



iWatt Solution For Streetlight

Summary and Features :

- 1. LED module, 50V, 350mA ; 8 Channel**
- 2. Wide AC input range: 90Vac-264Vac**
- 3. High Efficiency, High Power Factor , Lower cost than LLC solution**
- 4. Meet EMI Requirement (EN55015BQP&AV scan)**
- 5. Fully Protection Against AC input UV/OV,O/P Short &Open, OTP**

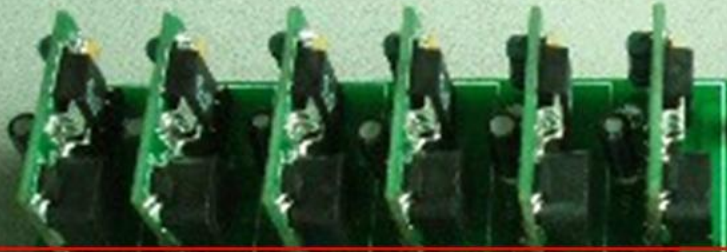


Specification

Description		Symbol	Min	Typ	Max	Units	Comment
Input							
Voltage		V_{IN}	90		264	V _{AC}	2 Wire
Frequency		f_{LINE}	47	50	63	Hz	
Open-load Input Power (264V _{AC})						W	
Output				8		Channel	
Const Voltage	Output Voltage	V_{OUT_CV}		50		V	Measured at the PCB connector
	Output Current	I_{OUT_CV}				A	
Const Current	Output Voltage	V_{OUT_CV}				V	Min Vout is depend on Vcc
	Output Current	I_{OUT_CV}		0.35		A	
Total Output Power				150		W	
Continuous Output Power		P_{OUT}		18		W	
Over Current Protection		I_{OUT_MAX}				A	Auto-restart
Efficiency		η	89.5			%	Measured at 230Vac
Power Fact		PF		0.98			Harmonic meet IEC61000-3-2
Turn on Delay Time						Sec	
Conducted EMI			Meets EN55015B				
Hi-pot test				3		KV	
Operation temperature		T_{opr}		60		° C	Free convection, sea level

A 240W Road Lamp Design with DC/DC Converters modules

DC/DC Modules (6x40W)



Resonant LLC Converter (48V; 6A)



PFC Front-End



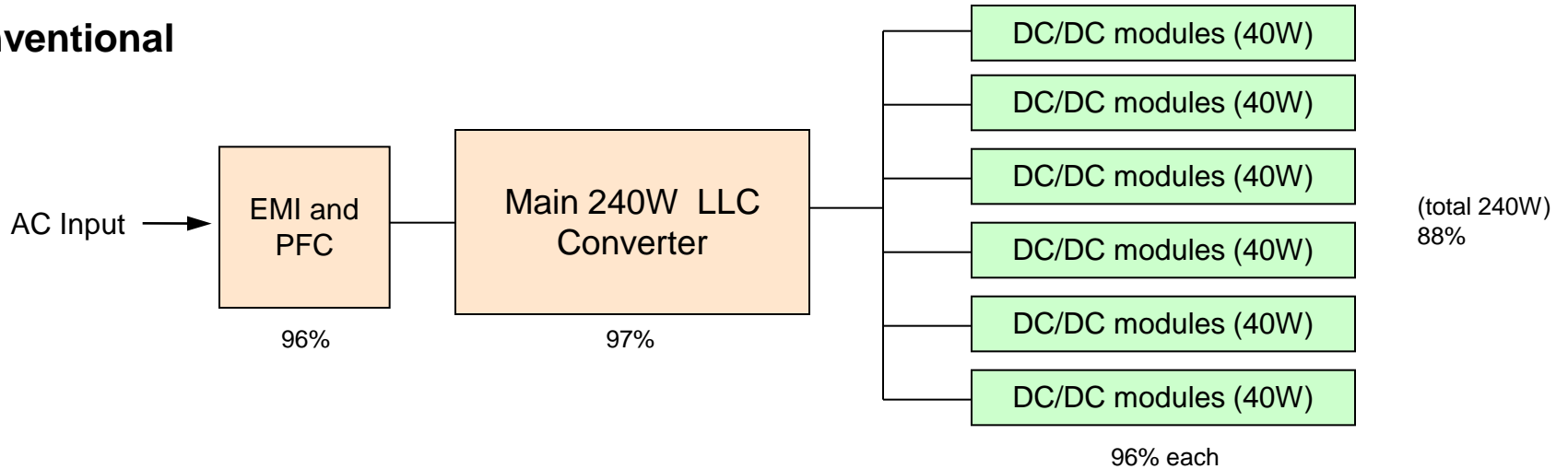
LLC converter FETs (reversed mounted on Heatsink)

LLC controller

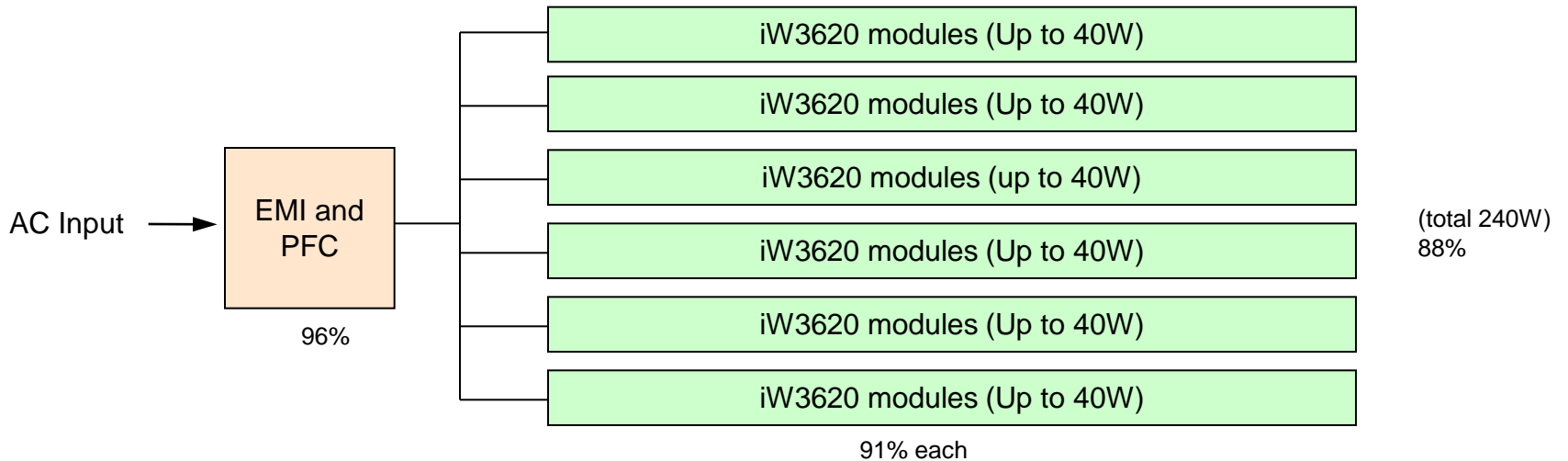


iWatt multi-drive vs. standard main + DC/DC modules

Conventional



iWatt with individual multi-drive 3620 modules

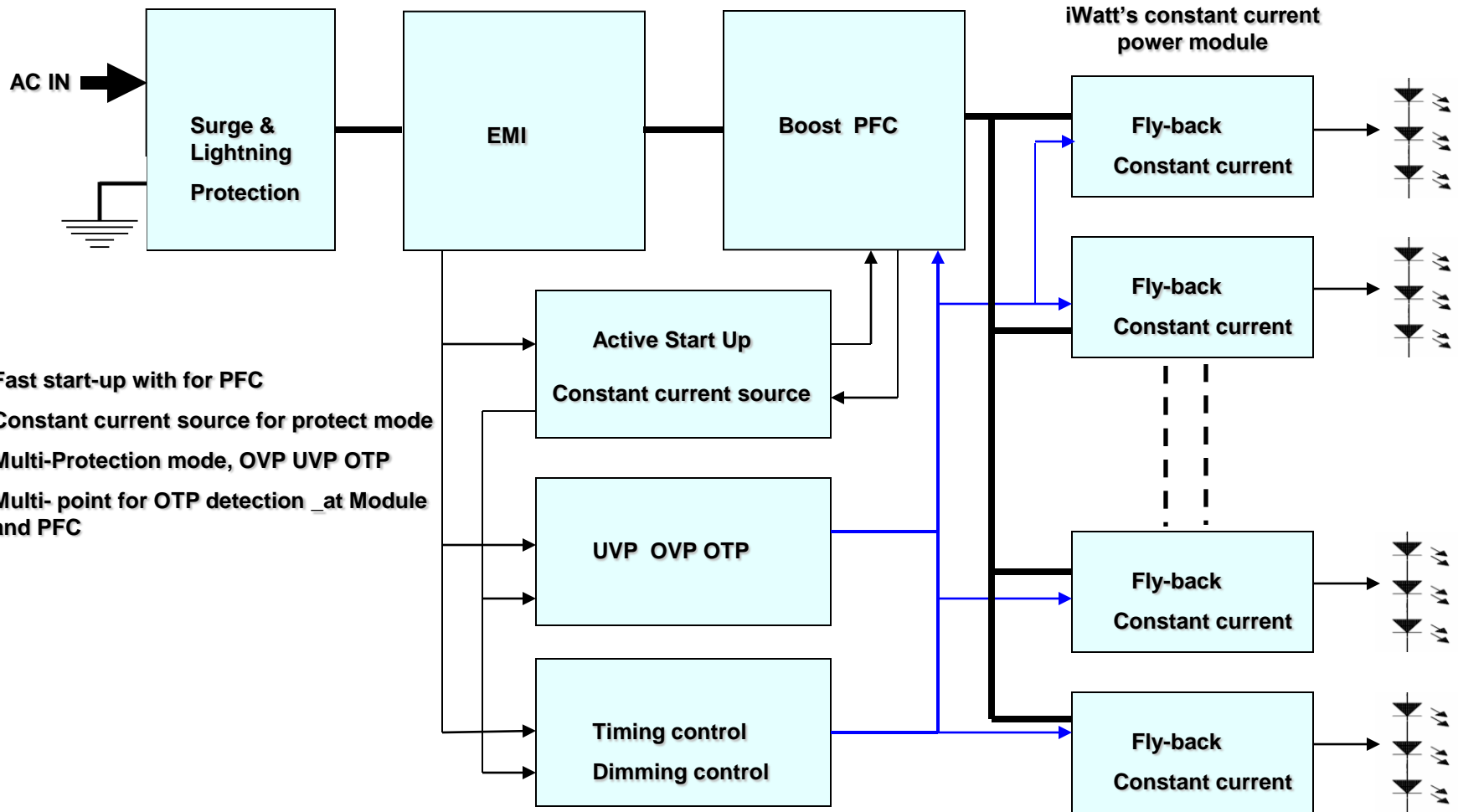


Comparison of 240W Road-Lamp designs

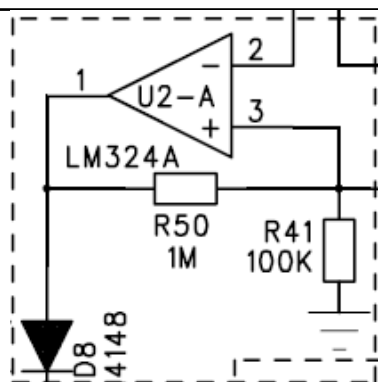


Item		Conventional PFC + 240W Isolated LLC Main + 6x DC/DC	iWatt – iW3620 Multi Drive PFC + 6x 40W module (for isolation & CC)	Result
Cost (exclude PFC)		DC/DC module 40W (~UD2 each) 240W main isolated converter (USD4.0) Total cost UD2x6 + 4 or <u>16 (USD)</u>	40W isolated module (UD2.4 each). Main isolation = 0 Total cost UD2.4 x 6 or <u>14.4 USD</u>	3620 has a lower total BOM cost
Performances	Efficiency	(95%x98%x95%) or 88%	97%x90% or 87%	Compatible
	Assembly	Main converter need to be scaled for different output level. (e.g. 80W, 120W, 180W, 200W, 240W, lot of variations.	Main converter is form by each individual modules and could be parallel connected to meet different power level.	3620 is more flexible
	Protections	Main converter 48V/6A will have high OCP is not adequately for protection against individual DC/DC modules. OVP & OTP need additional components added either main or DC/DC modules	Build in OTP, OCP, OVP in each channel without additional cost. OTP vs. NTC on SD pin OSP vs. Primary current limit OVP vs. Primary OVP loop on SD pin	Full system protections
Reliability (based on a 240W design)		Total number of converter : 8 A single 240W supply if failed could result complete lamp failure. (no redundancy)	Total number of converter : 7 Individual lamp driver failure rate is 1/λ. The reliability factor improved by 6 times.	Higher reliability with redundancy

System Block

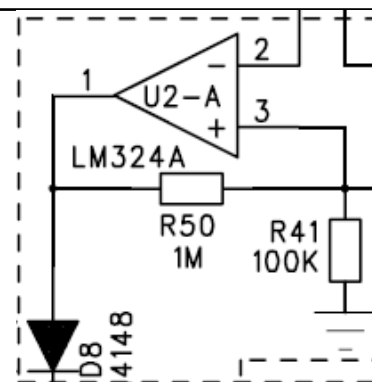


TURN ON

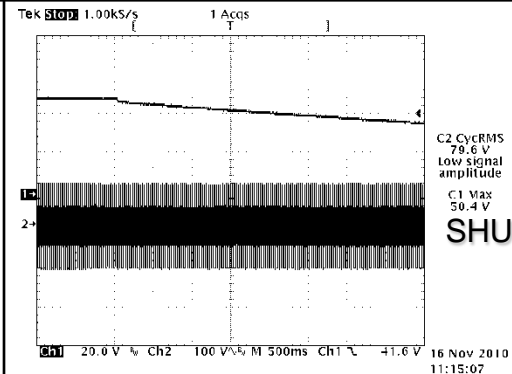
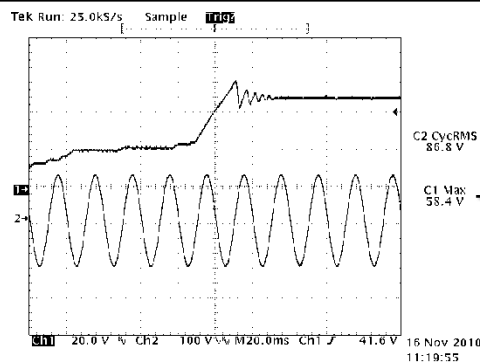


PIN1 0V
 PIN2 3.46V
 PIN3 3.42V

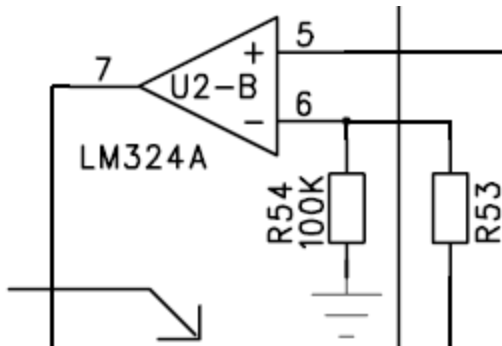
UVP



PIN1 16V
 PIN2 3.35V
 PIN3 3.42V

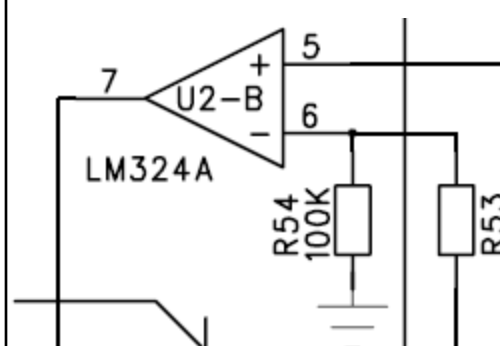


RESET

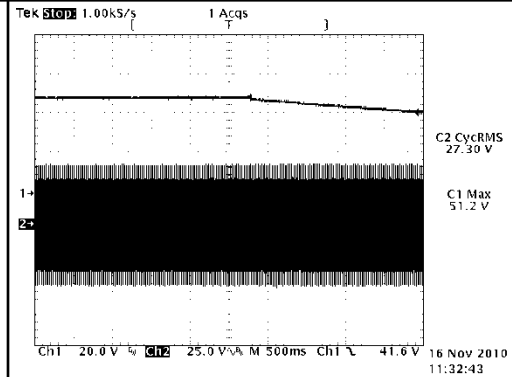
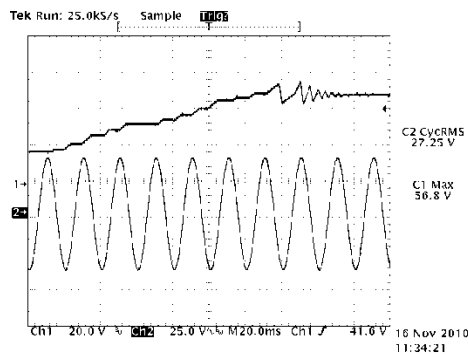


PIN7 0V
 PIN6 3.861V
 PIN5 3.815V

OVP



PIN7 16V
 PIN6 3.861V
 PIN5 3.865V

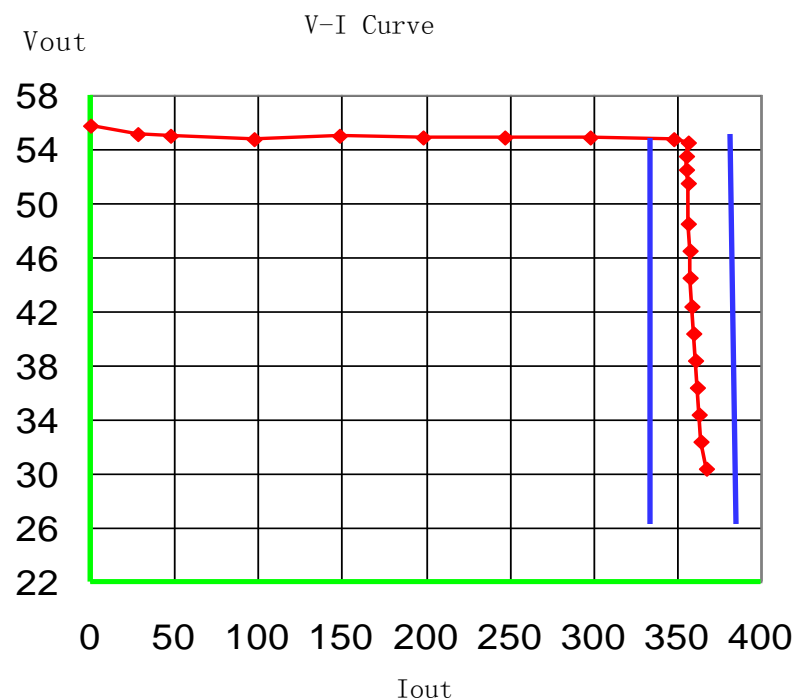
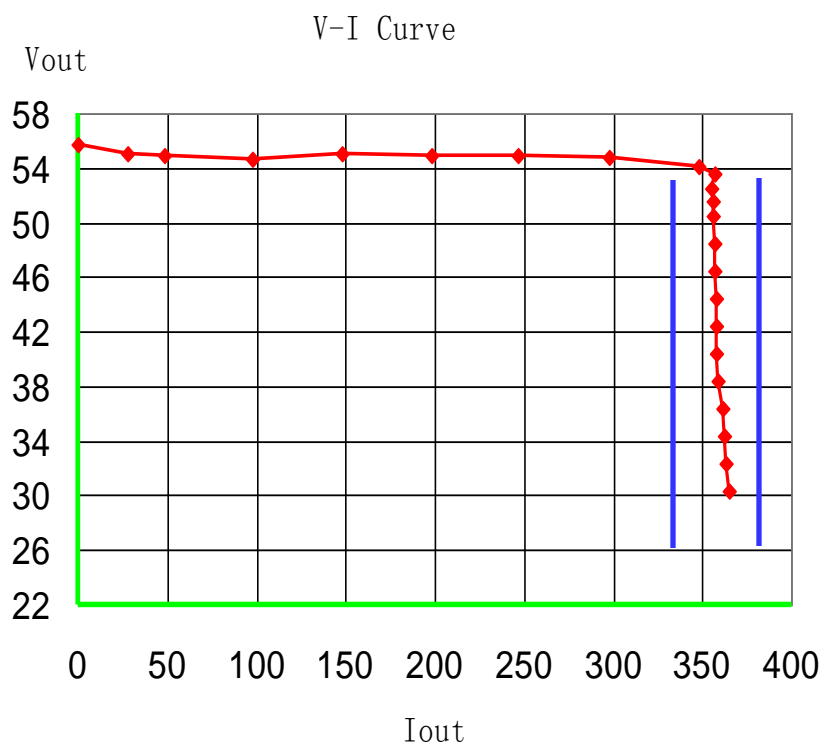


V-I Curve for LED channel

* Note: Output voltage measured at PCB end, $T_{AMB}=25\text{ }^{\circ}\text{C}$

$V_{IN}=380V_{DC}$, $T_{AMB}=25\text{ }^{\circ}\text{C}$

$V_{IN}=400V_{DC}$, $T_{AMB}=25\text{ }^{\circ}\text{C}$



Tight constant current tolerance

Wide constant current range for variable LED voltage

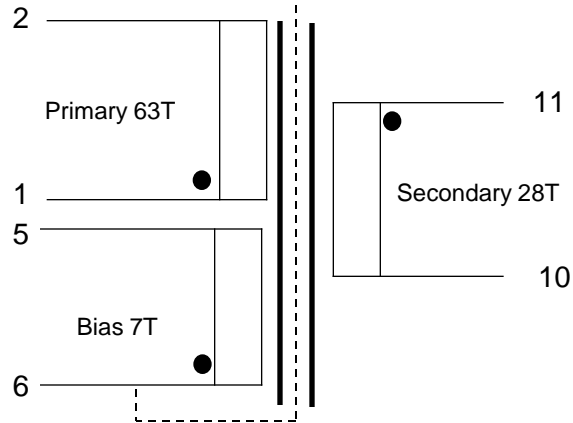
Efficiency: DC-DC module

Input DC voltage from PFC stage, from 300V to 400V

Vin	Pin	Vout	Iout	efficiency	PF
(Vdc)	(W)	(V)	(A)		
300	19.31	51.29	0.354	94.03%	
350	19.16	51.29	0.349	93.42%	
400	19.08	51.29	0.347	93.28%	
300	15.26	40.37	0.353	93.39%	
350	15.22	40.37	0.351	93.10%	
400	15.00	40.37	0.345	92.85%	

Transformer Design

SCHEMATIC



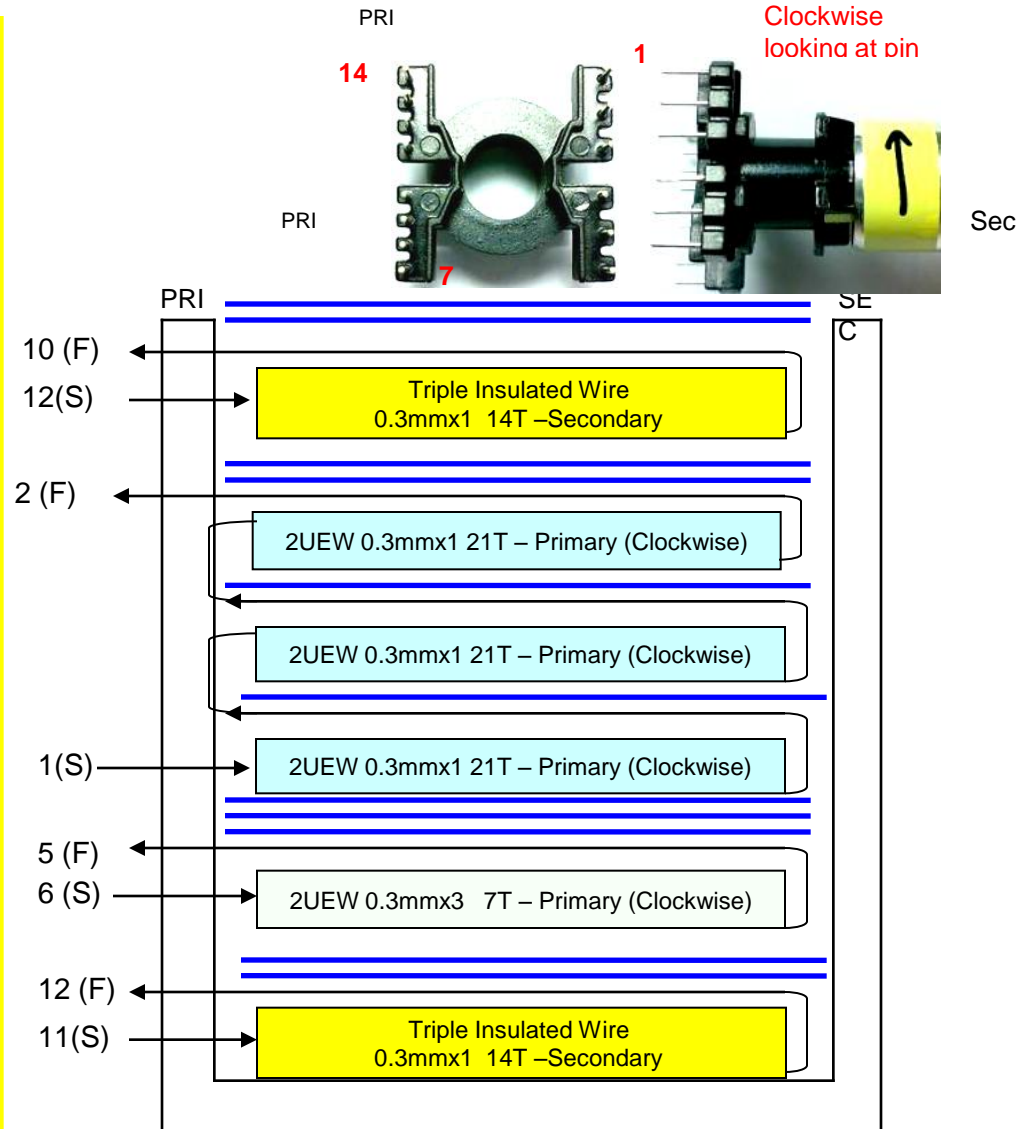
ELECTRICAL SPECIFICATIONS:

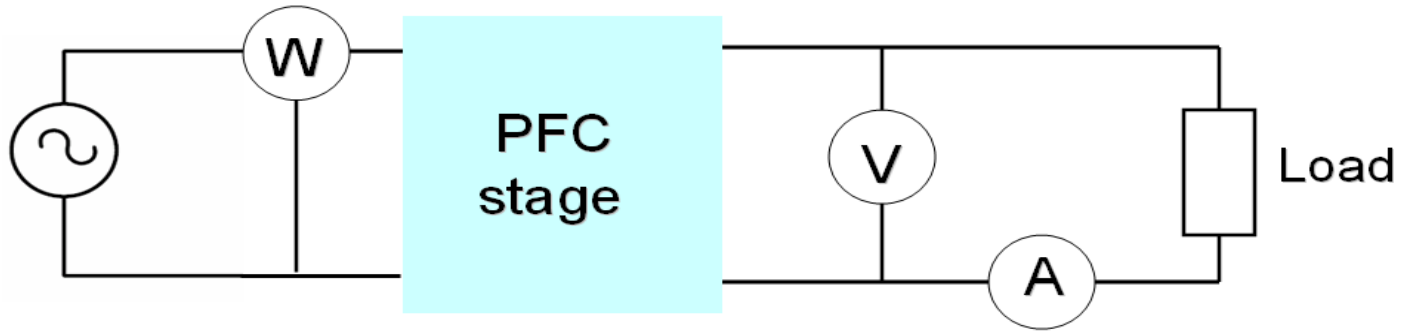
1. Primary Inductance (L_p) = 1.6mH @ 10KHz
2. Primary Leakage Inductance 68uH
3. Electrical Strength = 3KV, 50/60Hz, 1Min

MATERIALS:

1. Core : PQ2016 (Ferrite Material TDK PC40 or equivalent)
2. Bobbin : PQ2016 Vertical
3. Magnet Wires (Pri) : Type 2-U EW
4. Magnet Wire (Sec) : Triple Insulated Wires
5. ~~FINISHED~~ Insulation Tape : 3M1298 or equivalent.

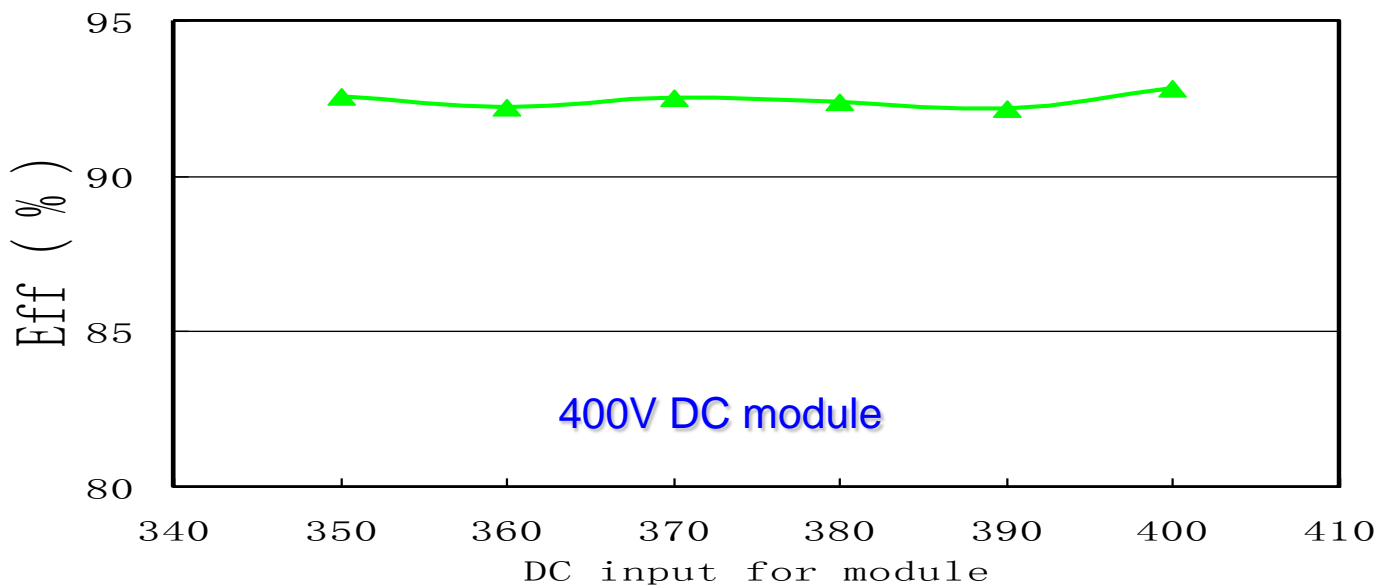
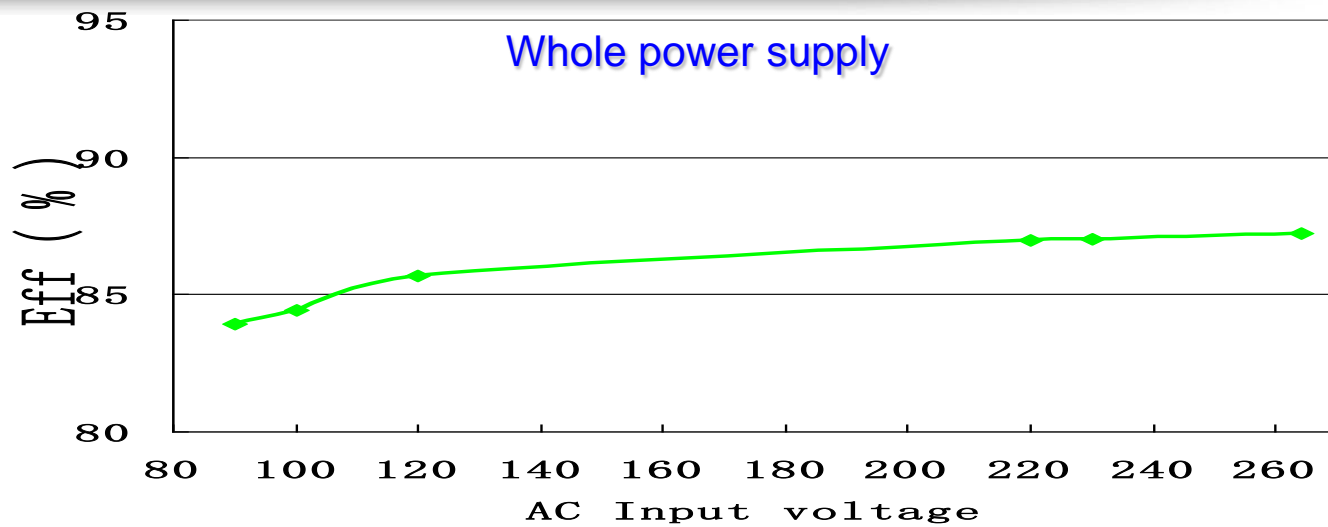
1. Varnish the complete assembly
2. Core is connected to pin5





V_{in} (V)	P_{in} (W)	V_{out} (V)	I_{out} (A)	efficiency	PF
90	150.00	245.8	0.569	93.24%	0.991
100	150.20	281	0.501	93.73%	0.991
110	152.48	304.8	0.471	94.23%	0.991
120	153.90	329	0.443	94.60%	0.990
200	155.35	373.5	0.403	96.87%	0.988
230	154.70	399.5	0.378	97.62%	0.984
264	154.20	399.8	0.376	97.49%	0.977

Efficiency Measurement



LED Current and Efficiency

Input : 90Vac

Vin (V)	Pin (W)	Channel	Pout (W)	Vout (V)	Iout (A)	efficiency	PF
90	160.80	CH1	17.24	49.4	0.349		
		CH2	17.16	48.9	0.351		
		CH3	17.44	49.7	0.351		
		CH4	17.10	49	0.349		
		CH5	17.12	48.9	0.350		
		CH6	17.36	49.6	0.350		
		CH7	17.06	48.6	0.351		
		CH8	17.26	48.9	0.353		
		Totoal Po	137.75				

Input : 100Vac

Vin (V)	Pin (W)	Channel	Pout (W)	Vout (V)	Iout (A)	efficiency	PF
100	158.00	CH1	17.17	49.2	0.349		
		CH2	17.05	48.7	0.350		
		CH3	17.24	49.4	0.349		
		CH4	17.07	48.9	0.349		
		CH5	17.01	48.6	0.350		
		CH6	17.29	49.4	0.350		
		CH7	17.02	48.5	0.351		
		CH8	17.14	48.7	0.352		
		Total	136.99				

LED Current and Efficiency

Input :110Vac

Vin (V)	Pin (W)	Channel	Pout (W)	Vout (V)	Iout (A)	efficiency	PF
110	156.08	CH1	17.14	49.1	0.349		
		CH2	17.06	48.6	0.351		
		CH3	17.22	49.2	0.350		
		CH4	17.00	48.7	0.349		
		CH5	16.98	48.5	0.350		
		CH6	17.26	49.3	0.350		
		CH7	16.95	48.3	0.351		
		CH8	17.06	48.6	0.351		
		Total	136.65				

LED Current and Efficiency

Input :120Vac

Vin (V)	Pin (W)	Channel	Pout (W)	Vout (V)	Iout (A)	efficiency	PF
120	155.20	CH1	17.07	48.9	0.349		
		CH2	17.02	48.5	0.351		
		CH3	17.19	49.1	0.350		
		CH4	16.96	48.6	0.349		
		CH5	16.94	48.4	0.350		
		CH6	17.26	49.3	0.350		
		CH7	16.92	48.2	0.351		
		CH8	17.02	48.5	0.351		
			136.37				

LED Current and Efficiency

Input :180Vac

Vin (V)	Pin (W)	Channel	Pout (W)	Vout (V)	Iout (A)	efficiency	PF
180	151.73	CH1	17.01	48.6	0.350		
		CH2	16.97	48.2	0.352		
		CH3	17.13	48.8	0.351		
		CH4	16.99	48.4	0.351		
		CH5	16.81	47.9	0.351		
		CH6	17.09	48.7	0.351		
		CH7	16.86	47.9	0.352		
		CH8	16.61	48	0.346		
		Total	135.47				

LED Current and Efficiency

Input :220Vac

Vin (V)	Pin (W)	Channel	Pout (W)	Vout (V)	Iout (A)	efficiency	PF
220	152.85	CH1	17.16	48.9	0.351		
		CH2	17.09	48.4	0.353		
		CH3	17.30	49	0.353		
		CH4	17.16	48.6	0.353		
		CH5	17.05	48.3	0.353		
		CH6	17.30	49	0.353		
		CH7	16.98	48.1	0.353		
		CH8	16.58	48.2	0.344		
		Total	136.61				

LED Current and Efficiency

Input :240Vac

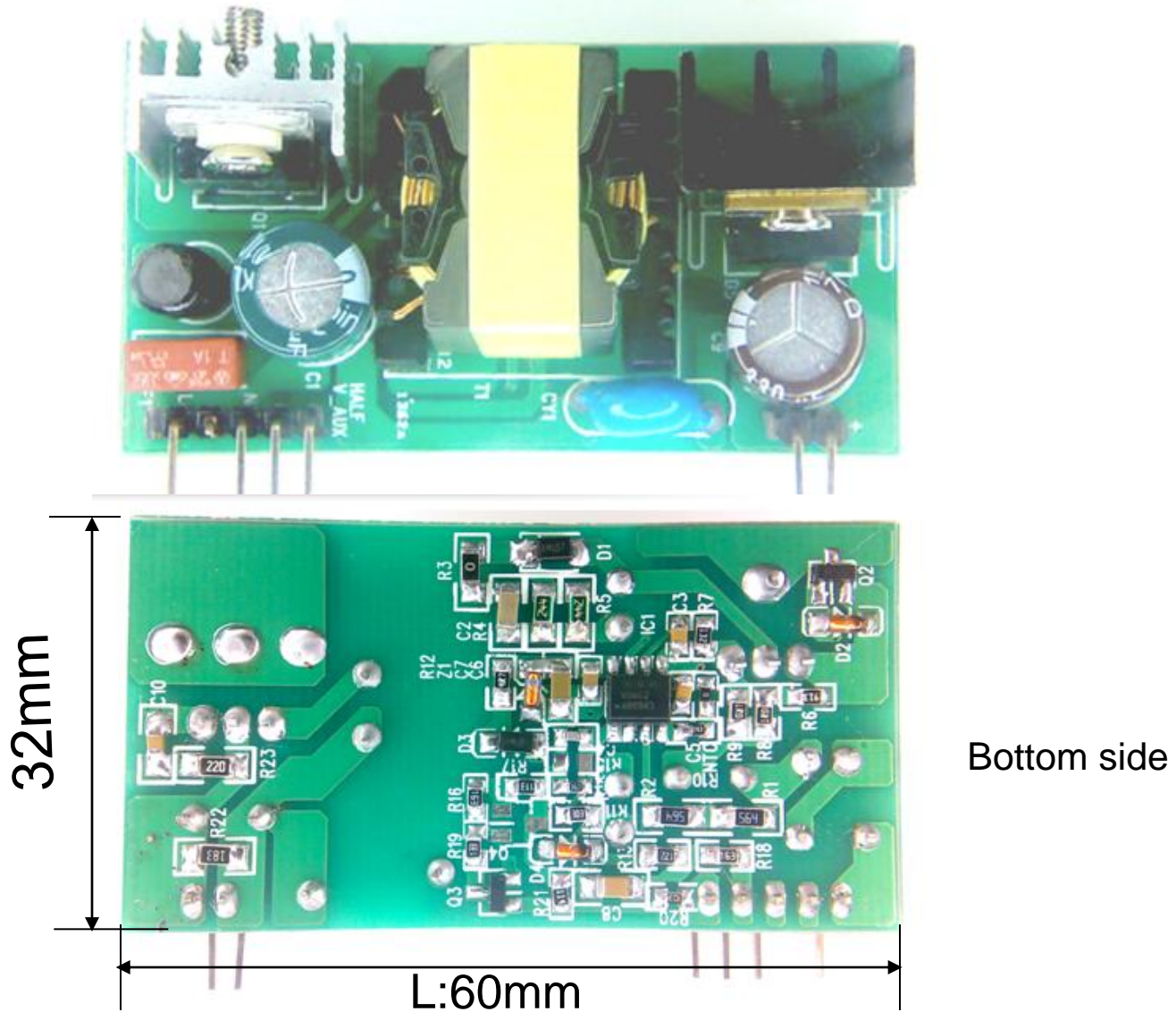
Vin (V)	Pin (W)	Channel	Pout (W)	Vout (V)	Iout (A)	efficiency	PF
240	152.74	CH1	17.18	48.8	0.352		
		CH2	17.09	48.4	0.353		
		CH3	17.30	49	0.353		
		CH4	17.12	48.5	0.353		
		CH5	17.01	48.2	0.353		
		CH6	17.26	48.9	0.353		
		CH7	16.94	48	0.353		
		CH8	16.50	48.1	0.343		
		Total	136.40				

LED Current and Efficiency

Input :264Vac

Vin (V)	Pin (W)	Channel	Pout (W)	Vout (V)	Iout (A)	efficiency	PF
264	151.65	CH1	17.18	48.8	0.352		
		CH2	17.05	48.3	0.353		
		CH3	17.23	48.8	0.353		
		CH4	17.09	48.4	0.353		
		CH5	16.98	48.1	0.353		
		CH6	17.23	48.8	0.353		
		CH7	16.94	48	0.353		
		CH8	16.50	48.1	0.343		
		Total	136.19				

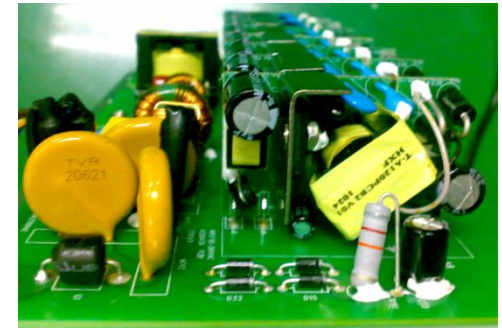
3.Circuit Board Photograph



Bottom side

Streetlight power supply __ 8-10 channels LED driver

AC Input



PFC board



AC Input

Power module

