ISOLATED DC/DC CONVERTERS

18 Vdc - 75 Vdc Input 5 Vdc /30 A Output

0RQB-C5U05x RoHS Compliant PRELIMINARY Rev.B

- Isolated
- Ultra Wide Input Range
- Fixed Frequency
- High Efficiency
- High Power Density
- Input Under-Voltage Lockout
- Input Over-Voltage Lockout
- Output Over-Voltage Shutdown
- Over Temperature Protection
- SCP/OCP
- Low Cost
- Remote On/Off
- Basic Isolation
- Positive/Negative Remote Sense
- Output Voltage Trim

Description

The 0RQB-C5U05x is an isolated dc/dc converter that operates from a wide input range (18 Vdc - 75 Vdc) and can cover both 24 Vdc and 48 Vdc input range. This unit will provide up to 150 W of output power. This unit is 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. This converter is provided in an industry standard 1/4 brick package.

Part Selection

Output Voltage	Input Voltage	Max. Output Current	Max. Output Power	Typical Efficiency	Model Number Active High	Model Number Active Low
5 Vdc	18 Vdc - 75 Vdc	30 A	150 W	91%	0RQB-C5U050	0RQB-C5U05L

Notes: 1. Add “G” suffix at the end of the model number to indicate Tray Packaging.
2. All part numbers above indicate RoHS 6. Change the second letter "R" to "7" for RoHS 5 part numbers.

Absolute Maximum Ratings

Parameter	Min	Typ	Max	Notes
Continuous Input Voltage	-0.3 V	-	80 V	Non-operating
Input Transient Voltage	-	-	100 V	100mS maximum
Remote On/Off	-0.3 V	-	18 V	
I/O isolation voltage	-	-	1500 V	
Ambient Temperature	-40 °C	-	85 °C	
Storage Temperature	-55 °C	-	125 °C	

Input Specifications

Parameter	Min	Typ	Max	Notes
Input Voltage	18 V	24 V/48 V	75 V	Operating
Input Current (full load)	-	-	10.5 A	
Input Current (no load)	-	100 mA	130 mA	
Remote Off Input Current	-	10 mA	15 mA	

Input Specifications (continued)

Parameter	Min	Typ	Max	Notes
Input Reflected Ripple Current (pk-pk)	-	46 mA	60 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 (rms)	-	13 mA	18 mA	
I^2t Inrush Current Transient	-	-	0.5 A^2s	
Turn-on Voltage Threshold	-	17.0 V	17.5 V	
Turn-off Voltage Threshold	15.5 V	16.0 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 15A on system board. Refer to the fuse manufacture's datasheet for further information.

Notes: 1. This converter has internal C-L-C (0.47uF-0.47uH-8.8uF) filter.
2. All specifications are typical at 25 °C unless otherwise stated.

Output Specifications

Parameter			Min	Typ	Max	Notes
Output Voltage Set Point			4.90 V	5.0 V	5.10 V	V_{in}=48 V, Io=50% load
Load Regulation			-	±10 mV	±20 mV	
Line Regulation			-	±10 mV	±20 mV	
Regulation Over Temperature (-40deg.C-85deg.C)			-	±30 mV	±50 mV	
Ripple and Noise (pk-pk)			-	70 mV	120 mV	0-20 MHz BW, with 1µF ceramic capacitor and a 10uF Tantalum capacitor at output.
Ripple and Noise (rms)			-	16 mV	25 mV	
Output Ripple and Noise(Pk-Pk) under worst case			-	-	150 mV	over all operating input voltage, load and ambient temperature condition
Output Current Range			0 A	-	30 A	
Output DC Current Limit			32 A	40 A	48 A	
Short Circuit Surge Transient			-	-	5 A^2s	
Rise time			3 ms	-	6 mS	
Turn on Time			-	160 mS	200 mS	Enable form Vin
			-	150 mS	200 mS	Enable form ON/OFF
Overshoot at Turn on			-	0%	3%	
Output Capacitance			0 uF	-	2000 uF	
Transient Response						
25% ~ 50% Max Load	Overshoot	V_O=5 V	-	120 mV	250 mV	di/dt=0.1A/us, Vin=48Vdc, Ta=25°C, with a 1µF ceramic capacitor and a 10uF Tantalum cap at output.
	Settling Time		-	100 uS	200 uS	
50% ~ 25% Max Load	Overshoot		-	120 mV	250 mV	
	Settling Time		-	100 uS	200 uS	

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

ISOLATED DC/DC CONVERTERS

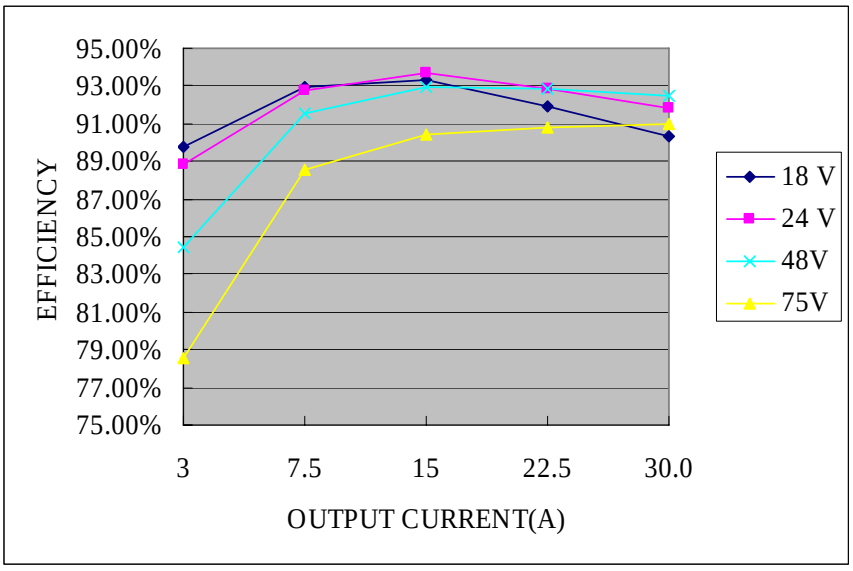
18 Vdc - 75 Vdc Input 5 Vdc /30 A Output

General Specifications

Parameter	Min	Typ	Max	Notes
Efficiency	90.5%	92.5%	-	V_{in}=48 V, full load
	90%	92%	-	V_{in}=24 V, full load
Switching Frequency	-	250 kHz	-	
Over Temperature Protection	-	125 °C	-	
Over Voltage Protection (Static)	-	6 V	6.5 V	This voltage is achieved by trimming up output slowly
Input to Output	-	-	1500 Vdc	
Input to Case	-	-	1500 Vdc	
Output to Case	-	-	500 Vdc	
Isolation Resistance	10M Ohm	-	-	
Isolation Capacitance	-	3900 pF	-	
FIT	429			Calculated Per Bell Core SR-332 (Vin=48 V, Vo=5 V, Io=24 A, Ta = 25C, FIT=109/MTBF)
Dimensions Inches millimeters	2.30 x 1.45 x 0.50 58.42 x 36.83 x 12.69			
Weight	-	70 g	-	

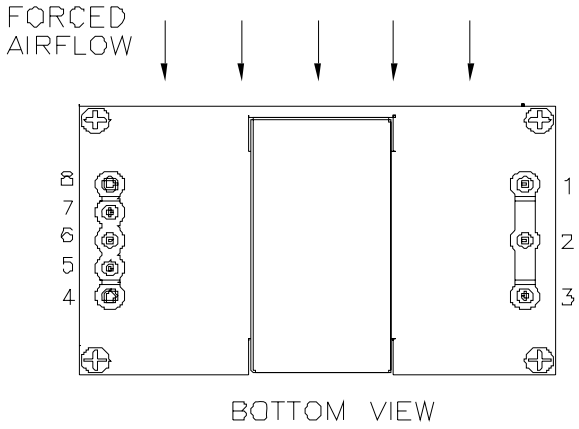
Note: All specifications are typical at 25 °C unless otherwise stated.

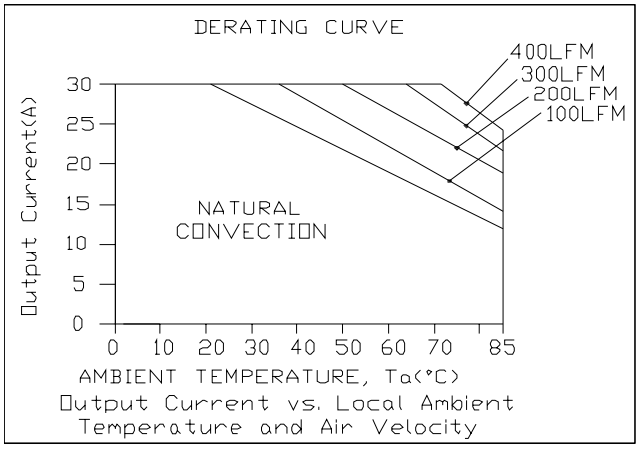
Efficiency Data



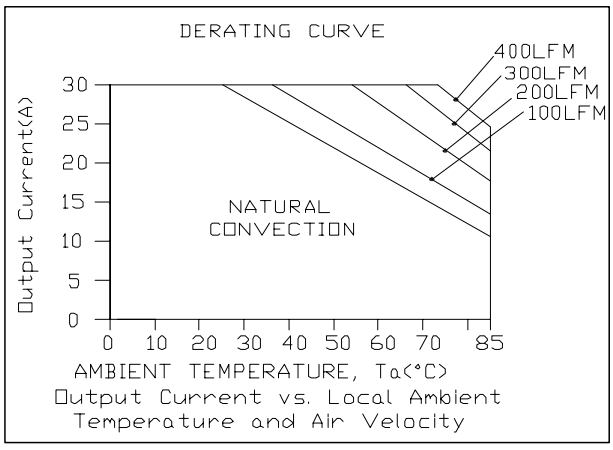
Thermal Derating Curve

Maximum junction temperature of semiconductors derated to 120 degree C.

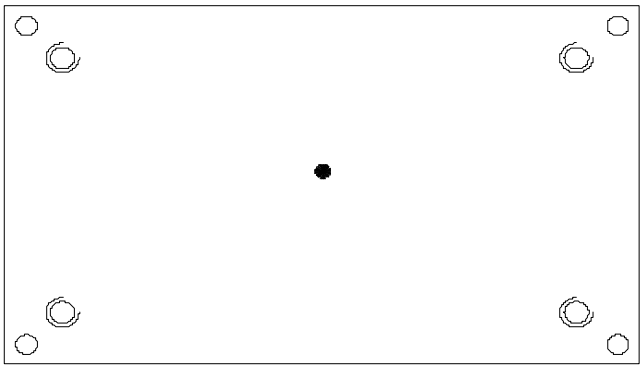




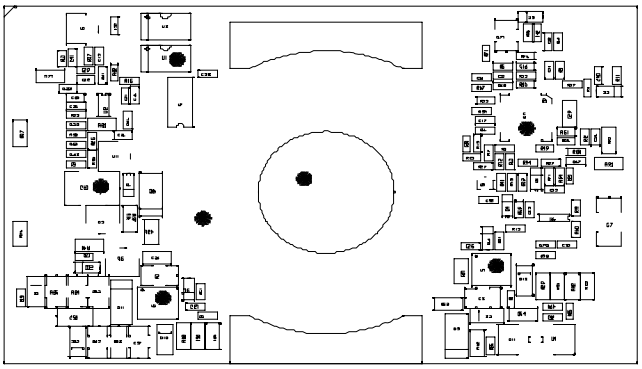
Vin=24V
Derating curve under normal 1 input



Vin=48V
Derating curve under normal 2 input

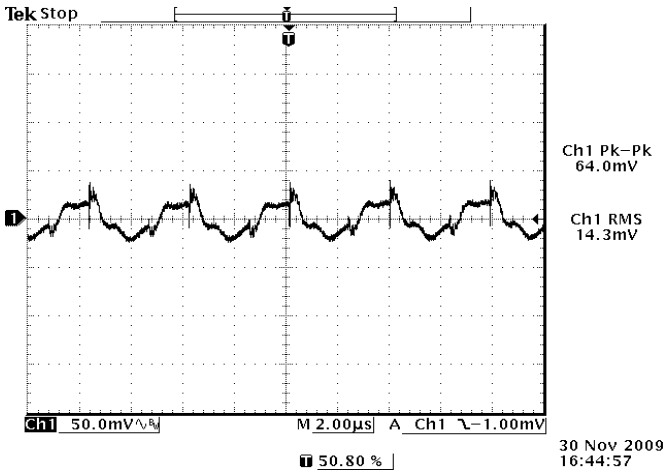


Temperature reference points on top side

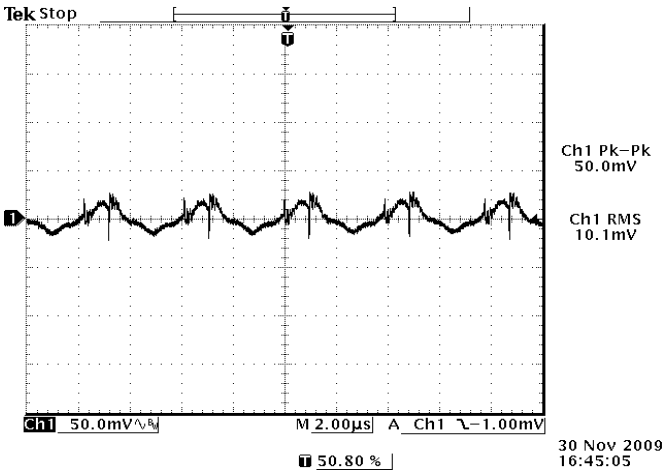


Temperature reference points on bottom side

Ripple and Noise Waveform



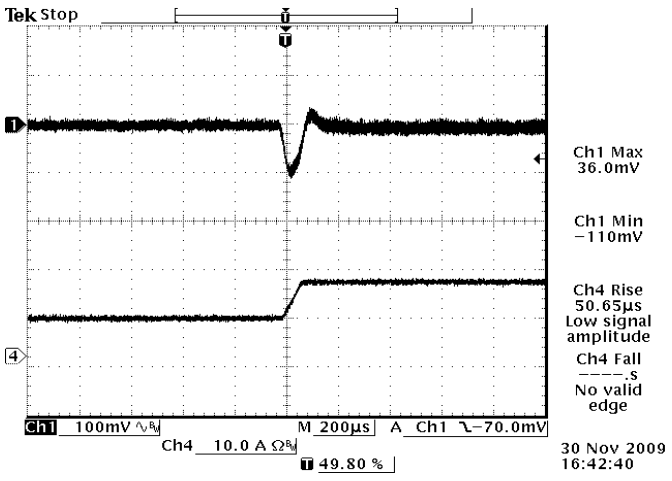
24Vdc input, 5Vdc/30A output



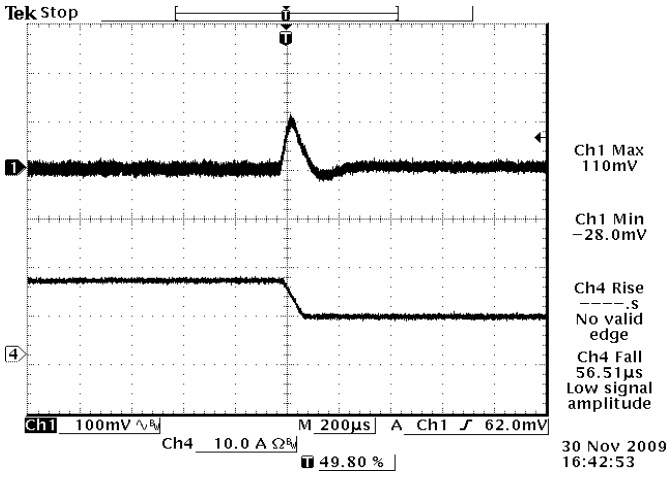
48Vdc input, 5Vdc/30A output

Note: Ripple and noise at full load, with a 1uF ceramic cap and a 10 uF Tantalum cap at output, Ta=25 deg C.

Transient Response Waveforms

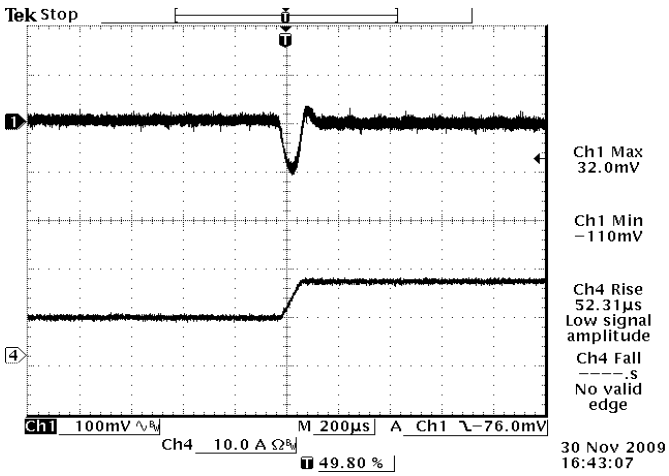


Vin= 24V, Vout= 5V 25%-50% Load Transients

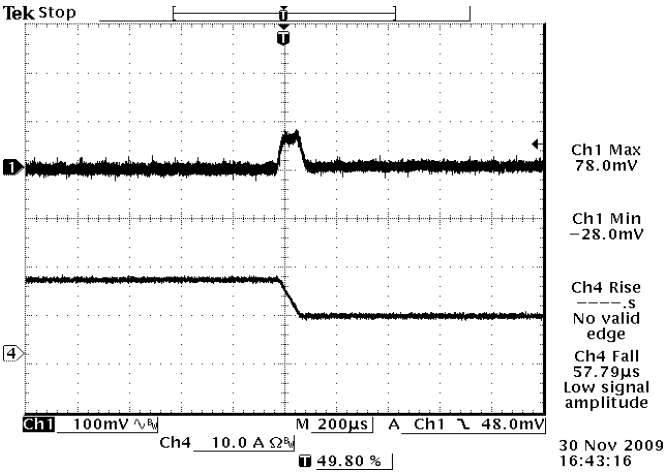


Vin= 24V, Vout= 5V 50%-25% Load Transients

Transient Response Waveforms (continued)



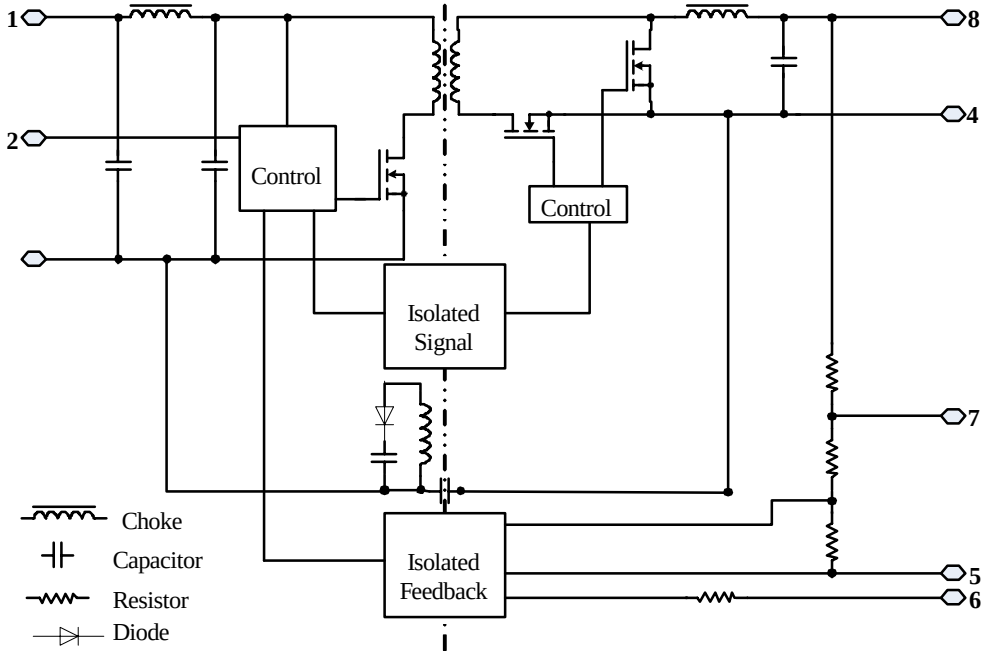
Vin= 48V, Vout= 5V 25%-50% Load Transients



Vin= 48V, Vout= 5V 50%-25% Load Transients

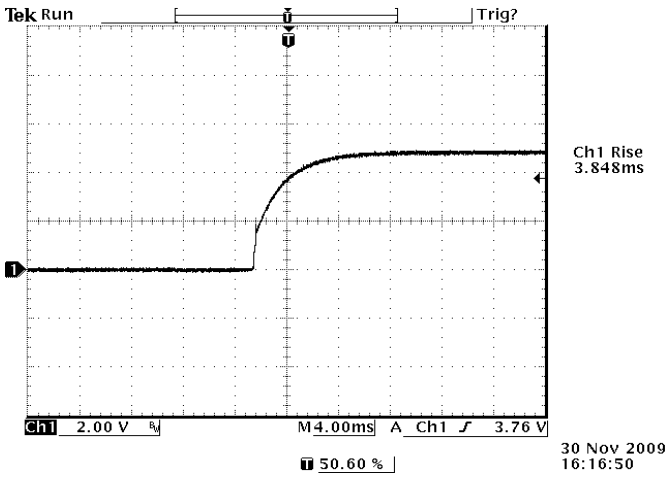
Note: Transient Response at di/dt=0.1A/uS, with a 1uF ceramic cap and a 10uF aluminum cap at the output, Ta=25 deg C.

Fundamental Circuit Diagram

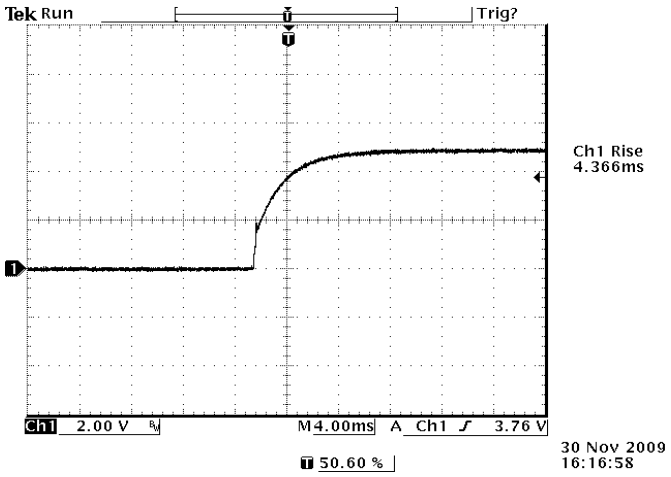


Startup & Shutdown

Rise Time

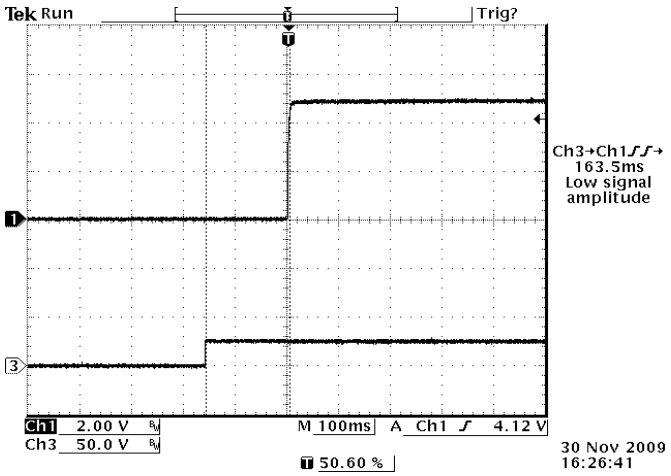


Vin=24V, Vo=5V, Io=30A

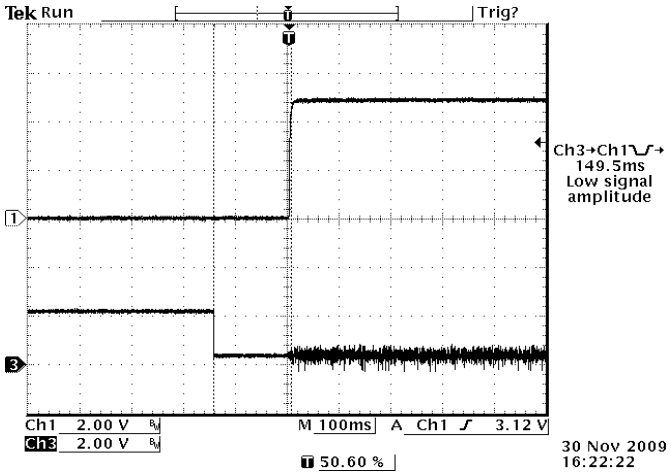


Vin=48V, Vo=5V, Io=30A

Startup time



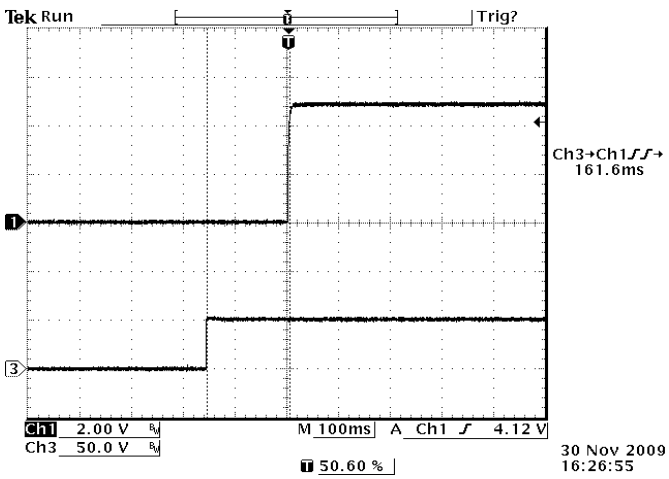
Startup from Vin
Ch1: Vo
Ch3: Vin
Vin=24V, Vo=5V, Io=30A



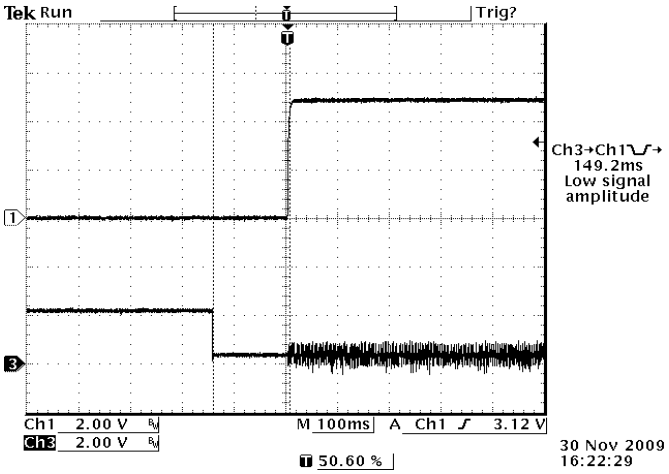
Startup from on/off
Ch1: Vo
Ch3: on/off
Vin=24V, Vo=5V, Io=30A

Startup & Shutdown (continued)

Startup time

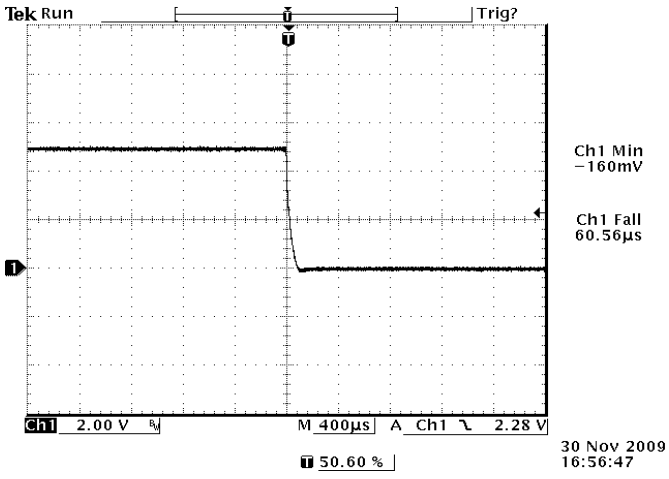


Startup from Vin
Ch1: Vo
Ch3: Vin
Vin=48V, Vo=5V, Io=30A

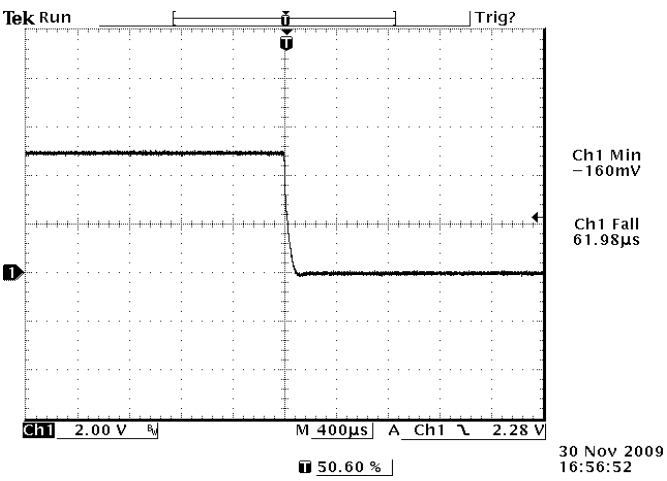


Startup from on/off
Ch1: Vo
Ch3: on/off
Vin=48V, Vo=5V, Io=30A

Shutdown



Vin=24V, Vo=5V, Io=30A

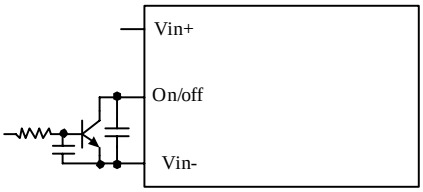


Vin=48V, Vo=5V, Io=30A

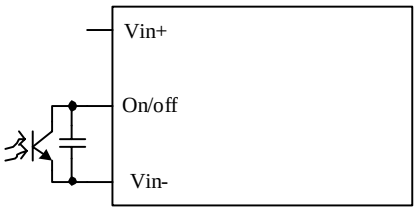
Remote On/Off

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	
Signal Low (Unit Off)	Active High	-0.3	-	0.8	V	The remote on/off pin open, Unit on.
Signal High (Unit On)		2.4	-	18	V	
Current Sink		0	-	1	mA	

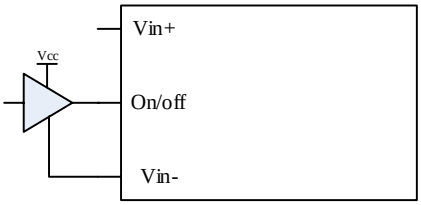
Recommended remote on/off circuit for active low



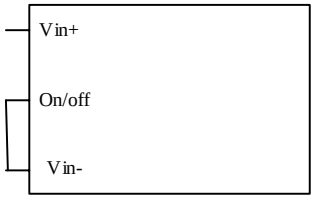
Control with open collector/drain circuit



Control with photocoupler circuit

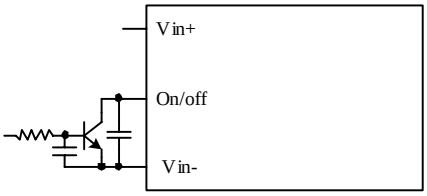


Control with logic circuit

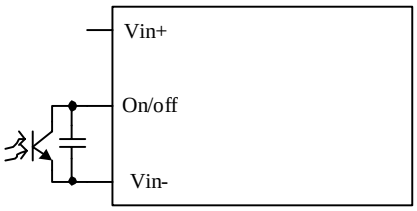


Permanently on

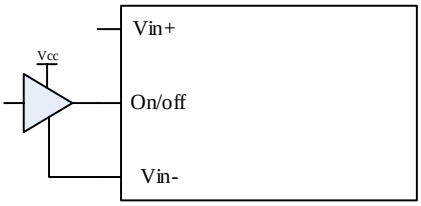
Recommended remote on/off circuit for active high



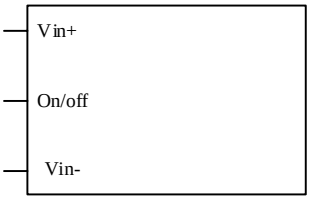
Control with open collector/drain circuit



Control with photocoupler circuit



Control with logic circuit



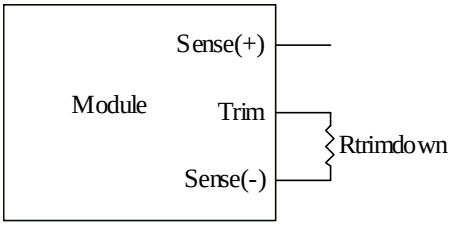
Permanently on

Output Trim Equations

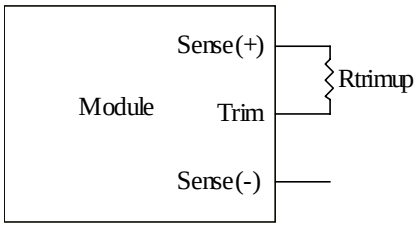
Equations for calculating the trim resistor are shown below. The Trim Down resistor should be connected between the Trim pin and Sense (-) pin. The Trim Up resistor should be connected between the Trim pin and the Sense (+). Only one of the resistors should be used for any given application.

Minimum trim down voltage is 4.5V
Maximum trim up voltage is 5.5V.
The total voltage increased by trim and remote sense should not exceed 10% of the nominal output voltage.

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

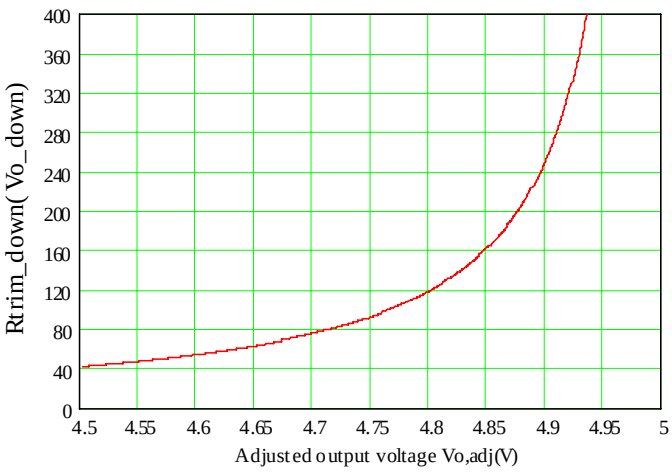


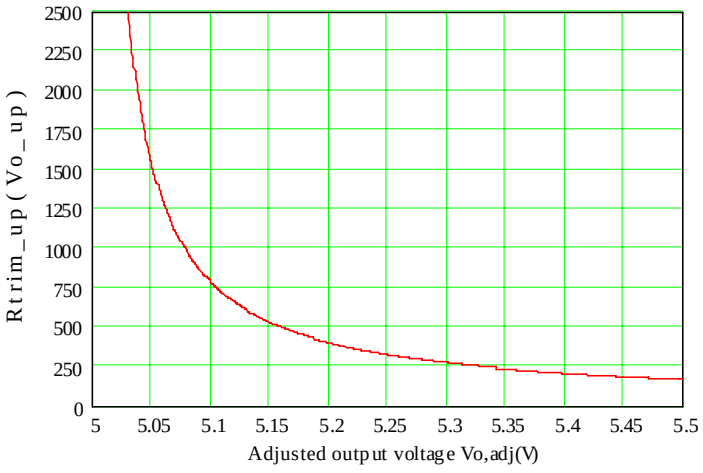
$$Rtrimup = \frac{(100 + delta) \cdot Vo \cdot 5.11 - 626}{1.225 \cdot delta} - 10.22[k\Omega]$$



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

Vo_req=Desired (trimmed) output voltage [V]
Output voltage Vo=5.000 V

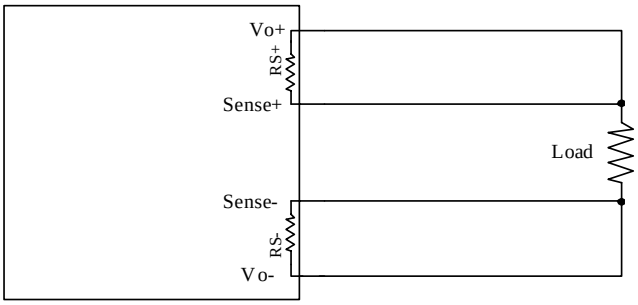




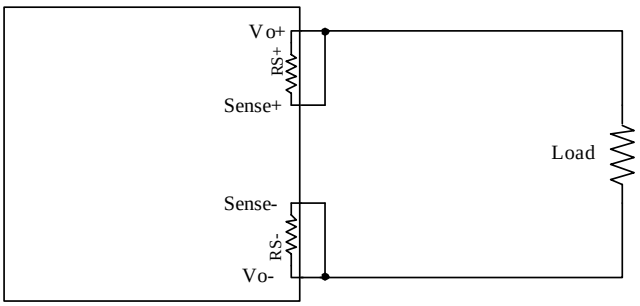
Remote Sense

This module has remote sense compensation feature. It can minimize the effects of resistance between module's output and load in system layout and facilitates accurate 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 incorporated 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+ (100 ohm) from Vo+ to Sense+ and a resistor RS- (51 ohm)) from Vo- to Sense- inside of this module.

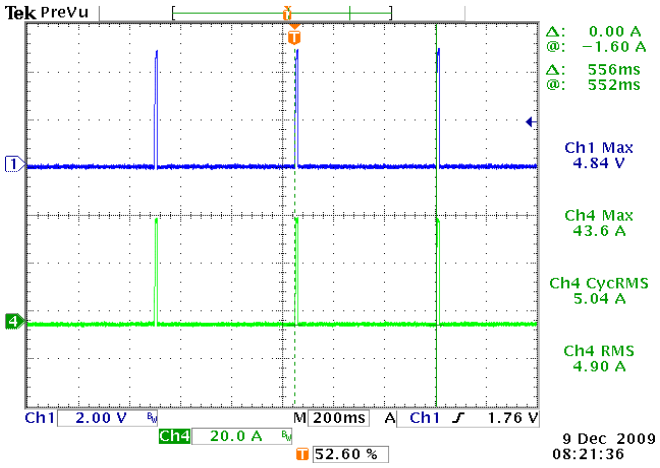


6. If not using remote sense compensation, please connect sense directly to output at module's pin, that is, connect sense+ to Vo+ and sense- to Vo- at module's pin, the shorter the better. See below figure.

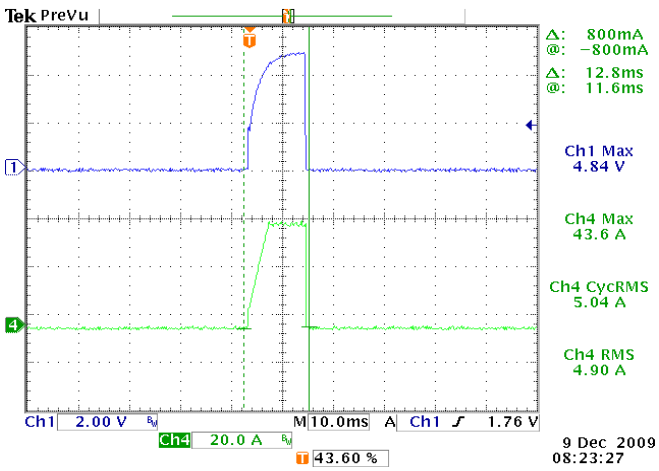


Over Current Protection

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 over current condition persists beyond a few milliseconds, the module will shut down into hiccup mode and restart once every 560mS. The module operates normally when the output current goes into specified range. The typical average output current is 5A during hiccup.



Vin=48V, Vout=5V, Rout=0.09Ω

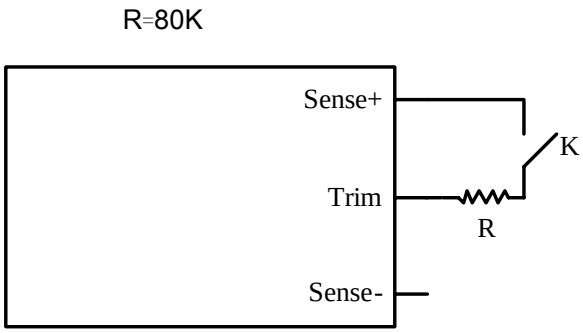


Expansion of on time portion

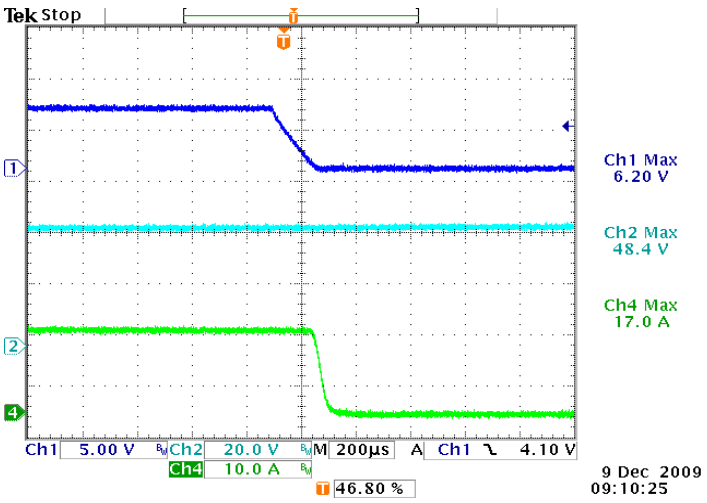
Over Voltage Protection

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 560mS. The module operates normally when the fault is cleared.

Test setup:



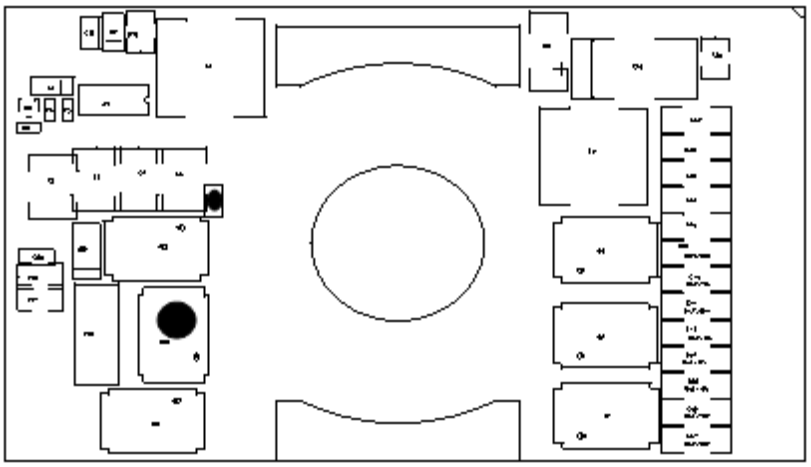
Waveform:



CH1: Output voltage waveform
CH2: Input voltage waveform
CH3: Output Current waveform

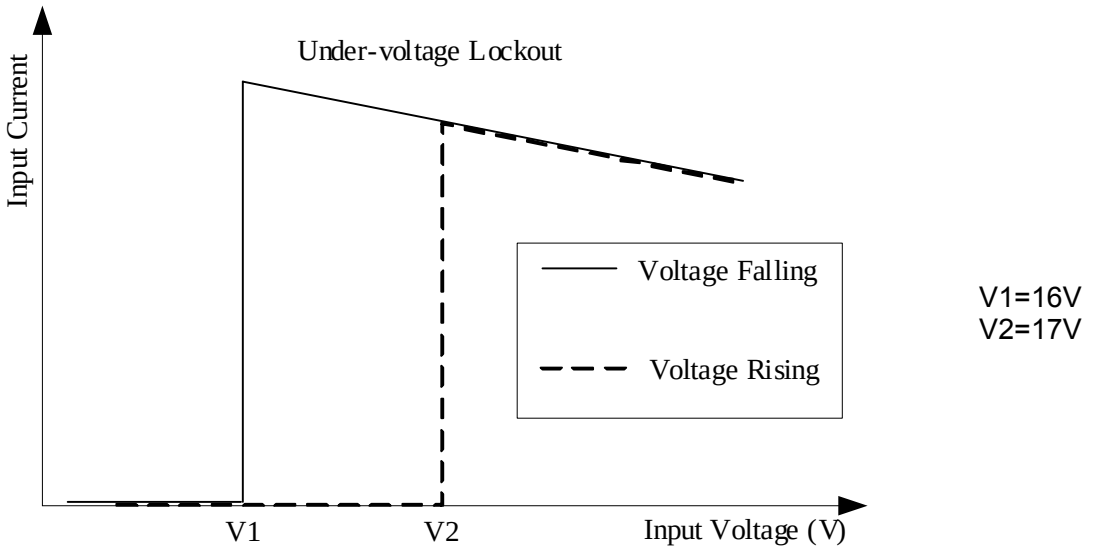
Over Temperature Protection

The OTP is achieved by thermistor RT and the threshold is set at 120C in non-latch mode; the hottest component Q12 reaches 130C 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...).



TOP VIEW

Input Under-voltage Lockout



V1=16V
V2=17V

Safety & EMC

Safety

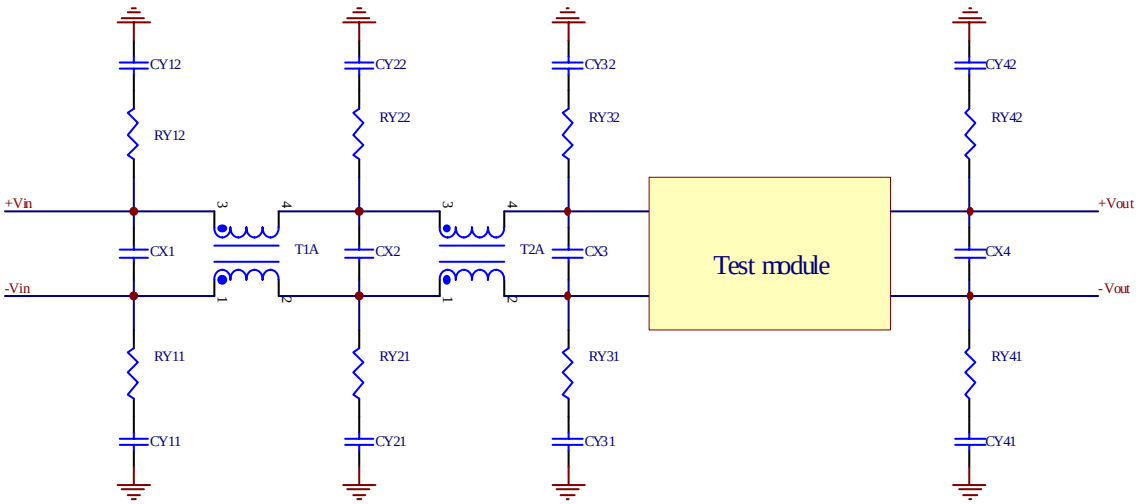
1. Material flammability UL94V-0
2. TUV Certification EN60950-1
3. UL Certification UL60950-1

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

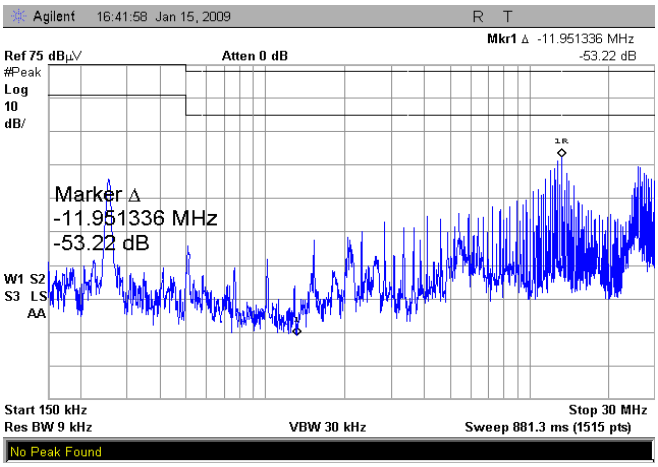
Setup:



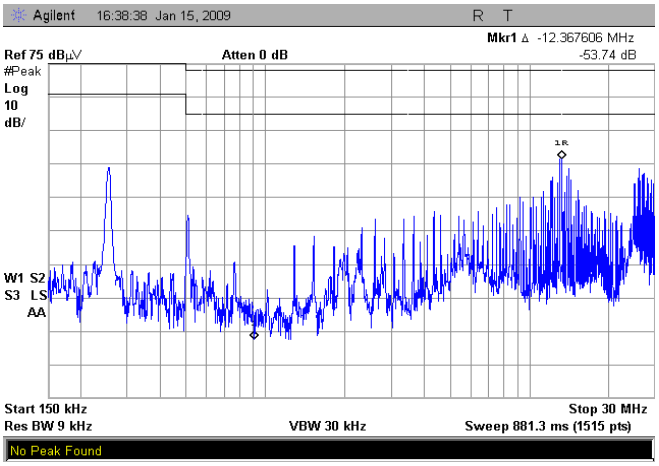
Item	Designator	Parameter	Vendor	Vendor P/N
1	CX1,CX2	2.2uF/100V,ceramic	Murata	GRF32ER72A225KA11L
2	CX3	2*100uF/100V,AL cap	Nichicon	UVZ2A101MPD
	RY21,RY22, RY41,RY42	0R	SEI	RMC0805 1/10W 0R 5%
	RY31,RY32	51.1R	SEI	RMC0805 1/10 51R1 1%
3	CY21,CY22	2*6.8nF/2kV, ceramic	Johanson	202S41W682KV4E
4	CY31,CY32, CY41,CY42	2*4.7nF/2kV, ceramic	Johanson	202S41W472KV4E
5	T1	1mH, common mode		PE-53910T
6	T2	2.2mH, common mode	Pulse	

Safety & EMC (continued)

Positive

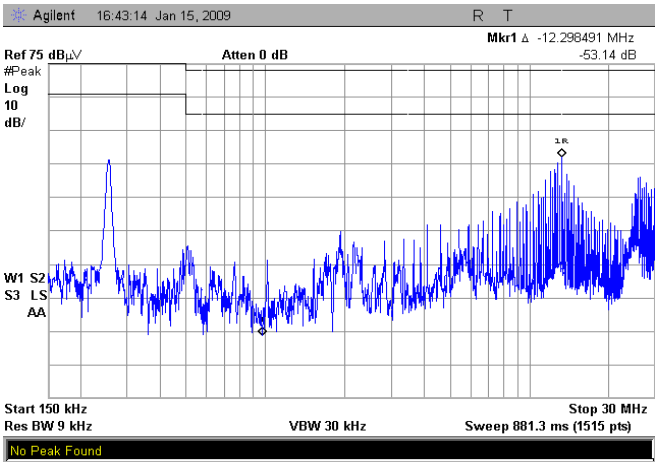


Vin=24V, Vo=5V, Io=30A

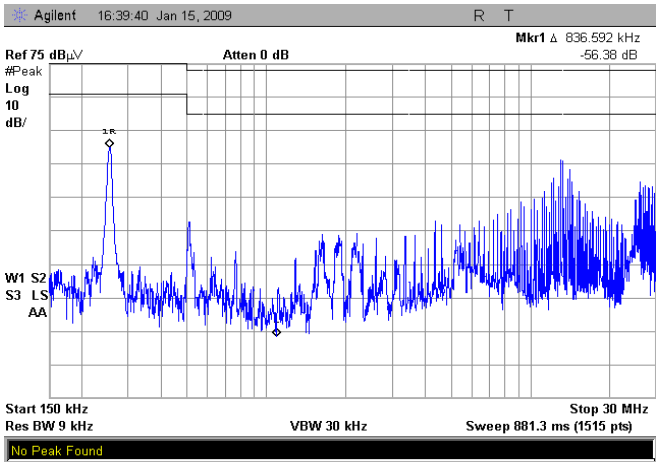


Vin=48V, Vo=5V, Io=30A

Negative

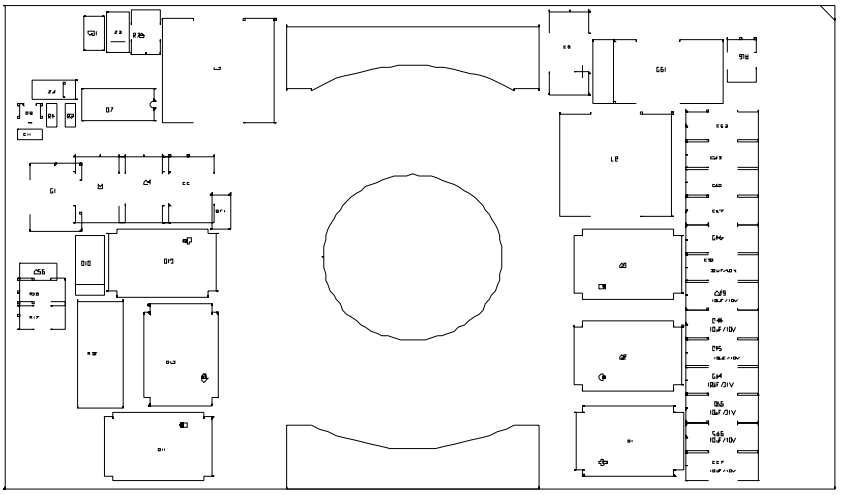


Vin=24V, Vo=5V, Io=30A

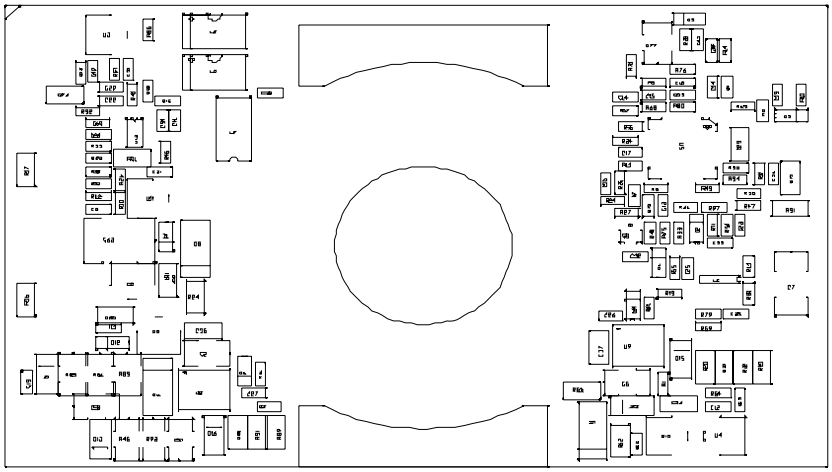


Vin=48V, Vo=5V, Io=30A

Layout



Layout of components on top side

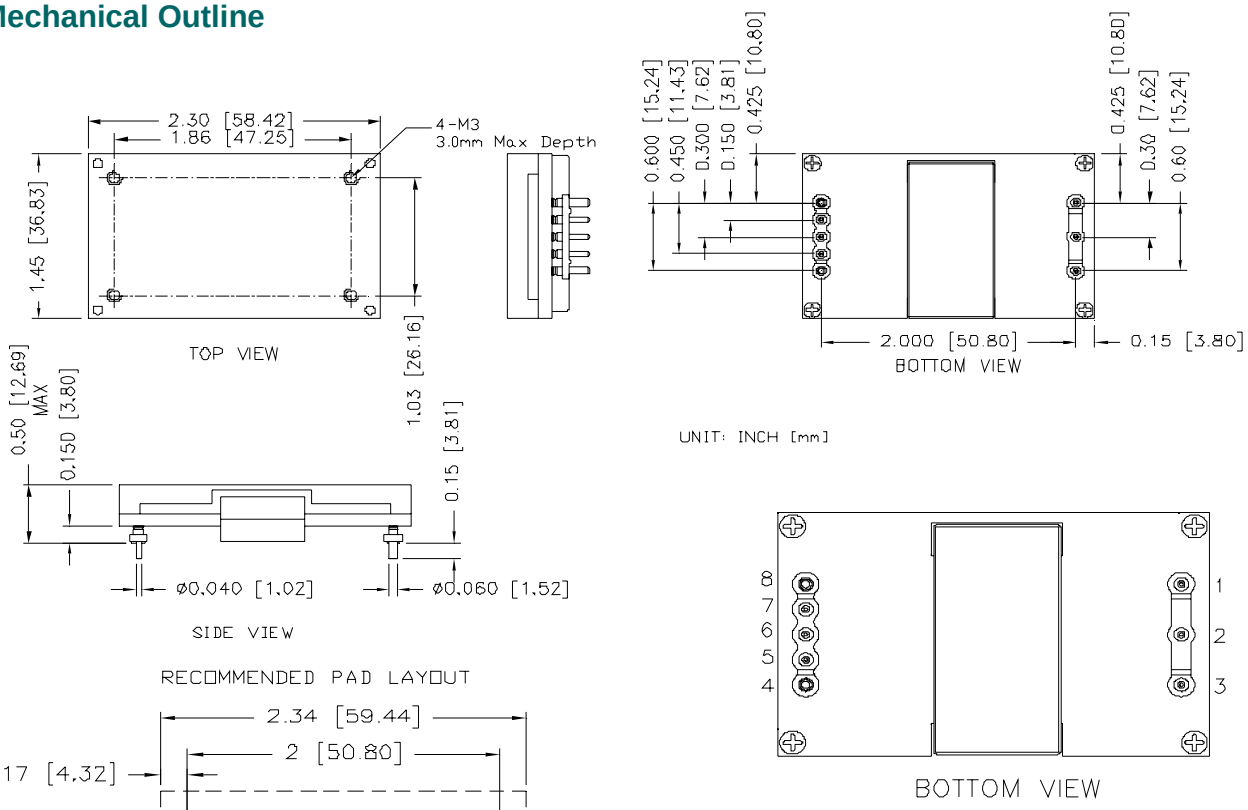


Layout of components on bottom side

ISOLATED DC/DC CONVERTERS

18 Vdc - 75 Vdc Input 5 Vdc /30 A Output

Mechanical Outline



Pin Connections

Pin	Function	Pin Size
1	Vin(+)	0.040"
2	On/Off	0.040"
3	Vin(-)	0.040"
4	Vo(-)	0.060"
5	Sense(-)	0.040"
6	TRIM	0.040"
7	Sense(+)	0.040"
8	Vo(+)	0.060"

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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