io = 100% load at 25°C	-	10	30	mV
Regulation Over Temperature (-40 ~ 85°C)	Vin = 36 – 40 V	-	50	100	mV
	Vin = 40 – 75 V	-	20	60	mV
Ripple and Noise (pk-pk)	Vin = 48 V, Io = 100% load at 25°C ambient, 0-20 MHz BW, with a 1 µF ceramic capacitor, a 10 µF Tantalum cap and a 270 µF AL. cap at output.	-	50	100	mV
Ripple and Noise (rms)		-	10	20	mV
Output Ripple and Noise (pk-pk) under worst case	Over entire operating input voltage range, load and ambient temperature condition.	-	-	150	mV
Output Current Range		0	-	25	A
Output DC Current Limit		26.5	30	34	A
Short Circuit Surge Transient		-	-	1	A^2s
Rise Time		-	12	20	ms
Turn on Time	Enable from Vin	-	30	35	ms
	Enable from ON/OFF	-	30	35	ms
Overshoot at Turn on		-	0	3	%
Output Capacitance	Except 0RCY-T0T12C/N.	270	-	6800	µF
	For 0RCY-T0T12C/N. See Note 1.	270	-	22000	uF
Transient Response					
△V 50%~75% of Max Load	di/dt = 0.1 A/µs, Vin = 48 VDC, Ta = 25°C, with a 1 µF ceramic capacitor, a 10 µF Tantalum cap and a 680 µF AL cap at output.	-	300	-	mV
Settling Time		-	500	-	µs
△V 75%~50% of Max Load		-	300	-	mV
Settling Time		-	500	-	µs

NOTE 1: External capacitor for 0RCY-T0T12C/N should be as below recommended or the equivalent.

Minimum: 270 µF Oscon capacitor.

Maximum: One 10000 µF (EEUHD1E103 from PANASONIC) plus two 4700 µF (EEUHD1E472 from PANASONIC) and 10X47 µF (16TQC47MYFD from PANASONIC).

6. GENERAL SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Efficiency	The efficiency is measured at Vin = 48 V, full load and Ta = 25°C.	-	95.8	-	%
Switching Frequency		-	350	-	kHz
Over Temperature Protection		-	125	-	°C
Weight	0RCY-T0T120G/LG	-	37.3	-	g
	0RCY-T0T12AG/BG/C/N	-	44.5	-	g
FIT	Calculated Per Bell Core SR-332 (Vin = 48 V, Vo = 12 V, Io = 20 A, 200 LFM, Ta = 25°C, FIT = 10^9/MTBF)	-	131	-	
Dimensions (L × W × H)	0RCY-T0T120G/LG		2.30 x 0.90 x 0.43		inch
			58.42 x 22.86 x 11.00		mm
	0RCY-T0T12AG/BG/C/N		2.30 x 0.90 x 0.51		inch
			58.42 x 22.86 x 13.00		mm
Isolation Characteristics					
Input to Output		-	-	1500	V
Input to Case		-	-	1500	V
Output to Case		-	-	500	V
Isolation Resistance		10M	-	-	Ohm
Isolation Capacitance		-	1000	-	pF

7. EFFICIENCY DATA

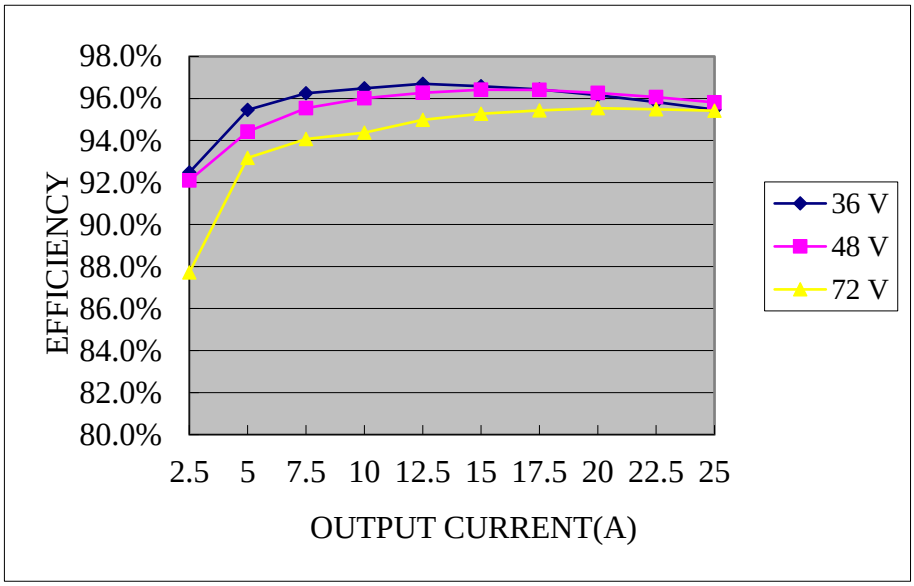


Figure 2. Efficiency data

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8. REMOTE ON/OFF

PARAMETER		DESCRIPTION	MIN	TYP	MAX	UNIT
Signal Low (Unit On)	Active Low	0RCY-T0T12LG/BG/C/N. Remote On/Off pin is open, the module is off.	-0.3	-	0.8	V
Signal High (Unit Off)			2.4	-	18	V
Signal Low (Unit Off)	Active High	0RCY-T0T120G/AG. Remote On/Off pin is open, the module is on.	-0.3	-	0.8	V
Signal High (Unit On)			2.4	-	18	V
Current Sink			0	-	1	mA

Recommended remote on/off circuit for active low:

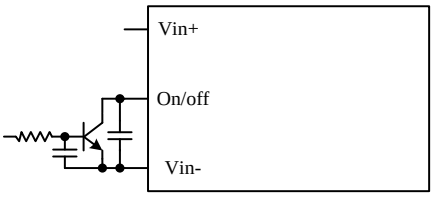


Figure 3. Control with open collector/drain circuit

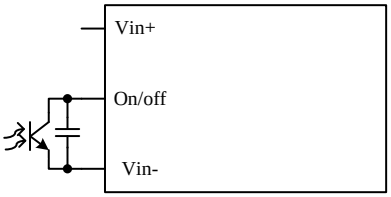


Figure 4. Control with photocoupler circuit

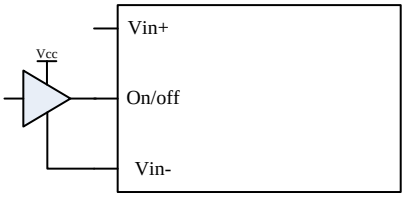


Figure 5. Control with logic circuit

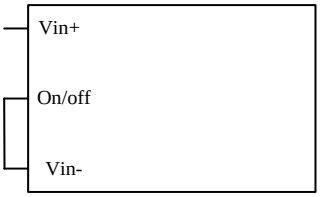


Figure 6. Permanently on

Recommended remote on/off circuit for active high:

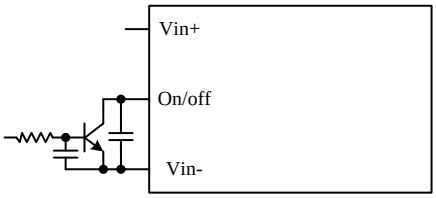


Figure 7. Control with open collector/drain circuit

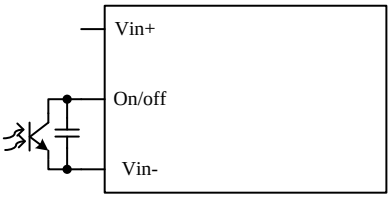


Figure 8. Control with photocoupler circuit

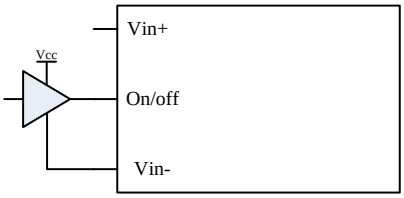


Figure 9. Control with logic circuit

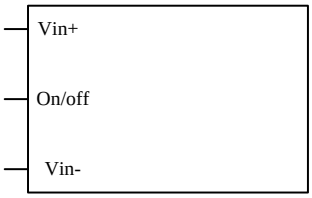


Figure 10. Permanently on

9. INPUT REFLECTED RIPPLE CURRENT

Testing setup

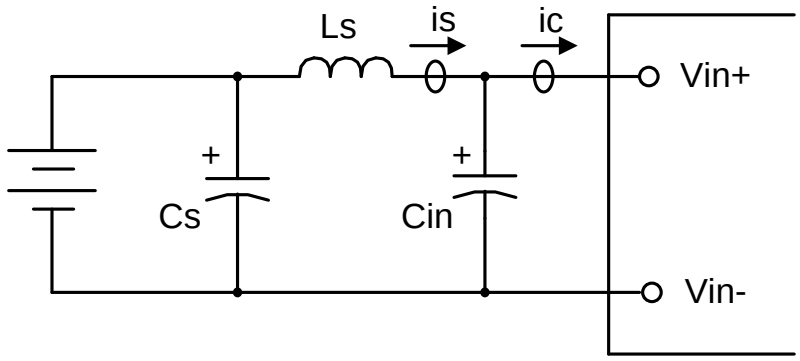


Figure 11.

Notes and values in testing.

is: Input Reflected Ripple Current

ic: Input Terminal Ripple Current

Ls: Simulated Source Impedance (10 µH)

Cs: Offset possible source Impedance (100 µF, ESR < 0.2 Ω @ 100 kHz, 20°C)

Cin: Electrolytic capacitor, should be as close as possible to the power module to damp ic ripple current and enhance stability. Recommendation: 100 µF, ESR < 0.2 Ω @ 100 kHz, 20°C.

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

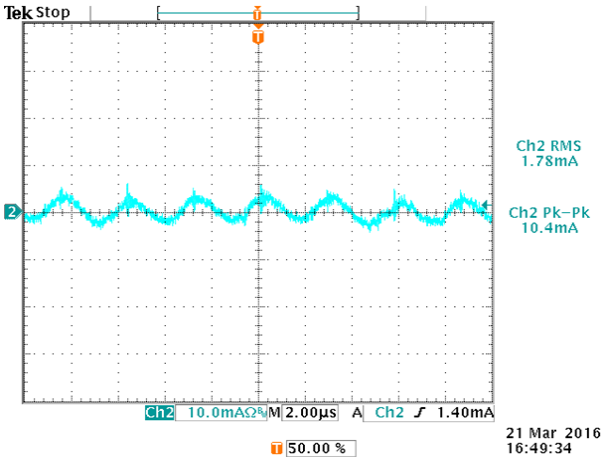


Figure 12. is (input reflected ripple current), AC component

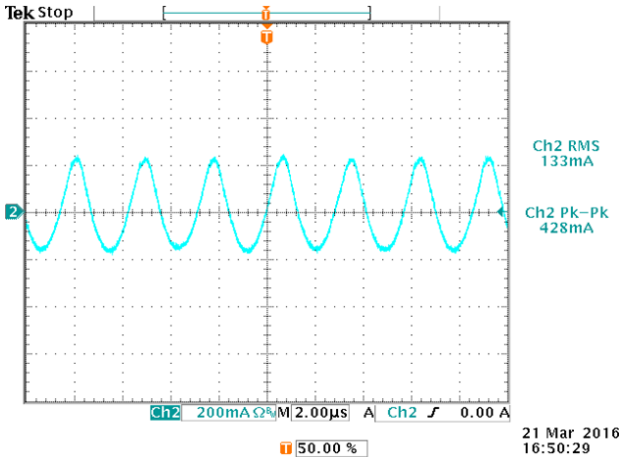


Figure 13. ic (input terminal ripple current), AC component

Test condition: 48 VDC input, 12 VDC/25 A output and Ta = 25 °C, with a 1 µF ceramic capacitor and a 270 µF AL. cap at output.

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10. RIPPLE AND NOISE WAVEFORM

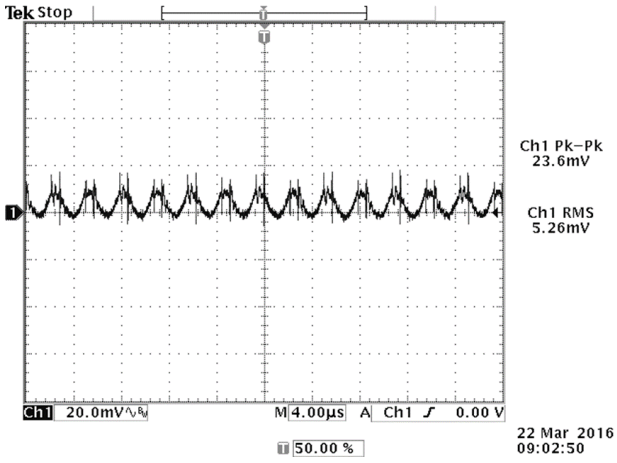


Figure 14. Ripple and noise waveform

Note: Ripple and noise at full load, 48 VDC input, 12 VDC/25 A output and Ta = 25 °C, and with a 1 µF ceramic capacitor, a 10 µF Tantalum cap and a 270 µF AL. cap at output.

11. TRANSIENT RESPONSE WAVEFORMS

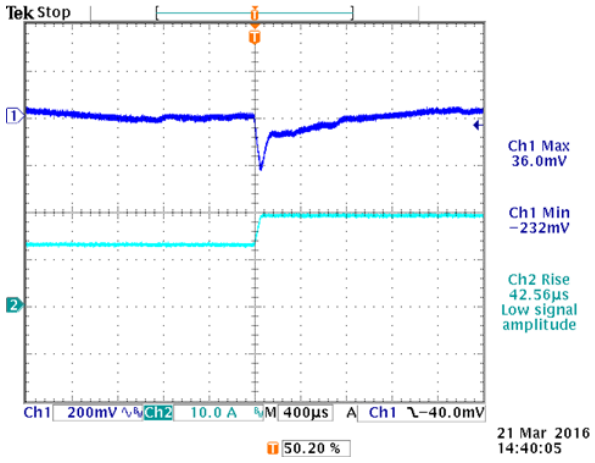


Figure 15. Vout = 12 V, 50%-75% Load Transients at Vin = 48 V @ Ta = 25°C

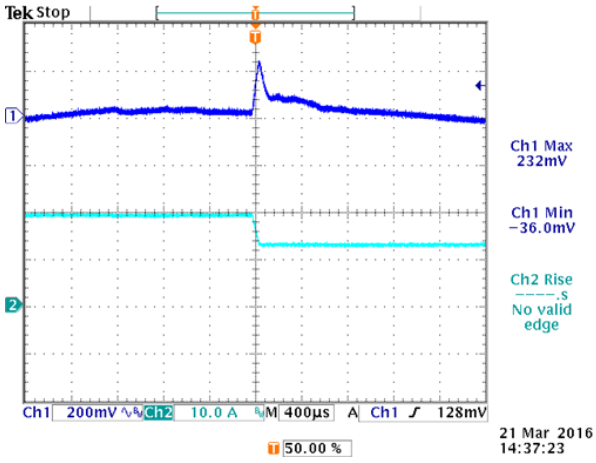


Figure 16. Vout = 12 V, 75%-50% Load Transients at Vin = 48 V @ Ta = 25°C

Note: Transient Response: di/dt = 0.1 A/µs, with a 1 µF ceramic capacitor, and a 680 µF AL cap at output.

12. STARTUP & SHUTDOWN

Rise time

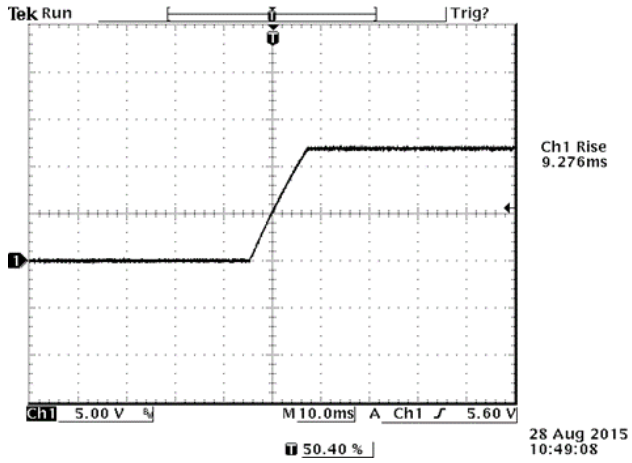


Figure 17. Vout = 12 V / 25 A at Vin = 48 V
@ Ta = 25°C, Cext = 270 µF

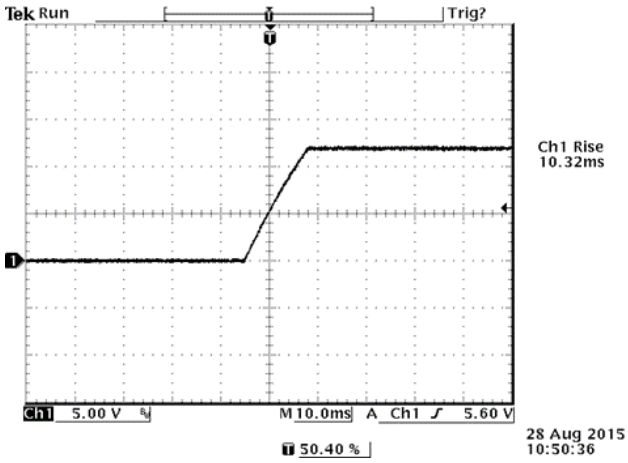


Figure 18. Vout = 12 V / 25 A at Vin = 48 V
@ Ta = 25°C, Cext = 6800 µF

Startup time

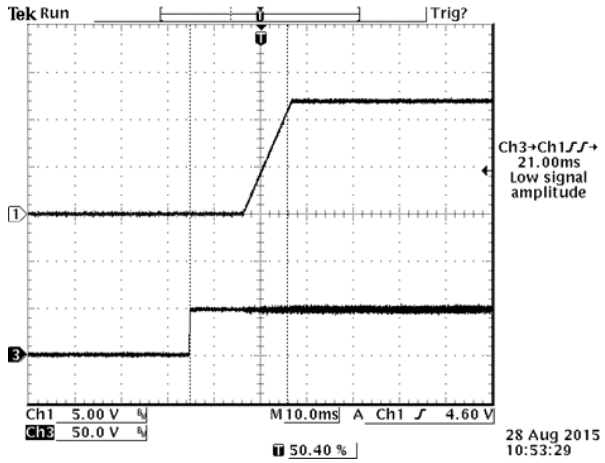


Figure 19. Startup from Vin
Ch1: Vo
Ch3: Vin
Vout = 12 V/ 25 A at Vin = 48 V @ Ta = 25°C
Cext = 270 µF

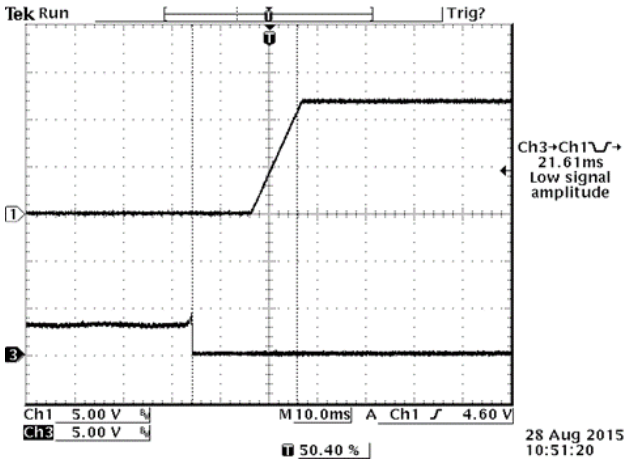


Figure 20. Startup from on/off
Ch1: Vo
Ch3: on/off
Vout = 12 V/ 25 A at Vin = 48 V @ Ta = 25°C
Cext = 6800 µF

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Shutdown

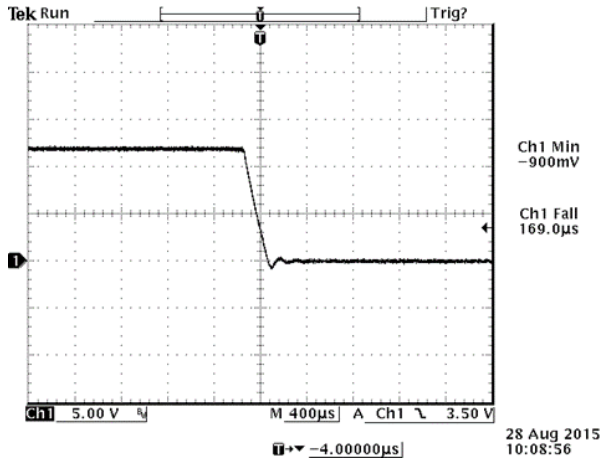


Figure 21. Vout = 12 V/ 25 A at Vin = 48 V
@ Ta = 25°C, Cext = 270 µF

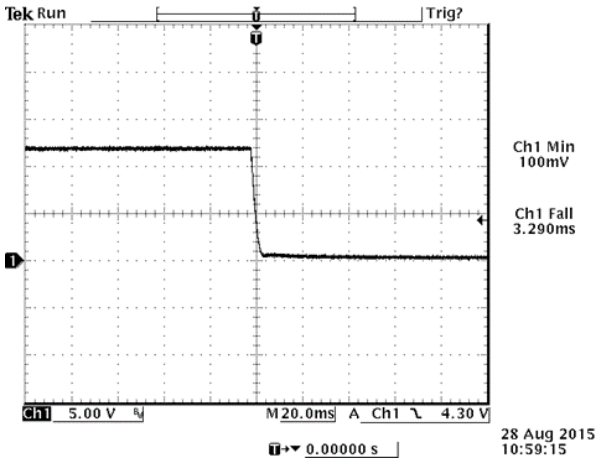


Figure 22. Vout = 12 V/ 25 A at Vin = 48 V
@ Ta = 25°C, Cext = 6800 µF

13. OVER CURRENT PROTECTION

To provide protection in a fault output overload condition, the module is equipped with internal over current protection circuitry. If the over current condition occurs, the module will shut down into hiccup mode and restart once every 400 ms. The module operates normally when the output current goes into specified range.

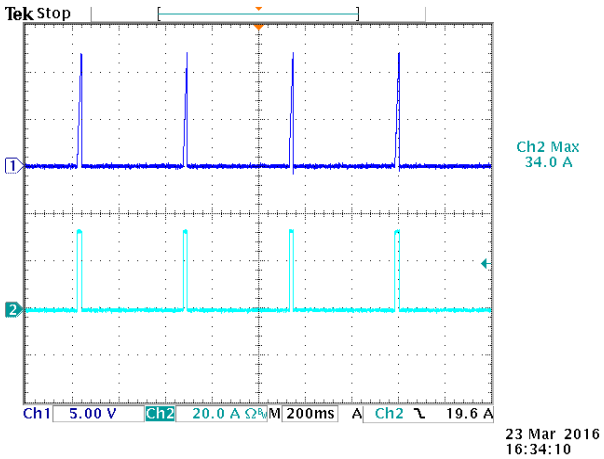


Figure 23. Vin = 48 V @ Ta = 25°C
CH1: Output Voltage
CH2: Output Current

14. INPUT UNDER-VOLTAGE LOCKOUT

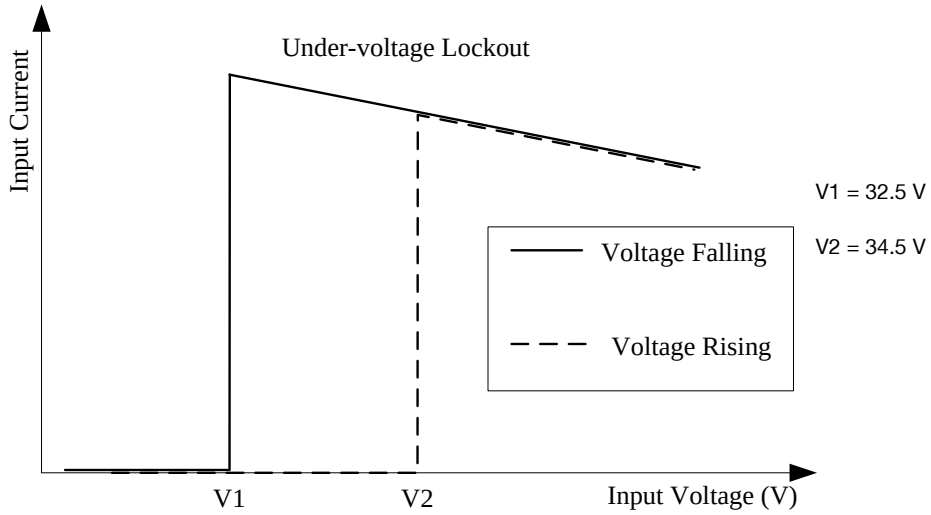


Figure 24. Input under-voltage lockout

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15. THERMAL DERATING CURVES

Maximum junction temperature of semiconductors derated to 120 °C.

The OTP is achieved by temperature sensor U10 and it's in non-latch mode when the hottest component Q13 reaches 120°C with 200 LFM air flow correspondingly. It will restart automatically when the temperature falls to 105°C. The protecting point will be varied a little under different conditions (air flow, ambient temperature, input voltage, load...).

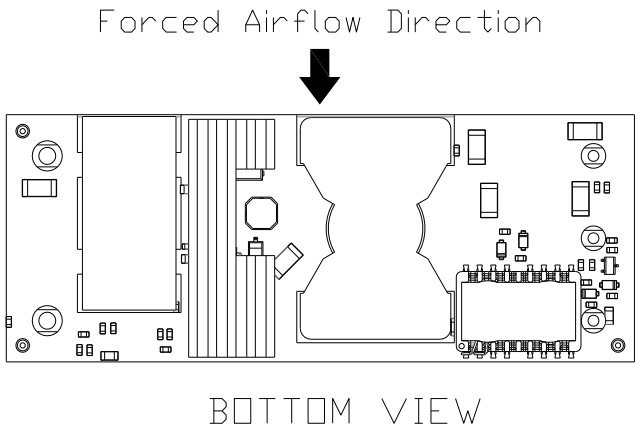


Figure 25. Airflow direction

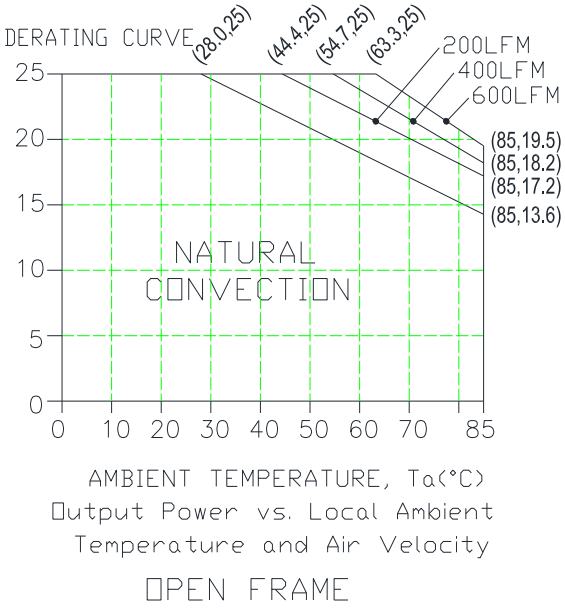


Figure 26. Derating curve-open frame

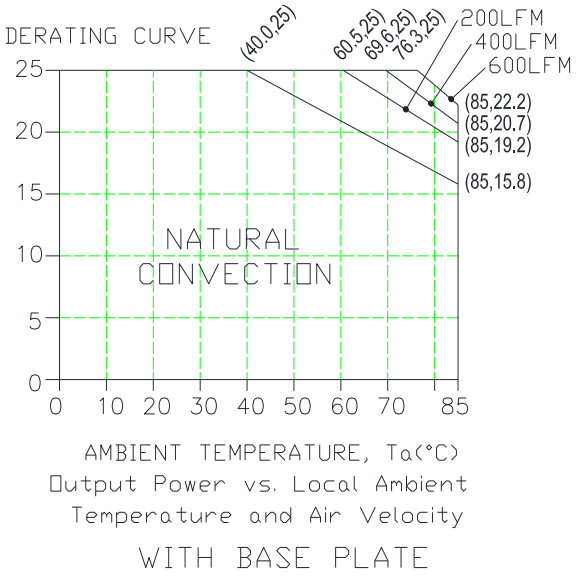


Figure 27. Derating curve-with base plate

Note: Output power vs. ambient temperature and air velocity @ Vin = 48 V.

16. SAFETY & EMC

Safety :
Approved to IEC/EN 62368-1
Approved to UL/CSA 62368-1
UL 94V-0 flammability compatible

EMC:

1. Surge: IEC 61000-4-5
2. DC-DIP: IEC 61000-4-29
3. Conductive EMI: EN 55032 class A

Compliance to EN 55032 class A (both peak and average) with the following inductive and capacitive filter

Setup:

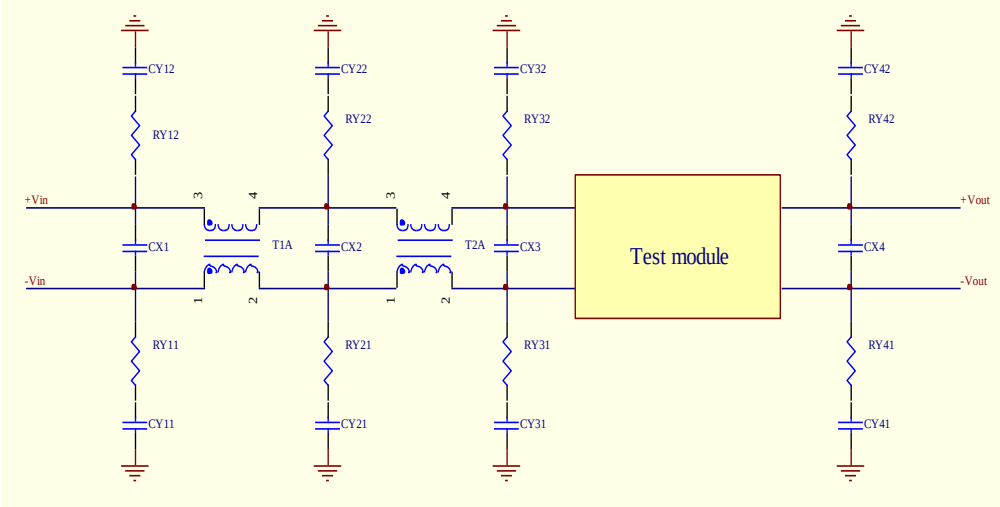


Figure 28.

ITEM	DESIGNATOR	PARAMETER	VENDOR	VENDOR P/N
1	CX2	100 µF/100 V, AL cap		
2	CX3	220 µF/100 V, AL cap		
3	CY31	2*6.8 nF/1000 V, ceramic		
4	CY32	2*6.8 nF/1000 V, ceramic		
5	CY41	6.8 nF/1000 V, ceramic		
6	CY42	6.8 nF/1000 V, ceramic		
7	RY31	1206,0R, Resistor		
8	RY32	1206,0R, Resistor		
9	RY41	1206,0R, Resistor		
10	RY42	1206,0R, Resistor		
11	T2A	0.125 mH, common mode		
12	T1A,CX1,CX2 RY11,RY21,RY12 RY22,CY11,CY21 CY12,CY22,CX4	NIL		

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Positive:

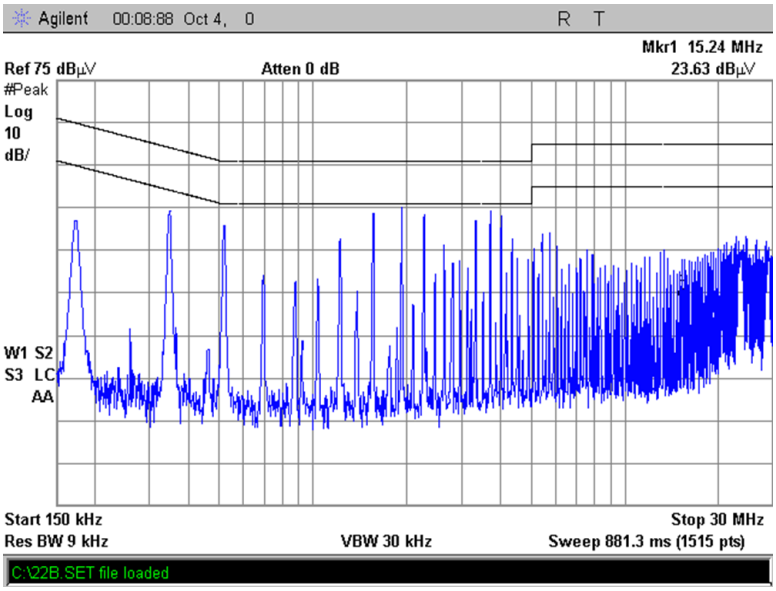


Figure 29.

Negative:

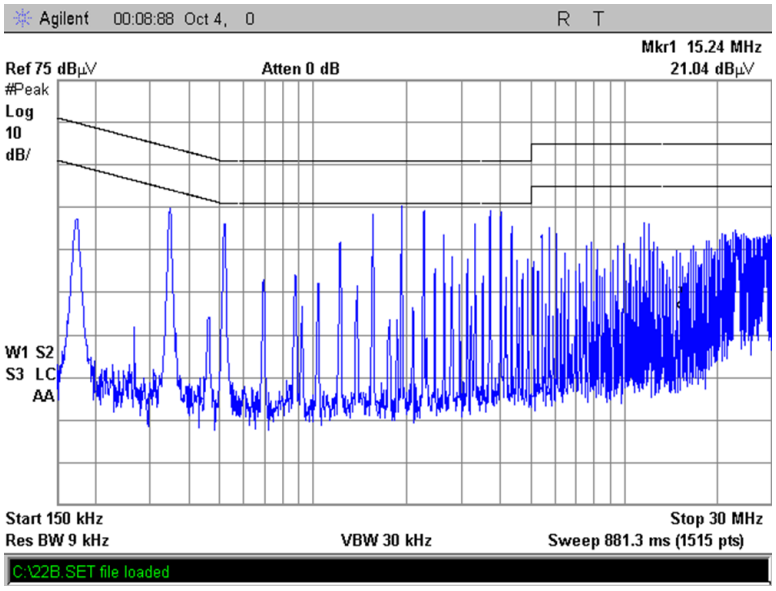


Figure 30.

17. MECHANICAL DIMENSIONS

0RCY-T0T120G/LG OUTLINE

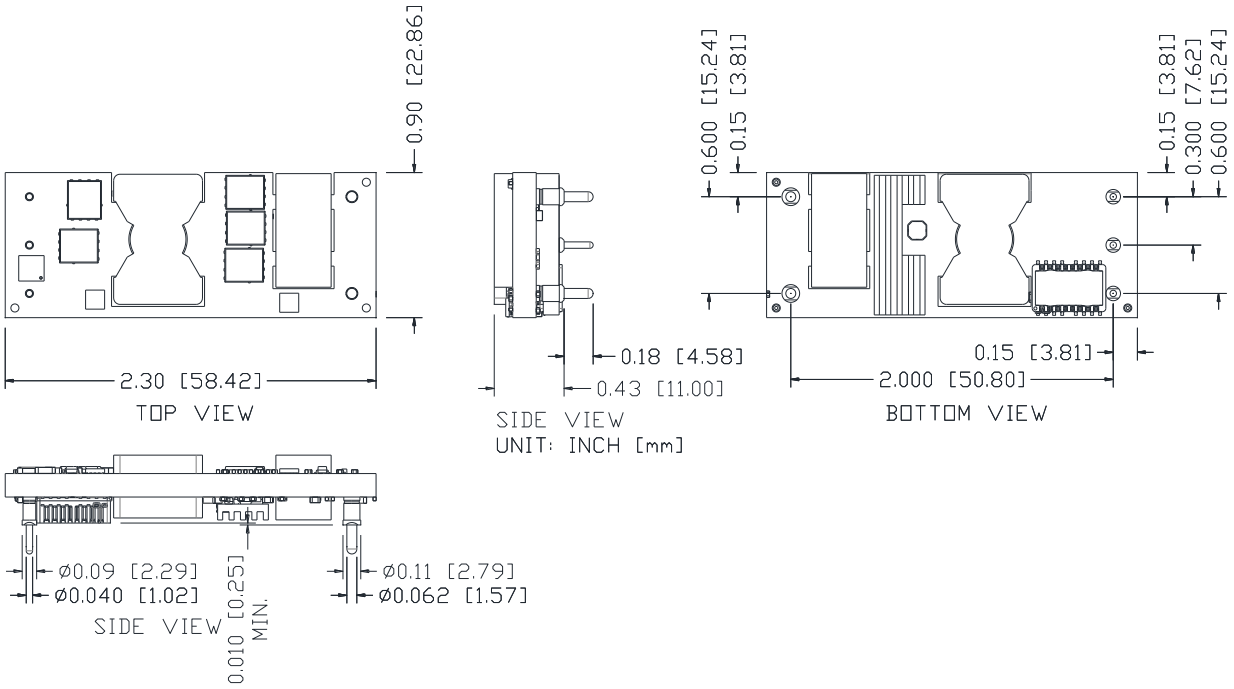


Figure 31. 0RCY-T0T120G/LG Outline

NOTE: This module is NOT PIH compatible. It 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 – Tin 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].

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0RCY-T0T12AG/BG OUTLINE

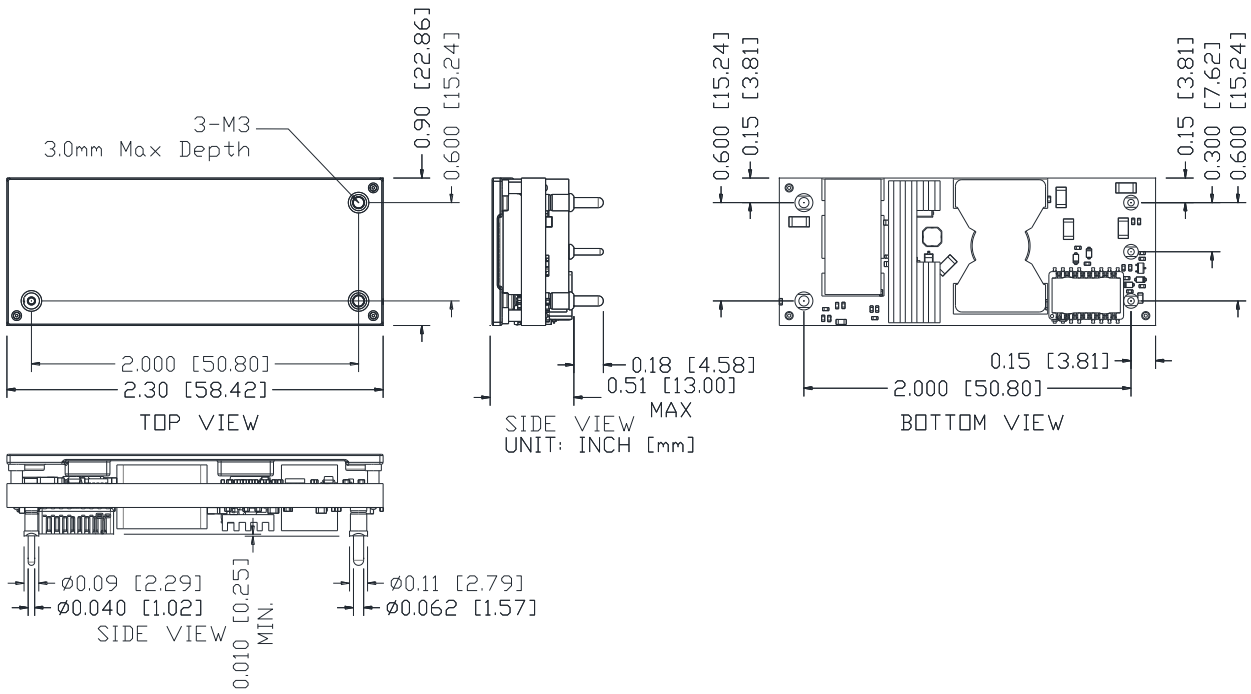


Figure 32. 0RCY-T0T12AG/BG Outline

NOTE: This module is NOT PIH compatible. It 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 – Tin 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].

0RCY-T0T12C/N OUTLINE

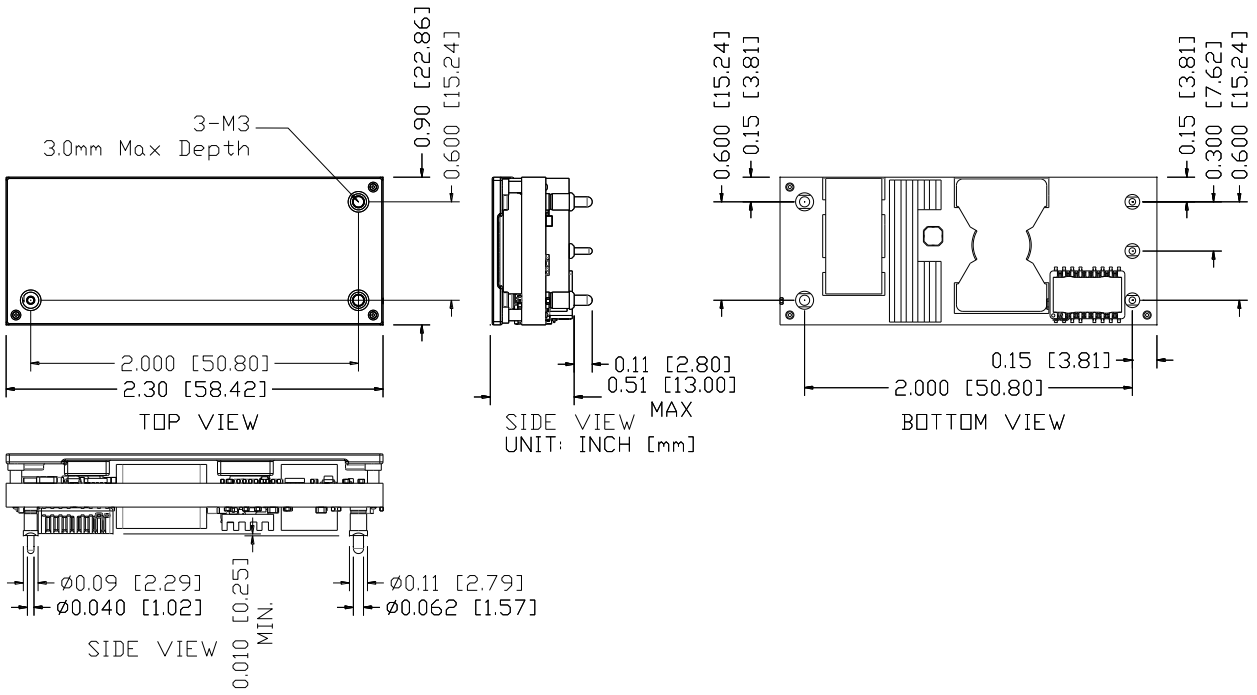


Figure 33. 0RCY-T0T12C/N Outline

NOTE: This module is NOT PIH compatible. It 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 – Tin 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].

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PIN DEFINITIONS

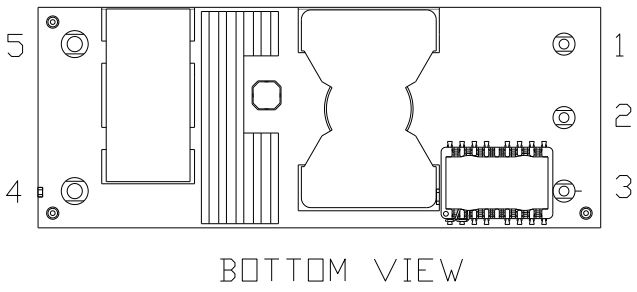


Figure 34. Pins

PIN	FUNCTION	PIN SIZE
1	Vin (+)	0.040”
2	ON/OFF	0.040”
3	Vin (-)	0.040”
4	Vout (-)	0.062”
5	Vout (+)	0.062”

RECOMMENDED PAD LAYOUT

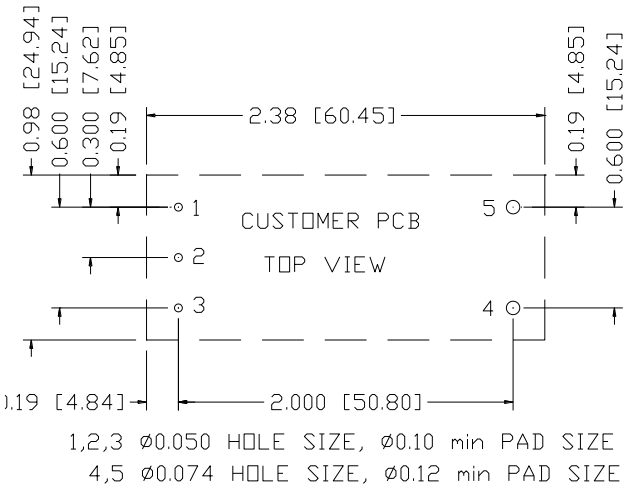


Figure 35. Recommended pad layout

18. REVISION HISTORY

DATE	REVISION	CHANGES DETAIL	APPROVAL
2016-03-24	PA	First release.	Z.Tang
2017-04-20	AB	Update Model.	HL.Lu
2017-12-18	AC	Add 0RCY-T0T12C.	XF.Jiang
2019-05-24	AD	Update TD curves.	XF.Jiang
2019-08-12	AE	Add a note of 0RCY-T0T12C in part number explanation.	XF.Jiang
2020-07-27	AF	Add module photo. Delete 0RCY-T0T12C.	F.Tao
2021-04-28	AG	Add object ID and safety certificate. Update 0RCY-T0T120/L outline.	XF.Jiang
2022-02-24	AH	Add PNs of 0RCY-T0T12C and 0RCY-T0T12N. Update altitude to 5000m. Add feature: UL 94V-0 flammability compatible. Add FIT value.	XF.Jiang
2022-05-06	AJ	Add safety certificate UL/CSA 62368-1 to all modules. Add safety to 0RCY-T0T12C and 0RCY-T0T12N.	XF.Jiang
2022-07-07	AK	Update load regulation max value, line regulation, regulation over temperature and output dc current limit min value. Add total output range and output plot vs input curve.	XF.Jiang

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

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