EVX2001-Y-00B

90VAC~265VAC/50Hz/60Hz, 12V/5A Evaluation Board

DESCRIPTION

The EVX2001-Y-00B Evaluation Board is mainly designed to demonstrate the capabilities of MPS highly integrated controller MPX2001. The MPX2001 is an all-in-one flyback controller aims at high-performance and high-integration solution. It combines the primary side driver, secondary side controller and synchronous rectifier (SR) driver in one chip. So the opto-coupler and TL431 can be removed from the secondary side and SR can be turned off on time without any shoot through risk.

The EVX2001-Y-00B is typically designed for a general adapter. Its specification is listed in the below table.

ELECTRICAL SPECIFICATION

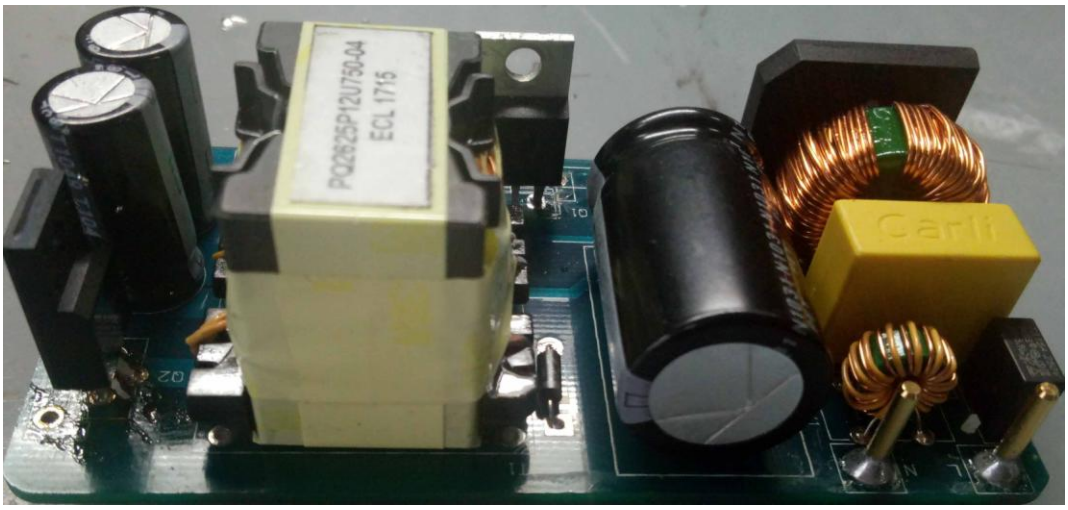
Parameter	Symbol	Value	Units
Input Voltage	V_{IN}	90 to 265	VAC
Output Voltage	V_{OUT}	12	V
Output Current	I_{OUT}	5	A
Output Power	P_{OUT}	60	W
Efficiency (4 Point Average)	η	≥91	%

The EVX2001-Y-00B has excellent efficiency, which can meet CoC V5 and DoE Level Ⅵ requirement easily. It meets IEC61000-4-5 surge immunity and EN55022 conducted EMI requirements. It has multi-protection function, e.g., Brown In/Out, over load protection, over voltage protection, short-circuit protection, cycle by cycle current limit and over-temperature protection, etc.

FEATURES

- 3.5kVrms primary side to secondary side isolation
- 700V integrated HV current source
- 200V integrated SR controller, supporting both DCM and CCM operation
- Precise constant voltage (CV), ±5% CV including transient response
- Extremely low operating current in standby mode
- Frequency modulation and peak current mode control, with slope compensation, line compensation and leading edge blanking
- Adjustable cable drop compensation
- Advanced protections, including primary sensed output Over Voltage Protection (OVP) and Primary Over Current Protection (POCP), real secondary sensed output Over Load Protection (OLP), Brown-in/Brown-out (B/O, B/I), Short Circuit Protection (SCP), Current-Sensing Short Protection (SSP), internal Thermal Shut Down (TSD), Under Voltage Locked-Out (UVLO), and External triggered Protection (Ext.P)

EVX2001-Y-00B EVALUATION BOARD



TOP VIEW

BOTTOM VIEW

(L x W x H) 10.5cm x 4.6cm x 2.8cm

Board Number	MPS IC Number
EVX2001-Y-00B	MPX2001

EVALUATION BOARD SCHEMATIC

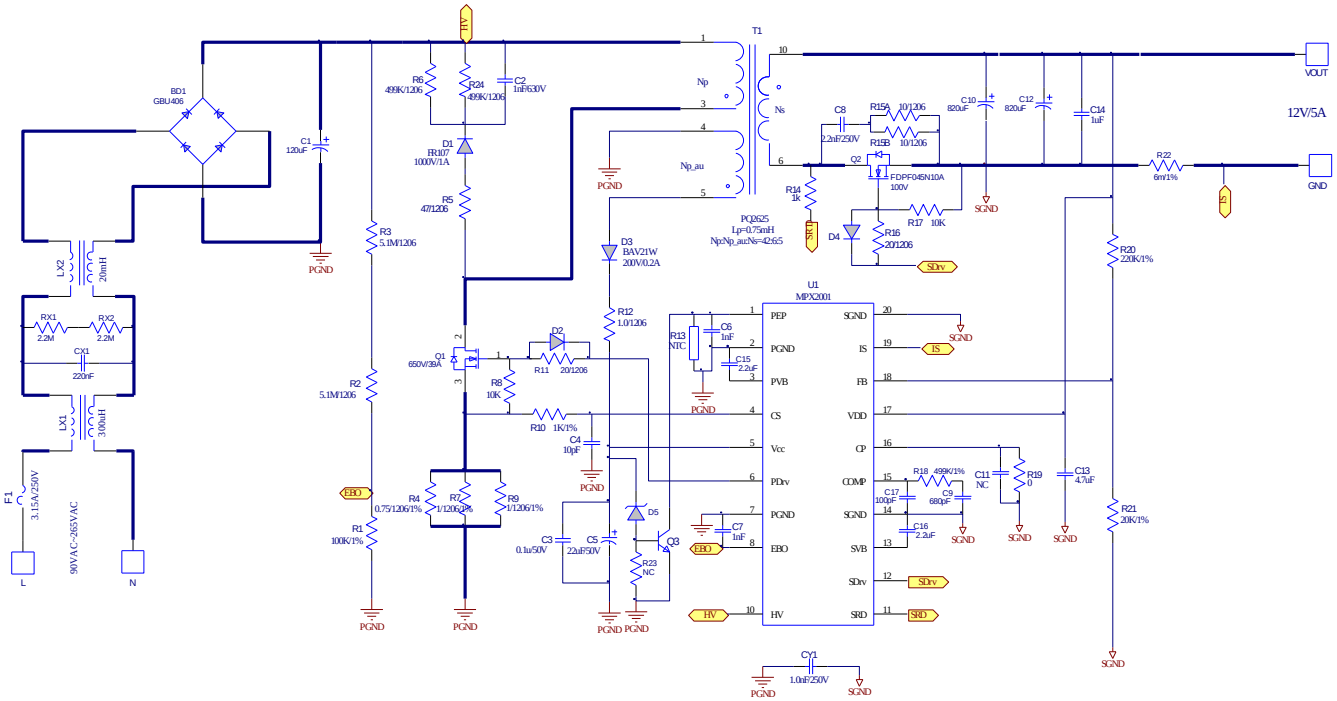


Figure 1—Schematic

PCB LAYOUT (SINGLE-SIDED)

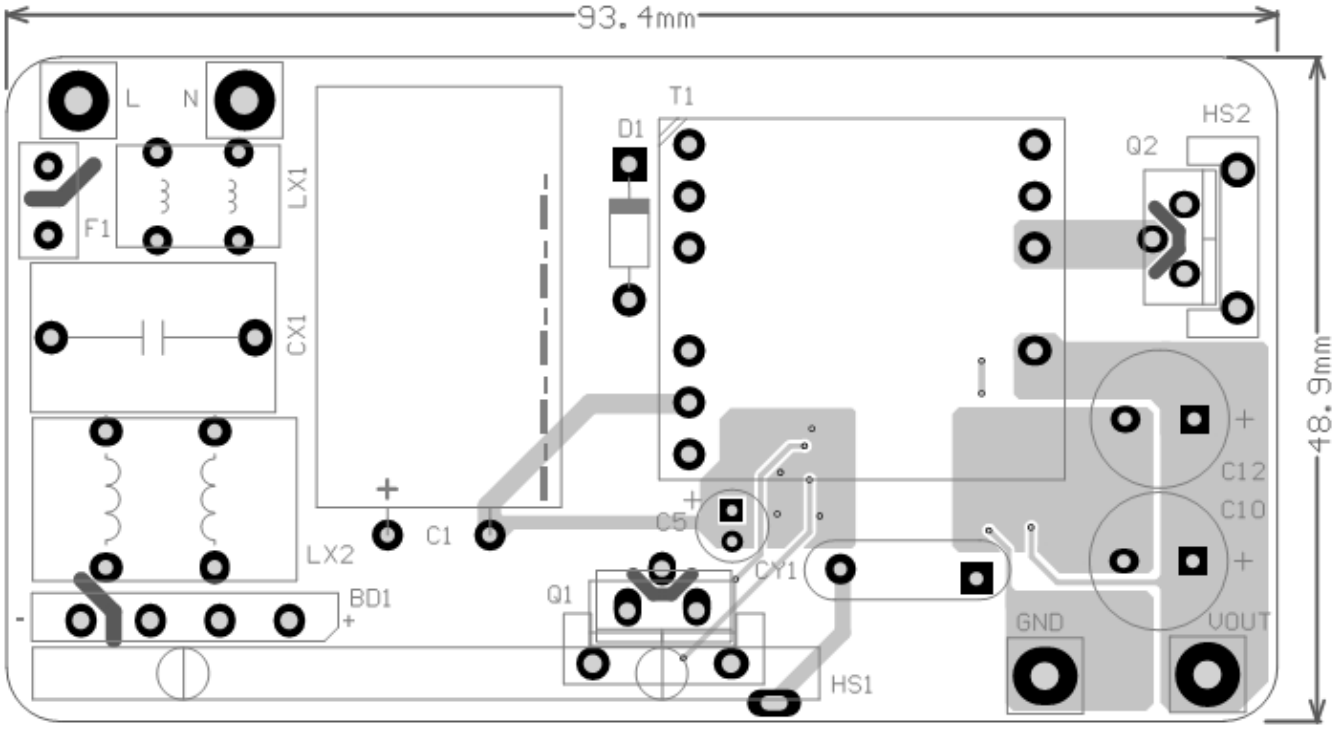


Figure 2—Top Layer

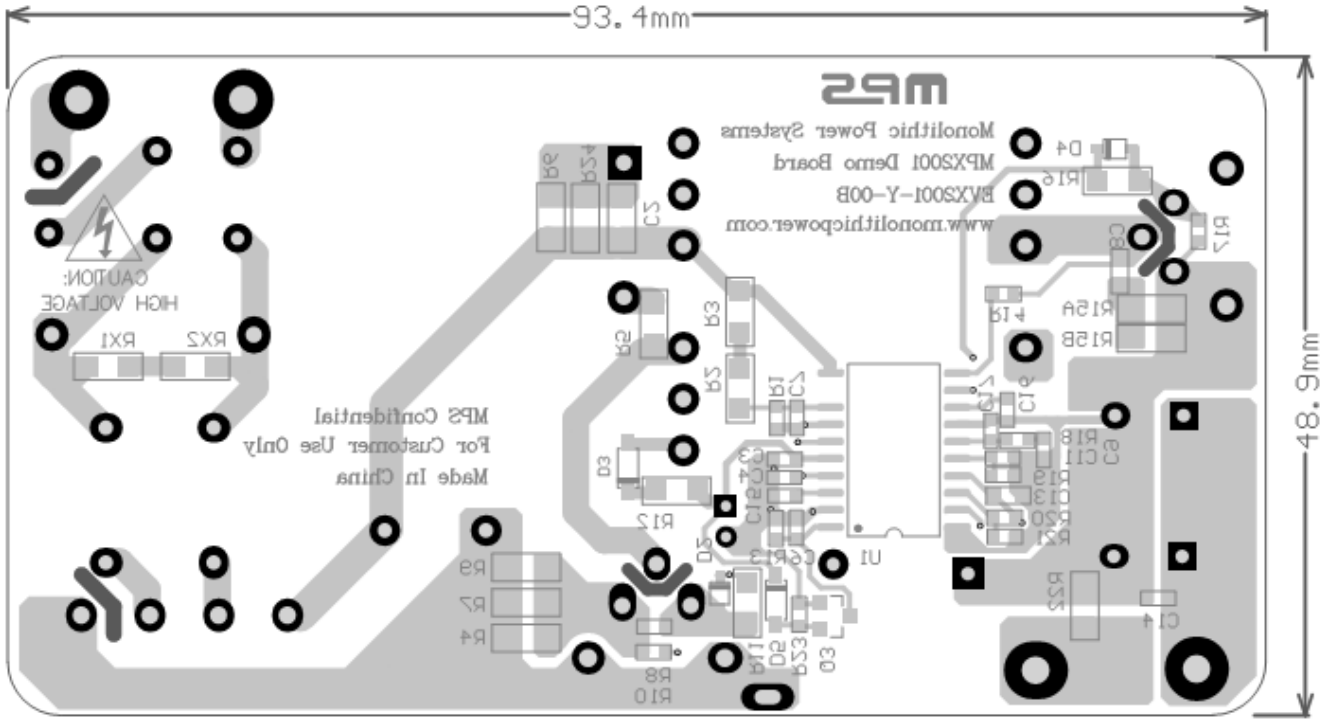


Figure 3—Bottom Layer

CIRCUIT DESCRIPTION

The EVX2001-Y-00B is a single-stage flyback converter with All-in-One controller. The input is universal and output is 12V/5A. The All-in-One controller integrates primary side and secondary side in one chip so the opto-coupler and TL431 can be saved.

F1, LX1, LX2, CX1, BD1, RX1 and RX2 compose the input stage. F1 is the fuse and is used to protect the component failure or some excessive short events. LX1, LX2 and CX1 are configured the EMI filter to suppress conducted EMI. BD1 is the rectifier bridge to convert AC voltage to DC voltage. RX1 and RX2 are the discharging resistors to make CX1 discharging time compliant with safety regulation.

C1 is the filter capacitor. D1, R5, R6, R24 and C2 are configured RCD snubber to suppress voltage spike of Mosfet.

R12, C3, C5 and D3 are used as Vcc power supply.

D5, R23 and Q3 are optional OVP circuit. The OVP threshold can be set by this external circuit.

MPX2001 and its peripheral components are configured flyback controller circuit. MPX2001 integrates the primary side and secondary side in one chip so the opto-coupler and TL431 can be saved.

Q1 is the main switch and R4, R7 and R9 are the current sensing resistors.

T1 is the transformer to transfer the power from primary side to secondary side. It is key component for the whole circuit normal working with good performance. So it should be designed carefully.

CY1 is Y capacitor lowering common mode noise to make sure there is enough EMI margin.

Q2 is secondary synchronous rectifier (SR) and R15A, R15B and C8 are their snubber to suppress SR high voltage spike.

C10, C12 and C14 are output capacitors. R18, C9 and C17 are configured as the compensation network. R20 and R21 are feedback resistors. R22 is the output current sensing resistor for the over current protection.

EVX2001-Y-00B BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Part Number
1	BD1	GBU406	Diode;600V;4A	DIP	Diodes	GBU406
1	C1	120μF	Electrolytic Capacitor; 400V;	DIP	Rubycon	KXW Series 18*30
1	C2	1nF/630V	Ceramic Capacitor; 630V;U2J	1206	Murata	GRM31A7U2J102JW31D
1	C3	0.1μF/50V	Ceramic Capacitor; 50V;X7R	0603	Murata	GRM188R71H104KA93D
1	C4	10pF	Ceramic Capacitor; 50V;C0G;	0603	TDK	C1608COG1H100D
1	C5	22μF/50V	Electrolytic Capacitor; 50V;	DIP	Wurth	860160672011
2	C6, C7	1nF	Ceramic Capacitor; 25V;C0G;	0603	muRata	GRM1885C1E102JA01D
1	C8	2.2nF/250V	Ceramic Capacitor; 250V;X7R;	0805	TDK	C2012X7R2E222K
1	C9	680pF	Ceramic 'Capacity; 50V; X7R;	0603	TDK	C1608X7R1H681K
2	C10, C12	820μF	Electrolytic Capacitor; 25V;	DIP	Rubycon	25ZL820
0	C11	NC	No Connected			
1	C13	4.7μF	Ceramic Capacitor; 25V;X7R;	0805	muRata	GRM21BR71E475KA73L
1	C14	1μF	Ceramic Capacitor; 25V;X5R;	0603	TDK	C1608X5R1E105K
2	C15, C16	2.2μF	Ceramic Capacitor; 10V;X7R;	0603	muRata	GRM188R71A225KE15D
1	C17	100pF	Ceramic Capacitor; 50V;C0G	0603	TDK	C1608C0G1H101J
1	CX1	220nF	Capacitor;275V;10%	DIP	Carli	PX224K3ID49L270D9R
1	CY1	1.0nF/250V	Y Capacitor; 250V;20%	DIP	鸿科	JNK09E102MY02N
1	D1	FR107	Diode;1000V;1A	DO-41	Diodes	FR107
2	D2, D4	1N4148WS	Diode;75V;0.15A;	SOD-323	Diodes	1N4148WS-7-F
1	D3	BAV21W	Diode;200V;0.2A;	SOD-123	Diodes	BAV21W-7-F
0	D5	NC	No Connected			
1	F1	SS-5-3.15A	Fuse;250V;3.15A	DIP	COOPER Bussman	SS-5-3.15A
1	LX1	300uH	Common Choke; 300uH;1A	DIP	Emei	TP4U300-00
1	LX2	20mH	Common Choke; 20mH;2A	DIP	Emei	TP4M20-02
1	Q1	IPP65R280E6	Mosfet; 700V;0.28/10V;	TO220	Infineon	IPP65R280E6

EVX2001-Y-00B BILL OF MATERIALS *(continued)*

Qty	Ref	Value	Description	Package	Manufacturer	Part Number
1	Q2	FDPF045N10A	N-Channel Mosfet; 100V/67A	TO-220	Fairchild	FDPF045N10A
0	Q3	NC	No Connected			
1	R1	100k/1%	Film Resistor;1%;	0603	Yageo	RC0603FR-07100KL
2	R2, R3	5.1M/1206	Film Resistor;1%;	1206	Yageo	RC1206FR-075M1L
1	R4	0.75/1206/1%	Film Resistor; 1%;1/4W;	1206	Royalohm	1206 F50LT5F
1	R5	47/1206	Film Resistor;1%	1206	Yageo	RC1206FR-0747R
2	R6, R24	499k/1206	Film Resistor;1%;	1206	Yageo	RC1206FR-07499KL
3	R7, R9, R12	1/1206/1%	Film Resistor; 1%;1/4W;	1206	Yageo	RC1206FR-071RL
2	R8, R17	10k	Film Resistor;1%;	0603	Yageo	RC0603FR-0710KL
2	R10,R14	1k	Resistor;1%;1/16W;	0603	Ralec	RF0603-1K
2	R11,R16	20/1206	Film Resistor;5%	1206	Yageo	RC1206JR-0720R
0	R13	NC	No Connected			
2	R15A,R15B	10/1206	Film Resistor;5%	1206	Yageo	RC1206JR-0710R
1	R18	499k/1%	Film Resistor;1%;	0603	Yageo	RC0603FR-07499KL
1	R19	0	Film Resistor;1%;	0603	Yageo	RC0603FR-070RL
1	R20	220k/1%	Film Resistor;1%;	0603	Yageo	RC0603FR-07220KL
1	R21	20k/1%	Film Resistor; 1%;1/10W;	0603	Yageo	RC0603FR-0720KL
1	R22	6m/1206/1%	Film Resistor; 1%;1/4W;	1206	TA-I Technology	RLM12FTCMR006
2	RX1,RX2	2.2M/5%	Film Resistor; 5%;1/4W;	1206	Yageo	RC1206JR-072M2L
1	T1	0.75mH	PQ2625, Lm=0.75mH,	PQ2625	Emei	FX0478
1	U1	MPX2001GY	All-in-one Controller		MPS	All In One
4	L, N, VOUT,GND		2.0mm 铜柱			
0	HS1, HS2	NC	No Connected			

TRANSFORMER SPECIFICATION

Electrical Diagram

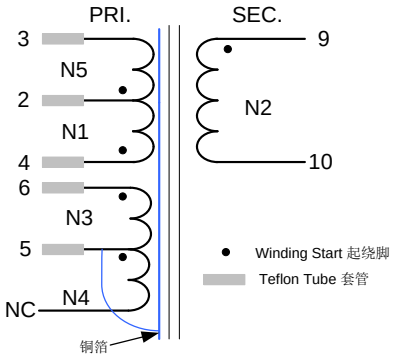


Figure 4—Transformer Electrical Diagram

Notes:
1. Core is connected to Pin 5 with naked wire.

Winding Order

Tape Layer	Winding #	Start-End	Wire Dia	Turns	Winding	Tube
0	N1	4 —〉 2	0.33mm*2	18		Fit with wire
1	One Layer Copper, connected to Pin5 with wire					
1	N2	9 —〉 10	0.6mm(T.I.W)*4	5	Spread evenly	Ft with wire
1	N3 N4	6 —〉 5 5 —〉 NC	0.33mm*1 0.33mm*1	6	Spread evenly	Fit with wire
1	N5	2—〉 3	0.33mm*2	24		Fit with wire
3						

Electrical Specifications

Electrical Strength	60 second, 60Hz, from PRI. to SEC.	3500VAC
	60 second, 60Hz, from PRI. to CORE.	500VAC
	60 second, 60Hz, from SEC. to CORE.	3500VAC
Primary Inductance	Pins 3 - 4, all other windings open, measured at 60kHz, 0.1 VRMS	0.75mH±10%
Primary Leakage Inductance	Pins 3 - 4 with all other pins shorted, measured at 60kHz. 0.1 VRMS	<15μH±10%

Materials

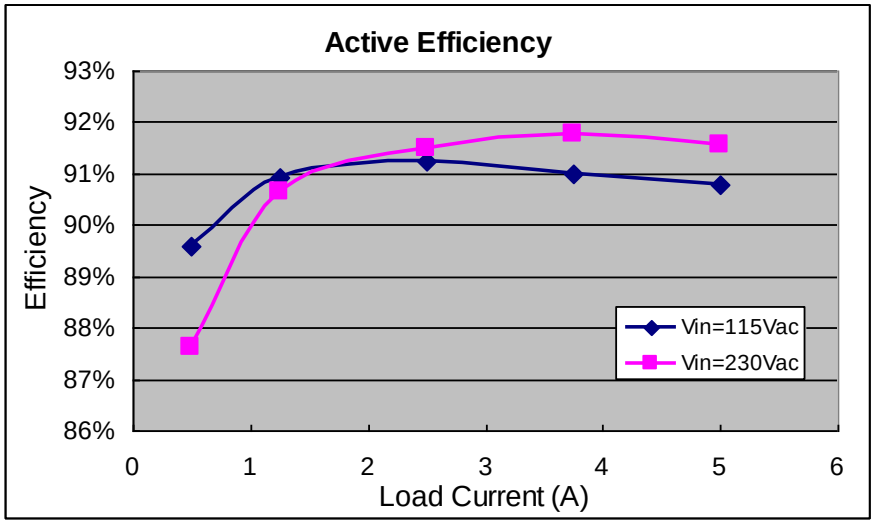
Item	Description
1	Core: PQ2625,
2	Bobbin: PQ2625, 4+2PIN 1 SECT TH, UL94V-0
3	Wire:Φ0.33mm,, 2UEW, Class B
4	Wire:Φ0.33mm,, 2UEW, Class B
5	Triple Insulation Wire: Φ0.6mm TIW
7	Tape: 10.5mm(W)×0.06mm(TH)
8	Varnish: JOHN C. DOLPH CO, BC-346A or equivalent
9	Solder Bar: CHEN NAN: SN99.5/Cu0.5 or equivalent

EVB TEST RESULTS

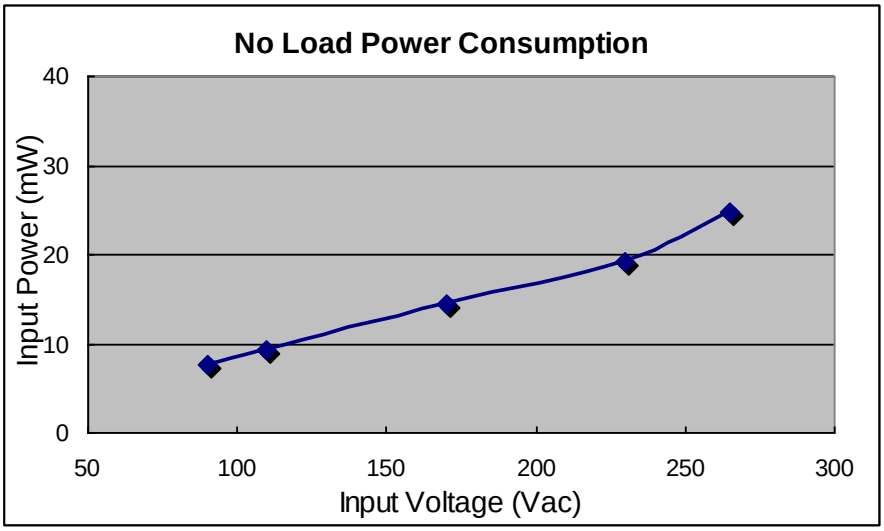
Performance Data

Ta=25℃, unless otherwise noted.

Efficiency



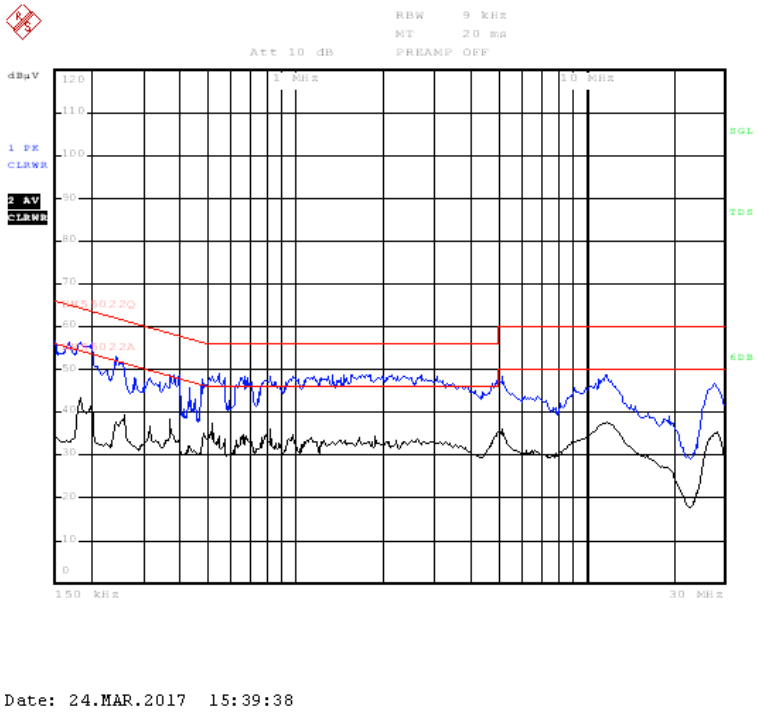
No Load Consumption



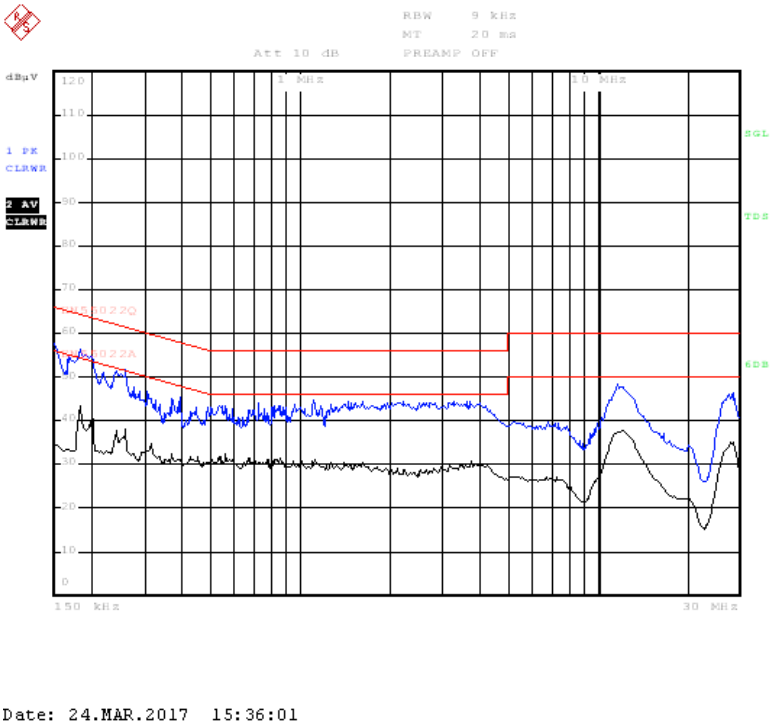
		4 points Average Efficiency	10% Load Efficiency	No Load Consumption
DoE Level Ⅵ		0.88	--	0.21
CoC V5	Tier1	0.89	0.79	0.25
	Tier2	0.89	0.79	0.15
Test Data	Vin=115Vac	0.910	0.895	0.00918
	Vin=230Vac	0.914	0.876	0.01909

Conducted EMI Test

Test with 115Vac/230Vac input and full load condition

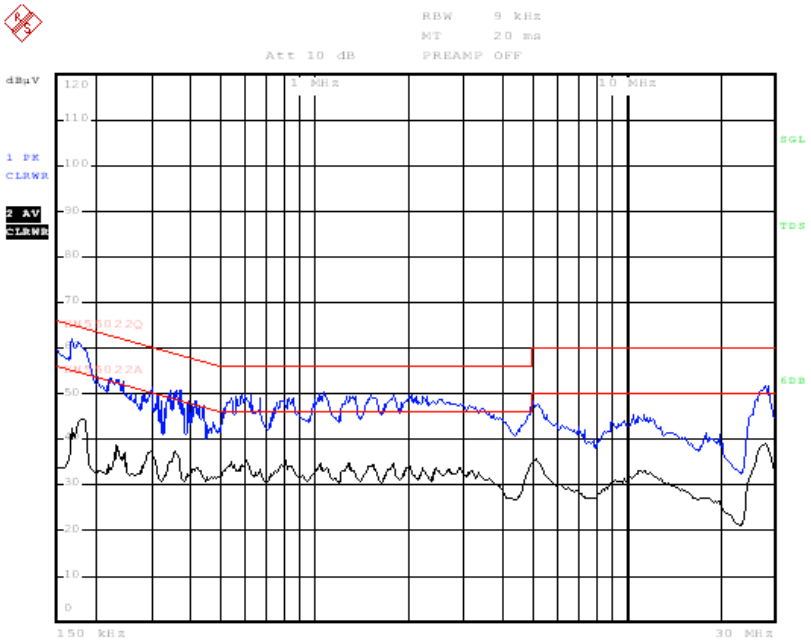


115Vac, 60Hz, Maximum Load, L Line, Output GND floats, EN55022 Limits



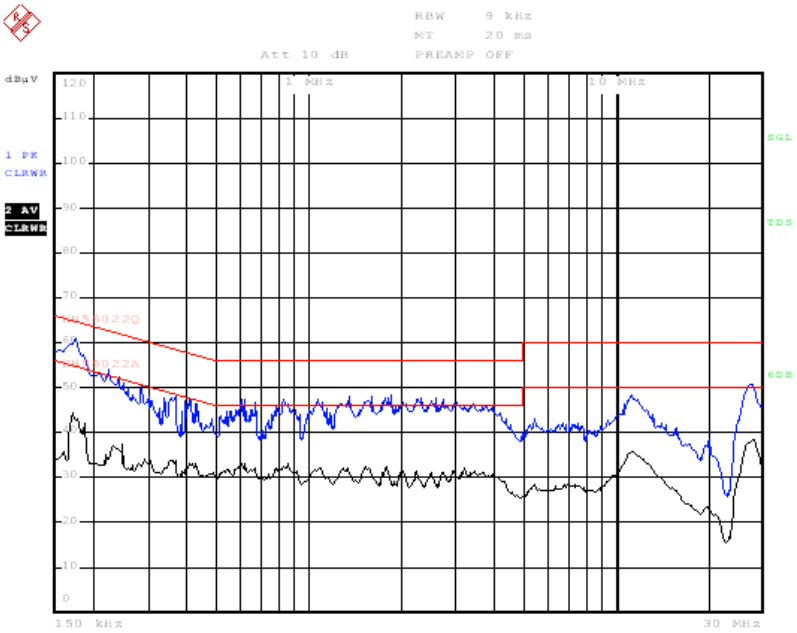
115Vac, 60Hz, Maximum Load, N Line, Output GND floats, EN55022 Limits

Conducted EMI Test (Continued)



Date: 24.MAR.2017 15:29:17

230Vac, 50Hz, Maximum Load, L Line, Output GND floats, EN55022 Limits



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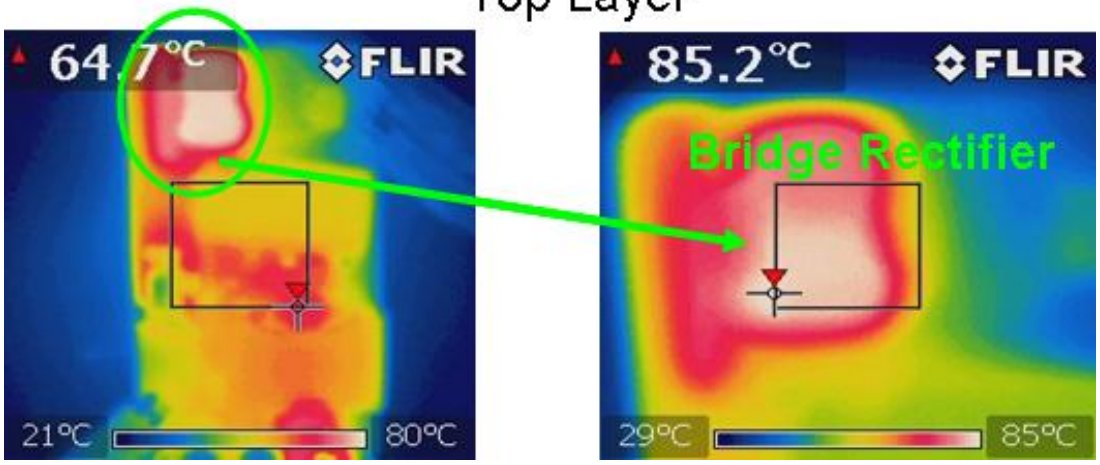
230Vac, 50Hz, Maximum Load, N Line, Output GND floats, EN55022 Limits

Thermal Test

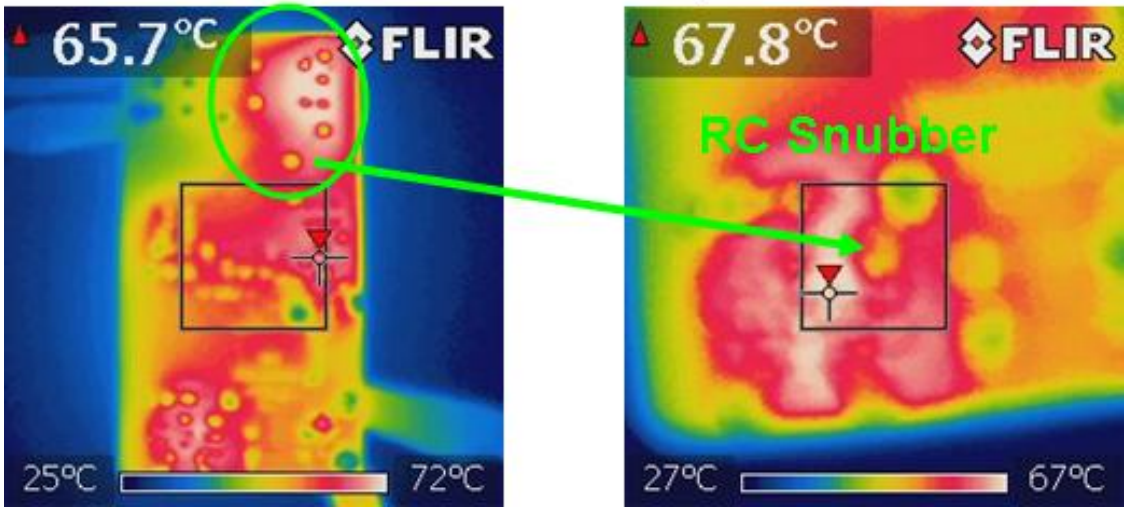
Test with 90Vac/265Vac input and full load condition. PCB layout with 1Oz copper.

Vin=90Vac

Top Layer



Bottom Layer

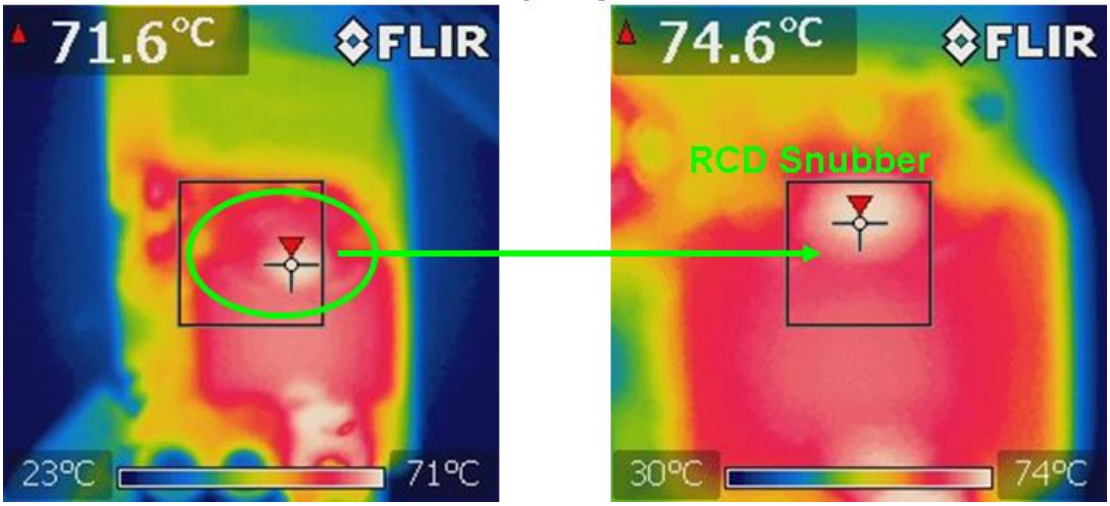


Thermal Test (Continued)

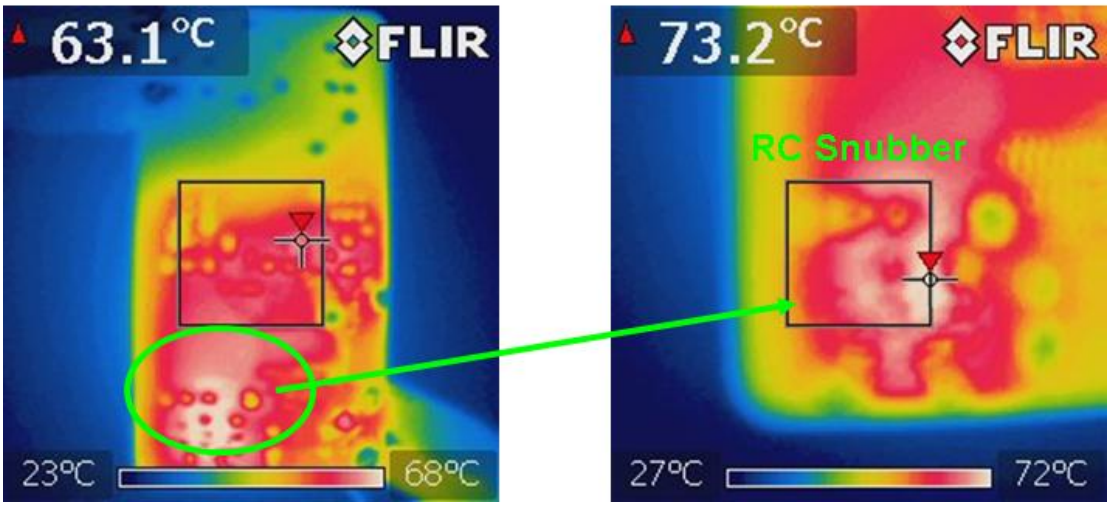
Test with 90Vac/265Vac input and full load condition. PCB layout with 1Oz copper

Vin=265Vac

Top Layer



Bottom Layer



Surge Test

Test with 220Vac input/full load condition and 1.2/50 μ s CWG waveform.

DM Surge Test

Surge Level (V)	Input Voltage (Vac)	Injection Location	Injection Phase (°)	Number of Surges	Test Result
2000	220	L-N	0	5	PASS
2000	220	L-N	90	5	PASS
2000	220	L-N	180	5	PASS
2000	220	L-N	270	5	PASS
-2000	220	L-N	0	5	PASS
-2000	220	L-N	90	5	PASS
-2000	220	L-N	180	5	PASS
-2000	220	L-N	270	5	PASS

CM Surge Test

Surge Level (V)	Input Voltage (Vac)	Injection Location	Injection Phase (°)	Number of Surges	Test Result
4000	220	L,N-PE	0	5	PASS
4000	220	L,N-PE	90	5	PASS
4000	220	L,N-PE	180	5	PASS
4000	220	L,N-PE	270	5	PASS
-4000	220	L,N-PE	0	5	PASS
-4000	220	L,N-PE	90	5	PASS
-4000	220	L,N-PE	180	5	PASS
-4000	220	L,N-PE	270	5	PASS

Quick Start Guide

1. Preset Power Supply to 90VAC ≤ V_{IN} ≤ 265VAC.
2. Turn Power Supply off.
3. Connect the Line and Neutral terminals of the power supply output to L and N port. For three-wire input application, make OUTPUT GND connected to Earth.
4. Connect Load to:
    a. Positive (+): VOUT
    b. Negative (–): GND
5. Turn Power Supply on after making connections.