

# 0RQB-15Y05X

## Isolated DC-DC Converter

The 0RQB-15Y05X is an isolated DC/DC converter providing 15 W of output power from a wide input range (24 V, 48 V, 72 V, 96 V, 110 V typical). Standard features include remote on/off, input under-voltage protection, output over-voltage protection, over current and short circuit protection.

This converter can also provide a 5 V/5 mA auxiliary supply.

When a large hold-up capacitor is added, the converter can still work up to 12 ms when the input supply is interrupted.

Conformal coated PCB is used for environmental ruggedness.



### Key Features & Benefits

- 24/48/72/96/110 VDC Input / 5 VDC @ 3 A Output
- Isolated
- High Efficiency
- Hold-up function
- Remote ON/OFF
- Conformal coated
- Input under-voltage protection
- Output over-voltage protection
- Over current and short circuit protection
- 5V auxiliary supply at primary side
- Wide input range (24 V, 48 V, 72 V, 96 V, 110 V typical)
- Approved to EN 60950-1, 2nd +A2 version
- Class II, Category 2, Isolated DC/DC Converter (refer to IPC-9592B)

### Applications

- Industrial
- Railways



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## 1. MODEL SELECTION

MODEL NUMBER	OUTPUT VOLTAGE	INPUT VOLTAGE	MAX. OUTPUT CURRENT	MAX. OUTPUT POWER	TYPICAL EFFICIENCY
ORQB-15Y05X	5 VDC	24/48/72/96/110VDC	3A	15 W	76%

**NOTE:** Add "G" suffix at the end of the model number to indicate Tray Packaging.

### PART NUMBER EXPLANATION

0	R	QB	-	15	Y	05	X	y
Mounting Type	RoHS Status	Series Name		Output Power	Input Range	Output Voltage	Logic status	Package Type
Through hole mount	RoHS	1/4th Brick		15 W	24/48/72/96/110V	5 V	X – active low, without HSK	G – Tray package

## 2. ABSOLUTE MAXIMUM RATINGS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNITS
Continuous non-operating Input Voltage		-0.3	-	160	V
Remote On/Off		-0.3	-	15	V
Operating Temperature	Hot spot temperature, see Thermal Derating Curves section	-40	-	105	°C
Thermal resistance	Module to ambient	-	4	-	°C/W
Storage Temperature		-40	-	125	°C
Altitude		-	-	2500	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 1	Fully functioning for long term operation.	16.8	24	137.5	V
			48		V
			72		V
			96		V
Operating Input Voltage 2	Fully functioning for 0.1s operation. Full function is not guaranteed but undamaged for 1s operation.	14.4	-	16.8	V
			137.5	-	154
Input Voltage Rising Slope		-	-	2	V/ms
Input Current (full load)	Test at 9V input voltage	-	-	2.0	A
Input Current (no load)	Vin=24V, Ta=25°C	-	-	110	mA
Remote Off Input Current		-	-	40	mA
Input Reflected Ripple Current (rms)	With simulated source impedance of 10uH, 5Hz to 20MHz. Use two 100uF/250V electrolytic capacitors with ESR=0.5R max, at 200kHz@25°C.	-	-	20	mA
Input Reflected Ripple Current (pk-pk)		-	-	60	mA
Turn-on Voltage Threshold		14.5	15.2	16	V
Turn-off Voltage Threshold		12.5	13.2	14	V

**CAUTION:** This converter is not internally fused. An input line fuse must be used in application. Recommend a input fast-acting fuse with Typical of 3A on system board. Refer to the fuse manufacture's datasheet for further information.

## 4. OUTPUT SPECIFICATIONS

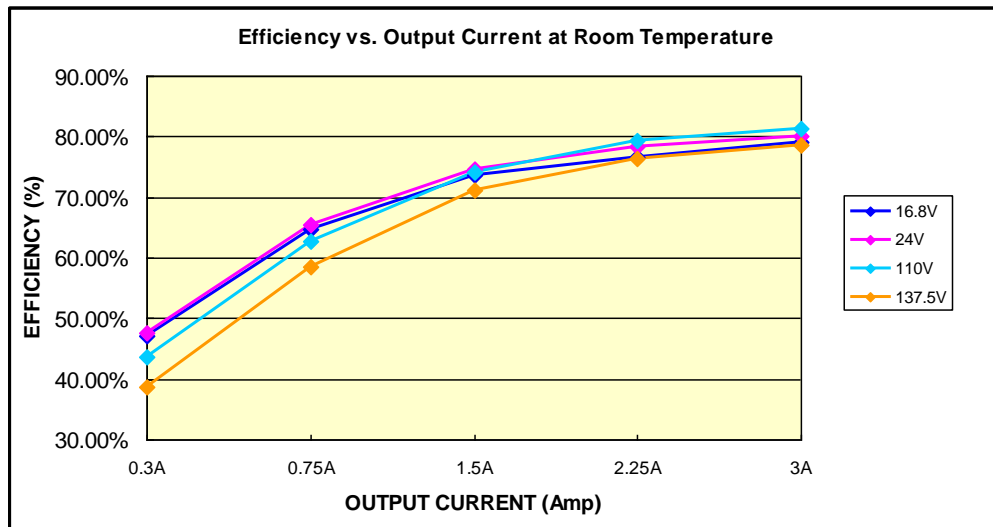
All specifications are typical at nominal input, full load at 25°C unless otherwise stated.

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Output Voltage Set Point		4.9	5	5.1	V
Load Regulation		-	-	10	mV
Line Regulation		-	-	10	mV
Regulation Over Temperature		-	-	60	mV
Output Ripple and Noise(Pk-Pk)	With a 100uF ceramic and a 100uF electrolytic capacitors at output.	-	30	55	mV
Output Ripple and Noise(RMS)		-	3	10	mV
Output Ripple and Noise(Pk-Pk) under worst case		-	32	-	mV
Output Current Range		0	-	3	A
Output DC Current Limit		4	5	5.5	A
Rise time		-	-	28	ms
Turn on Time	Ton(Enable form Vin)	-	-	1100	ms
	Ton(Enable form ON/OFF)	-	-	110	ms
Overshoot at Turn on		0	-	3	%
Output Capacitance	Typically 50% ceramic and 50% electrolytic capacitors.	200	-	1000	uF
5V Auxiliary Supply Source Current	At primary side.	-	-	5	mA
<b>Transient Response</b>					
$\Delta V$ 50%~75% of Max Load		80	105	130	mV
Settling Time	$V_{in}=24V$ , 0.1A/us, a 100uF ceramic and a 100uF electrolytic capacitors are near the brick output.	0.04	0.08	0.12	ms
$\Delta V$ 75%~50% of Max Load		80	105	130	mV
Settling Time		0.04	0.08	0.12	ms

## 5. GENERAL SPECIFICATIONS

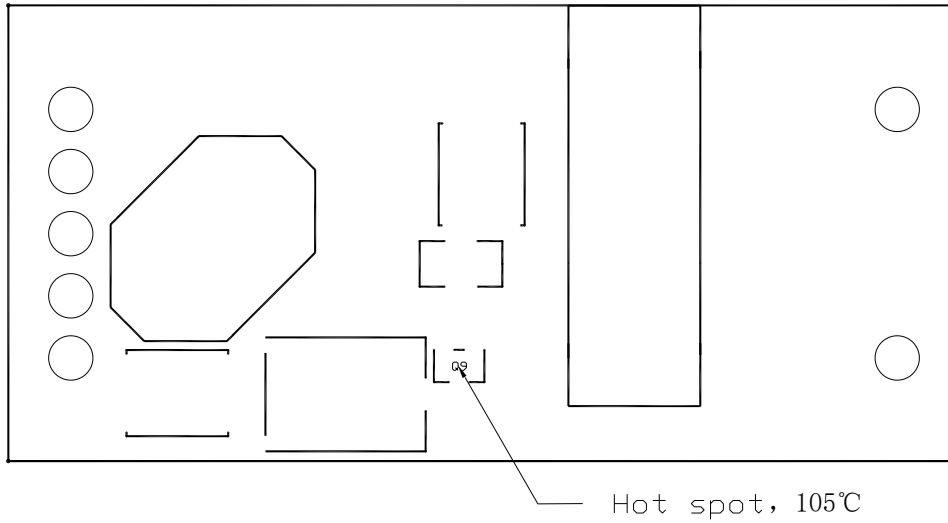
PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Efficiency	Vin=24V, Iout=3A	-	77	-	%
	Vin=48V, Iout=3A	-	78	-	%
	Vin=72V, Iout=3A	-	78	-	%
	Vin=96V, Iout=3A	-	78	-	%
	Vin=110V, Iout=3A	-	80	-	%
Switching Frequency	1st stage	-	150	-	kHz
	2nd stage	-	250	-	kHz
Over Temperature Protection	Hot spot temperature.	-	125	-	°C
Over Voltage Protection(Static)			6	-	V
FIT	Calculated Per IEC 62380 TR 1 (Utec 80-810) (Vin=24 V, Vo=5V, Io=3A, 0 LFM, Tac = 50°C, Tae=35°C)	-	160.61	-	-
MTBF		-	6.23	-	Mhrs
Isolation Voltage	Hot spot temperature.	-	-	2250	V
Weight		-	29	-	g
Dimensions (L x W x H)			2.30 x 1.1 x 0.425		Inches
			58.42 x 27.94 x 10.8		Millimeters

## 6. EFFICIENCY DATA



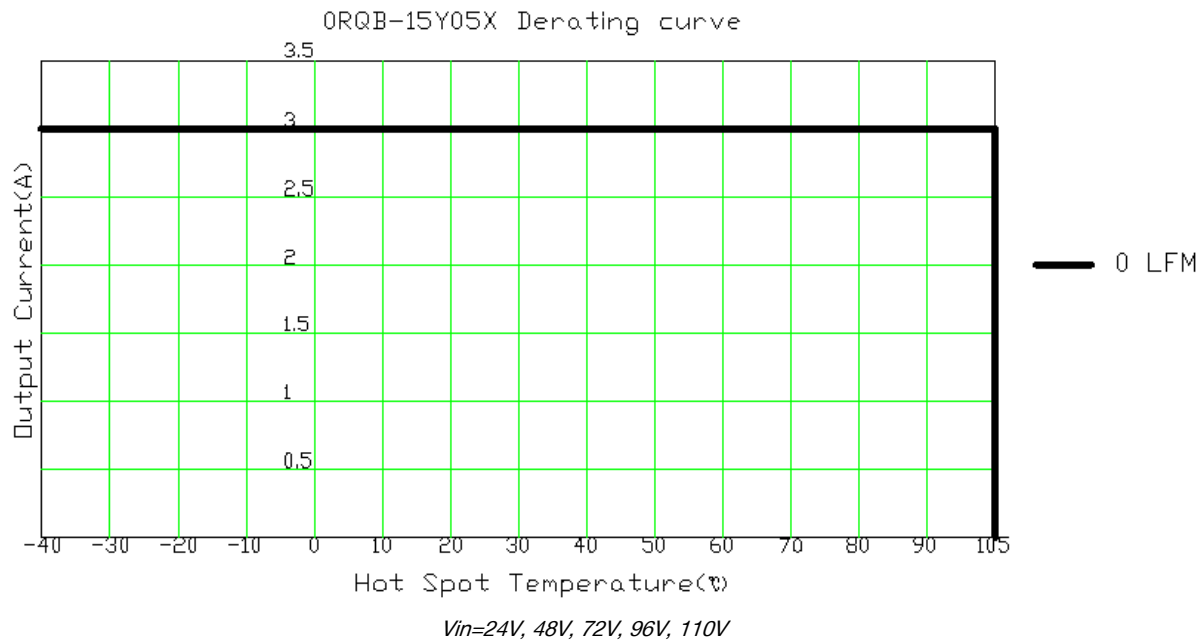
**7. THERMAL DERATING CURVE**

Hot spot location and allowed maximum temperature



Module top view

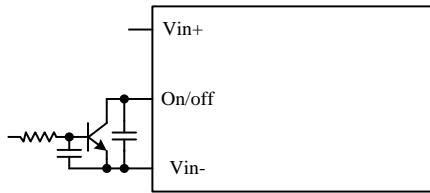
Derating curve under normal input



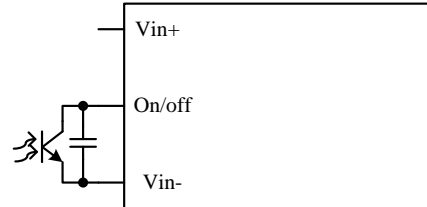
### 8. REMOTE ON/OFF

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Signal Low (Unit On)	Active Low	-0.3	-	0.8	V
Signal High (Unit Off)		2.4	-	15	V
Current Sink		0	-	1	mA

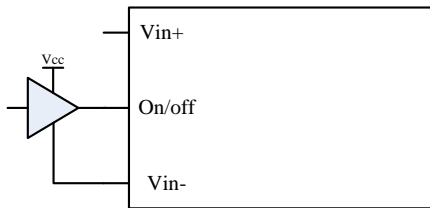
Recommended remote on/off circuit for active low



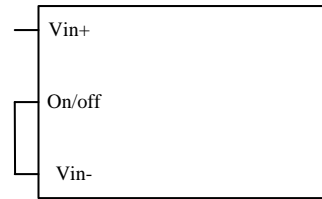
*Control with open collector/drain circuit*



*Control with photocoupler circuit*



*Control with logic circuit*

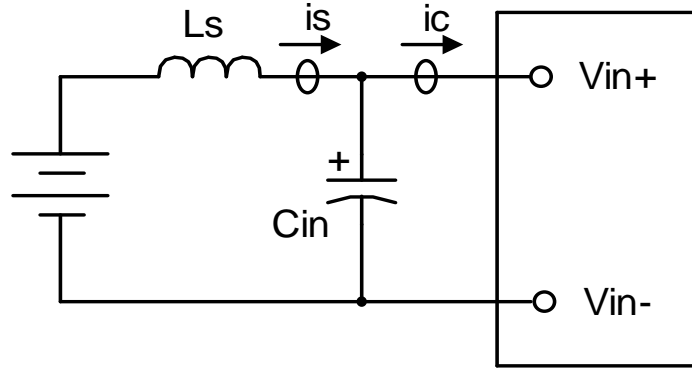


*Permanently on*

9. INPUT NOISE

Input reflected ripple current

Testing set up



Notes and values in testing.

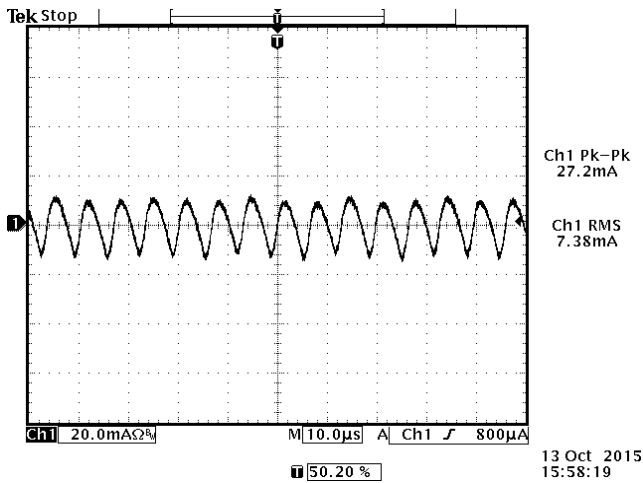
*is*: Input Reflected Ripple Current

*ic*: Input Terminal Ripple Current

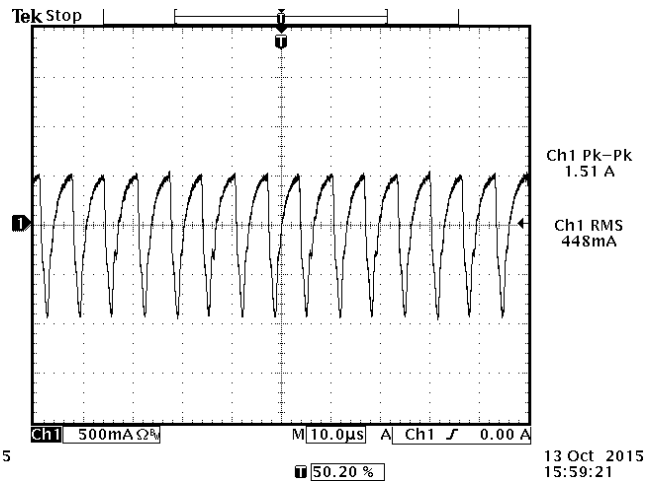
*Ls*: Simulated Source Impedence (10 $\mu$ H)

*Cin*: Electrolytic capacitor, should be as closed as possible to the power module to swallow *ic* ripple current and help with stability. Recommendation: 2\* 100 $\mu$ F, ESR<0.5R @ 100kHz, 20C

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



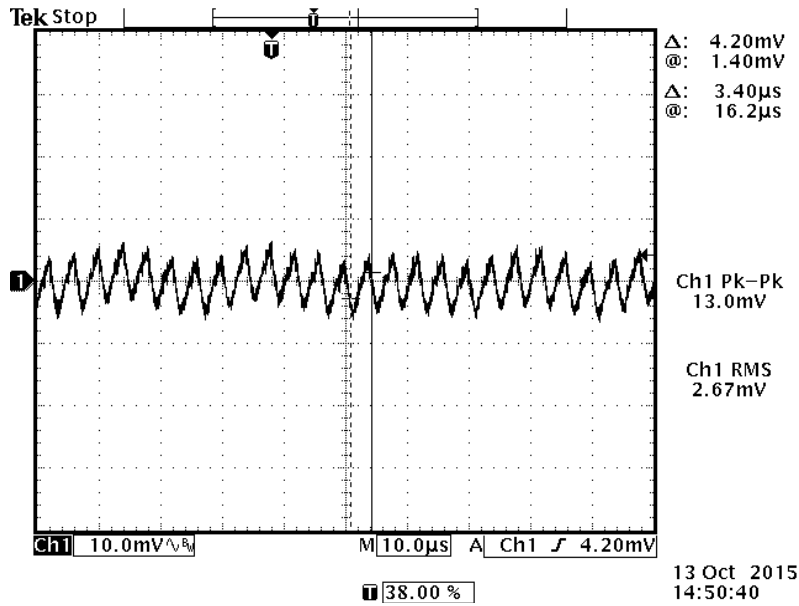
*is* (input reflected ripple current), AC component



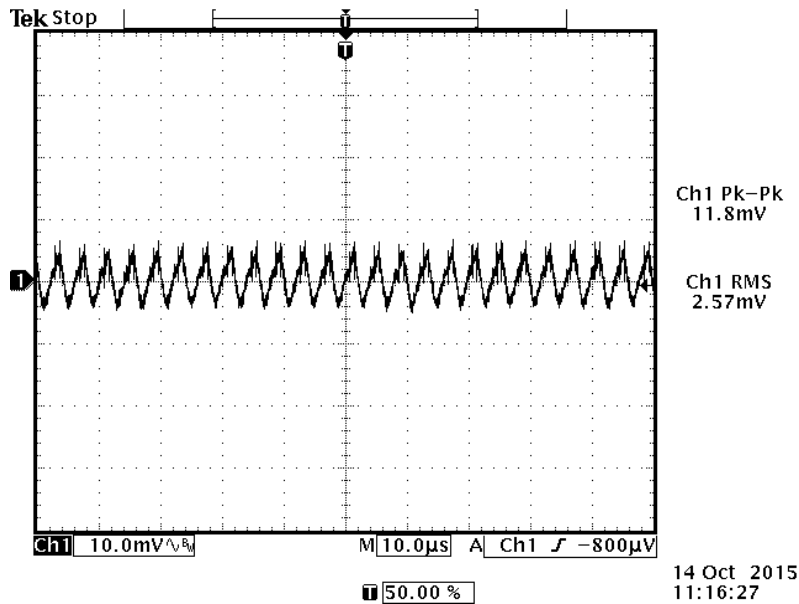
*ic* (input terminal ripple current), AC component

Test condition: 24Vdc input, 5Vdc/3A output and  $T_a=25$  deg C, with 100 $\mu$ F ceramic capacitor and 100 $\mu$ F AL. cap at output.

10. RIPPLE AND NOISE WAVEFORM



Ripple and noise, 24Vdc input, 5Vdc/3A output and  $T_a=25$  deg C, with 100µF ceramic capacitor and 100uF AL. cap at output.

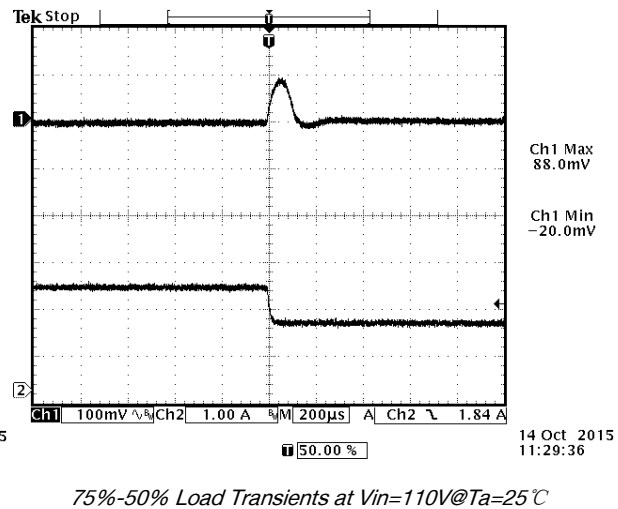
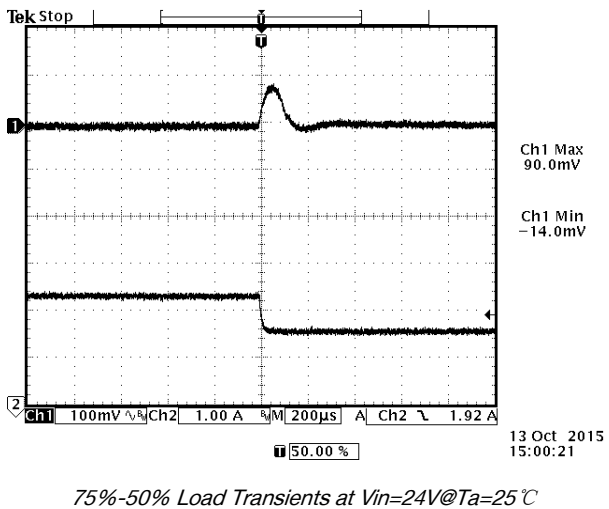
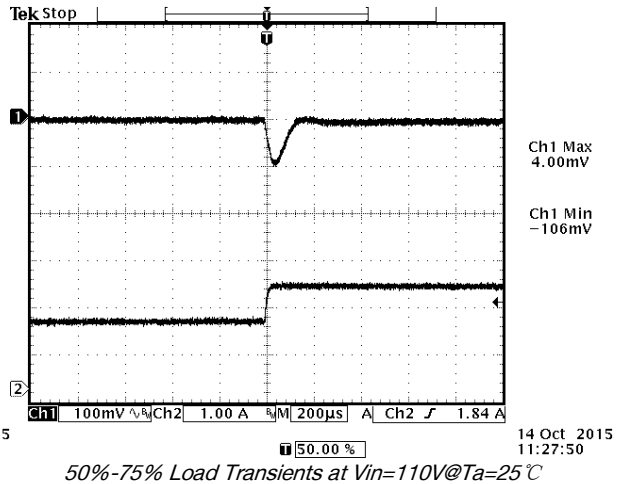
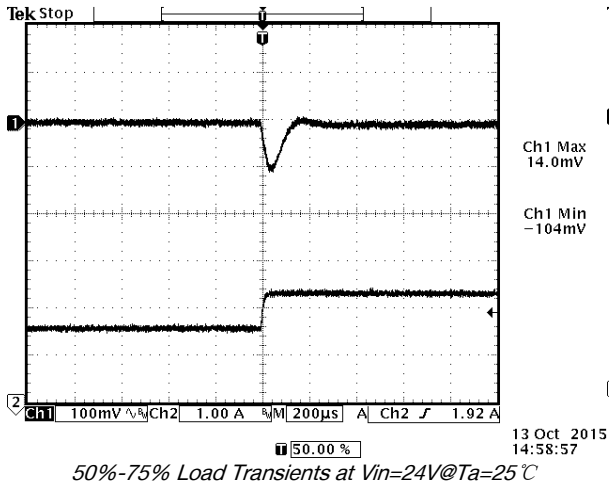


Ripple and noise, 110Vdc input, 5Vdc/3A output and  $T_a=25$  deg C, with 100µF ceramic capacitor and 100uF AL. cap at output.



## 11. TRANSIENT RESPONSE WAVEFORMS

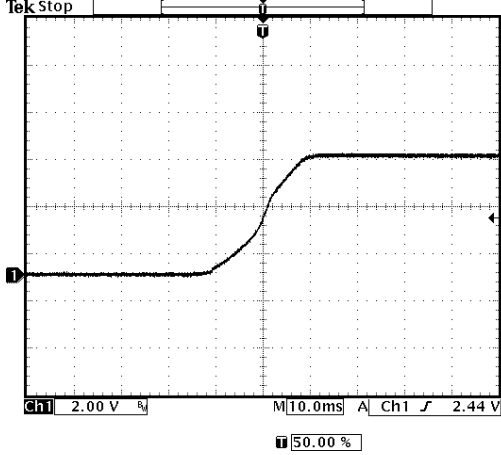
$di/dt=0.1A/\mu s$ , with a  $100\mu F$  ceramic capacitor and a  $100\mu F$  electrolytic capacitors near the brick output.



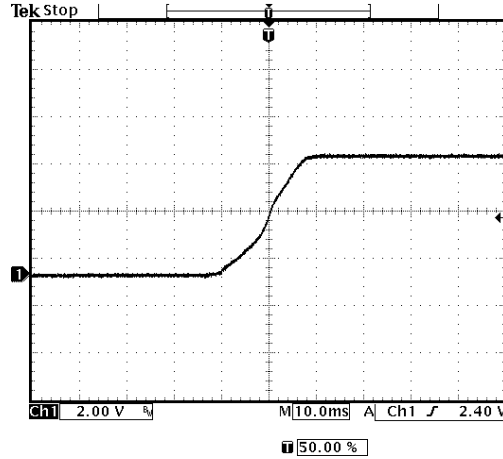
## 12. STARTUP & SHUTDOWN

$di/dt=0.1A/us$ , with a  $100\mu F$  ceramic capacitor and a  $100\mu F$  electrolytic capacitors near the brick output.

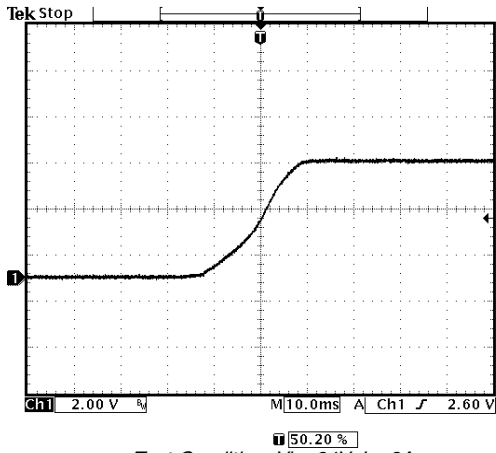
### Rise time



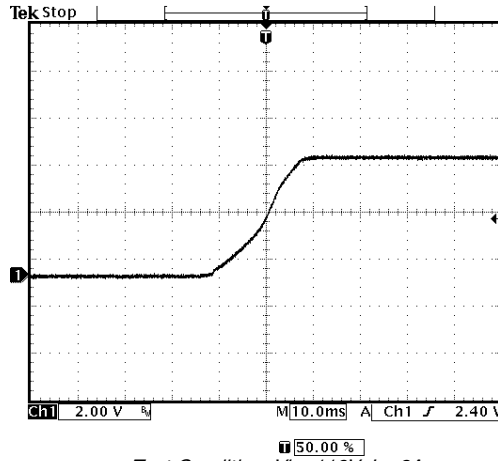
Test Condition:  $V_{in}=24V$ ,  $I_o=3A$ ,  $V_o=5V$



Test Condition:  $V_{in}=110V$ ,  $I_o=3A$ ,  $V_o=5V$

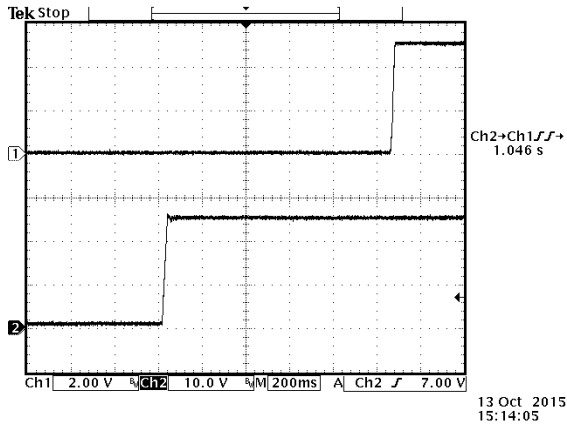


Test Condition:  $V_{in}=24V$ ,  $I_o=3A$ ,  $V_o=5V$ , with  $C_{ext}=880\mu F$

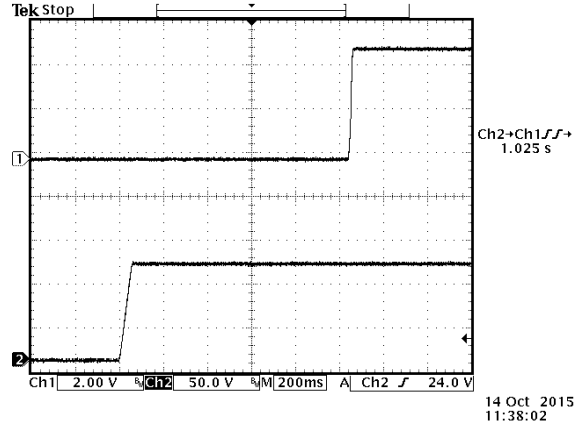


Test Condition:  $V_{in}=110V$ ,  $I_o=3A$ ,  $V_o=5V$ , with  $C_{ext}=880\mu F$

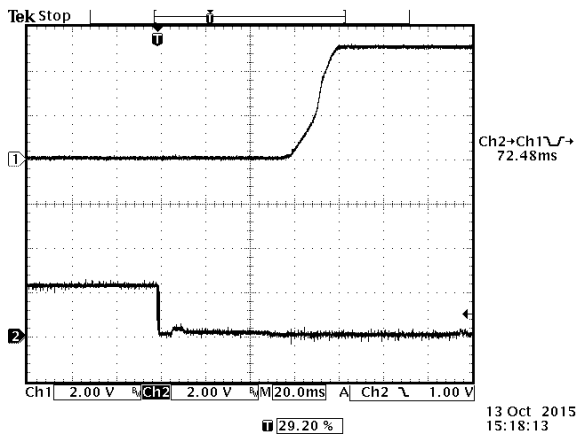
### Turn on delay time



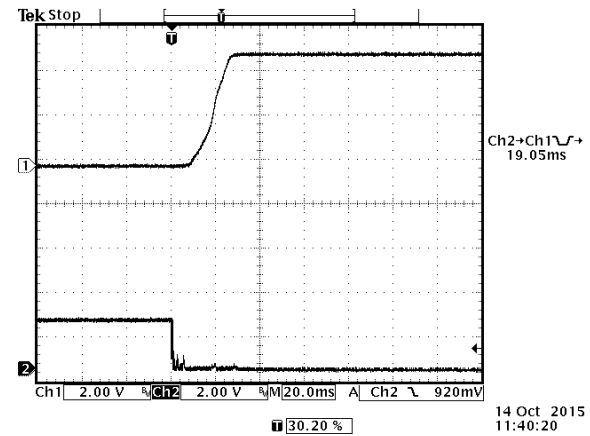
Startup from Vin  
Ch1: Vo  
Ch2: Vin  
Test Condition: Vin=24V, Io=3A, Vo=5V



Startup from Vin  
Ch1: Vo  
Ch2: Vin  
Test Condition: Vin=110V, Io=3A, Vo=5V

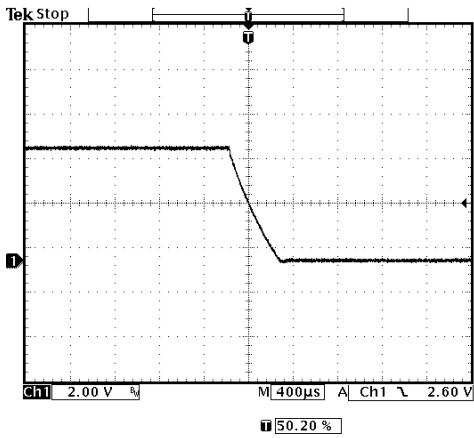


Startup from on/off  
Ch1: Vo  
Ch2: on/off  
Test Condition: Vin=24V, Io=3A, Vo=5V



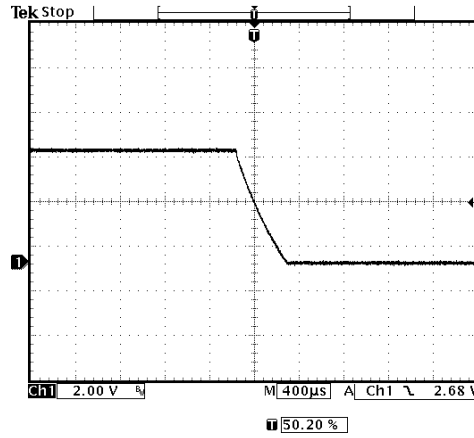
Startup from on/off  
Ch1: Vo  
Ch2: on/off  
Test Condition: Vin=110V, Io=3A, Vo=5V

**Shutdown**



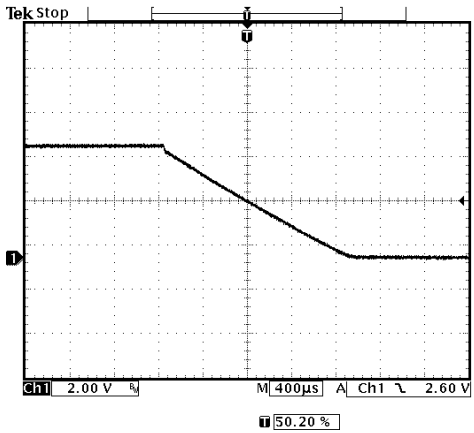
13 Oct 2015 15:21:23

*Test Condition:  $V_{in}=24V$ ,  $I_o=3A$ ,  $V_o=5V$*



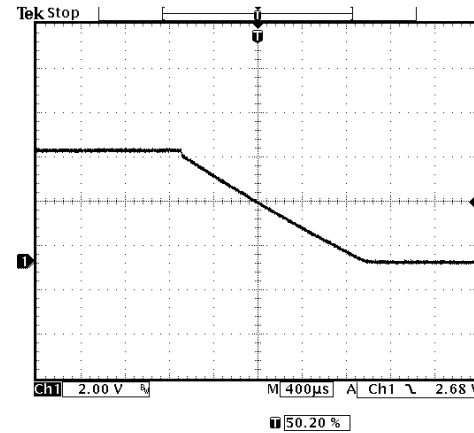
14 Oct 2015 11:42:27

*Test Condition:  $V_{in}=110V$ ,  $I_o=3A$ ,  $V_o=5V$*



13 Oct 2015 15:24:39

*Test Condition:  $V_{in}=24V$ ,  $I_o=3A$ ,  $V_o=5V$  with  $C_{ext}=880\mu F$*



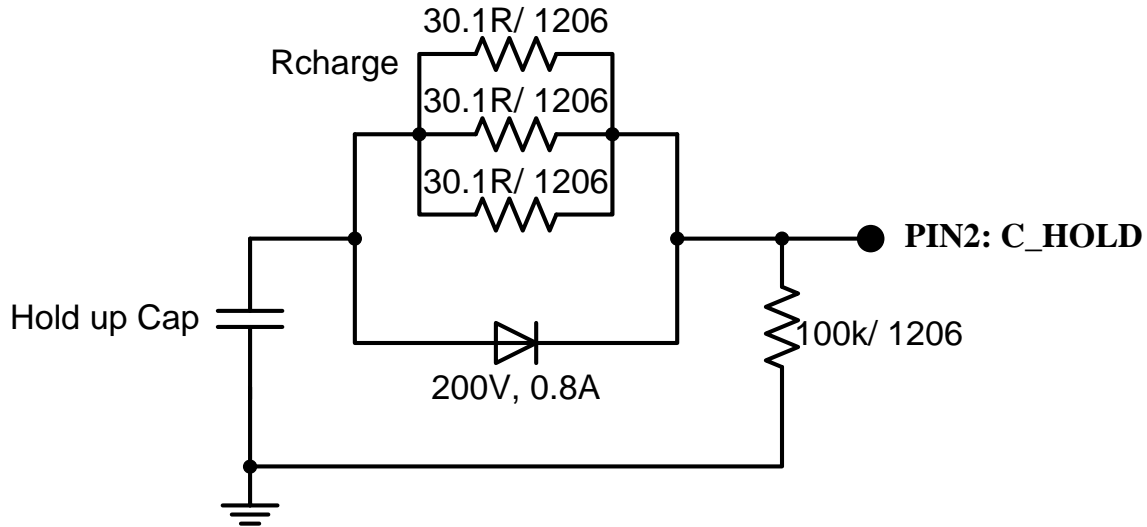
14 Oct 2015 11:43:50

*Test Condition:  $V_{in}=110V$ ,  $I_o=3A$ ,  $V_o=5V$  with  $C_{ext}=880\mu F$*

### 13. HOLD UP CIRCUIT

PARAMETER	Notes	Symbol	MIN	TYP	MAX	UNITS
Hold up capacitor	Working voltage rating should be 200V. Caution: This capacitor is necessary for both normal and hold up operation.	C_HOLD	100	-	330	uF
Hold up voltage	Normal operation.	V_HOLD	55	98	154	V
Hold up time	16.8-137.5V input and all output range.	T_HOLD	12	-	-	ms

#### Recommended external hold up circuit



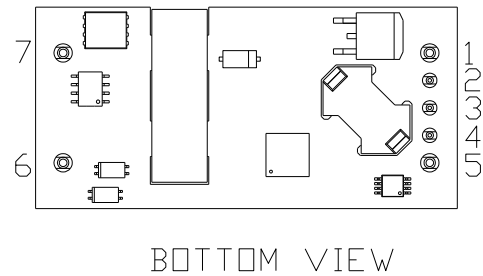
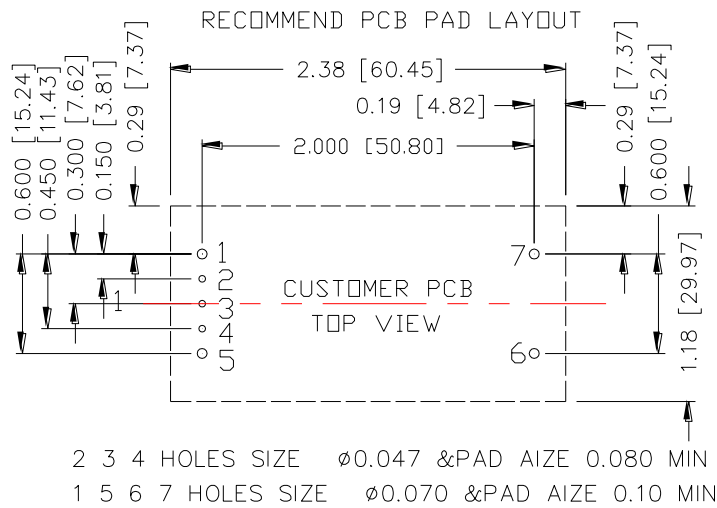
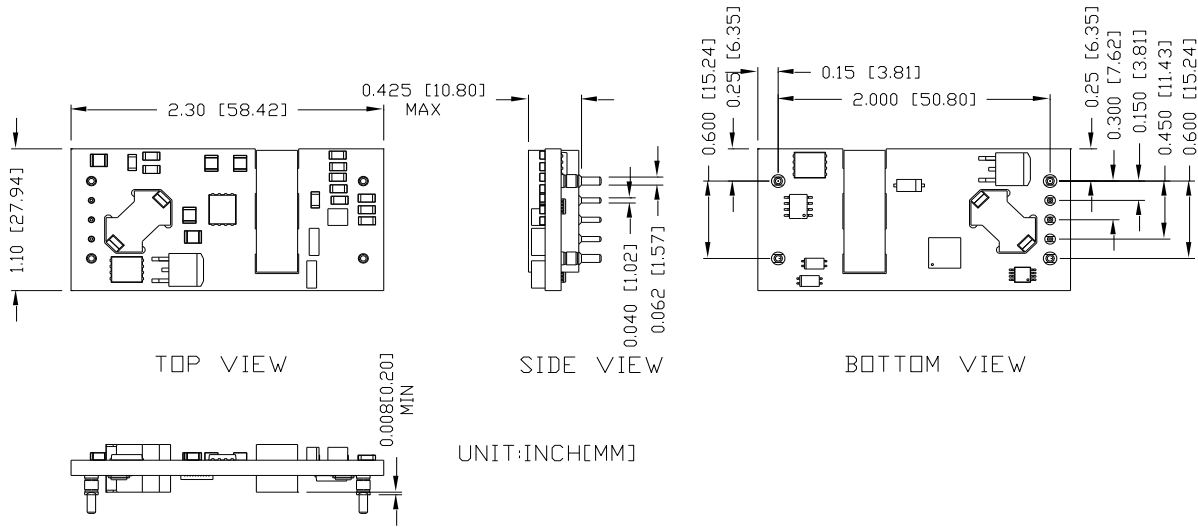
**Note:** Three 1206 resistors are recommended for Rcharge for power dissipation consideration.

### 14. SAFETY

TUV certificated to EN60950-1, 2nd edition+ A2 version

CE certificated to Low Voltage Directive 2014/35/EU

15. MECHANICAL DIMENSIONS



PIN CONNECTIONS

PIN	FUNCTION
1	Vin(+)
2	C_HOLD
3	ON/OFF
4	V_AUX(5V)
5	Vin(-)
6	Vout(-)
7	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 °C for less than 5 seconds.

NOTES:

All Pins: Material - Copper Alloy;  
Finish - Tin plated.

- 1) Undimensioned components are shown for visual reference only.
- 2) All dimensions in inches; Tolerances: x.xx +/-0.02 in [0.51 mm]. x.xxx +/-0.010 in [0.25 mm].

## 16. REVISION HISTORY

DATE	REVISION	CHANGES DETAIL	APPROVAL
2014-04-14	A	First release	Jessica Yan
2014-7-23	B	Update hold up capacitor, Update Input spec	Jessica Yan
2014-10-17	C	Update Input spec, hold up circuit spec, frequency, start up spec, TD spec, output capacitor spec, efficiency curve.	Jessica Yan
2014-12-24	D	Update No Load Input Current (note), turn on time, hold up circuit, mechanical design.	Jessica Yan
2015-07-27	E	Update MD.	Jessica Yan
2015-10-15	F	Update Input Reflected Ripple Current, Load Regulation, Regulation Over Temperature, Output DC Current Limit, Transient Response, MTBF, Dimensions. Add input noise, output noise, transient, start up figures.	Jessica Yan
2016-02-26	G	Update Operating Temperature, Thermal resistance and Hot spot location graph.	Jessica Yan
2016-04-21	H	Update Safety Certification, MTBF, Thermal Derating Curve.	Jessica Yan
2016-10-14	I	Update Altitude	Jessica Yan

**For more information on these products consult: [tech.support@psbel.com](mailto:tech.support@psbel.com)**

**NUCLEAR AND MEDICAL APPLICATIONS** - Products are not designed or intended for use as critical components in life support systems, equipment used in hazardous environments, or nuclear control systems.

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Asia-Pacific  
+86 755 298 85888

Europe, Middle East  
+353 61 225 977

North America  
+1 408 785 5200