ISOLATED DC/DC CONVERTERS

18 Vdc - 75 Vdc Input 12 Vdc /7 A Output

Feb. 7. 2014

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

0RCY-60U12C RoHS Compliant Preliminary Rev.C

Features

- Isolated
- High Efficiency
- High Power Density
- Fixed Frequency (258 kHz)
- Input Under-Voltage Lockout
- Input Over-Voltage Lockout
- Ultra Wide Input Range: 18 Vdc - 75 Vdc
- Output Over-Voltage Shutdown
- OCP/SCP
- Over Temperature Protection
- Low Cost
- Output Voltage Trim
- Positive/Negative Remote Sense
- Basic Insulation
- Remote On/Off
- Class 2, Category 2, Non-Isolated DC/DC Converter (refer to IPC-9592B)
- Certificated to UL60950-1/CSA C22.2 No.60950-1, 2rd edition, am1
- IEC60950-1, 2rd edition, am1 safety approved.

Applications

- Networking
- Computers and peripherals
- Telecommunications

Description

The 0RCY-60U12x is part of the isolated dc/dc converters that operate from a wide input range (18 Vdc - 75 Vdc) and can cover both 24 Vin and 48 Vin input range. These units will provide up to 84 W of output power. They are designed to be highly efficient and low cost. Features include remote on/off, over current protection, over voltage shut down, over temperature protection and under-voltage lockout. These converters are provided in an industry standard 1/8 brick package.

Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Model Number Active Low
12 Vdc	18 Vdc - 75 Vdc	7 A	84 W	92%	0RCY-60U12C

Notes: Add “G” suffix at the end of the model number to indicate Tray Packaging.

Part Number Explanation

0	R	CY	–	60	U	12	C	x
1	2	3		4	5	6	7	8

1---Through hole
2---RoHS 6, change “R” to “7” means RoHS 5
3---Series name
4---Series code
5---Input range (18-75V)
6---Output voltage 12V
7---Option, “x” of the model part number to be 0-9, A-Z, which will represent the special request of customer.
8---Package

Absolute Maximum Ratings

Parameter	Min	Typ	Max	Unit	Notes
Input Voltage (continuous)	-0.3	-	80	V	
Input Transient Voltage	-	-	100	V	100 mS maximum
Remote On/Off	-0.3	-	18	V	
I/O Isolation Voltage	-	-	1500	V	
Ambient Temperature	-40	-	85	°C	
Storage Temperature	-55	-	125	°C	

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	18	24/48	75	V	
Input Current	-	-	6.7	A	
Input Current (no load)	-	100	180	mA	
Remote Off Input Current	-	10	15	mA	
Input Reflected Ripple Current (rms)	-	5	10	mA	With simulated source impedance of 10uH, 5Hz to 20MHz. Use a 100uF/100V electrolytic capacitor with ESR=1 ohm max, at 200KHz@25°C.
Input Reflected Ripple Current (pk-pk)	-	15	30	mA	
I^2t Inrush Current Transient	-	0.05	0.1	A^2s	
Turn-on Voltage Threshold	16.0	17.0	17.5	V	
Turn-off Voltage Threshold	15.0	16.0	16.5	V	
Input Over Voltage Lockout	76	78	80	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 8A on system board. Refer to the fuse manufacture's datasheet for further information.

Notes: 1. This converter has internal C-L-C (2.2uH-2*0.47uF+2.2uF) filter.
2. All specifications are typical at 25 °C unless otherwise stated.

Output Specifications

Parameter	Min	Typ	Max	Unit	Notes
Output Voltage Set Point	11.76	12.00	12.24	V	Vin=48 V, Io=50% load
Load Regulation	-	±6	±12	mV	
Line Regulation	-	±12	±24	mV	
Regulation Over Temperature	-	±30	±50	mV	
Ripple and Noise (rms)	-	30	50	mV	0-20MHz BW, with a 1μF ceramic capacitor and a 10uF Tantalum cap at output.
Ripple and Noise (pk-pk)	-	100	150	mV	
Output Ripple and Noise(Pk-Pk) under worst case	-	-	200	mV	over all operating input voltage, load and ambient temperature condition
Output Current Range	0	-	7	A	

Output Specifications (continued)

Parameter	Min	Typ	Max	Unit	Notes
Output DC Current Limit	7.7	-	12	A	Vin=48 V, in Hiccup Mode.
Short Circuit Surge Transient	-	3	5	A^2s	
Rise Time	5	10	15	mS	
Turn on Time	-	20	30	mS	Ton(Enable from Vin)
	-	20	30	mS	Ton(Enable from ON/OFF)
Overshoot at Turn on	-	0	3	%	
Output Capacitance	220	-	7000	uF	Resistor load with maximum AL-capacitor.
Transient Response					
△V75% ~ 50% Max Load	-	300	400	mV	di/dt=1A/us, Vin=48Vdc, Ta=25°C, with a 1µF ceramic capacitor and a 10uF Tantalum cap at output.
Settling Time	-	100	150	uS	
△V 50% ~ 75% Max Load	-	300	400	mV	
Settling Time	-	100	150	uS	

Note: All specifications are typical at nominal input, full load at 25°C unless otherwise stated.

General Specifications

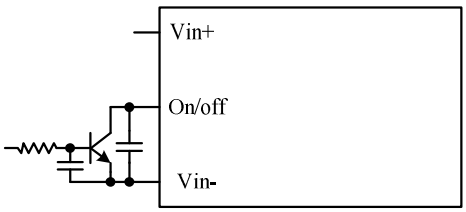
Parameter	Min	Typ	Max	Unit	Notes
Efficiency Vin =48V; Io=Io, max	90.5	92	-	%	The efficiency is measured at Vin=48V, full load and Ta=25°C.
Efficiency Vin =24V; Io=Io, max	90	91.5	-	%	The efficiency is measured at Vin=24V, full load and Ta=25°C.
Switching Frequency	240	258	280	kHz	
Over Temperature Protection	-	125	-	°C	
Over Voltage Protection	-	-	13.8	V	This voltage is achieved by trimming up output slowly.
FIT	-	452	-	-	Calculated Per Bell Core SR-332 (Vin=48 V, Vo=12 V, Io=7 A, Ta = 25C, FIT=10^9/MTBF)
Dimensions Inches (L × W × H) Millimeters (L × W × H)	2.30 x 0.900 x 0.50 58.42 x 22.86 x 12.70			-	
Weight	-	31.2	-	g	
Isolation characteristics					
Input to Output	-	-	1500	Vdc	
Input to Case	-	-	1500	Vdc	
Output to Case	-	-	500	Vdc	
Isolation Resistance	10M	-	-	Ohm	
Isolation Capacitance	-	1500	-	pF	

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

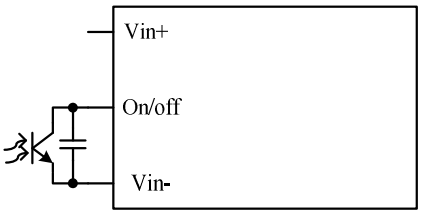
Remote On/Off

Parameter		Min	Typ	Max	Unit	Notes
Signal Low (Unit On)	Active Low	-0.3	-	0.8	V	The remote on/off pin open, Unit off.
Signal High (Unit Off)		2.4	-	18	V	
Current Sink		0	-	2	mA	

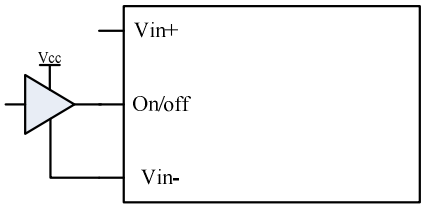
Recommended remote on/off circuit for active low



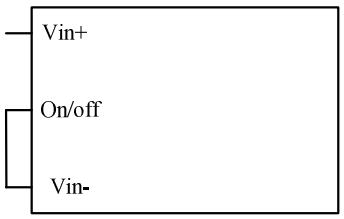
Control with open collector/drain circuit



Control with photocoupler circuit

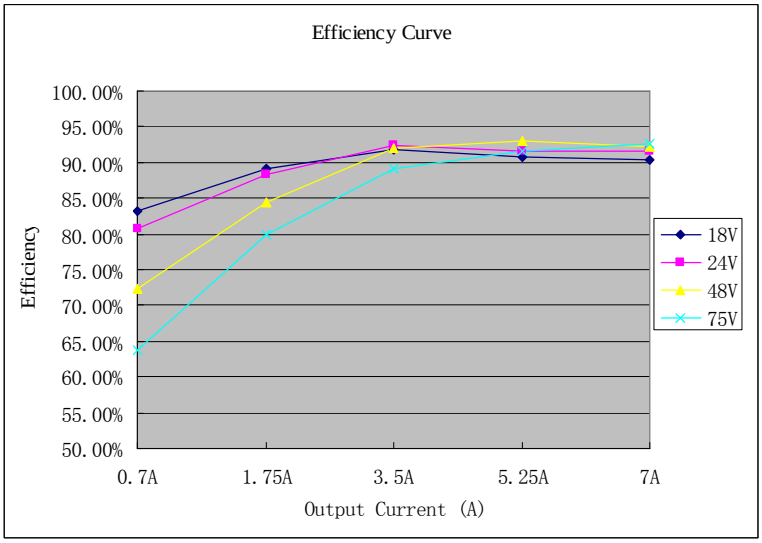


Control with logic circuit



Permanently on

Efficiency Data



Remote sense

This module has remote sense compensation feature. It can minimizes the effects of resistance between moudle's output and load in system layout and facilitates accutate voltage regulation at load terminals or other selected point.

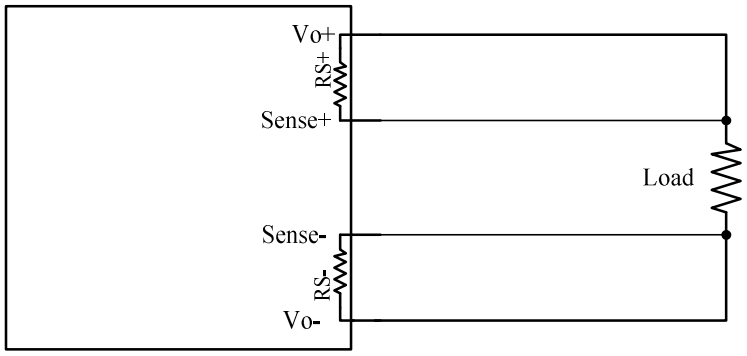
1. The remote sense lines carries very little current and hence do not require a large cross-sectional area.

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

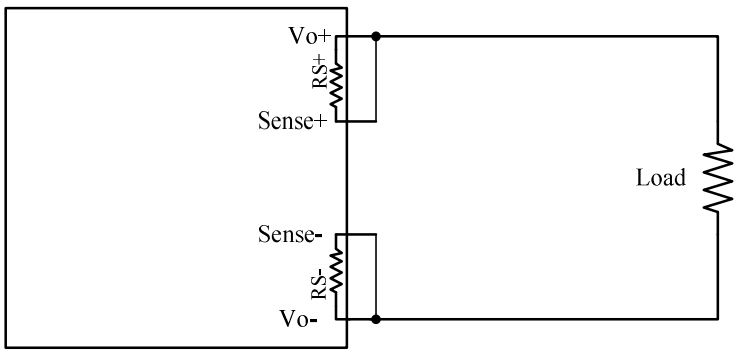
3. If the unit is already trimmed up, the available remote sense compensation range should be correspondingly reduced. The total voltage increased by trim and remote sense should not exceed 10% of the nominal output voltage.

4. When using remote sense compensation, all the resistance, parasitic inductance and capacitance of the system are incorpotated within the feedback loop of this module. The can make an effect on the module's compensation, affecting the stability and dynamic response. A 0.1uF 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+ (30.1 ohm) from Vo+ to Sense+ and a resistor RS- (30.1 ohm)) from Vo- to Sense- inside of this module.



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.

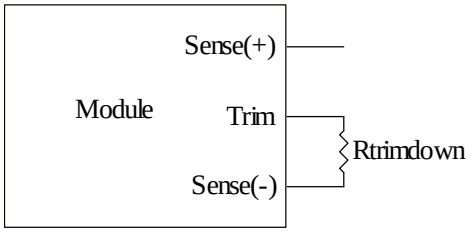


Output Trim Equations

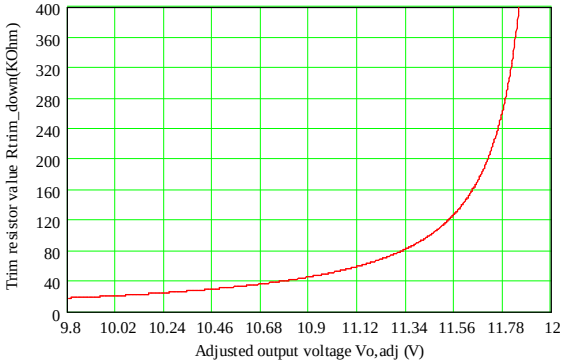
Equations for calculating the trim resistor are shown below. The Trim Down resistor should be connected between the Trim pin and Sense (-) pin. The Trim Up resistor should be connected between the Trim pin and the Sense (+). Only one of the resistors should be used for any given application.

Minimum trim down voltage is 10.8 V
Maximum trim up voltage is 13.2V.
The total voltage increased by trim and remote sense should not exceed 10% of the nominal output voltage.

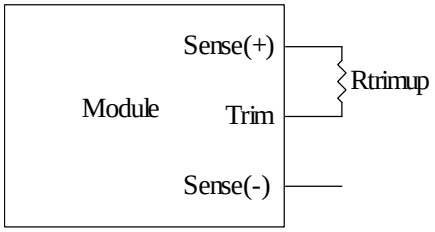
Trim down test circuit



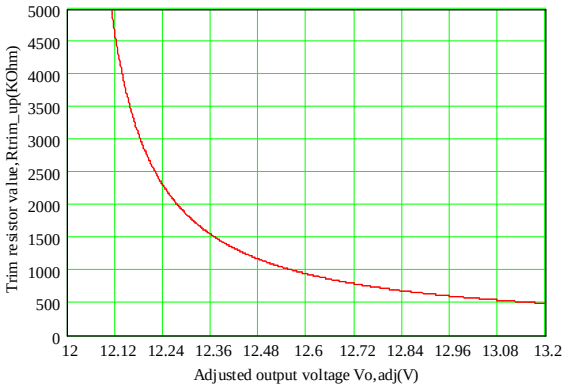
$$Rtrimdown = \frac{511}{|delta|} - 10.22[k\Omega]$$



Trim up test circuit



$$Rtrimup = \frac{(100 + delta) \cdot Vo \cdot 5.11 - 626}{1.225 \cdot delta} - 10.22[k\Omega]$$

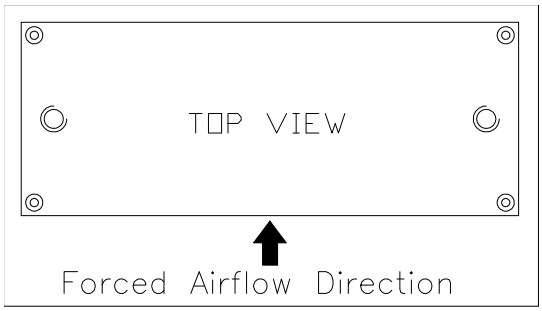


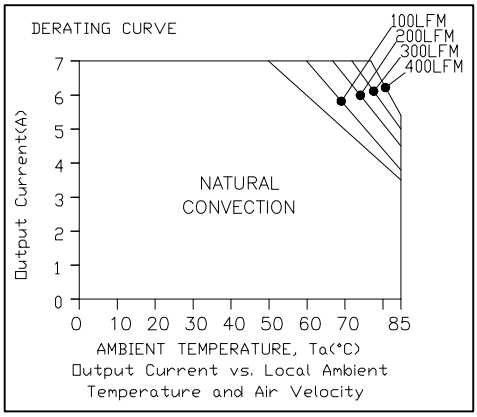
Note:
Vo_req=Desired(trimmed) output voltage[V]
Output voltage Vo=12V

$$delta = \frac{(Vo\_req - Vo)}{Vo} \times 100[\%]$$

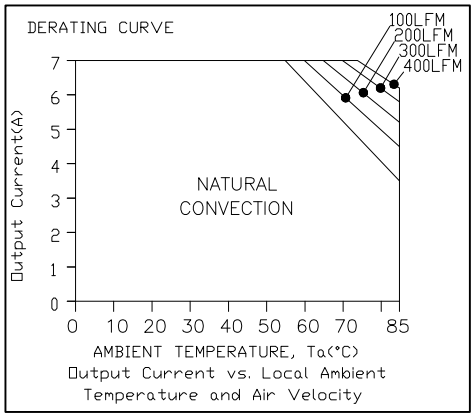
Thermal Derating Curves

Maximum FET junction temperature derated to 120 C

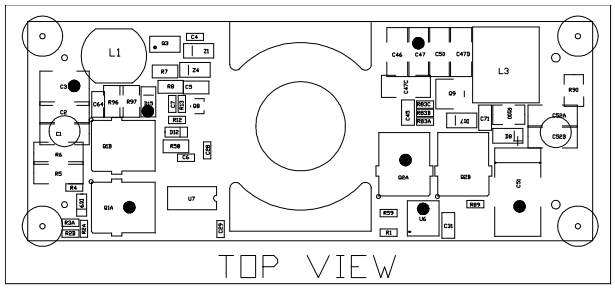




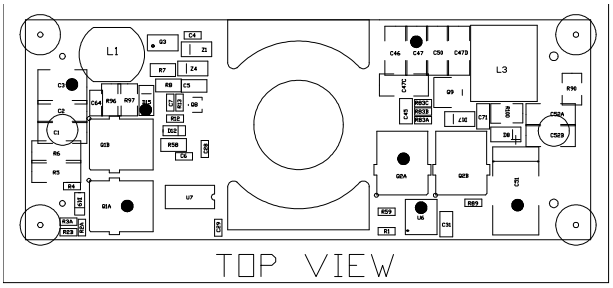
Vin=24 V



Vin=48 V

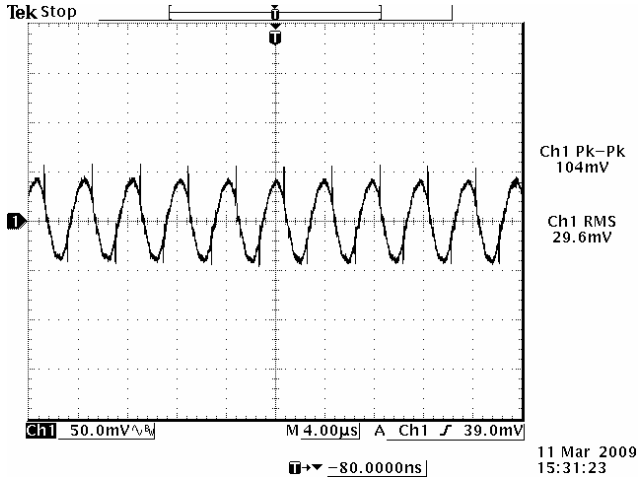


Temperature reference points on top side

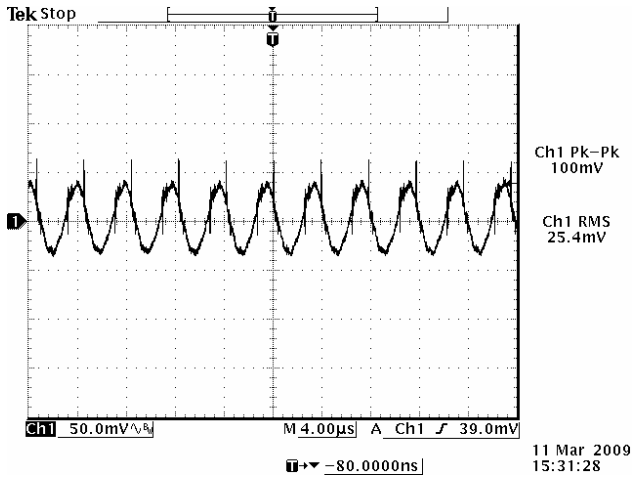


Temperature reference points on top side

Ripple and Noise Waveforms



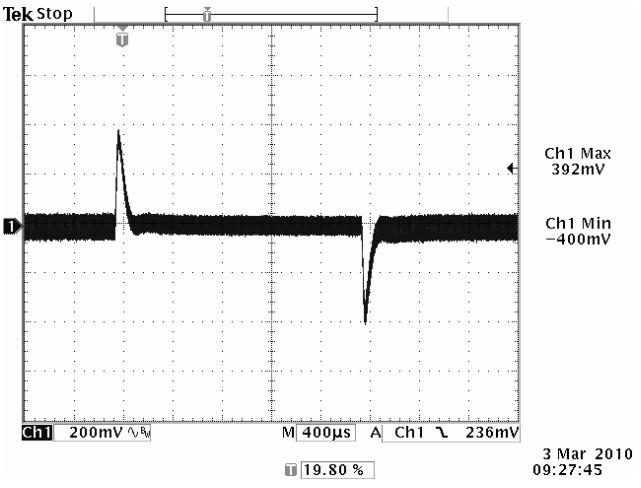
24 Vdc input, 12Vdc/7A output



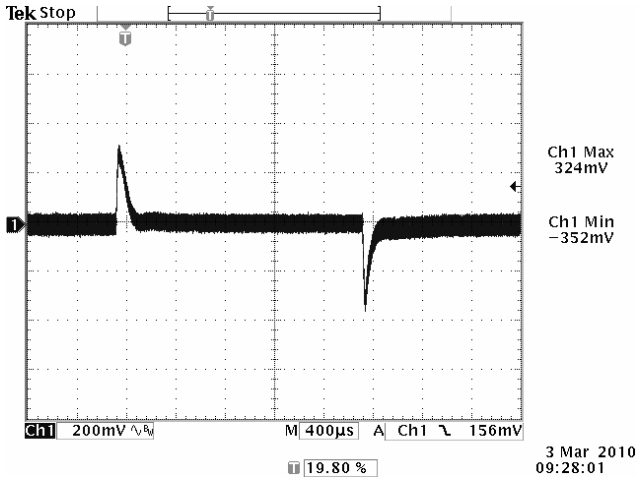
48 Vdc input, 12Vdc/7A output

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

Transient Response Waveforms



50%-75% Load Transients at Vin=24 V

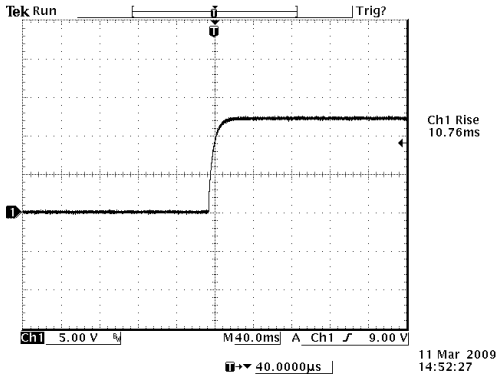


75%-50% Load Transients at Vin=48 V

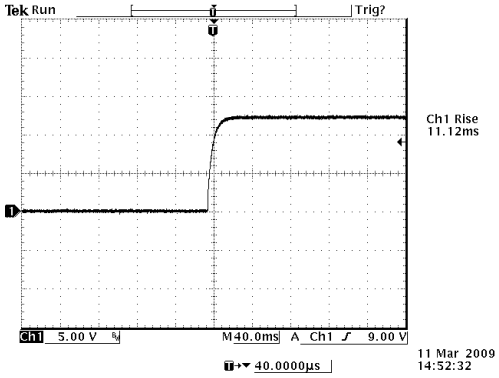
Note: Transients Response at Vo=12V, di/dt=0.1 A/us, with a 0.1 µF ceramic cap and a 10 uF tantalum cap at output, and Ta=25 deg C.

Startup & Shutdown

Rise time

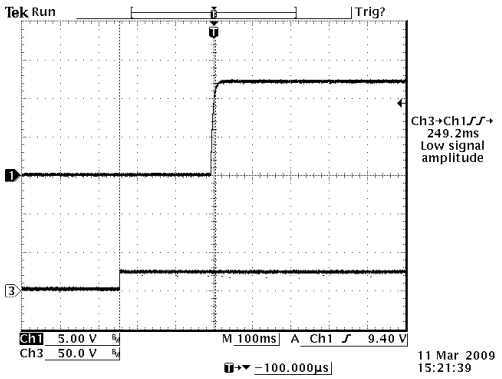


Vout= 12V full load at Vin=24V@Ta=25℃

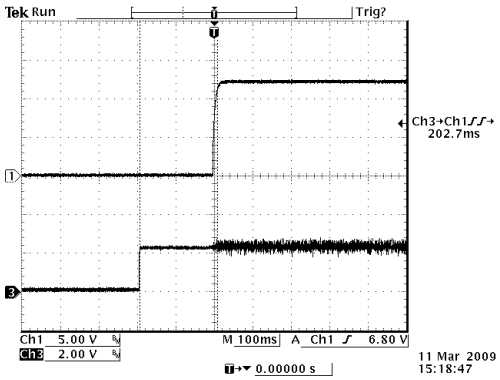


Vout= 12V full load at Vin=48V@Ta=25℃

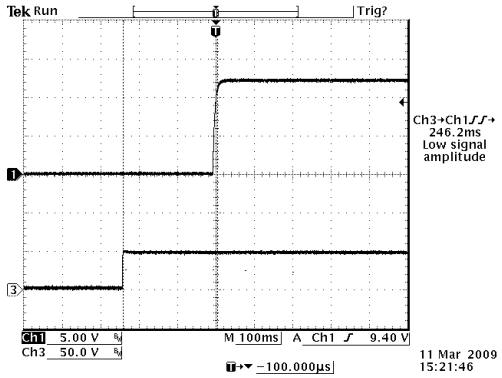
Startup time



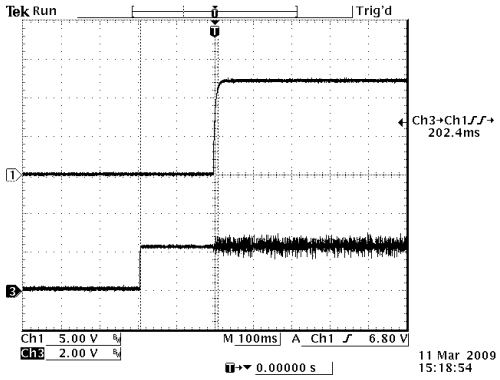
Startup from Vin
Ch1: Vo
Ch3: Vin
Vout= 12V full load at Vin=24V@Ta=25℃



Startup from on/off
Ch1: Vo
Ch3: on/off
Vout= 12V full load at Vin=24V@Ta=25℃



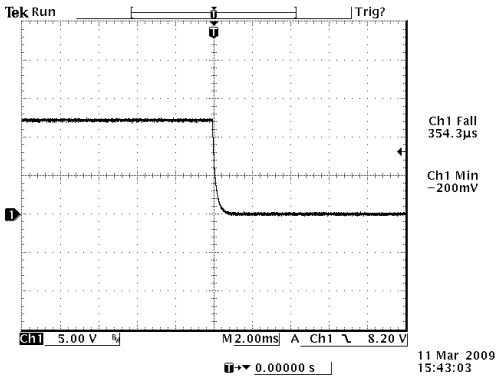
Startup from Vin
Ch1: Vo
Ch3: Vin
Vout= 12V full load at Vin=48V@Ta=25℃



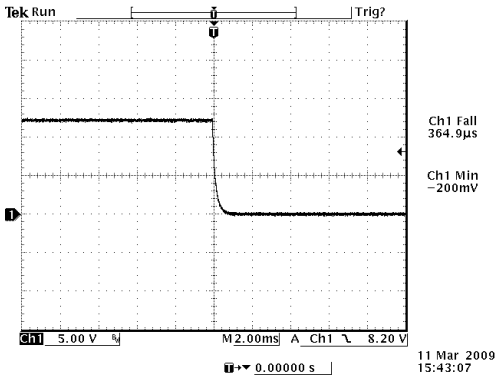
Startup from on/off
Ch1: Vo
Ch3: on/off
Vout= 12V full load at Vin=48V@Ta=25℃

Startup & Shutdown(continued)

Shutdown



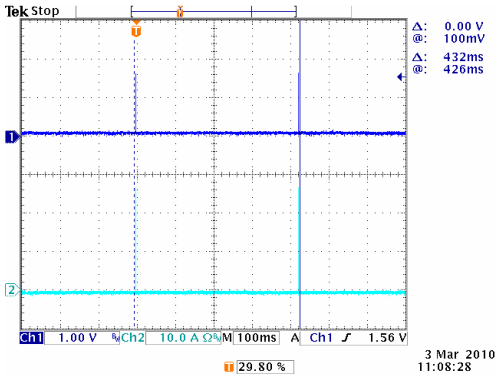
Vout= 12V full load at Vin=24V@Ta=25℃



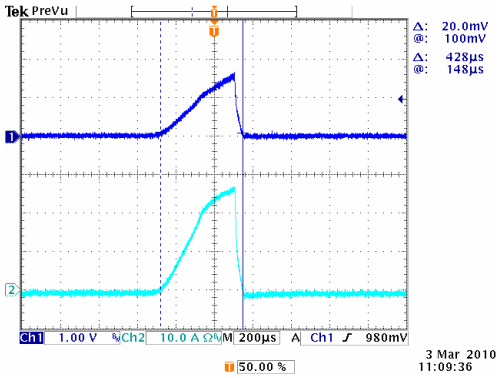
Vout= 12V full load at Vin=48V@Ta=25℃

Over Current Protection

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 400mS. The module operates normally when the output current goes into specified range.



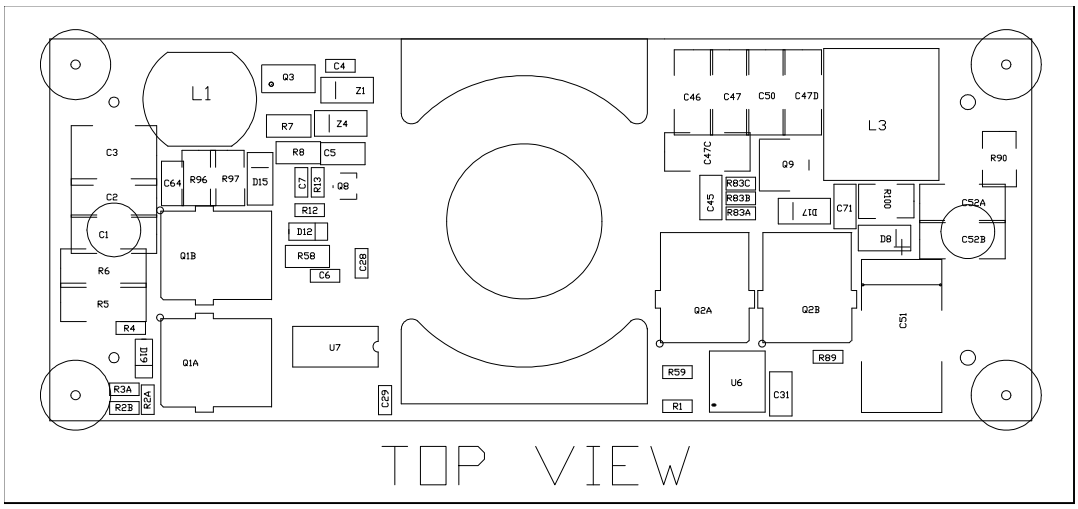
CH1: Output voltage waveform
CH2: Output current waveform
48V input with a Rout (0.171ohm)



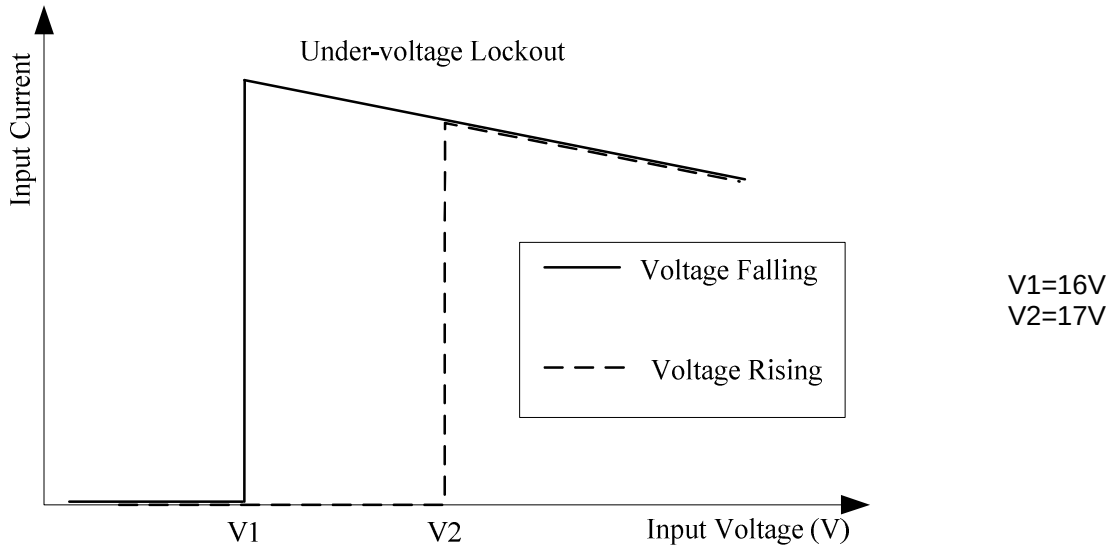
CH1: Output voltage waveform
CH2: Output current waveform
48V input with a Rout (0.171ohm)
Expansion of on time portion of above figure

Over temperature protection

The OTP is achieved by thermistor RT and the threshold is set at 125C in non-latch mode; the hottest component Q1 reaches 125C with 100LFM air flow correspondingly. It will restart automatically when the temperature falls down to 100C. The protecting point will be varied a little under different conditions (air flow, ambient temperature,input voltage, load...).



Input under-voltage lockout

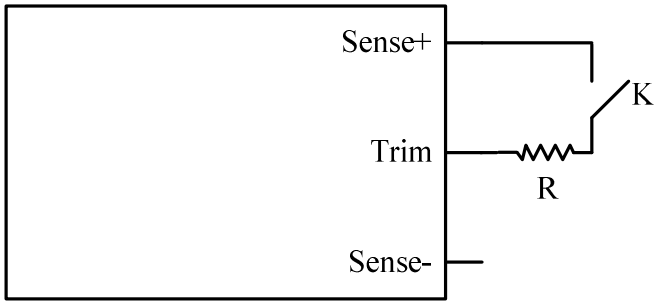


V1=16V
V2=17V

Output Overvoltage Protection

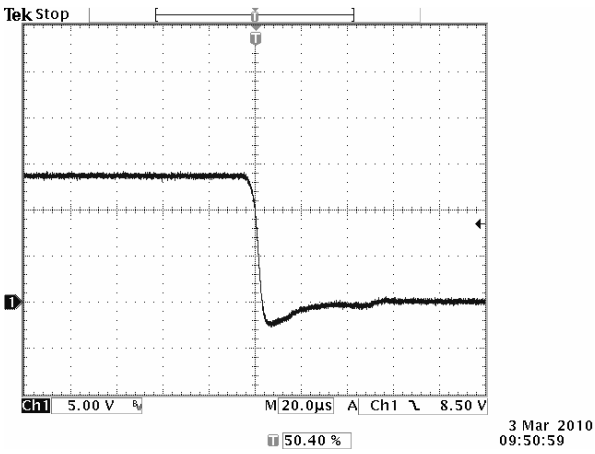
The output overvoltage protection consists of circuitry that monitors the voltage on the output terminals. If the voltage on the output terminals exceeds the over voltage protection threshold, the module will shutdown into hiccup mode and restart once every 400mS. The module operates normally when the fault is cleared.

Test setup:



R=350K

Waveform:



CH1: Output voltage waveform

Safety&EMC

Safety :

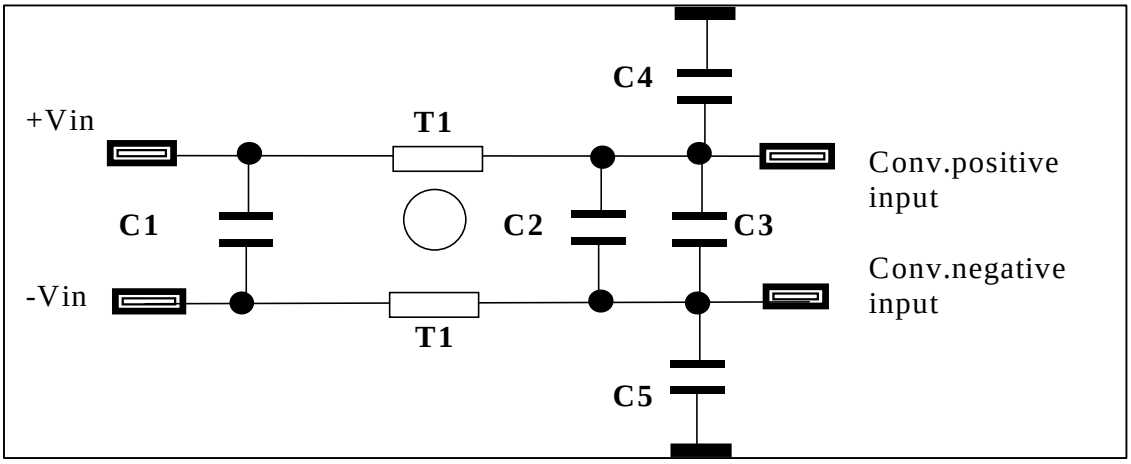
Material flammability: UL94V-0
TUV certicification to EN60950-1
UL certicification to UL60950-1

EMC:

1. Surge: IEC61000-4-5
2. DC-DIP: IEC61000-4-29
3. Conductive EMI: EN55022 class A

Compliance to EN55022 class A (both q.peak and average) with the following inductive and capacitive filter.

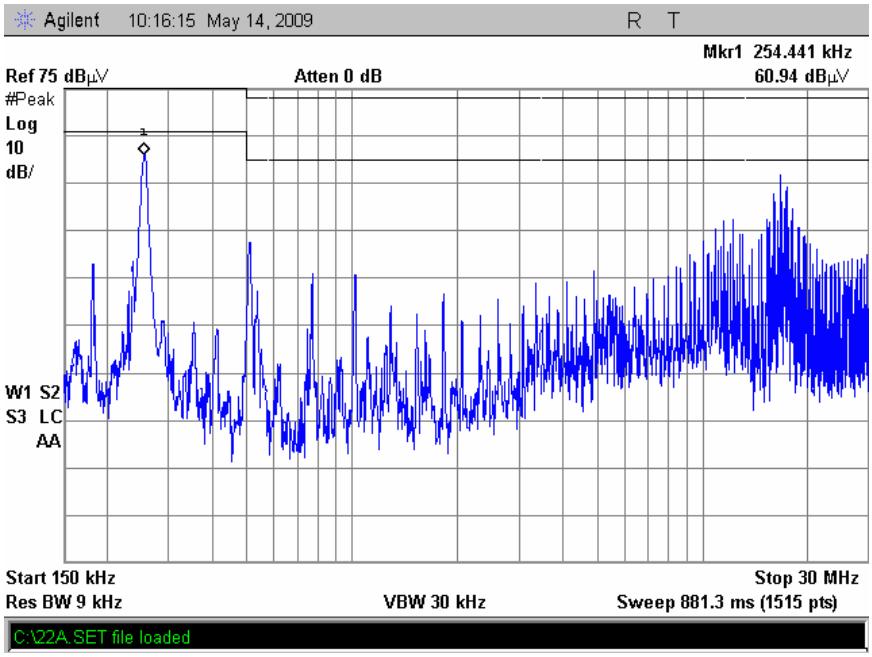
Setup:



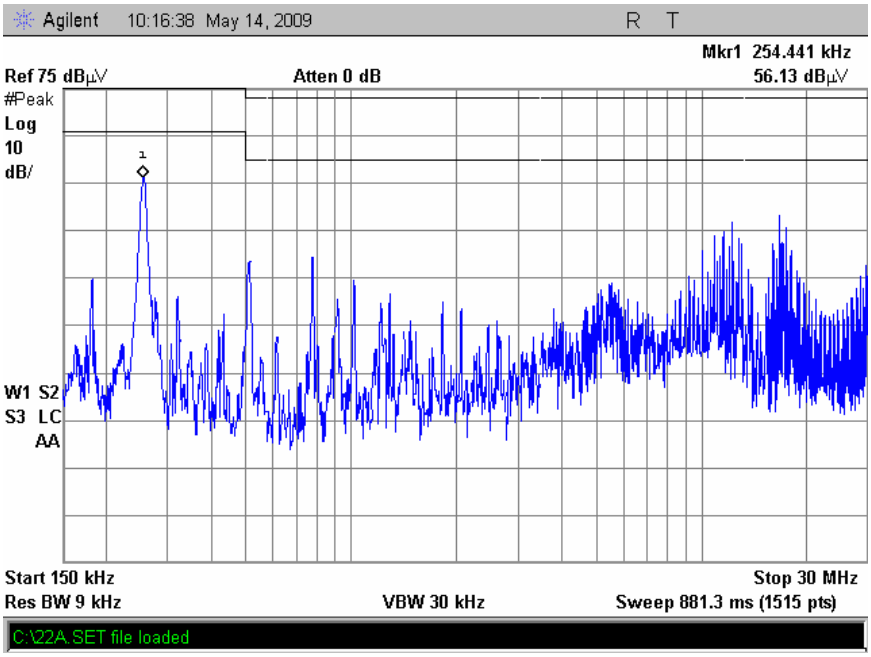
Item	Designator	Parameter	Vendor	Vendor P/N
1	C1	2.2uF/100V,ceramic	Murata	GRF32ER72A225KA11L
2	C2	47uF/100V, AL cap	Nichicon	UUJ2A470MNL1MS
3	C3	100uF/100V, AL cap	Nichicon	UVZ2A101MPD
4	C4	1000pF/2000V,ceramic	Johanson	202R18W102KV4E-****-RC
5	C5	1000pF/2000V,ceramic	Johanson	202R18W102KV4E-****-RC
6	T1	1.3mH, common mode	Pulse	P0402NL

Safety&EMC(continued)

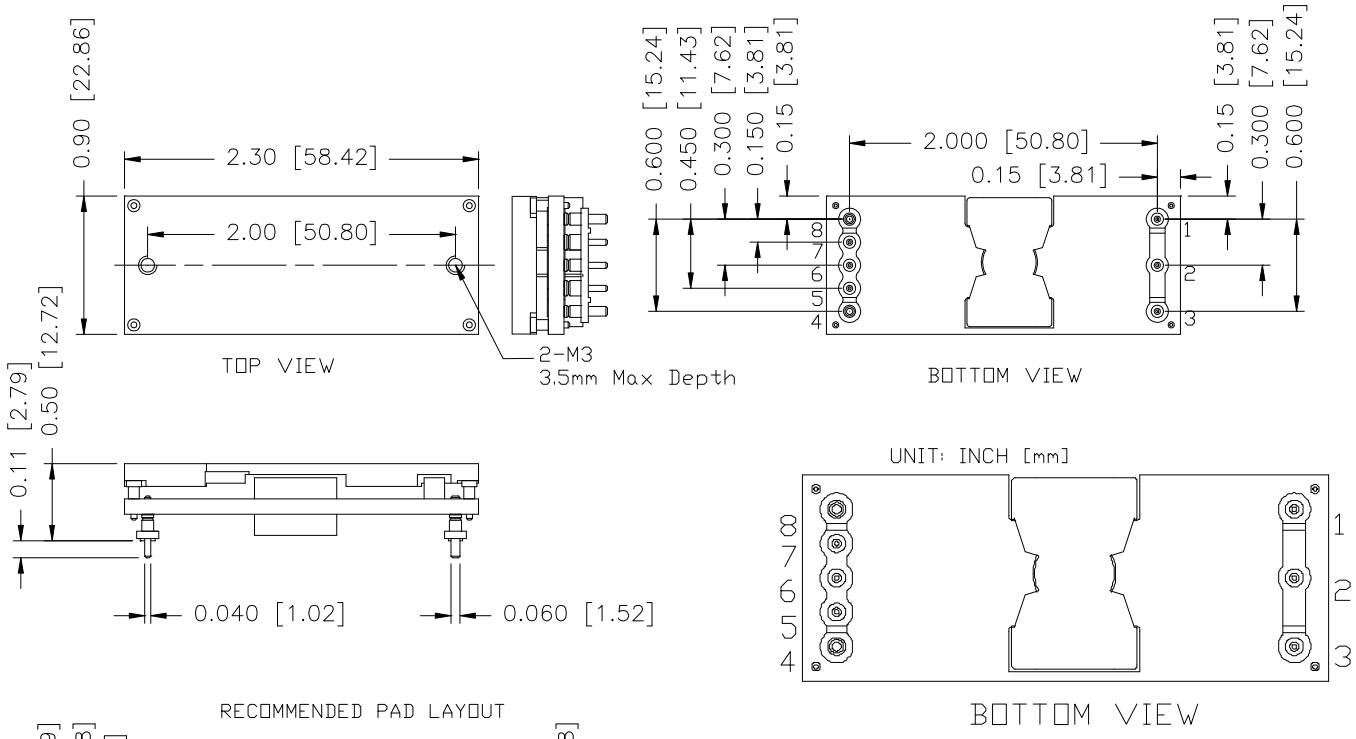
Positive:



Negative:



Mechanical Outline



Pin Connections

Pin	Name	Function	Pin Dia
1	Vin+	Positive input voltage	0.040"
2	On/Off	Input to turn converter on and off, referenced to Vin-	0.040"
3	Vin-	Negative input voltage	0.040"
4	Vout-	Negative output voltage	0.062"
5	Sense-	Negative remote sense	0.040"
6	Trim	Output voltage trim	0.040"
7	Sense+	Positive output voltage	0.040"
8	Vout+	Positive output voltage	0.062"

Notes: 1. Pin 5 must be connected to Vout-.
2. Leave Pin 6 open for nominal voltage.
3. Pin 7 must be connected to Vout+.

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.

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. (x.x +/-0.5mm) x.xxx +/-0.010 in. (x.xx +/-0.25mm).

Revision History

Date	Revision	Changes Detail	Approval
2012-7-27	PA	First release	XF Jiang
2013-5-3	PB	Updated Cout to 7000uF	XF Jiang
2014-2-7	PC	Updated MD	XF Jiang

RoHS Compliance

Complies with the European Directive 2002/95/EC, calling for the elimination of lead and other hazardous substances from electronic products.

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