



T8 LED Driver Module using SQ6214 with Active Power Factor Correction and Integrated MOSFET

AC Input Voltage Range	LED DC Output Voltage/Current	Output Power
90V _{AC} /60Hz ~ 264(300 ^{**})V _{AC} /50Hz	70V/230mA	16.1W

** - Change the CX1 form 104/275V to 104/340V to increase input range to 300V_{AC}

Key Features

- Universal input from 90V_{AC}/60Hz to 264(300^{**})V_{AC}/50Hz, LED DC 70V/230mA output
- One cycle control Power Factor Correction (PFC) and typical PF value > 0.96 @110V_{AC} and PF>0.92@220V_{AC}
- Fixed frequency buck converter and maximum efficiency : 91%
- LED output current variation :
 - ±2% for Low Voltage(90-132V_{AC})
 - ±1% High Voltage(180-264V_{AC})
- Dimension : 130mm×16mm×12mm
- Typical application : T8

Introduction

This application note describes a constant current T8 lamp power module with one cycle control active power factor correction for full range input voltage from 90V_{AC} ~ 264(300^{**})V_{AC} by adopting the SQ6214. Based on buck PFC topology, the SQ6214 is able to achieve high power factor value for bulb lighting application. This application provides multiple advanced fault protections to enhance the systems' safety, including natural Open Loop Protection (OLP), Short Circuit Protection (SCP), V_{DD} under-voltage lockout and thermal shut down. All protections have auto-restart mechanisms. Schematics, PCB Gerber, BOM, as well as typical performance are covered in details by this application note. A complete application circuit is depicted in Figure 5, which can work on universal input voltage range from 90V_{AC} ~ 264(300^{**})V_{AC}.

BOM

BOM is shown in Table 3.

PCB Layout

The PCB dimension is 130mm × 16mm × 1.6mm and Module dimension is 130mm × 16mm × 12mm in order to fit bulb lamp space.

Power Module Photo

Pictures of power module and key components are shown in Figure 6 and 7.

Specification

The Table 1 represents the specification that this design intends to achieve.

Performance

It is to drive output at 70V/230mA targeting to achieve high efficiency ($\eta_{MAX}=91\%$), high power factor (typical PF > 0.92) and current accuracy for AC universal input voltage range 90V_{AC}~264(300^{**})V_{AC}. Actual performance is shown on Table 2. Figure 1, 2, 3 and 4 depict power factor, output current, current variation and efficiency at AC input voltage range 90V_{AC} ~ 264(300^{**})V_{AC} for this module.



Table 1. Related Specification

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
AC input voltage	V _{AC}	90		264(300**)	V	
LED DC output voltage	V _{OUT}		70		V	
LED output current	I _{OUT(SET)}		230		mA	

Table 2. Actual Performance

AC Input	Input Power (W)	Output Current (I _{OUT} , mA)	Output Voltage (V _{OUT} , V)	Current Variation (%) ^(Note)	Efficiency (η, %)	PF
90V _{AC} /60Hz	17.21	224	70	-2.6	91.1	0.942
110V_{AC}/60Hz	17.33	227	70	-1.3	91.7	0.964
132V _{AC} /60Hz	17.39	227	70	-1.3	91.4	0.962
180V _{AC} /50Hz	17.27	228	70	-0.9	92.4	0.942
220V_{AC}/50Hz	17.38	229	70	-0.4	92.2	0.922
264V _{AC} /50Hz	17.55	230	70	0.0	91.7	0.912

Note :

Current Variation is defined as follows :

$$\% = \frac{I_{OUT} - I_{OUT(SET)}}{I_{OUT(SET)}} \times 100\%$$

where I_{OUT(SET)} = 230 mA

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Figure 1. Power Factor for AC Input Voltage Range 90V_{AC} ~ 264V_{AC}

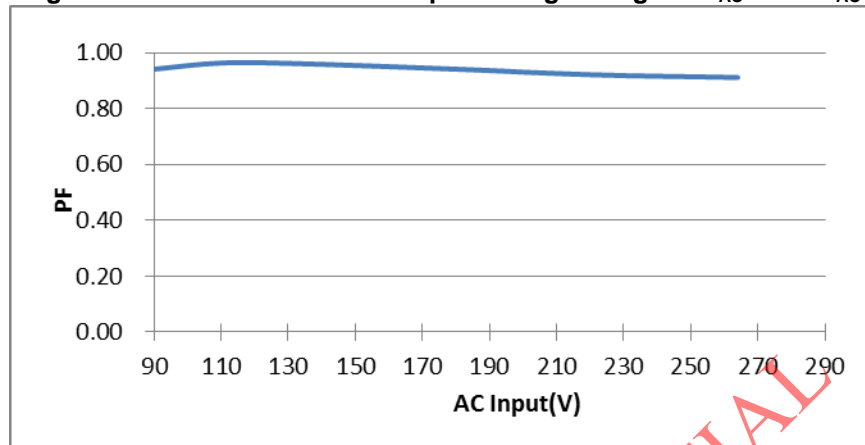


Figure 2. Output Current for AC Input Voltage Range 90V_{AC} ~ 264V_{AC}

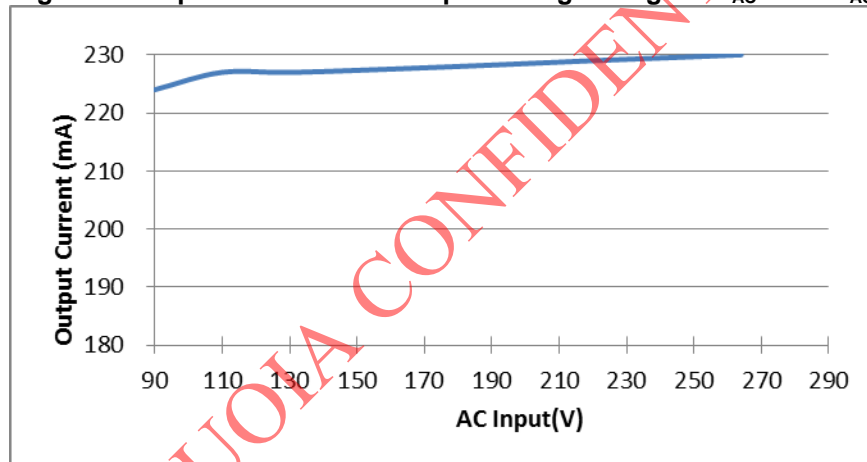


Figure 3. Current Variation for AC Input Voltage Range 90V_{AC} ~ 264V_{AC}

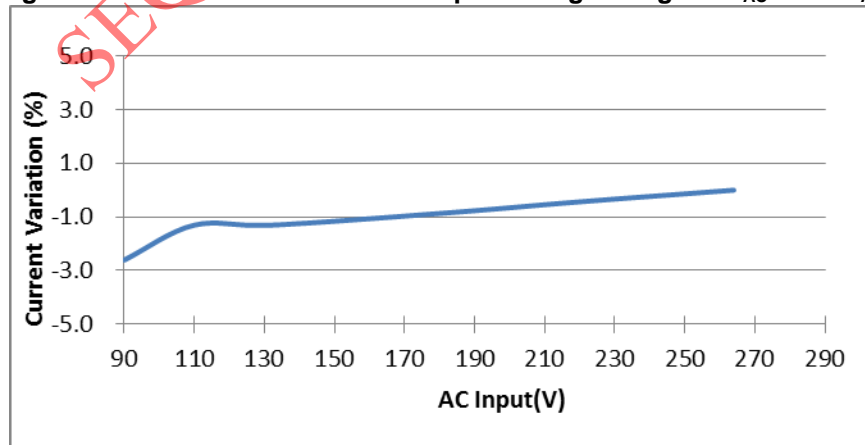


Figure 4. Efficiency for AC Input Voltage Range 90V_{AC} ~ 264V_{AC}

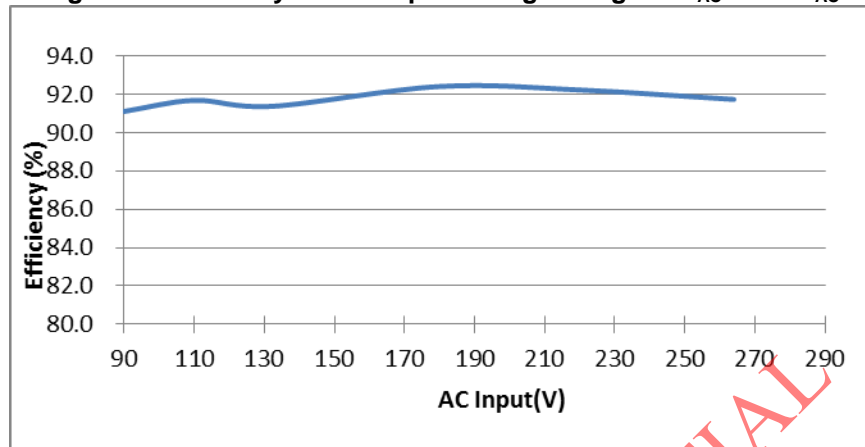


Figure 5. A Complete Application Circuit by Adopting the SQ6214

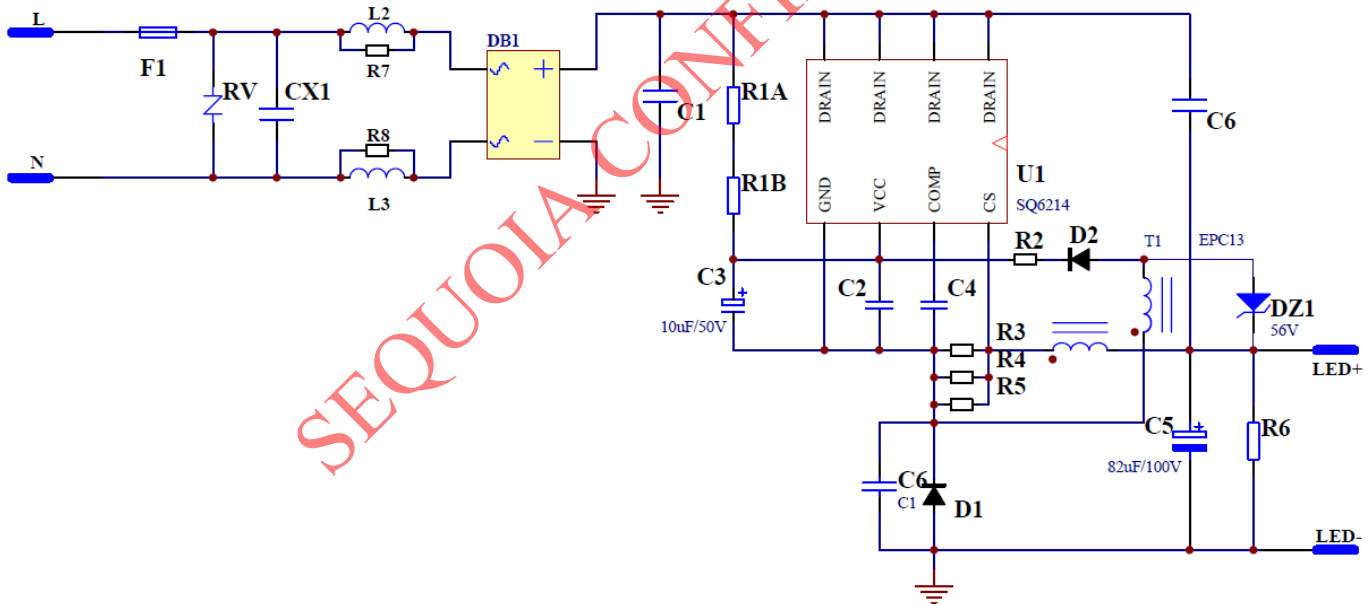




Table 3 : Bill of Material

Item	Symbol	Value	Description	Qty	Note
1	C1	104/400V	Polyester capacitors, CBB, plug-pitch 10mm	1	
2	C2	0.1uF/50V	C0805	1	
3	C3	10uF/50V	RB1, electrolytic capacitors, plug-ins, 2.54mm pitch	1	
4	C4	1uF/50V	C0805	1	
5	C5	82uF/100V	C5-10 * 16mm, electrolytic capacitors, plug-ins,	1	
6	C6	102/1KV	C1206 high voltage ceramic capacitors	1	
7	CX1	0.1uF/275V	CX2 X capacitor pitch 10mm	1	For EMI (104/340V (for 300Vac)
8	D1	SF26	D4-SMA SMD fast recovery diode	1	
9	D2	FR107	SMA SMD diode	1	
10	DB1	DB107G	DB107G SMD rectifier bridge	1	
11	DZ1	56V	NC	1	NC
12	F1	1A/250V	FUSE-1A plug-in fuse	1	
11	L2	2.5MH,8*10mm	8 * 10mm-shaped plug-inductance	1	For EMI
12	L3	2.5MH,8*10mm	8 * 10mm-shaped plug-inductance	1	For EMI
13	R1A	270K	R0805	1	For EMI
14	R1B	270K	R0805	1	For EMI
15	R2	10	1206	1	
16	R3	2	1206	1	
17	R4	2	1206	1	
17	R6	100K	R1206	1	
18	R7	3.9K	R1206	1	
19	R8	3.9K	R1206	1	
20	RV	7D471	NTC9-5.0 varistor plugin	1	
21	T1	EPC13	EPC13 (5 +5) plug-in skeleton	1	
22	U1	SQ6214	SOP8		

Figure 6. Picture of Top Side of the Power Module

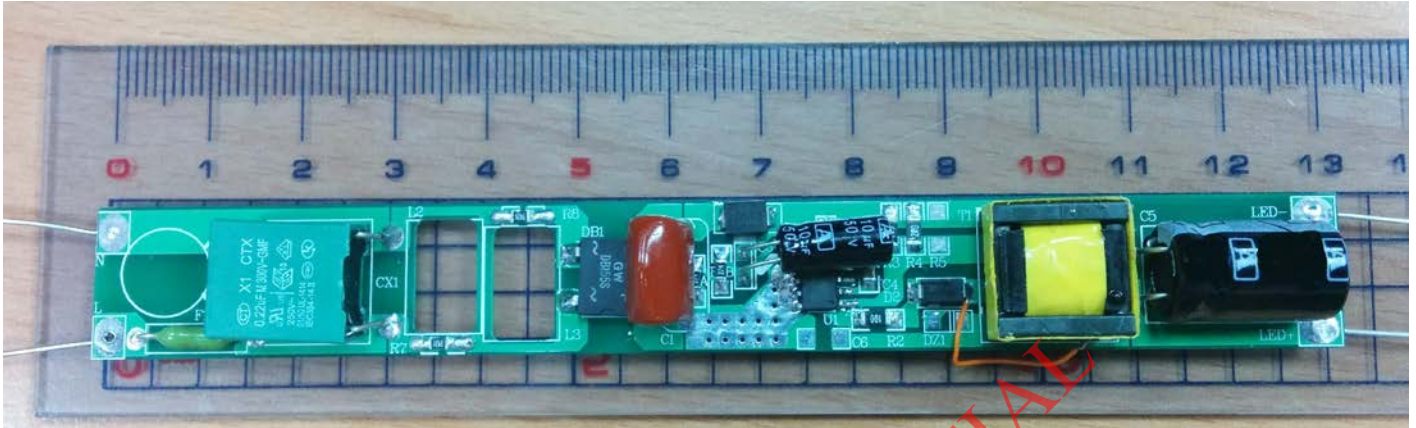


Figure 7. Picture of Bottom Side of the Power Module

