

IS31LT3935 Bulb Lighting Evaluation Board Guide

Description

The Flicker-Free™ IS31LT3935 is a single stage current mode LED driver optimized for high power factor and compatibility with all TRIAC dimmers. The PFC architecture enables excellent power factor over a wide range of operating line and load conditions, even with the simplest of inductor based driver topologies, thereby reducing system cost and size while maximizing efficiency.

The IS31LT3935 LED controller features patent pending AccuDim™ flicker-free dimming technology that mimics the characteristics of an incandescent light bulb. It presents a dynamic impedance to the dimmer and integrates an active bleed circuit for true dimming performance across all dimmers.

The device is available in a tiny 10 lead DFN-EP (3mm ×3mm) package. It operates over the temperature range of -40°C to +85°C.

Features

- Smooth 0-100% Flicker-free Dimming Range
- Compatibility with all TRIAC Dimmers (Digital, Leading and Trailing-edge)
- Near unity PFC without External PFC Circuitry
- Spread Spectrum Switching for Reduced EMI
- Low 500µA Quiescent Current
- Protections:
 - Soft Start
 - Under-voltage, (Over-voltage) Lockout
 - Thermal Shutdown

Applications

- Dimmable Retrofit LED Lamps and Luminaries up to 30W
- Industrial and Commercial Lighting
- Offline LED Driver Modules and Bricks

Quick Start

Recommended Equipment

- 85~265VAC/50~60Hz power supply

For pricing, delivery, and ordering information, please contact ISSI at analog_mkt@issi.com or call +1-408-969-6600

- LED array(12 in series)40Vdc-0.37A
- 220V input TRIAC Dimmer

Absolute Maximum Ratings

- ≤ 264VAC power supply
- ≤ 47V Vout (Total Vf)

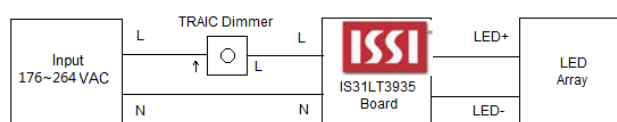
Caution: Do not exceed the conditions listed above, otherwise the board will be damaged or the output will be limited

Procedure

The IS31LT3935 DEMO Board is fully assembled and tested. Follow the steps listed below to verify board operation.

Caution: Do not turn on the power supply until all connections are completed.

- 1) Connect the positive terminal of the LEDs to the LED+ of the DEMO and the negative terminal of the LEDs to the LED- of the Evaluation Board.
- 2) Connect the input pin N of the Evaluation Board via the main power switch to AC power supply N.
- 3) Connect the input pin L of the Evaluation Board via TRIAC Dimmer pin L, Another pin of TRIAC Dimmer Connect to the AC power supply L.
- 4) Turn on the power supply, Adjust the angle of TRIAC Dimmer

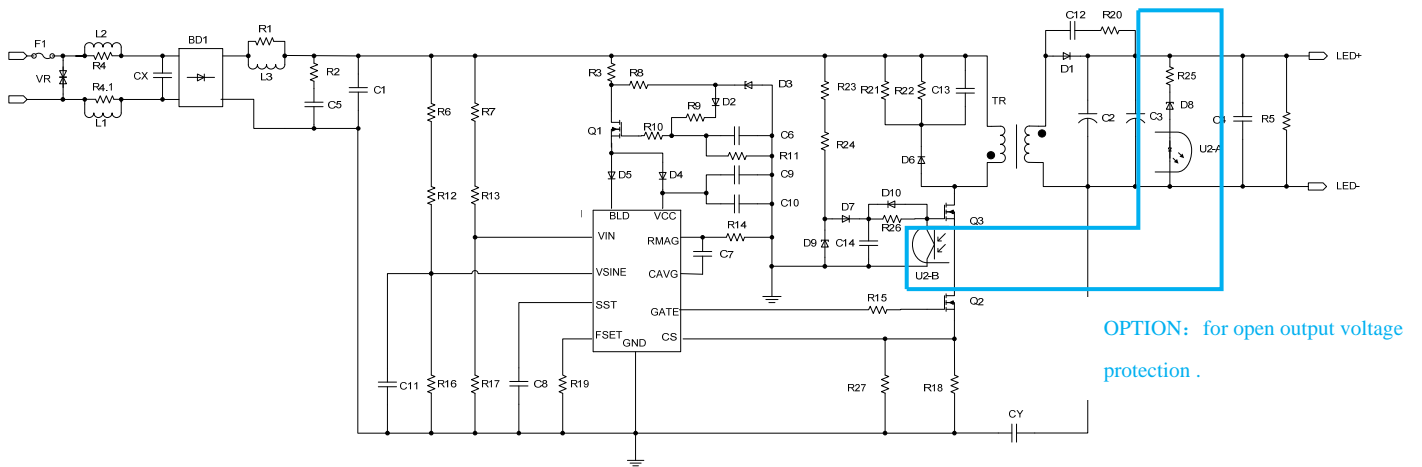


Ordering Information

PART#	TEMP RANGE	IC PACKAGE
IS31LT3935-DLS2-TR	-40 to 125°C	DFN-10 (Exposed Pad)

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Figure 1 IS31LT3935 Evaluation Board Schematic



Note: ISSI Evaluation Board does not include a LED array



Figure 2 Picture of Evaluation Board

NOTE: Physical dimensions are (L×W×H): 73mm×25mm×23mm

PCB Layout

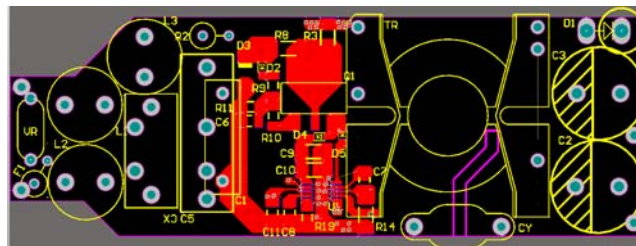


Figure 3 PCB Layout – Top layer

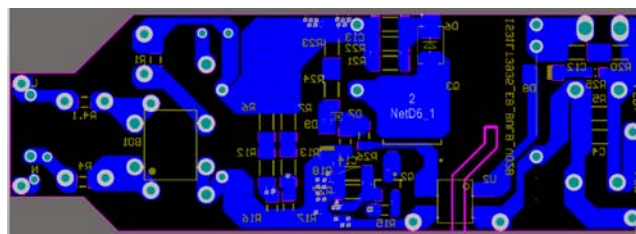


Figure 4 PCB Layout – Bottom layer

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Bill of Materials

No.	Name	Description	Ref Des.	Qty.	Mfr P/N
1	FUSE	1A250V ϕ 3	F1	1	
2	MOV	7D471 PIN7	VR	1	
3	Bridge rectifier	DB107 DIP4	BD1	1	
4	Inductor	3mH 0810	L1, L2	2	
5	Inductor	6mH 0810	L3	1	
6	Transformer	450uH PQ2016	TR	1	
7	Resistor	5.1k Ω 5% 0805	R1, R4, R4.1	3	
8	Resistor	510 Ω 5% 1W	R2	1	
9	Resistor	200k Ω 1% 1206	R6	1	
10	Resistor	180k Ω 1% 1206	R12	1	
11	Resistor	3.0k Ω 1% 0805	R16	1	
12	Resistor	270k Ω 1% 1206	R7	1	
13	Resistor	200k Ω 1% 1206	R13	1	
14	Resistor	5.6k Ω 1% 0805	R17	1	
15	Resistor	10 Ω 1% 1206	R3, R14	2	
16	Resistor	330k Ω 5% 1206	R8	1	
17	Resistor	1.0 Ω 5% 0805	R9, R15	1	
18	Resistor	10.0 Ω 5% 0805	R15	1	
19	Resistor	100 Ω 5% 0805	R10	1	
20	Resistor	5.6M Ω 5% 0805	R11	1	
21	Resistor	NC	R20,R5,C12,C4,R27	0	
22	Resistor	300k Ω 5% 1206	R21,R22	2	
23	Resistor	180k Ω 5% 1206	R23,R24	2	
24	Resistor	180k Ω 1% 0805	R19	1	
25	Resistor	0.16 Ω 1% 1206	R18	1	
26	Resistor	200 Ω 5% 0805	R26	1	
27	Resistor	51 Ω 5% 0805	R25	1	
28	CBB-CAP	68nF 630V pin10	C1	1	
29	CBB-CAP	220nF 630V pin15	C5	1	
30	E-CAP	470uF 50V 1020	C2,C3	2	
31	SMD-CAP	22nF 25V X7R 0805	C6	1	
32	SMD-CAP	1uF 25V X7R 0805	C7,C8	2	
33	SMD-CAP	10uF 25V X7R 0805	C14	1	
34	SMD-CAP	10uF 25V X7R 1206	C9,C10	2	
35	SMD-CAP	33PF 25V X7R 0805	C11	1	
36	SMD-CAP	1nF 1000V X7R 1206	C13	1	
37	Y1-CAP	1nF PIN10	CY	1	
38	SMD-DIODE	ES2J	D1	1	
39	SMD-DIODE	FR107	D6	1	

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40	SMD-DIODE	1N914BWT	SOD-523F	D2,D4,D5,D7	4	
41	SMD-DIODE	1N4148	SOD-80	D10	1	
42	SMD-ZENER	9.1V 1%	SOD-80	D3	1	
43	SMD-ZENER	16V 1%	SOD-80	D9	1	
44	SMD-ZENER	47V 1%	SOD-80	D8	1	
45	MOS	4N60C	TO-252	Q3	1	
46	MOS	AP2306	SOT-23	Q2	1	
47	MOS	BSP125	SOT223	Q1	1	
48	Photo-coupler	EL357	MSOP-4	U2	1	
49	IC	IS31LT3935	DFN10	U1	1	
50	CBB-CAP	22nF 630V	PIN10	CX	1	

NOTE: please make sure you Dimmer parameter is suitable you application voltage and frequency.

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Transformer Design

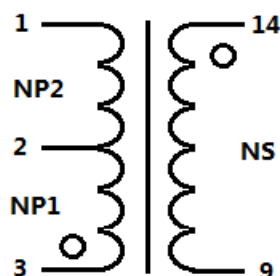
ELECTRICAL SPECIFICATIONS:

1. Primary inductance(L_p)=450uH@10kHz
2. Primary Leakage Inductance (L_k)< = 20uH @10KHz
3. Electrical Strength = 3KV, 50/60Hz,1Min

MATERIALS:

1. Core:PQ2016(Ferrite Material TDK PC40 or equivalent)
2. Bobin:PQ2016 Primary 6,Secondary:8
- 3.. Magnet Wires (Pri) : Type 2-UEW
4. Magnet Wire (Sec) : Triple Insulated Wires
5. Layer Insulation Tape :3M1298 or equivalent.

SCHEMATIC



NO.	winding	Start	End	number of turns	number of plies	diameter	number of plies	tape	remarks
1	NP1	3	2	17T	2	0.40mm-2-UEW	2	0.02*7.5mm	
2	NS	14	9	16T	2	2P*0.20mm-TEX	3	0.02*7.5mm	
3	NP2	2	1	16T	1	0.40mm- 2-UEW	3	0.02*7.5mm	

Line Regulation and Efficiency

Input Voltage	Input Power	THD	PF	Output Voltage	Output Current	Efficiency
176Vac/50Hz	15.53	11.8%	0.979	40.4	0.329	85.60%
198Vac/50Hz	17.24	13.8%	0.964	40.8	0.360	85.20%
220Vac/50Hz	18.69	26.0%	0.945	41.2	0.386	85.09%
242Vac/50Hz	19.95	27.3%	0.925	41.5	0.407	84.66%
264Vac/50Hz	21.10	28.5%	0.905	41.8	0.424	84.00%

Load Regulation and Efficiency

Input Voltage	Input Power	THD	PF	Output Voltage	Output Current	Efficiency
220Vac/50Hz	18.72	26.1%	0.945	38.14	0.418	85.16%
220Vac/50Hz	18.69	26.0%	0.945	41.2	0.386	85.09%
220Vac/50Hz	18.6	26.0%	0.945	43.9	0.359	84.73%

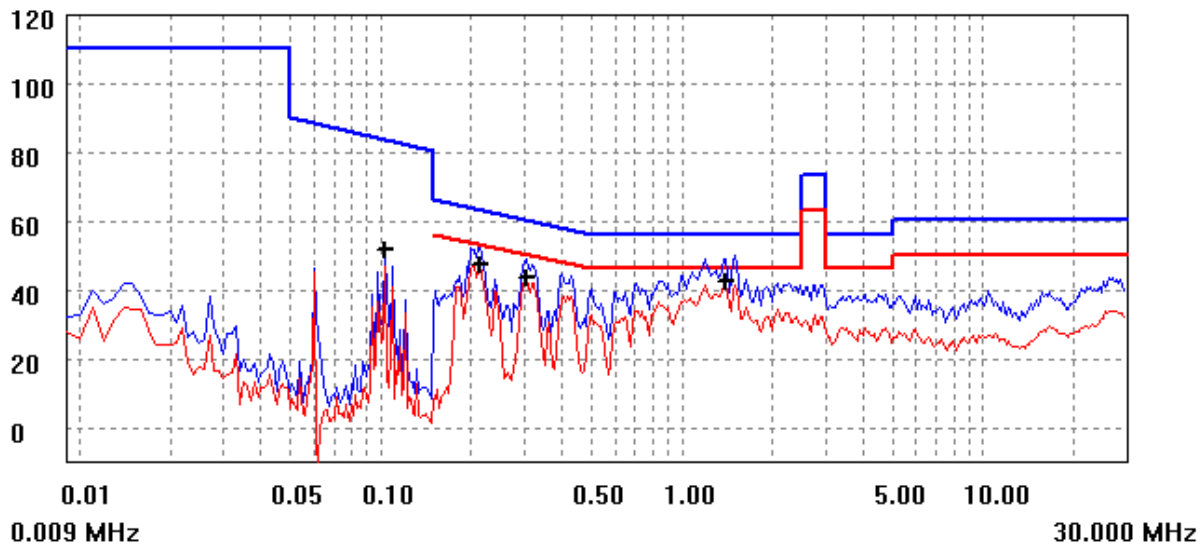
NOTE: Please don't make the DEMO operation long time without load.

EMI TEST REPORT

Organization:		Operator:	EUT:
Place:	XM	Time:	2013/4/18/9:31
Detector:	PK+AV	Test-time(ms):	10
Limit:	EN55015	Transductor:	PK0
Remark:			

Start(MHz)	End(MHz)	Step(MHz)
0.009	0.150	0.001
0.150	3.000	0.002
3.000	10.000	0.020
10.000	30.000	0.025

dBuV



final test

(AV)	freq(MHz)	lev(dBuV)	Lim(dBuV)	Δ (lev-Lim)
	0.104	51.5	0.0	51.5
	0.212	47.3	54.2	-6.9
	0.303	43.3	51.6	-8.4
	1.388	42.2	46.0	-3.8

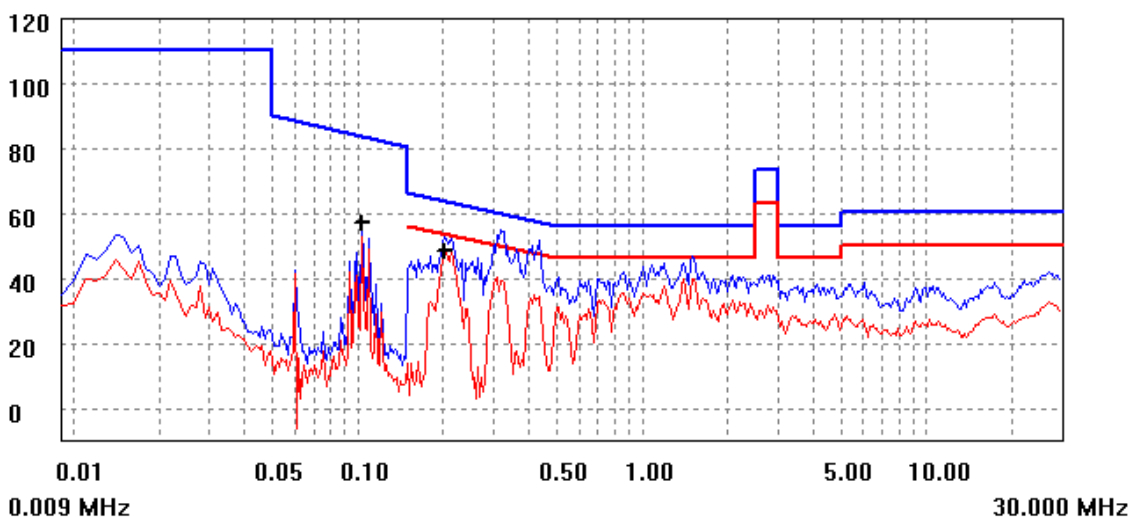
Figure 5. L line

EMI TEST REPORT

Organization:		Operator:	EUT:
Place:	XM	Time:	2013/4/18/9:28
Detector:	PK+AV	Test-time(ms):	10
Limit:	EN55015	Transductor:	PK0
Remark:			

Start(MHz)	End(MHz)	Step(MHz)
0.009	0.150	0.001
0.150	3.000	0.002
3.000	10.000	0.020
10.000	30.000	0.025

dBuV



(AV)	freq(MHz)	lev(dBuV)	Lim(dBuV)	Δ(lev-Lim)
	0.104	57.0	0.0	57.0
	0.203	48.5	54.5	-6.0

Figure 6. N line

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- a.) the risk of injury or damage has been minimized;
- b.) the user assume all such risks; and
- c.) potential liability of Integrated Silicon Solution, Inc is adequately protected under the circumst

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Modify value of a few components for different output voltage and current application

NO.	Ref Des.	Vout=40V Iout=0.38A	Vout=33V Iout=0.42A	Vout=24V Iout=0.65A
		Description	Description	Description
1	D1	ES2G	ES2G	SB5200
2	C2	470uF 50V	470uF 50V	470uF 35V
3	C3	470uF 50V	470uF 50V	470uF 35V
4	R18	0.16Ω 1% 1206	0.33Ω 1% 1206	0.18Ω 1% 1206
5	R27	NC	0.33Ω 1% 1206	3.0Ω 1% 1206
6	D8	47V 1% SOD-80	39V 1% SOD-80	30V 1% SOD-80

Vout=33V Iout=0.42A

Transformer Design

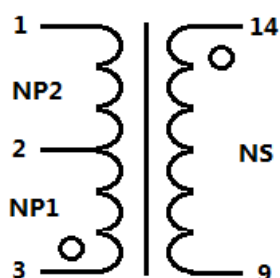
ELECTRICAL SPECIFICATIONS:

1. Primary inductance(L_p)=450uH@ 10kHz
2. Primary Leakage Inductance (L_k)< = 20uH @10KHz
3. Electrical Strength = 3KV, 50/60Hz,1Min

MATERIALS:

1. Core:PQ2016(Ferrite Material TDK PC40 or equivalent)
2. Bobin:PQ2016 Primary 6,Secondary:8
- 3.. Magnet Wires (Pri) : Type 2-UEW
4. Magnet Wire (Sec) : Triple Insulated Wires
5. Layer Insulation Tape :3M1298 or equivalent.

SCHEMATIC



NO.	winding	Start	End	number of turns	number of plies	diameter	number of plies	tape	remarks
1	NP1	3	2	17T	2	0.40mm-2-UEW	2	0.02*7.5mm	
2	NS	14	9	13T	2	0.32mm-TEX	3	0.02*7.5mm	
3	NP2	2	1	16T	1	0.40mm- 2-UEW	3	0.02*7.5mm	



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Line Regulation and Efficiency

Input Voltage	Input Power	THD	PF	Output Voltage	Output Current	Efficiency
176Vac/50Hz	14.01	17.1%	0.969	33.74	0.352	84.77%
198Vac/50Hz	15.37	18.9%	0.949	34.09	0.380	84.28%
220Vac/50Hz	16.37	30.8%	0.927	34.37	0.402	84.40%
242Vac/50Hz	17.39	27.3%	0.904	34.60	0.421	83.76%
264Vac/50Hz	18.31	28.5%	0.881	34.81	0.438	83.27%

Load Regulation and Efficiency

Input Voltage	Input Power	THD	PF	Output Voltage	Output Current	Efficiency
220Vac/50Hz	16.38	30.9%	0.926	31.34	0.440	84.19%
220Vac/50Hz	16.37	30.8%	0.927	34.37	0.402	84.40%
220Vac/50Hz	16.43	30.9%	0.926	37.38	0.370	84.73%

NOTE: Please don't make the DEMO operation long time without load.

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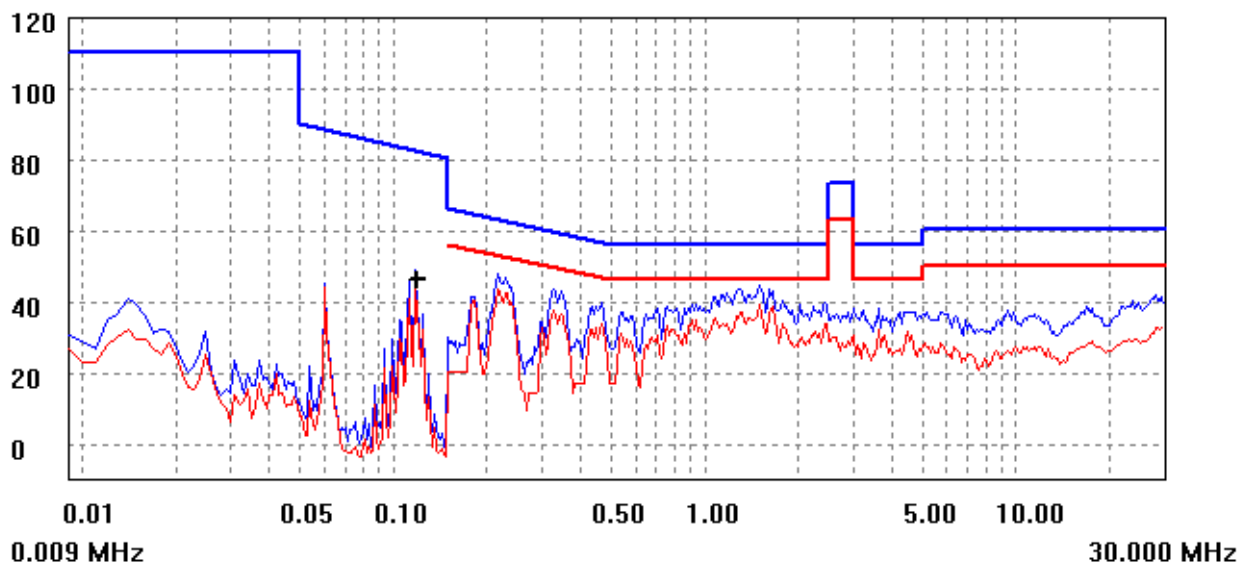
EMI test Report

EMI TEST REPORT

Organization:	Operator:	LORY CHEN	EUT:	parameter
Place: XM	Time:	2013/4/25/14:47		
Detector: PK+AV	Test-time(ms):	10		
Limit: EN55015	Transductor:	PK0		
Remark:				

Start(MHz)	End(MHz)	Step(MHz)	freq, step
0.009	0.150	0.001	
0.150	3.000	0.002	
3.000	10.000	0.020	
10.000	30.000	0.025	

dBuV scan result



final test

(AV)	freq(MHz)	lev(dBuV)	Lim(dBuV)	Δ (lev-Lim)
	0.119	46.1	0.0	46.1

Figure 7. L line

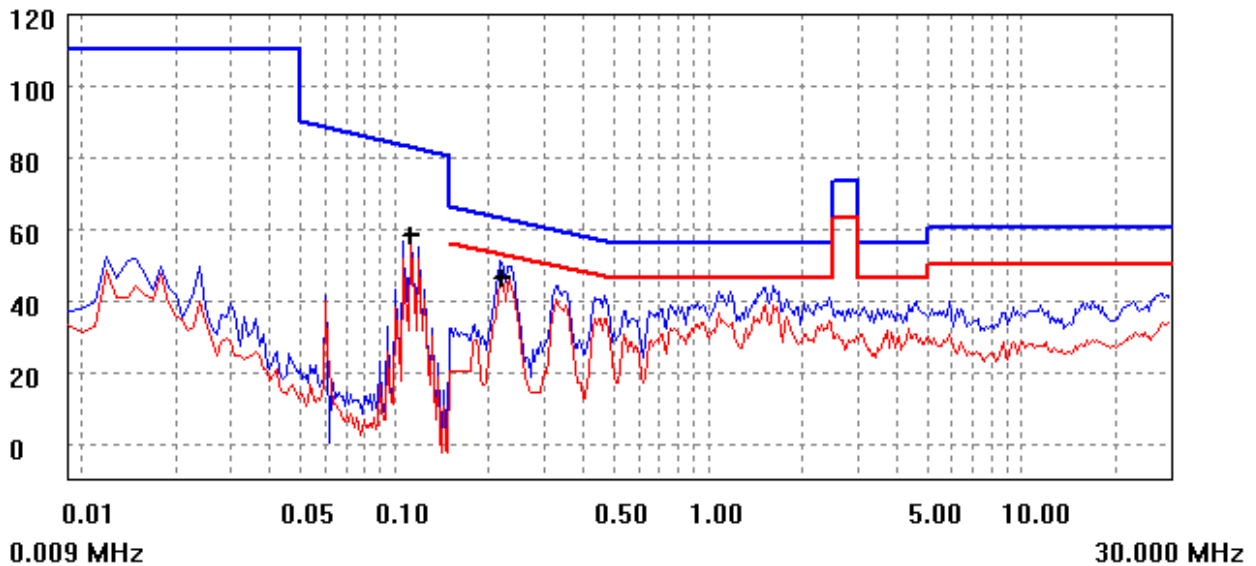
EMI TEST REPORT

Organization:	Operator: LORY CHEN	EUT:	parameter
Place: XM	Time: 2013/4/25/14:50		
Detector: PK+AV	Test-time(ms): 10		
Limit: EN55015	Transductor: PK0		
Remark:			

Start(MHz)	End(MHz)	Step(MHz)	freq, step
0.009	0.150	0.001	
0.150	3.000	0.002	
3.000	10.000	0.020	
10.000	30.000	0.025	

scan result

dBuV



final test

(AV)	freq(MHz)	lev(dBuV)	Lim(dBuV)	Δ (lev-Lim)
	0.113	57.7	0.0	57.7
	0.221	45.9	54.0	-8.0

Figure 8. N line

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Vout=24V Iout=0.64A

Transformer Design

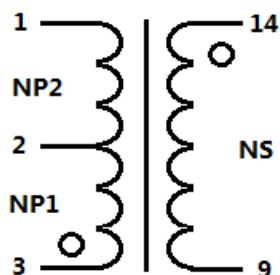
ELECTRICAL SPECIFICATIONS:

1. Primary inductance(Lp)=450uH@ 10kHz
2. Primary Leakage Inductance (Lk)< = 20uH @10KHz
3. Electrical Strength = 3KV, 50/60Hz,1Min

MATERIALS:

1. Core:PQ2016(Ferrite Material TDK PC40 or equivalent)
2. Bobin:PQ2016 Primary 6,Secondary:8
- 3.. Magnet Wires (Pri) : Type 2-UEW
4. Magnet Wire (Sec) : Triple Insulated Wires
5. Layer Insulation Tape :3M1298 or equivalent.

SCHEMATIC



NO.	winding	Start	End	number of turns	number of plies	diameter	number of plies	tape	remarks
1	NP1	3	2	17T	2	0.40mm-2-UEW	2	0.02*7.5mm	
2	NS	14	9	10T	2	0.40mm-TEX	3	0.02*7.5mm	
3	NP2	2	1	16T	1	0.40mm- 2-UEW	3	0.02*7.5mm	

Line Regulation and Efficiency

Input Voltage	Input Power	THD	PF	Output Voltage	Output Current	Efficiency
176Vac/50Hz	14.48	11.5%	0.977	21.81	0.556	83.75%
198Vac/50Hz	16.08	13.4%	0.961	22.17	0.606	83.55%
220Vac/50Hz	17.35	25.5%	0.942	22.45	0.644	83.33%
242Vac/50Hz	18.48	26.8%	0.921	22.67	0.675	82.80%
264Vac/50Hz	19.42	27.8%	0.899	22.85	0.698	82.13%

Load Regulation and Efficiency

Input Voltage	Input Power	THD	PF	Output Voltage	Output Current	Efficiency
220Vac/50Hz	17.25	25.5%	0.941	19.42	0.735	82.75%
220Vac/50Hz	17.35	25.5%	0.942	22.45	0.644	83.33%
220Vac/50Hz	17.25	25.5%	0.941	25.37	0.568	83.54%

NOTE: Please don't make the DEMO operation long time without load.

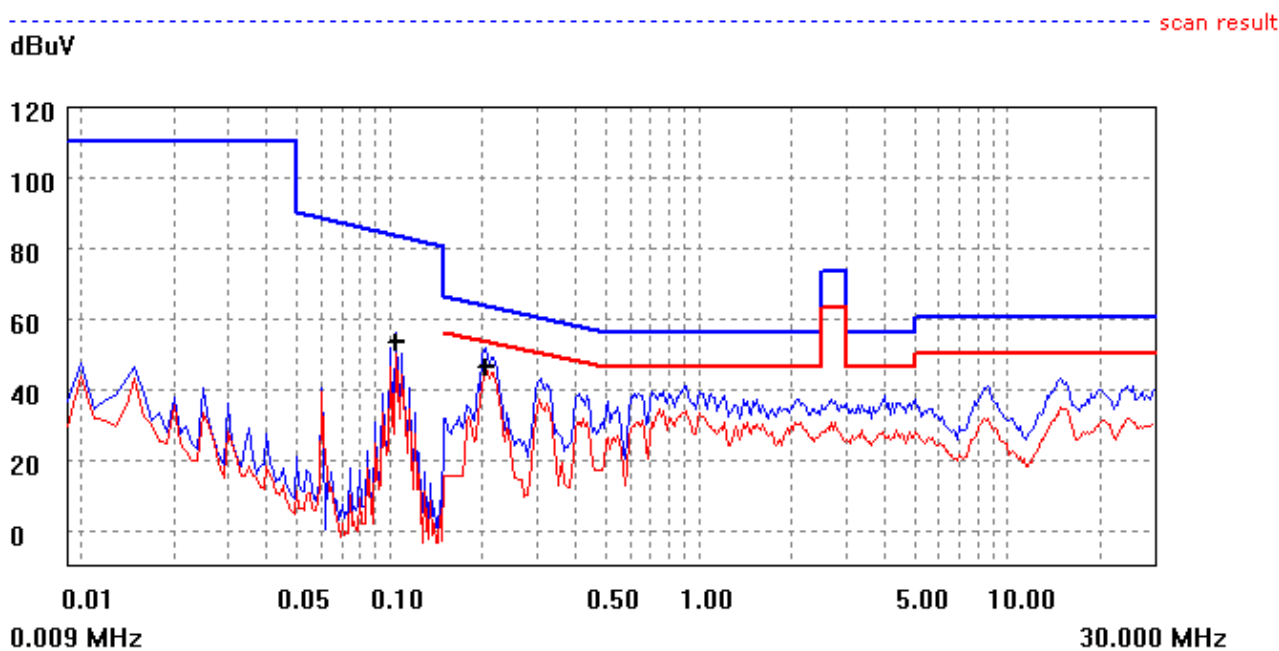
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EMI test Report

EMI TEST REPORT

Organization:	Operator:	LORY CHEN	EUT:
Place:	Time:	2013/4/25/14:42	
Detector:	Test-time(ms):	10	
Limit:	Transductor:	PK0	
Remark:			

Start(MHz)	End(MHz)	Step(MHz)
0.009	0.150	0.001
0.150	3.000	0.002
3.000	10.000	0.020
10.000	30.000	0.025



(AV)	freq(MHz)	lev(dBuV)	Lim(dBuV)	Δ (lev-Lim)
	0.105	52.9	0.0	52.9
	0.204	46.3	54.5	-8.2

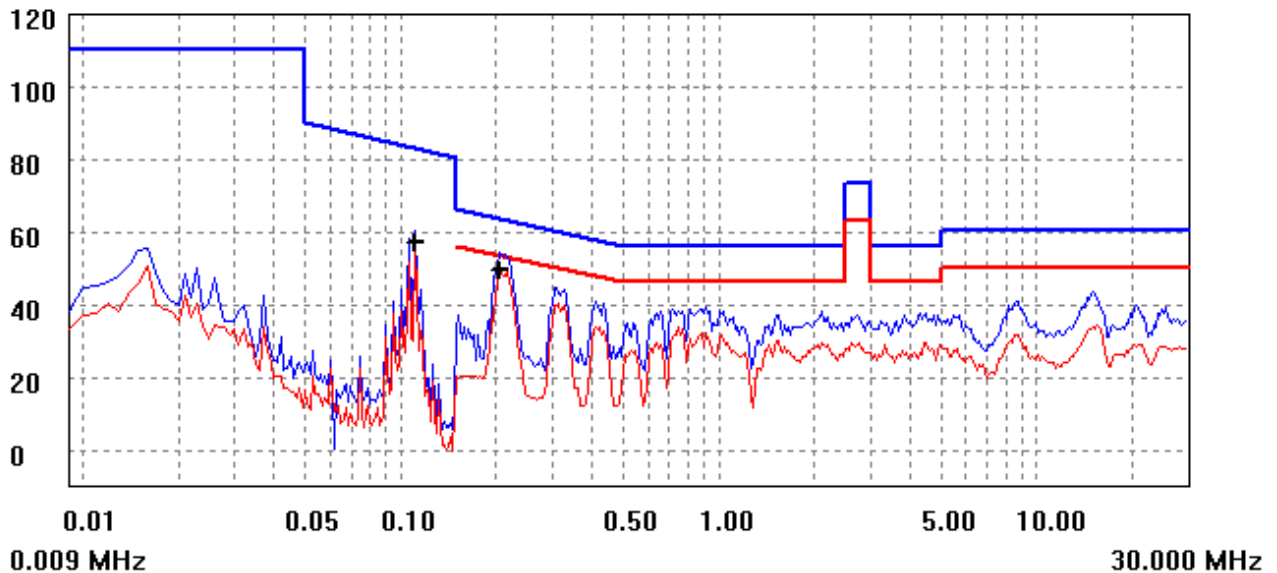
Figure 9. L line

EMI TEST REPORT

Organization:		Operator:	LORY CHEN	EUT:
Place:	XM	Time:	2013/4/25/14:38	
Detector:	PK+AV	Test-time(ms):	10	
Limit:	EN55015	Transductor:	PK0	
Remark:				

Start(MHz)	End(MHz)	Step(MHz)
0.009	0.150	0.001
0.150	3.000	0.002
3.000	10.000	0.020
10.000	30.000	0.025

dBuV



final test

(AV)	freq(MHz)	lev(dBuV)	Lim(dBuV)	Δ (lev-Lim)
	0.110	56.8	0.0	56.8
	0.206	49.3	54.4	-5.1

Figure 10. N line