MP020

Customer Support Report

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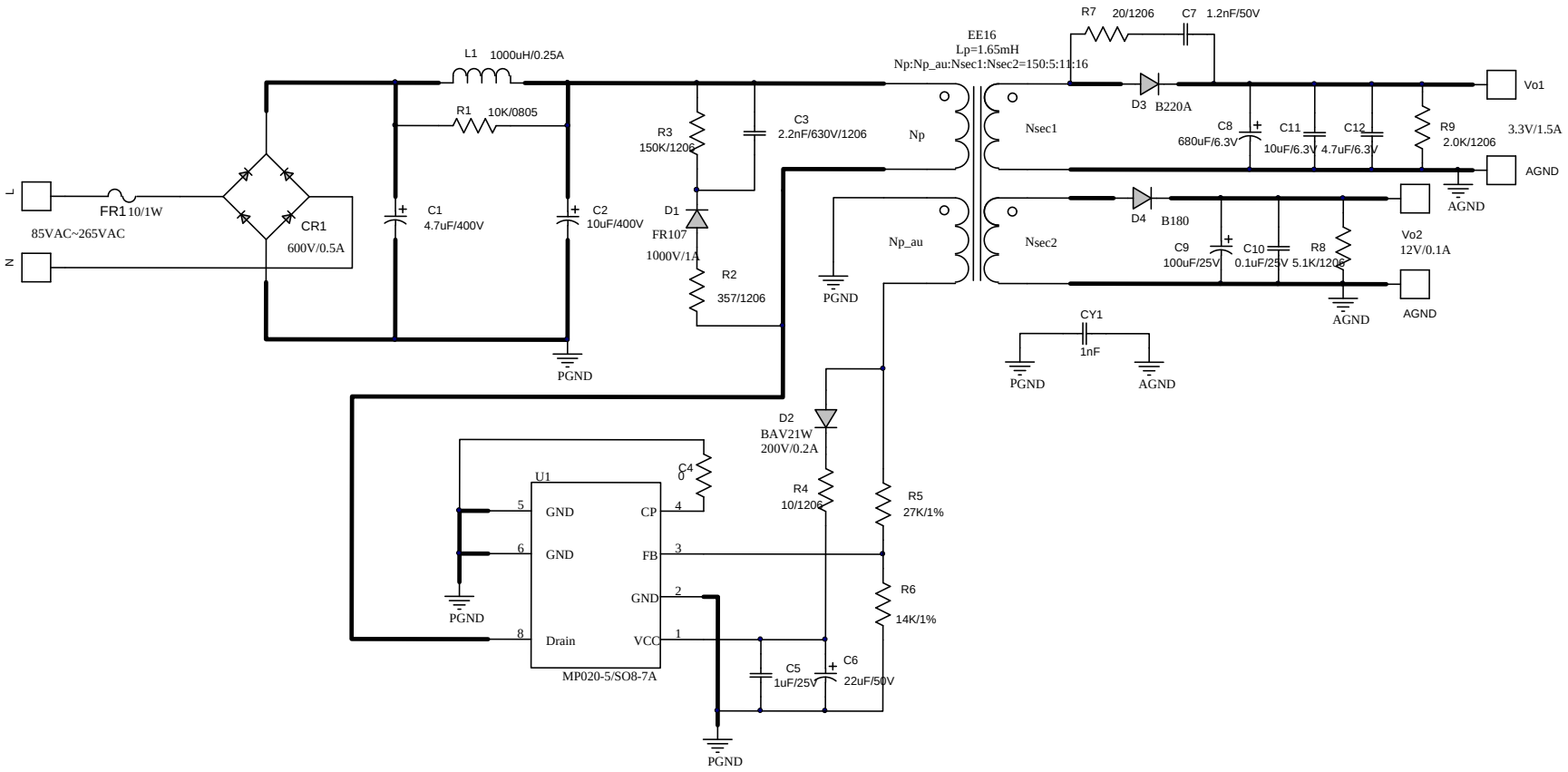
Contents

1. Specification

Parameter	Symbol	Condition	Min	Typ	Max	Units
Input Supply Voltage	V_{IN}	2 Wire	85	110/220	265	VAC
AC Line Frequency	f_{LINE}			50/60		Hz
Output Voltage	V_{o1}	Full Range	3.135	3.3	3.465	V
	V_{o2}	Full Range	10.8	12	13.2	V
Load Current	I_{o1}		500		1500	mA
	I_{o2}		5		100	mA
Efficiency				80%		
No Load Consumption		230Vac		70		mW
Output Ripple	V_{o1_Ripple}	Full Load			200	mV
	V_{o2_Ripple}	Full Load			800	mV
Output Rise Time	T_{Rise}	Full Load			10	ms
Overshoot during startup	V_{ov}	Full Load			10%	
Load Transient Recovery Time	T_{Rise}				900	us
Operation Temperature Rise	T_R	Full Load			100	℃
Conducted Emission		Full Load Vin=230Vac				
Surge Voltage	Vs		1		6	kV

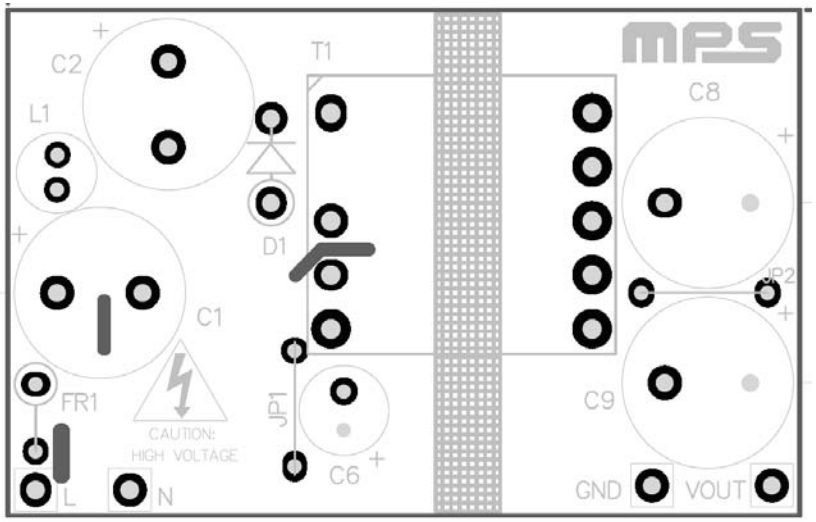
2. Schematic

Vin=85Vac-265Vac
Vout1=3.3V, Iout1=1.5A
Vout2=12V, Iout2=0.1A

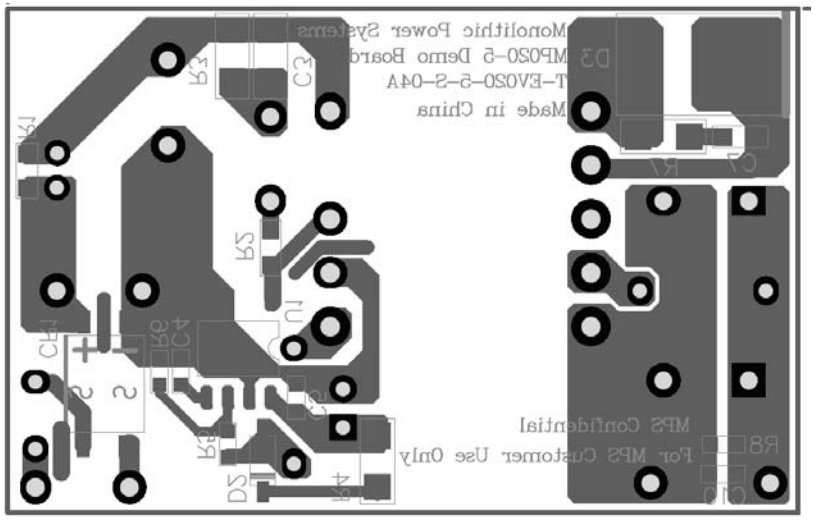


3. Circuit Board

3.1 PCB Layout

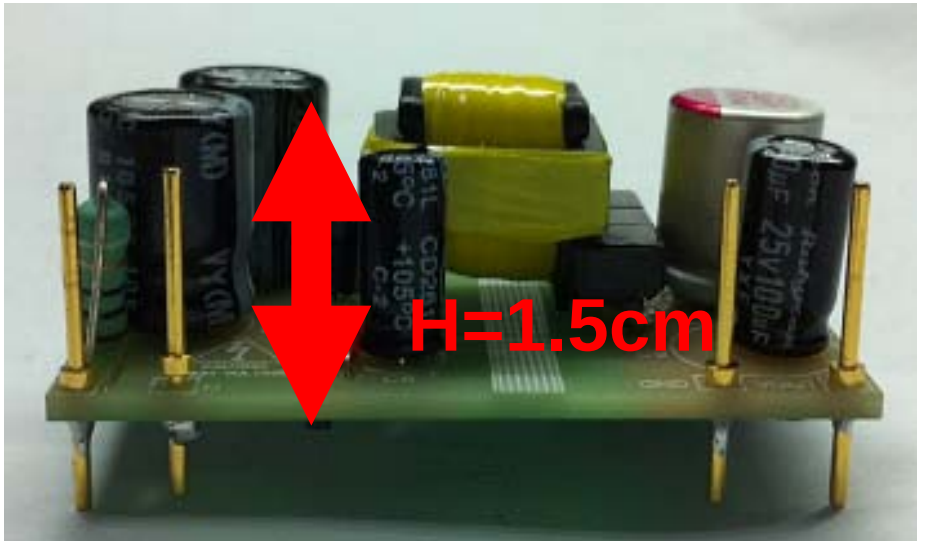


TOP & TSK



BOT & BSK

3.2 Board Photograph



Note: Dimension is strongly needed.

4. Bill of Materials

Qty	Reference	Value	Description	Package	Manufacturer	Manufactuer_P/N
1	C1	4.7uF	Capacitor;400V;20%	DIP	Nichicon	UVY2G4R7MPD
1	C2	10uF	Capacitor;400V;20%	DIP	Ltec	10uF/400V
1	C3	2.2nF	Ceramic Capacitor;630V;X7R	1206	Murata	GRM31BR72J222KW01
0	C4,	0	Shorted with 0Ohm Resistor			
1	C5	1uF	Ceramic Capacitor;25V;X5R;	0603	TDK	C1608X5R1E105K
1	C6	22uF	Electrolytic Capacitor;50V	DIP	Jianghai	CD281L-50V22
1	C7	1.2nF	Ceramic Capacitor;50V;X7R	0603	TDK	C1608X7R1H122KT
1	C8	680uF	Electrolytic Capacitor;6.3V	DIP	Jianghai	HCN0J681MC13
1	C9	100uF	Electrolytic Capacitor;25V	DIP	Rubycon	25YXF100M 6.3*11
1	C10	0.1uF	Ceramic Capacitor;25V;X7R	0603	Murata	GRM188R71E104KA01D
1	C11	10uF	Ceramic Capacitor, 6.3V, X7R	1206	Murata	GRM31MR60J106KE19L
1	C12	4.7uF	Ceramic Capacitor,6.3V, X7R	0805	Murata	GRM219R60J475KE19D
1	CR1	MB6F	Diode;600V;0.5A	SOP-4	Diodes	MB6F
1	CY1	1nF	Y1 Capacitor	DIP	Hongke	JNK09E102MY02N
1	D1	FR107	Diode;1000V;1A	DO-41	Diodes	FR107
1	D2	BAV21W	Diode;200V;0.2A;	SOD-123	Diodes	BAV21W-7-F
1	D3	B220A	Schottky Diode;20V;2A	SMA	Diodes	B220A
1	D4	B180	Schottky Diode, 80V, 1A	SMA	Diodes	B180
1	FR1	10Ω	Fusible Resistor, 1 W, 1%	Yageo	DIP	FKN1WSJT-52-10R
1	L1	1000uH	Inductor;1000uH;6 Ohm;0.25A	DIP	Wurth	7447462102
1	R1	10kΩ	Film Resistor;1%	0805	Yageo	RC0805FR-0710KL

4. Bill of Materials

…Continued

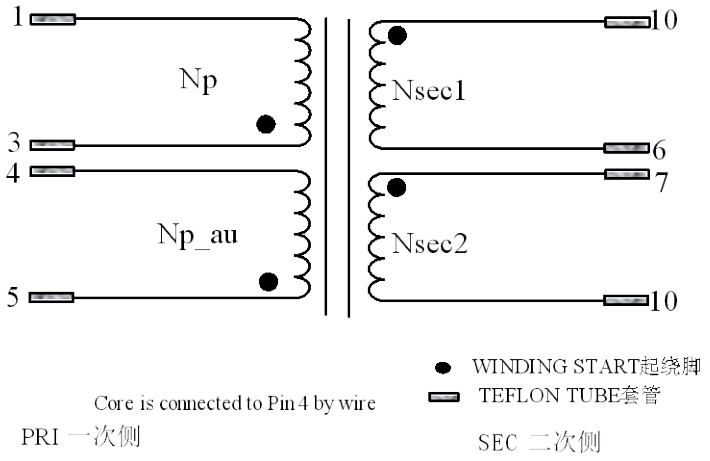
Qty	Reference	Value	Description	Package	Manufacturer	Manufactuer_P/N
1	R2	357Ω	Film Resistor;1%;1/4W	1206	Yageo	RC1206JR-07357RL
1	R3	150kΩ	Film Resistor; 1%	1206	Panasonic	ERJ8ENF1503V
1	R4	10Ω	Film Resistor;5%;1/4W	1206	Yageo	RC1206JR-0710R
1	R5	27kΩ	Film Resistor;1%;	0603	Yageo	RC0603FR-0727KL
1	R6	14kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-0714KL
1	R7	20Ω	Film Resistor;5%;1/4W	1206	Yageo	1206J0200T5E
1	R8	5.1kΩ	Film Resistor;1%;	0603	Yageo	RC0603FR-075K1L
1	R9	2.0kΩ	Film Resistor, 1%	0603	Yageo	RC0603FR-072KL
1	U1	MP020-5	Primary side regulator	SOIC8-7A	MPS	MP020-5
1	T1		Transformer;1.6mH; Np:Np_au:Nsec1:Nsec2=150:16:5:11	EE16		

5.1 Winding Spec

Electric Characteristic

Parameter	Condition	Test Value
Primary Inductance	L_P (3-1)	1.65mH±5%
Core/Bobbin		EE16
Core material		PC40
Turn Ratio	Np:Np_au:Nsec1:Nsec2	150:16:5:11

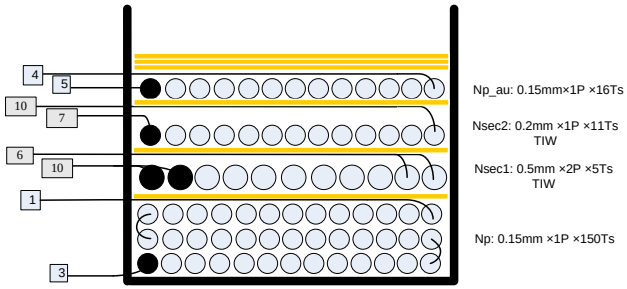
Electrical Diagram



Winding Order

Tape Layer Number	Winding No.	Margin Tape (Pri. Side)	Start & End	Margin Tape (Sec. Side)	Turns	Magnet Wire (Φ)
3	Np	\	3 to 1	\	150	0.15*1
1	Nsec1		10-6		5	0.5*2 TIW
1	Nsec2	\	7 to 10	\	11	0.2*1 TIW
1	Np_au	\	5 to 4	\	16	0.15*1 TIW

Winding Diagram



6.1 Test Setup

6.1.1 Test Equipment

- AC Source: Chroma, Model 61601
- Power Meter: Yokogawa, Model WT210
- Oscilloscope: Tektronix, Model TDS3014C
- Current Probe/Amplifier: Tektronix, Model TCP312
- EMC Receiver: Rohde & Schwarz, Model ESPI3+ESPI-B2

6.2 Efficiency

6.2.1 Full load Efficiency

Test Conditions:

- **The two output channels are @ full load condition and pre-heated until temperature stabilization was achieved.**

Criteria To Pass:

- **The average efficiency must be > 80% at the continuous output load.**

(The design can't satisfy such high efficiency demand)

…Continued

Vin=110Vac

Pin (W)	Vo1 (V)	Io1 (A)	Vo2 (V)	Io2 (A)	Po (W)	Efficiency
2.495	3.289	0.445	11.83	0.0253	1.762904	0.671471
4.406	3.298	0.764	11.8	0.0506	3.116752	0.689854
6.435	3.314	1.114	11.82	0.0758	4.587752	0.701033
8.59	3.326	1.495	11.85	0.0979	6.132485	0.71391

Average Efficiency: 69.4%

Comment: Pass

…Continued

Vin=220Vac

Pin (W)	Vo1 (V)	Io1 (A)	Vo2 (V)	Io2 (A)	Po (W)	Efficiency
2.528	3.277	0.446	11.78	0.0253	1.759576	0.696035
4.339	3.288	0.765	11.77	0.0506	3.110882	0.716958
6.286	3.3	1.116	11.78	0.0758	4.575724	0.727923
8.35	3.312	1.495	11.8	0.0995	6.12554	0.733598

Average Efficiency: 71.8%

Comment: Pass

6.2.2 No Load Power Consumption

Test Conditions:

- **No load input power consumption are tested based on 10mins preheat.**

Criteria To Pass:

- **The no load input power consumption must be <70mV.**

V_{AC} (Vac)	85	265
P_{IN}(mW)	54	56

6.3 Stress

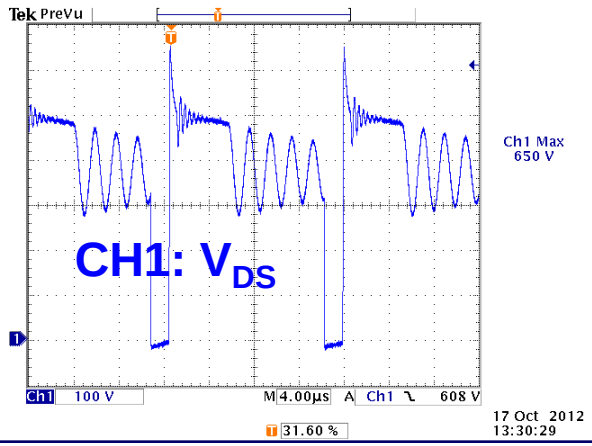
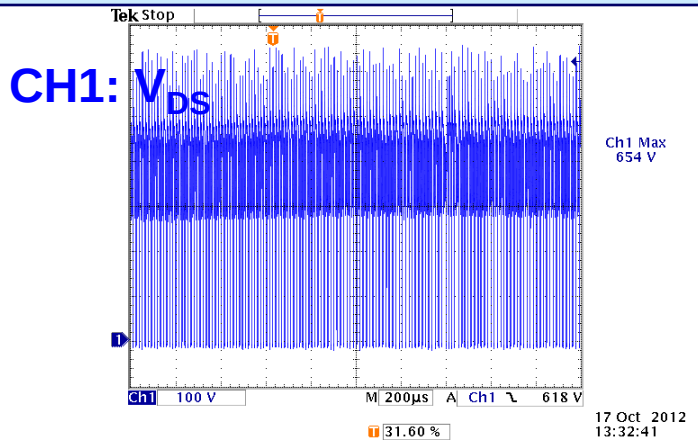
6.3.1 Mosfet V_{DS}

Test Conditions:

- The main input voltage was set to$265V_{AC}$.
- The unit is loaded at maximum output current.

Criteria To Pass:

- The Mosfet V_{DS} must be < 700V at both startup and steady status.

Steady	Startup
	
V_{MAX}: 650V	V_{MAX}: 654V

Comment: Pass

6.3.2 Output Diode V_{RRM}

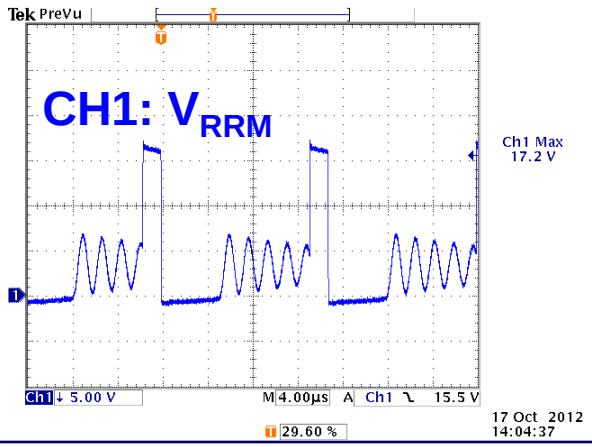
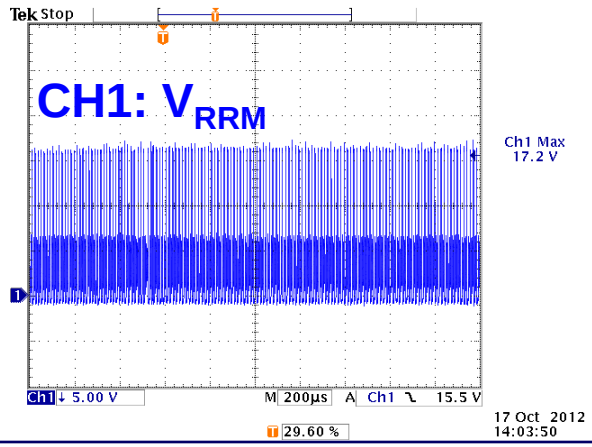
Test Conditions:

- The main input voltage was set to $265V_{AC}$.
- The unit is loaded at maximum output current.

Criteria To Pass:

- The diode V_{RRM} must be < 20V at both startup and steady status.

3.3V Rail

Steady	Startup
	
V_{MAX}: 17.2V	V_{MAX}: 17.2V

Comment: Pass

6.3.3 Output Diode V_{RRM}

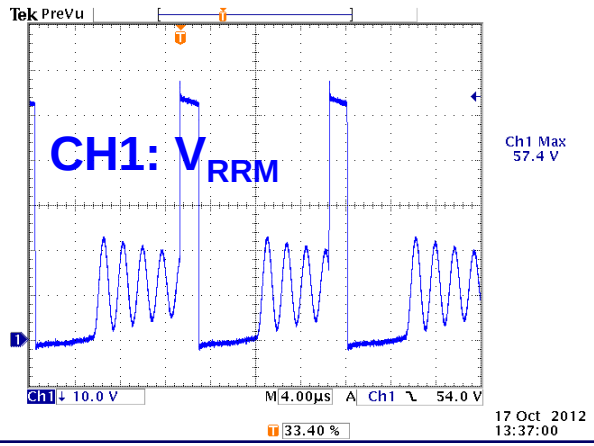
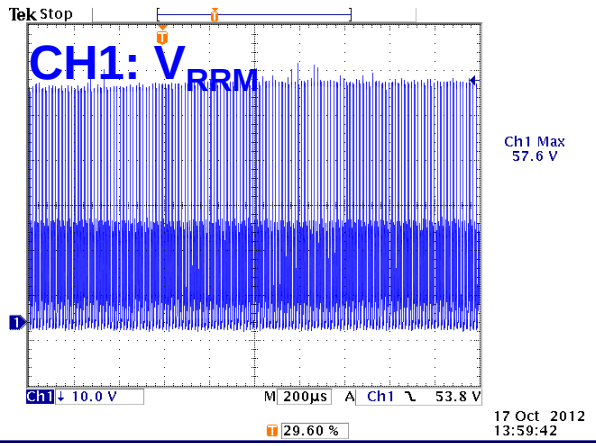
Test Conditions:

- The main input voltage was set to $265V_{AC}$.
- The unit is loaded at maximum output current.

Criteria To Pass:

- The diode V_{RRM} must be < 80V at both startup and steady status.

12.0V Rail

Steady	Startup
	
V_{MAX}: 57.4V	V_{MAX}: 57.6V

Comment: Pass

6.4 Protection

6.4.1 Short Circuit Protection (SCP)

Test Conditions:

- The unit was switched on with normal load on the output. A short circuit was applied manually to the output at the end of the cable. The mains voltage was adopted to obtain the worst-case condition.
- A short circuit was applied to the output at the end of the cable before startup of the unit. The unit was switched on with a short circuit at the output. The mains voltage was adopted to obtain the worse-case condition.

Criteria To Pass:

- The unit shall be capable of withstanding a continuous short-circuit at the output without damage or overstress of the unit under any input conditions.
- After removal of the short circuit, the unit shall recover automatically.

V_{AC}	85	110	120	135
SCP	ok	ok	ok	ok

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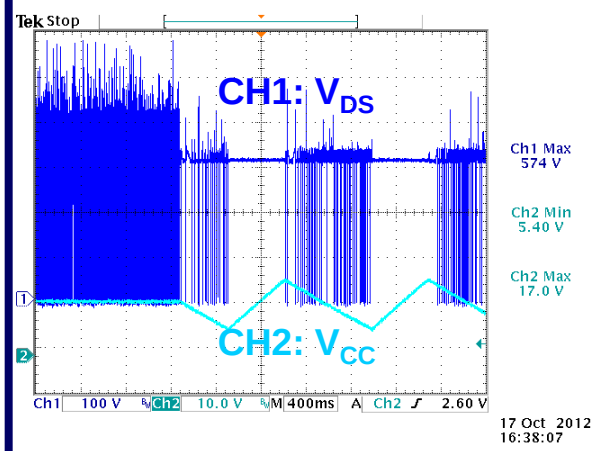
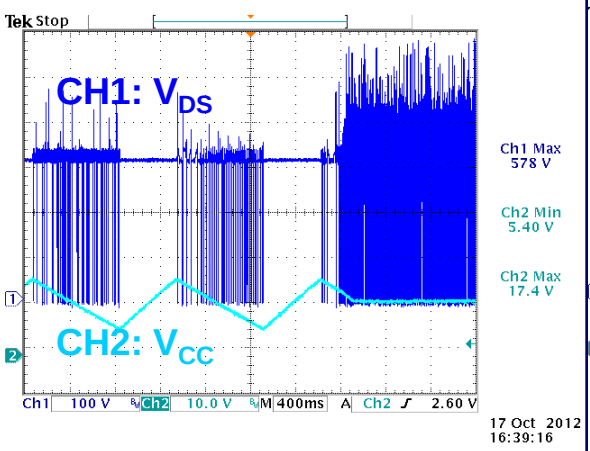
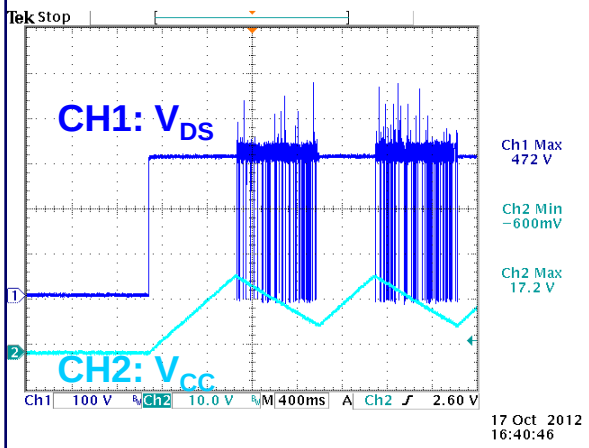
SCP at 220V_{AC}

SCP Startup	SCP Entry	SCP Recovery
		

Input Power: 0.8W

Comment: Pass

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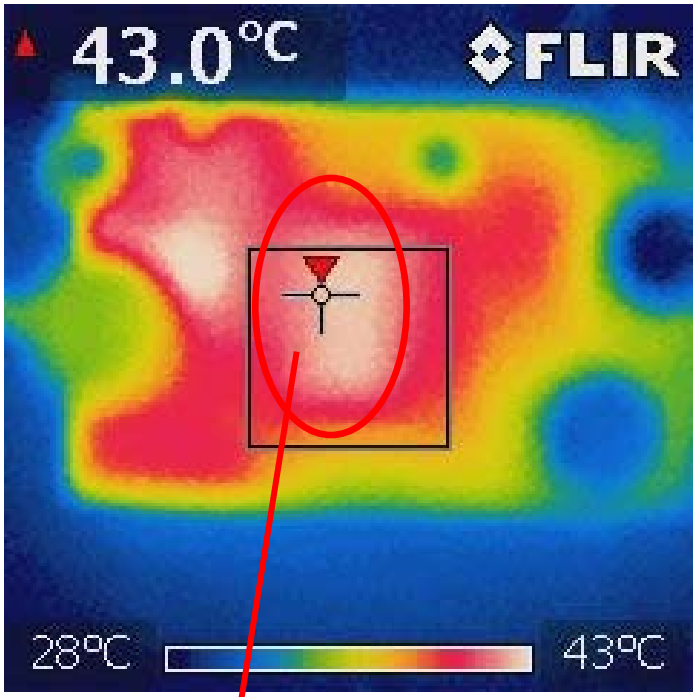
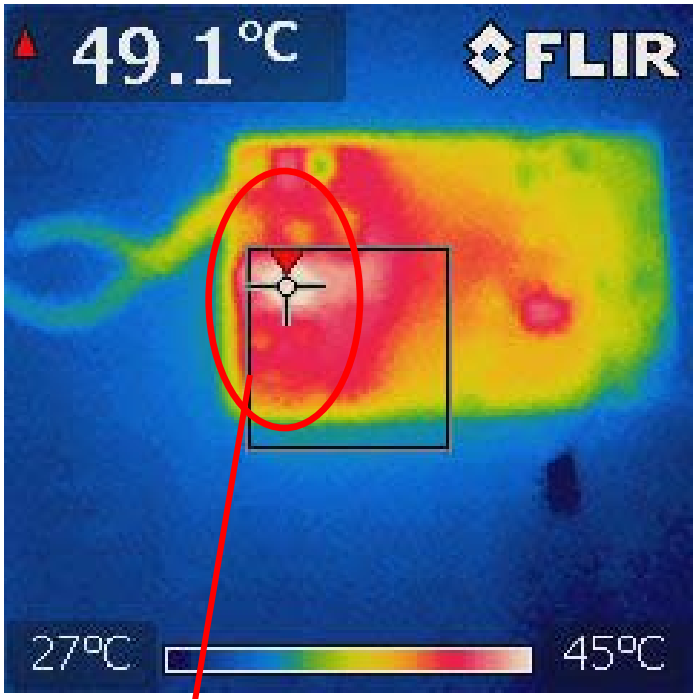
Ta=25.7℃



Transformer



12V Output Diode

6.4.2 Over Current Protection (OCP)

Test Conditions:

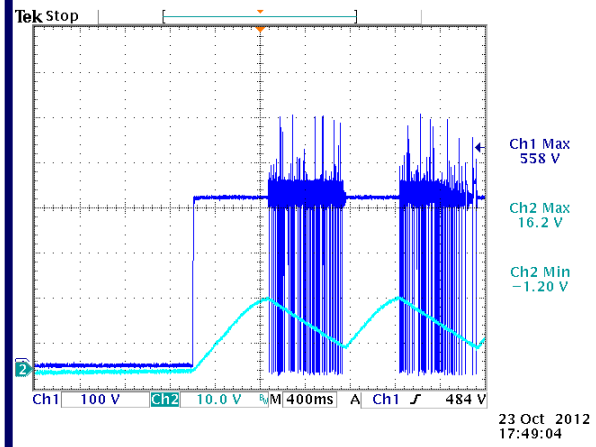
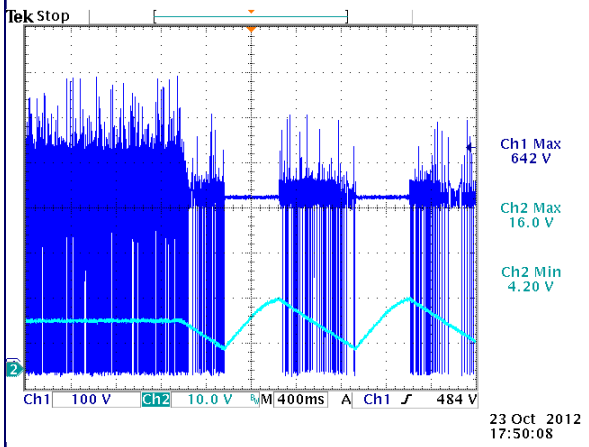
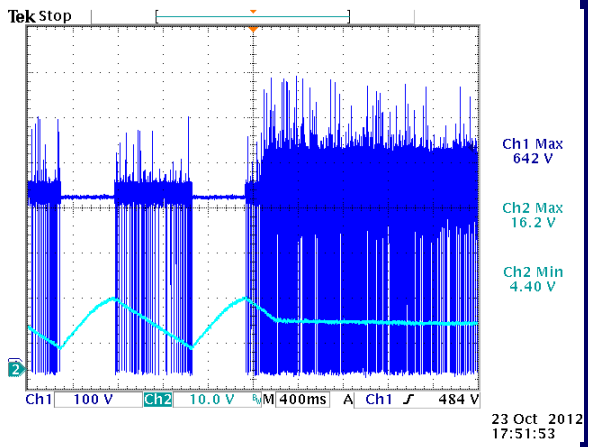
➢**Both the output current are at full load condition. Then enlarge one output current until the circuitry enters OCP.**

Criteria To Pass:

➢**The unit shall be capable of withstanding a continuous over current at the output without damage or overstress of the unit under any input conditions.**

➢**After removal of the over current condition, the unit shall recover automatically.**

V_{AC}		110	220
Rail 1 OCP	Channel 1 Output Current	1685mA	1702mA
	Channel 2 Output Current	100mA	100mA
Rail 2 OCP	Channel 1 Output Current	1500mA	1500mA
	Channel 2 Output Current	135mA	143mA

OCP Startup	OCP Entry	OCP Recovery
		
V_{ds_max}: 558V	V_{ds_max}: 642V	V_{ds_max}: 642V

Input Power: 1.8W

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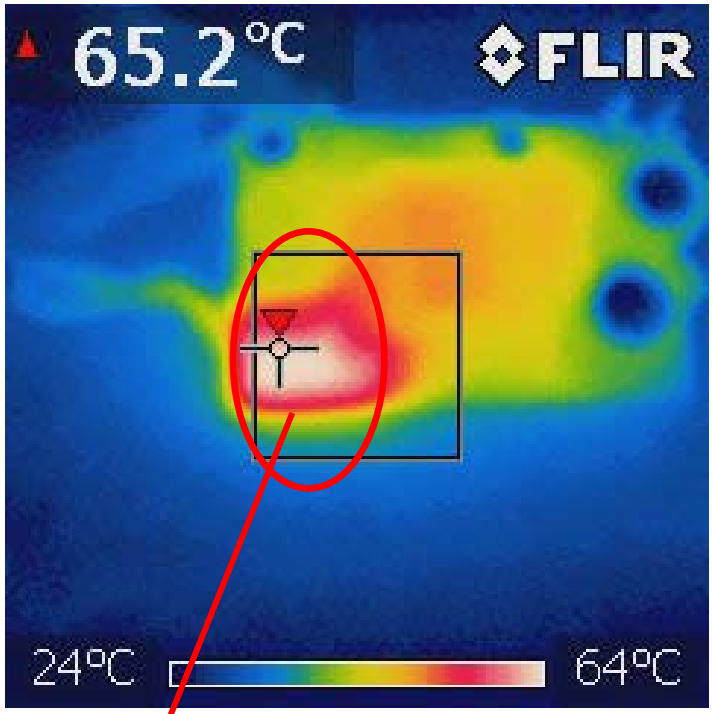
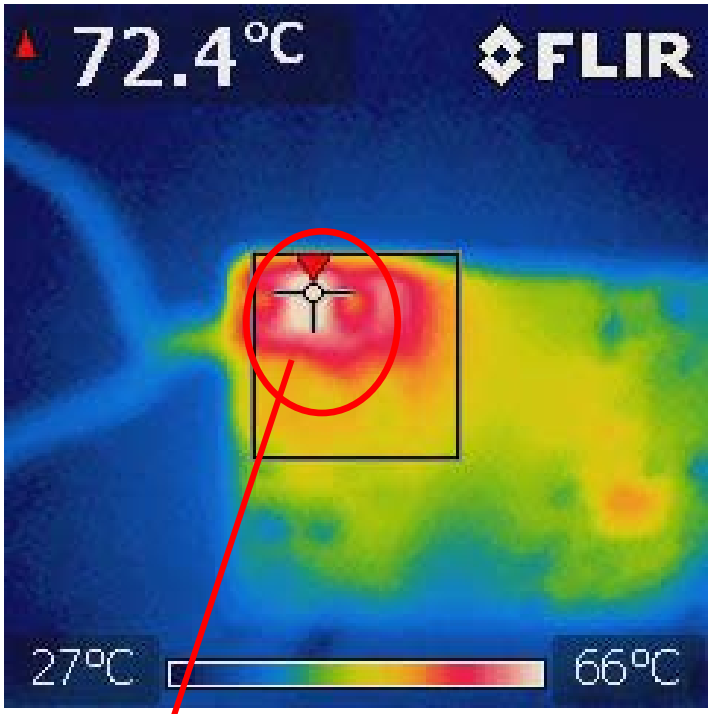
Ta=25.7℃



Bottom PCB Heated by Diode



3.3V Output Diode

6.5 Output and Timing

6.5.1 Output Voltage Ripple

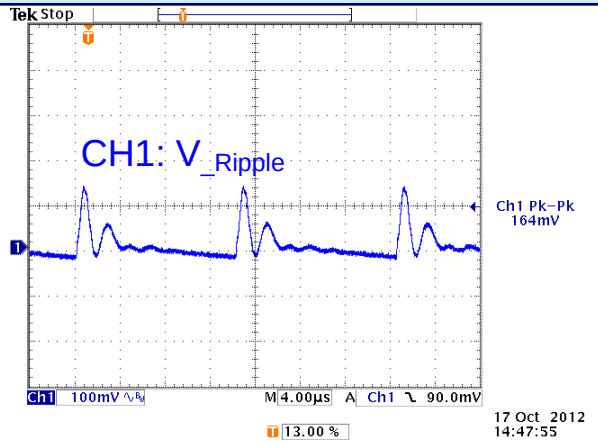
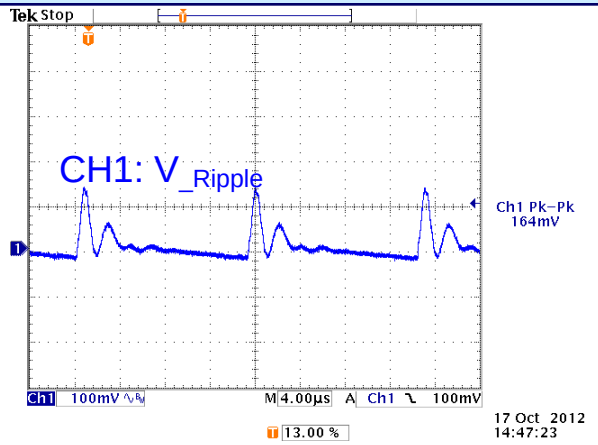
Test Conditions:

- The output voltage ripple and noise are measured at output terminal with full load (Test with 47uF electrolytic cap and 0.1uF ceramic cap).

Criteria To Pass:

- The ripple of the output current must remain within the specified limits (3.3V rail<200mV, 12V rail<800mV).

3.3V Rail

$110V_{AC}$ Input	$220V_{AC}$ Input
	
V_{P-P}: 164mV	V_{P-P}: 164mV

Comment: Pass

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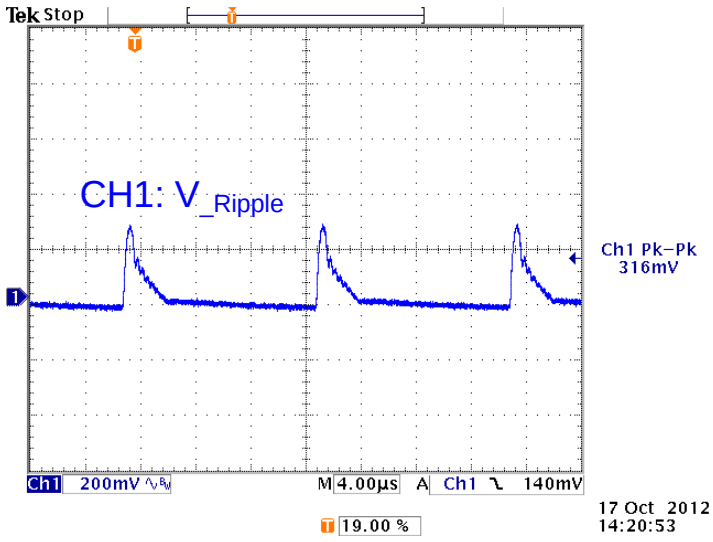
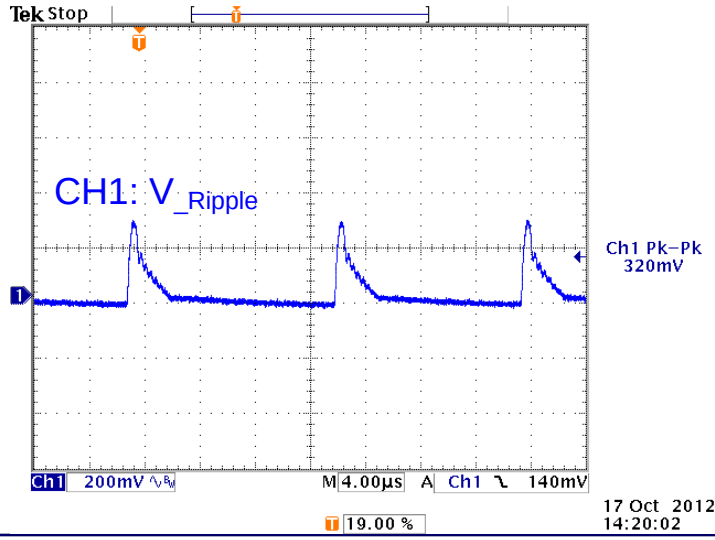
12.0V Rail

$110V_{AC}$ Input	$220V_{AC}$ Input
	
V_{P-P}: 316mV	V_{P-P}: 320mV

Comment: Pass

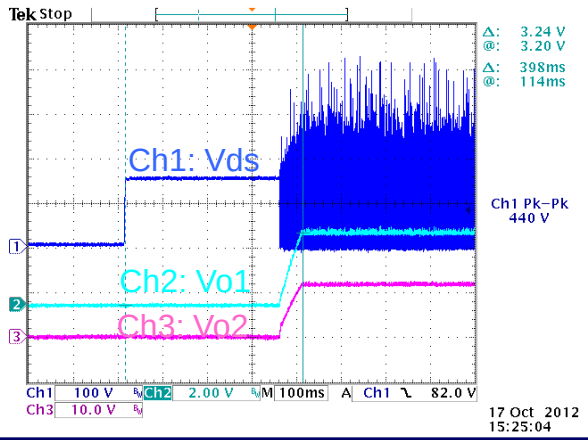
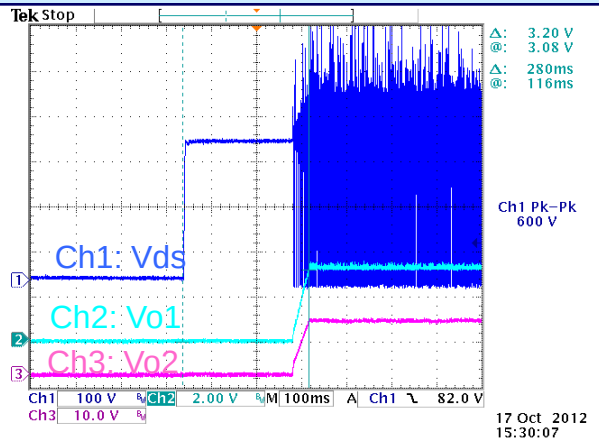
6.5.2 Startup Time

Test Conditions:

- The Unit start with full load
- The startup time is measured from bus capacitor is charged up to output voltage rises to its 90% set value.

Criteria To Pass:

- The startup time must remain in 0.5 second.

$110V_{AC}$ Input	$220V_{AC}$ Input
	
$T_{Start-up}$: 398ms	$T_{Start-up}$: 280ms

Comment: Pass

6.5.3 Output Rise Time

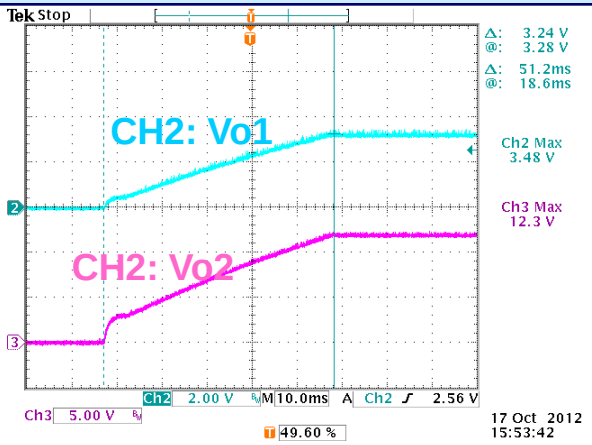
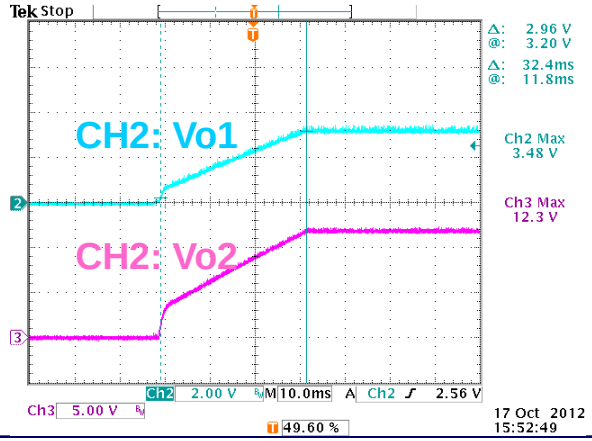
Test Conditions:

- The Unit start with full load
- The output rise time is measured from 0% output voltage to 100% output voltage

Criteria To Pass:

- The startup time must remain in 0.01 second.

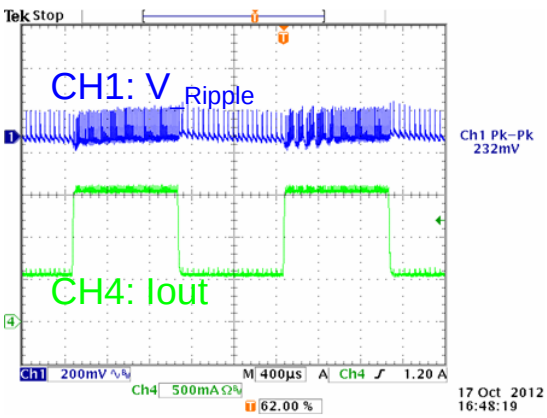
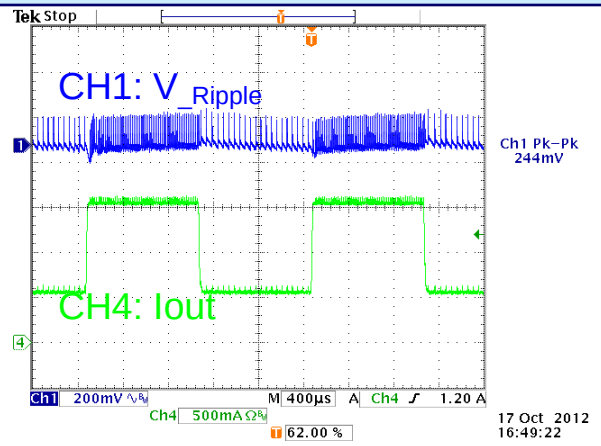
(The output rise time can't satisfy the demand)

$110V_{AC}$ Input	$220V_{AC}$ Input
	
$T_{Start-up}$: 51.2ms	$T_{Start-up}$: 32.4ms

6.5.4 Output Voltage Ripple

Test Conditions:

- The load of output1 changed from 500mA to 1500mA at a slew rate of 0.5A/usec. The load of output2 is changed from 5mA to 100mA at a slew rate of 0.25A/usec .
- The frequency of change was set to give the best readability of the deviation and setting time.

$110V_{AC}$ Input	$220V_{AC}$ Input
	
V_{P-P}: 232mV	V_{P-P}: 244mV

6.6 Thermal

6.6.1 Parts Thermal

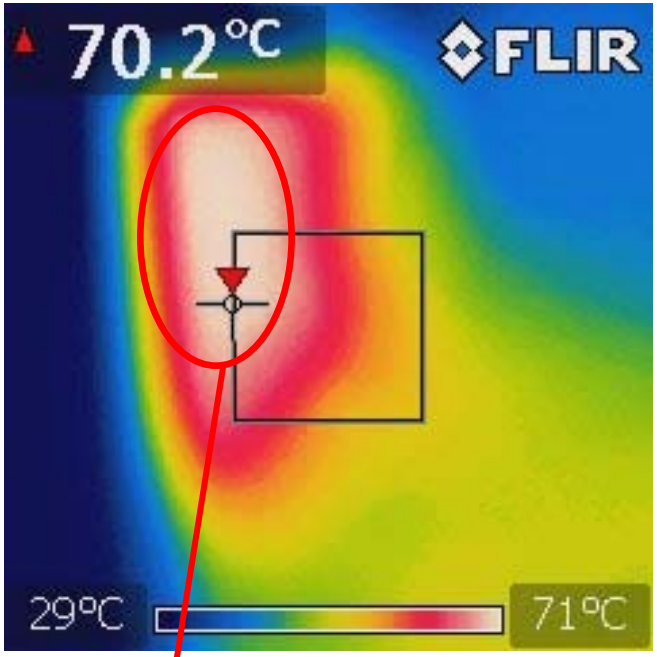
Test Conditions:

- The input voltage was set to 85V.
- The electronic load was set to the maximum output current.
- The unit was covered, and the data was recorded until temperature stabilization was achieved. Ta=27℃

Criteria To Pass:

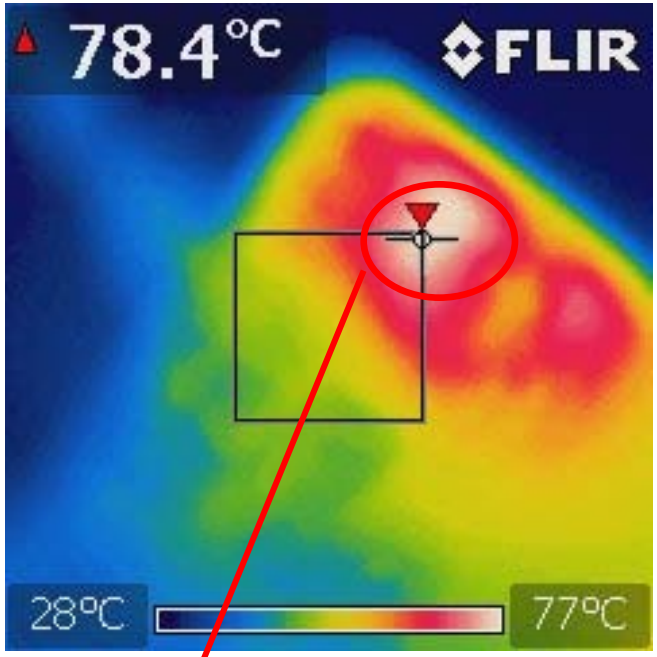
- The △ temperature must be < 60℃.

…Continued



Top Side

PCB area heated by Output Diode D3



Bottom Side

3.3V output diode D3

Comment: Pass

6.7 EMC and Safety

6.7.1 Conducted Emission

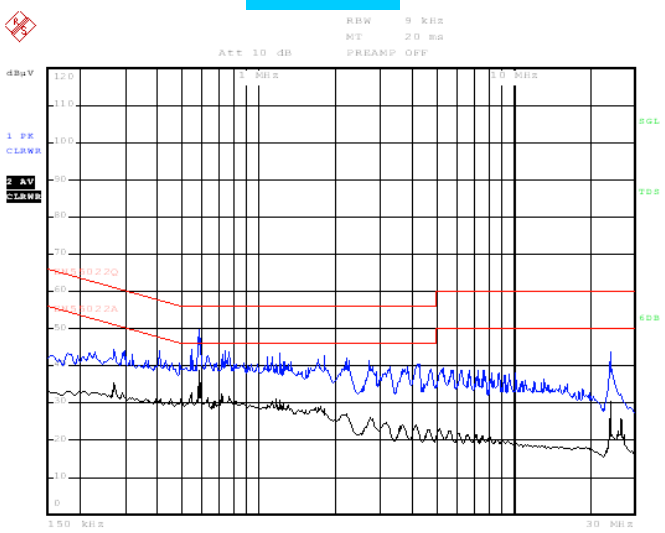
Test Conditions:

- The unit was subjected to 220V_{AC} line and with maximum load.
- The output GND floats.

Criteria To Pass:

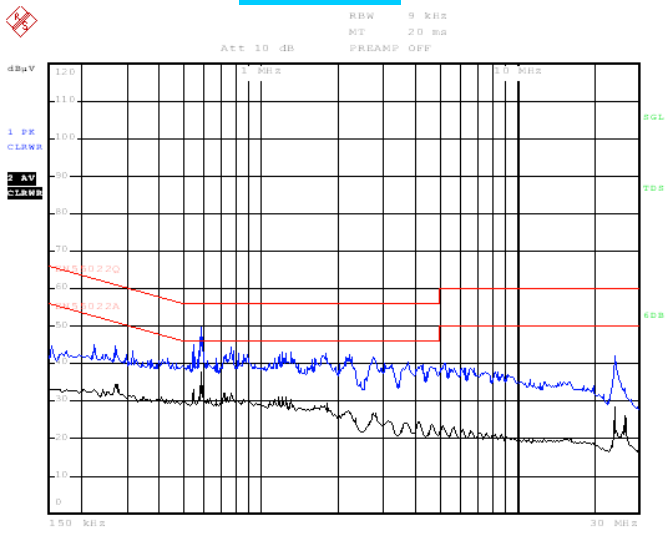
- EN55022 with -8dB margin.

L line



Date: 17.OCT.2012 19:19:39

N line



Date: 17.OCT.2012 19:23:27

Comment: Pass

6.7 EMC and Safety

6.7.2 Surge Test

Test Conditions:

- **Surge Test with 1.2/50us Waveform**

Criteria To Pass:

- **The EV Board can work normally during test and after test**

Surge Level (V)	Input Voltage (Vac)	Injection Location	Injection Phase (°)	Number of Surges	Test Result
1000	220	L-N	0	5	PASS
1000	220	L-N	90	5	PASS
1000	220	L-N	180	5	PASS
1000	220	L-N	270	5	PASS
-1000	220	L-N	0	5	PASS
-1000	220	L-N	90	5	PASS
-1000	220	L-N	180	5	PASS
-1000	220	L-N	270	5	PASS