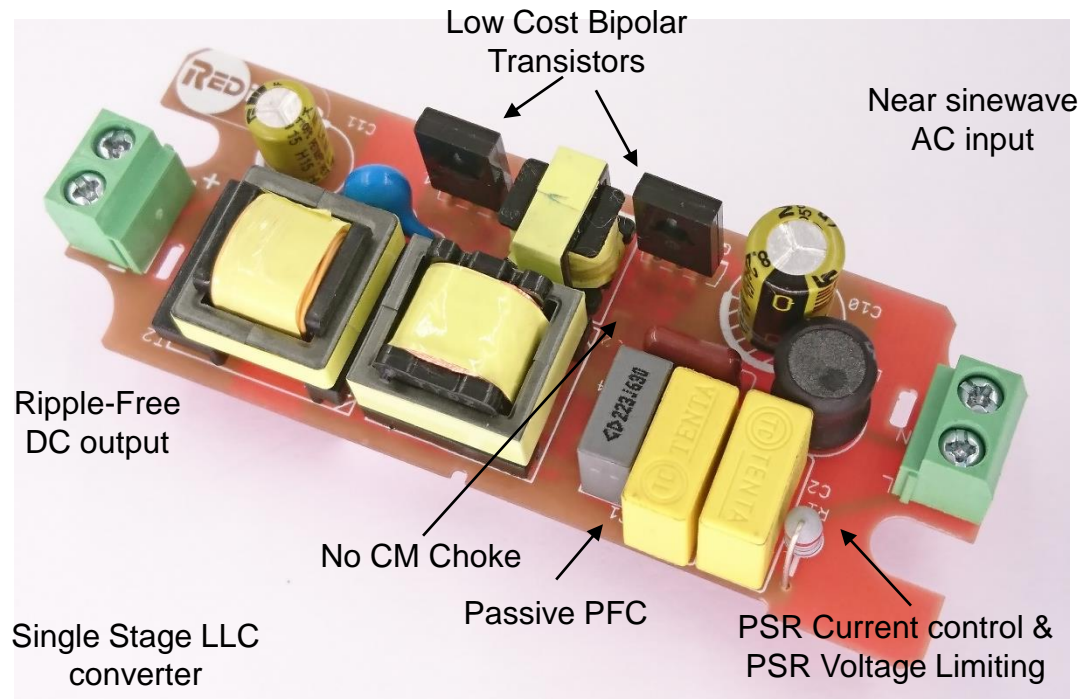
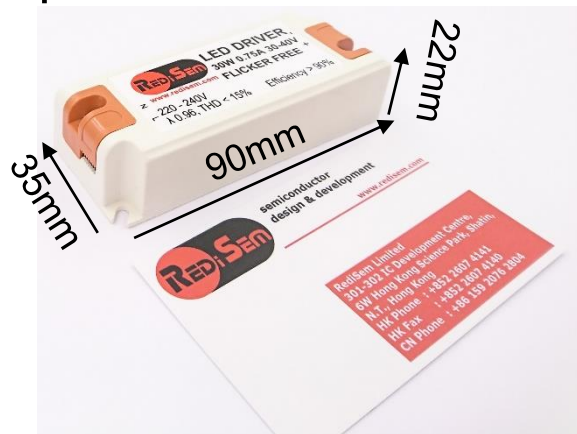




RED2422

30W 750mA LED Driver Design Report

- Low-cost Flicker-free CC LED driver
- RED2422 SOT23-6 Controller IC
- Efficiency 91%
- High Power Factor >0.96
- 750mA 30-40V output
- Low EMI – no CM choke
- Optimized for COB/Panel

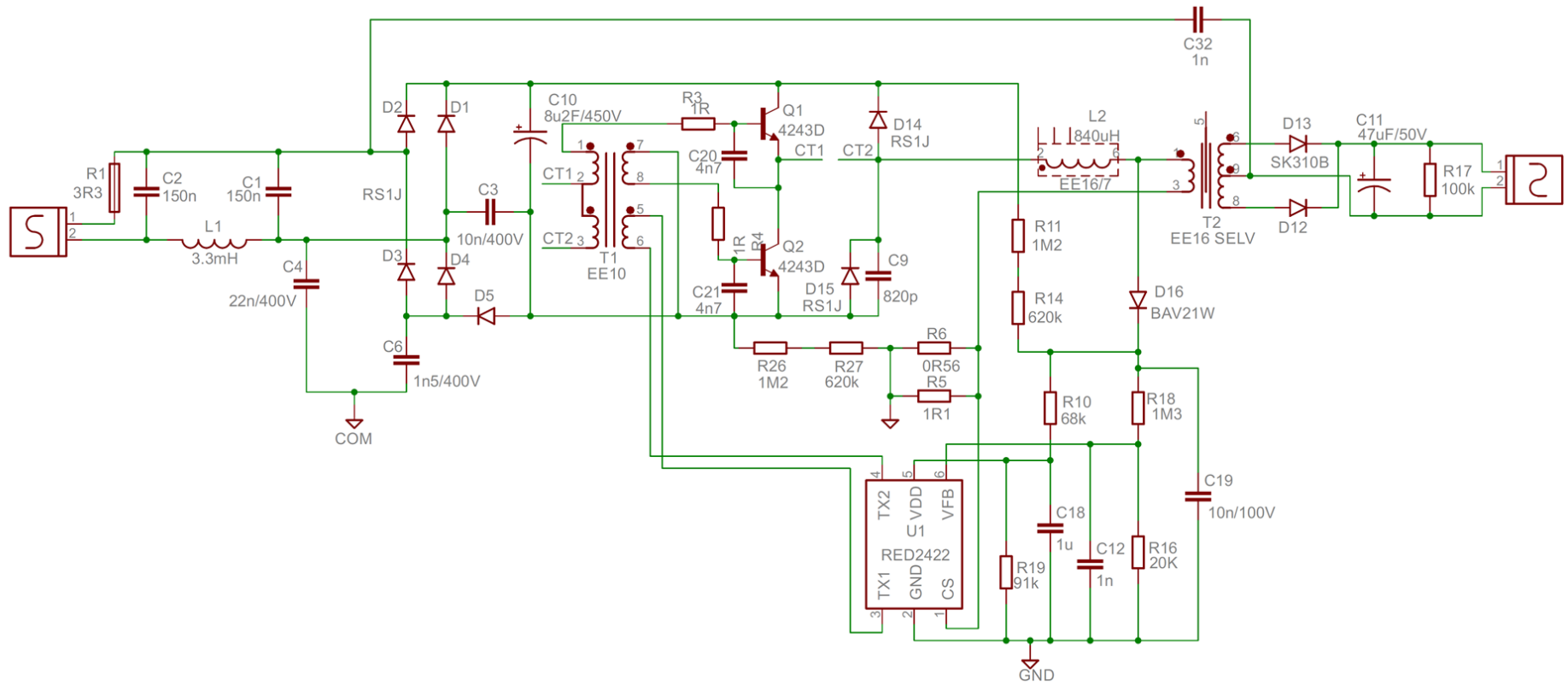


Specifications



Specification	Value	Test condition
Input voltage 50Hz	198 - 264VAC	Functional specifications
Input functional range	170 - 320VAC	5 minute survival
Output voltage	33 - 40V	198 - 264VAC
Output current	750mA \pm 5%	198 - 264VAC
LF Ripple (Flicker)	<2%	230VAC, 40VDC
Harmonic compliance	220 - 240VAC	33-40V DC
Total Ripple	< 20%	230VAC, 40VDC
Time to light	< 200ms	230VAC, 40VDC
Efficiency	> 91%	230VAC, 40VDC
Power factor	> 0.95	230VAC, 40VDC
THD	< 20%	230VAC, 40VDC
No-load voltage	< 60V	264VAC
Protection	Overtemperature, short circuit, open circuit	
EMI test	8dB margin	Driver on LED panel
Surge	1kV DM , 2kV CM	
Ambient Temperature	-20 to 50°C	

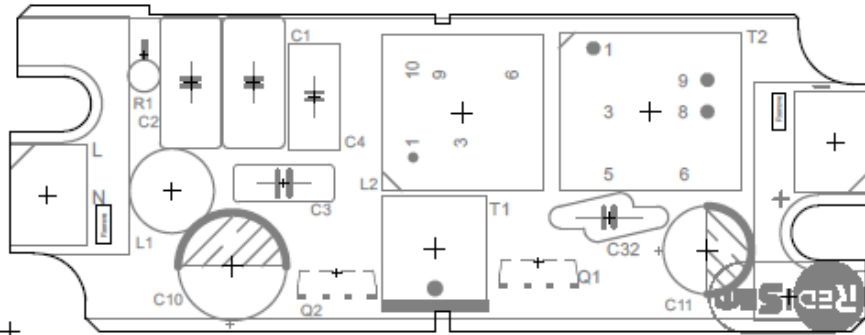
Schematic



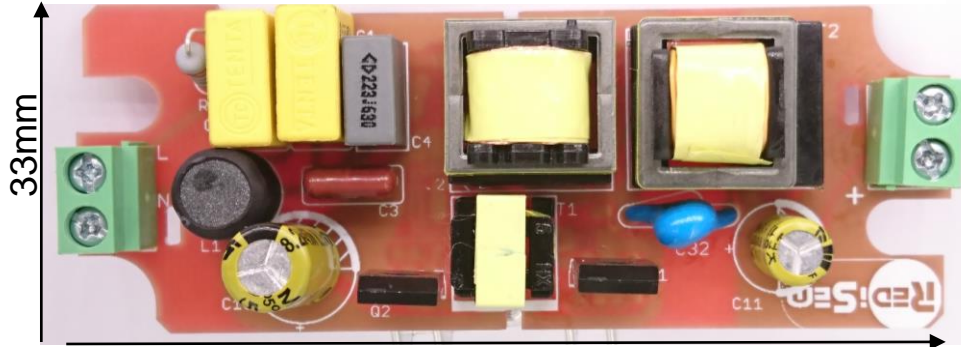
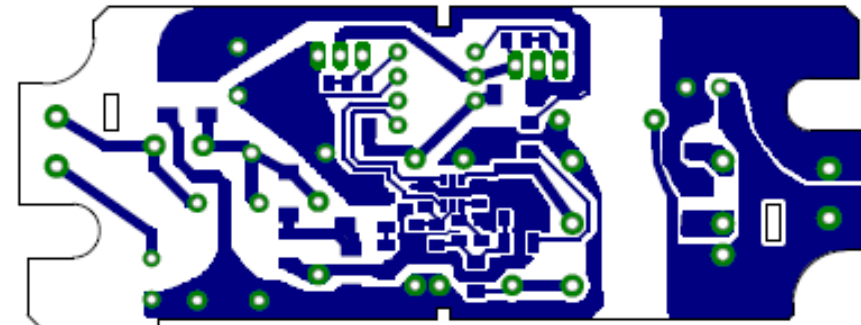
Code	Value	Description	Qty	Supplier
C1	150n	X2 MKP 20% 275VAC	1	
C2	150n	X2 MKP 20% 275VAC	1	
C3	10n	MKP 5% 400VDC	1	Faratronic
C4	22n	MKP 5% 400VDC	1	Faratronic
C6	1n5	1206 NPO 5% 500VDC	1	Murata
C9	820p	1206 NPO 5% 500VDC	1	Murata
C10	8u2	ELEC 20% 450VDC	1	
C11	47u	ELEC 20% 50VDC	1	
C12	1n	0805 X7R 10% 50VDC	1	
C19	10n	0805 X7R 10% 100VDC	1	
C18	1u	0805 X7R 10% 16VDC	1	
C20 21	4n7	0805 X7R 10% 16VDC	2	
C32	1n	Y-CAP	1	
D1,2,3,4,5,14,15	RS1J	SMA Fast Diode 600VDC	7	TSC
D12,D13	SK310B	Schottky Diode, 100V 3A	2	
D16	BAV21W	MiniMELF	1	
L1	3m3H	8x10 Drum Core	1	
L2	840uH	Main Inductor EE16/7	1	
R1	3R3	Fuse resistor 3R3	1	
R3,4	1R	0805 0.06W 1.0%	2	
R5	1R1	1206 0.25W 1.0%	1	
R6	0R56	1206 0.25W 1.0%	1	
R14,27	620k	1206 0.25W 1.0%	2	
R11,26	1M2	1206 0.25W 1.0%	2	
R10	68k	0805 0.06W 1.0%	1	
R16	20k	0805 0.06W 1.0%	1	
R17	100k	1206 0.06W 1.0%	1	
R18	1M3	0805 0.06W 1.0%	1	
R19	91k	0805 0.06W 1.0%	1	
P1,P2		Terminal 2 Pin	2	
Q1,Q2	3DD4243DM	NPN (Ts=2-2.5us) TO126 2A	2	Huawei
T1	EE10	Base Drive: 18:6:6:1 turns	1	
T2	EE16	Output Transformer	1	
U1	RED2422	Low Ripple LED controller IC	1	RediSem
TOTAL			47	

PCB layout

Top Side

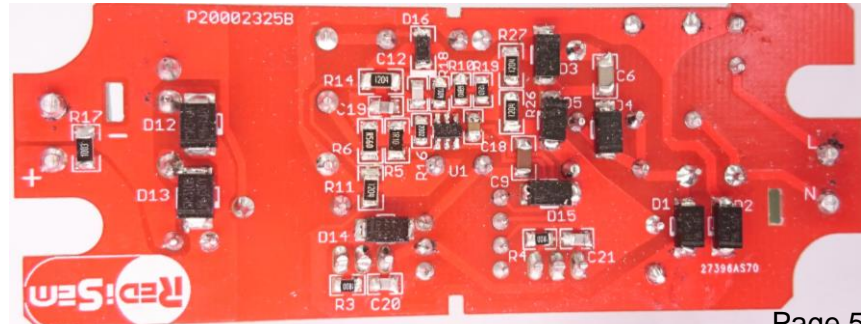
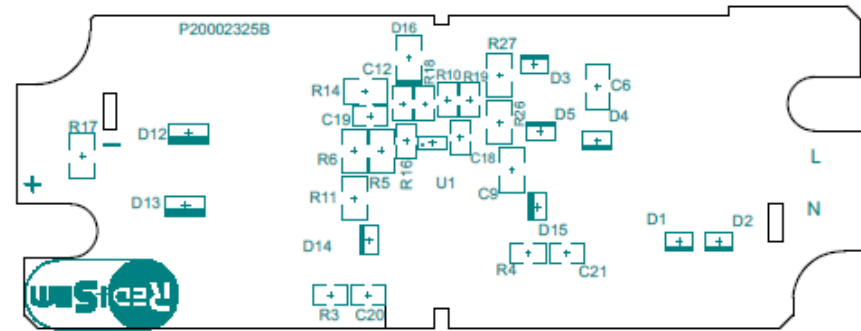


Bottom Side



87mm

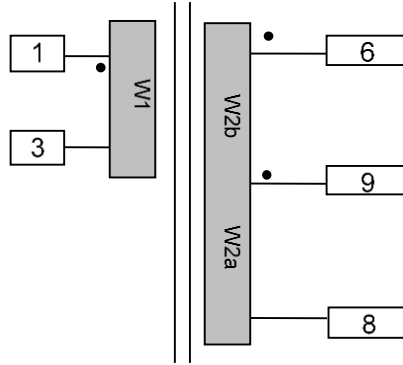
- Single sided PCB
- 1mm thick
- 1 Oz copper



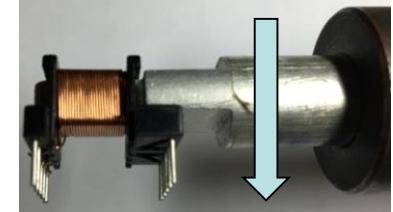
Transformer Construction



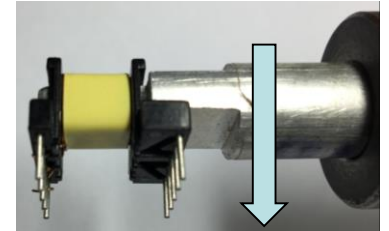
Transformer	
Core type	EE16 PC45
Bobbin Type	EE16 SELV 5+5
Pri	51t x1s x 0.29mm ECW
Pri Inductance	>2.7mH
Sec1&2	29t x 1s x 0.30mm TEXE



2 layers W1

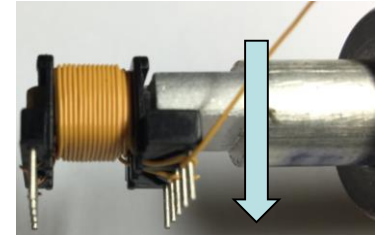


1 layer Tape

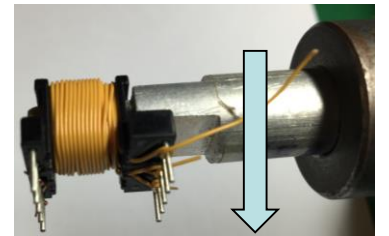


Winding	Turns	Start Pin	End Pin	Wire	Layers	Type	Purpose
W1	51	1	3	0.29mm	2	ECW	Primary
Tape	1						
W2a	29	6	9	0.30mm	2	TEXE	Secondary
W2b	29	9	8	0.30mm	2	TEXE	Secondary
Tape	1						

2 layers W2a



2 layers W2b



1 layer Tape

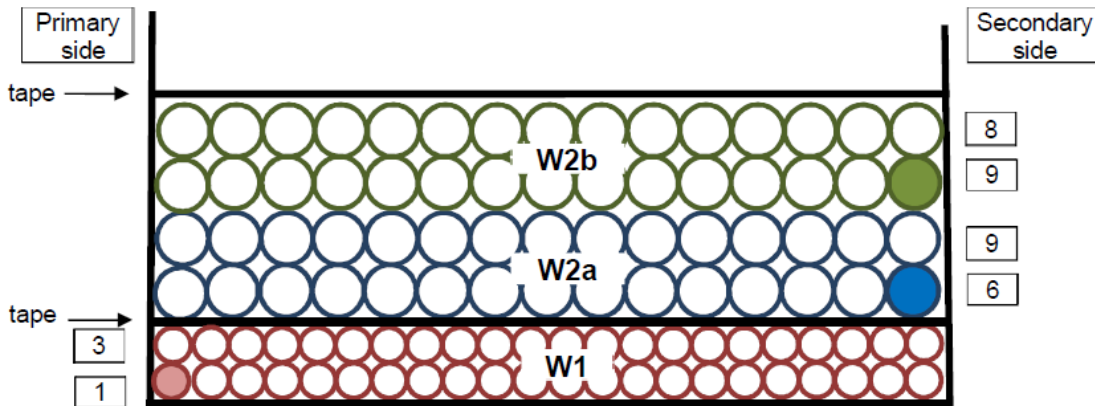
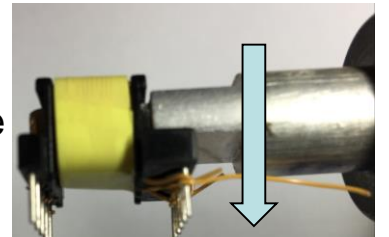


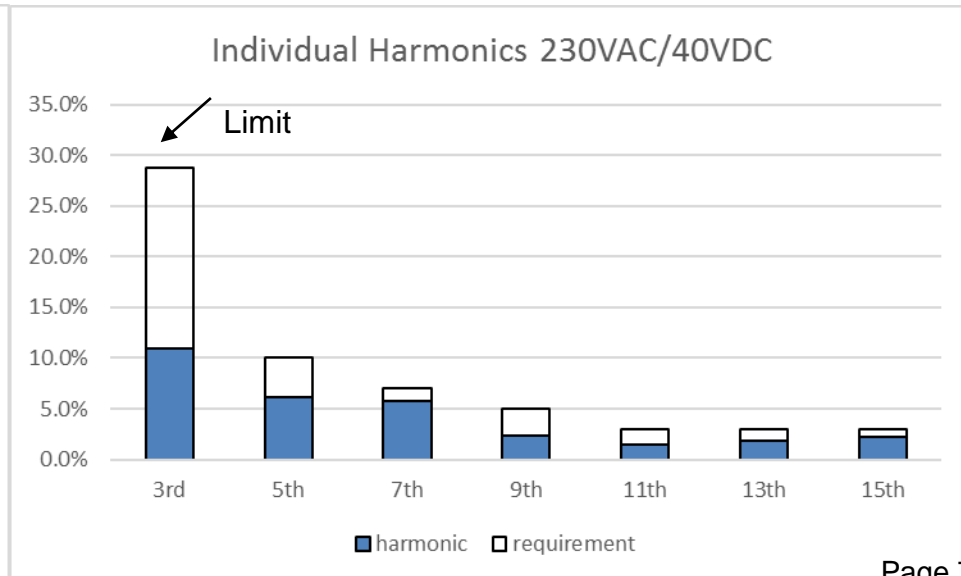
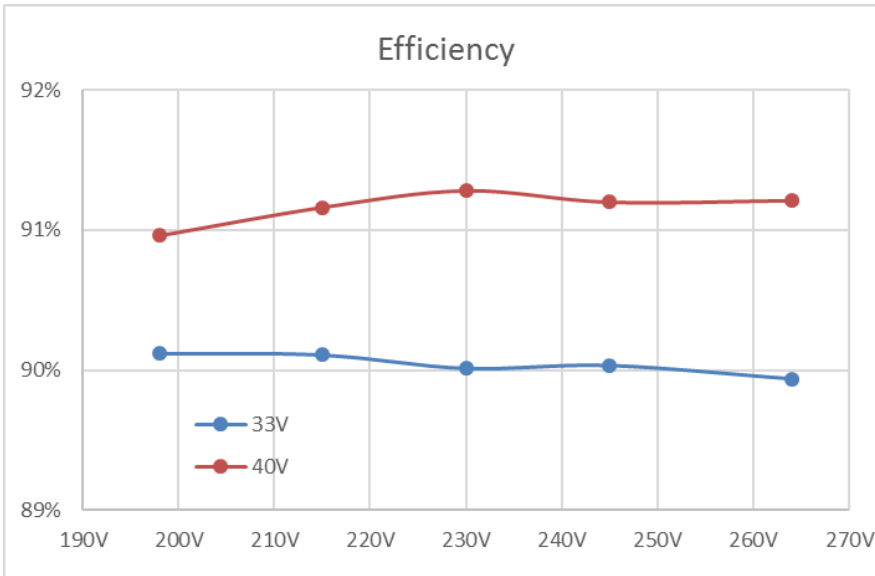
Figure 2: Transformer Winding Arrangement

Test Results



Output Voltage	33V					40V				
Input voltage	198V	215V	230V	245V	264V	198V	215V	230V	245V	264V
Output current	751mA	752mA	752mA	753mA	753mA	752mA	753mA	754mA	754mA	755mA
Input Power	27.50	27.54	27.57	27.60	27.63	33.07	33.04	33.04	33.07	33.11
Output Power	24.78	24.82	24.82	24.85	24.85	30.08	30.12	30.16	30.16	30.20
Efficiency	90.1%	90.1%	90.0%	90.0%	89.9%	91.0%	91.2%	91.3%	91.2%	91.2%
Power Factor	0.971	0.958	0.942	0.926	0.904	0.964	0.963	0.958	0.948	0.932
THD	8.7%	15.6%	17.0%	26.4%	32.0%	15.2%	13.5%	15.2%	18.7%	24.1%
Ripple (Flicker) @36V	1.57%	1.25%	1.10%	1.00%	0.89%					

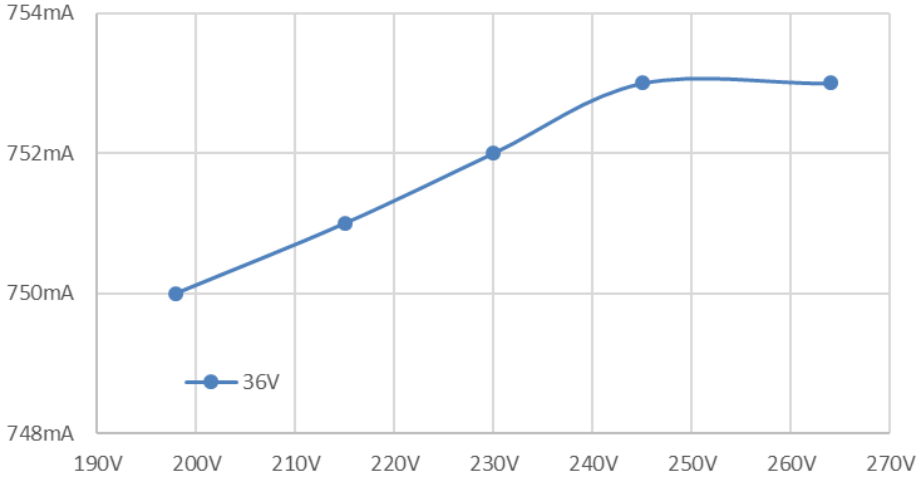
Test	Result	Condition
Peak no-load Voltage	47.00V	230VAC
Time To light	110ms	230VAC



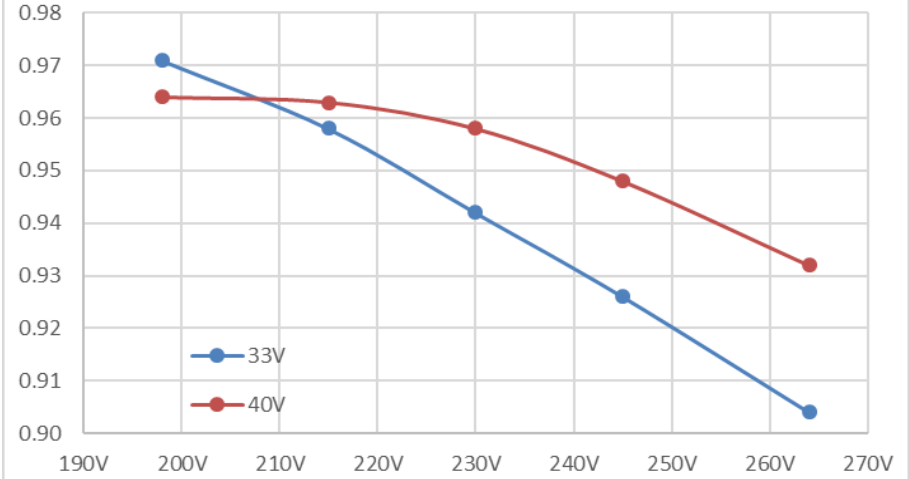
Test Results



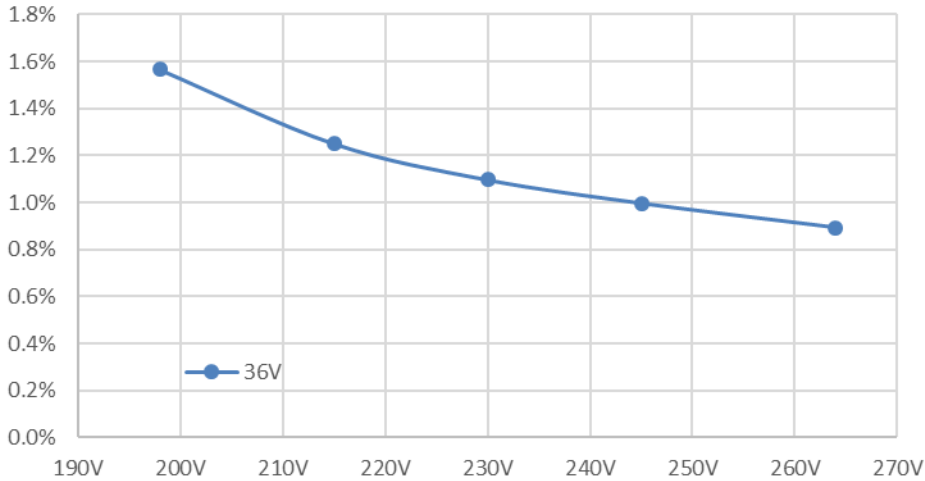
Current Regulation



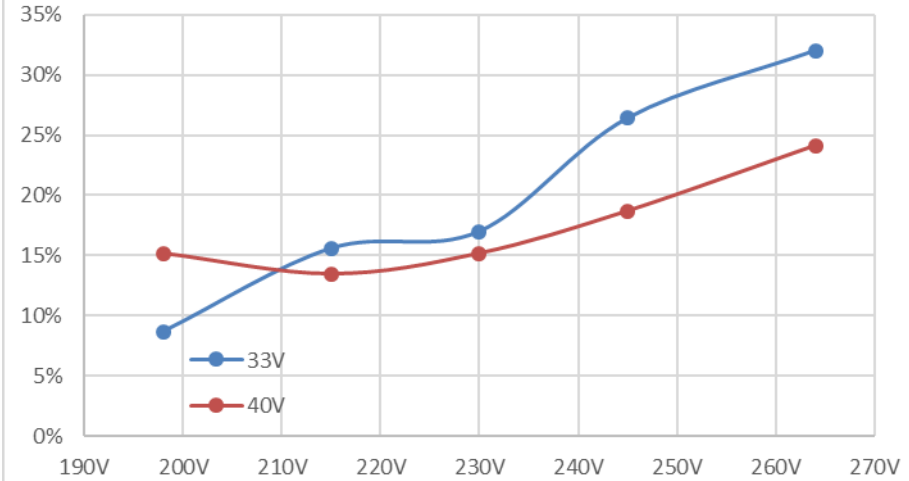
PF



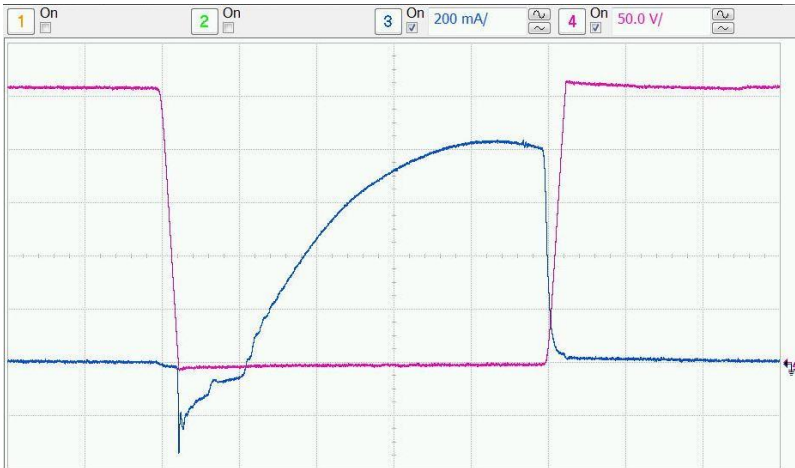
Flicker



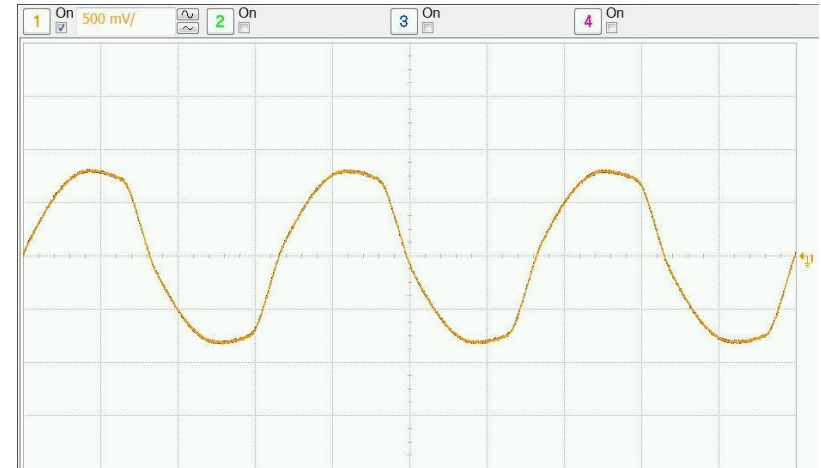
THD



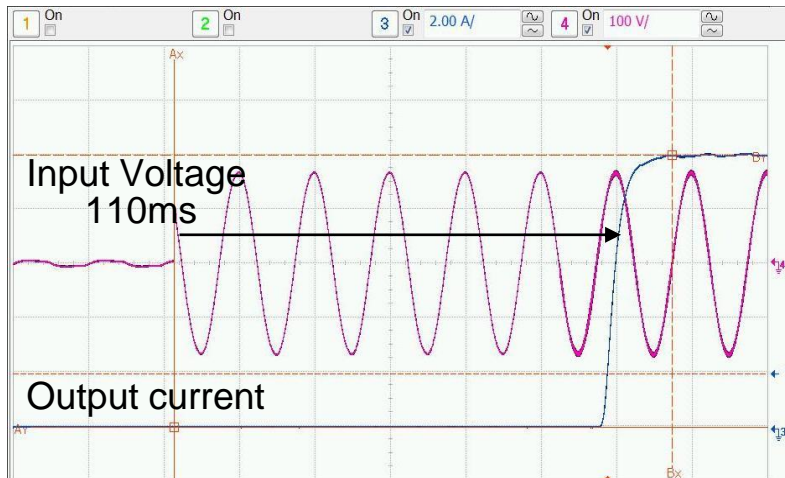
Test Results - Plots



Collector current and voltage



Inductor current 230VAC, 40VDC



Time To light 230VAC, 40VDC

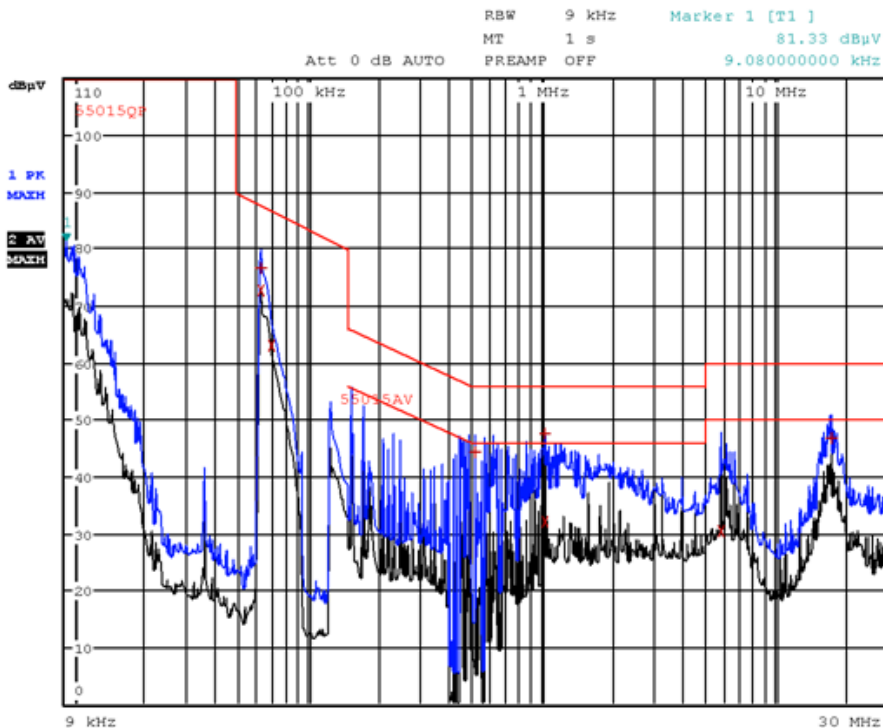


Input current and output flicker current

Test Results – EMI & Surge

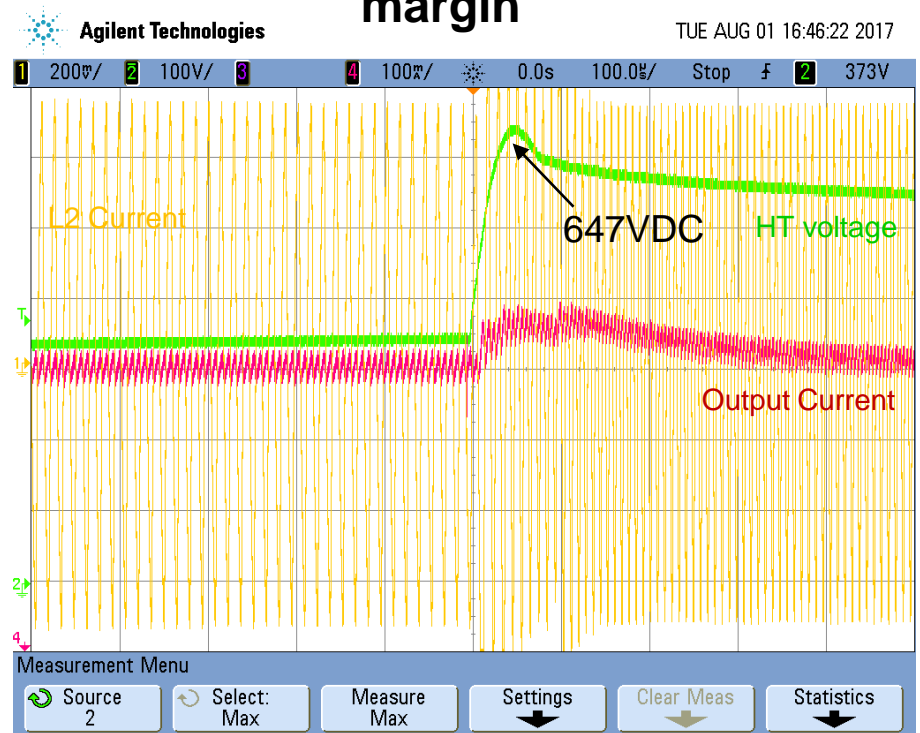


>8dB Margin Pass



Conducted EMI 9k~30MHz
Driver located on LED panel

1kV surge pass with margin



Plot of HT bus voltage and L2
(resonant) current during 1kV surge
with fuse resistor

Test Results - Thermals



Test condition:

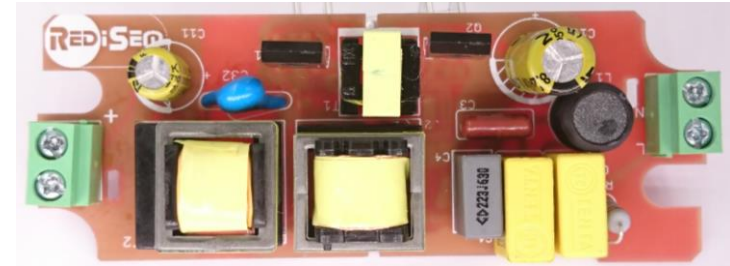
In a box in a heated oven

Ta = 50C

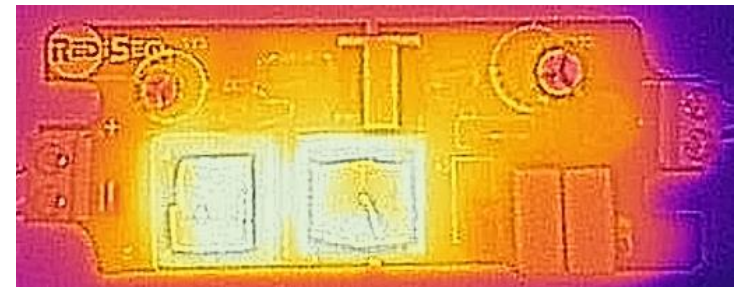
Thermal Results (cased)	198V 40V	264V 33V
Ta	50C	50C
Q1	94C	98C
Q2	92C	93C
L2 core	104C	112C
L2 winding	103C	111C
T2 core	106C	104C
T2 winding	98C	98C



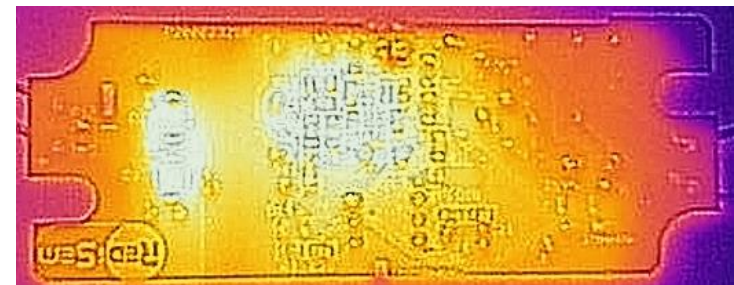
Test condition:



Open on the bench



Top side Thermal



Bottom side Thermal



RED2422

Low Power LED Controller for LLC converters

Features

- Advanced LED Controller IC for high efficiency low-cost LLC converters with bipolar transistors and integrated PFC
- PSR - +/-5% Primary Side Regulation of LED current and voltage with no Flicker
- 50% duty cycle, variable frequency control of resonant half-bridge
- Automatic dead-time control and capacitive mode protection
- Protection modes:
 - Overload
 - No-Load
 - Over-temperature
- Low output capacitance allows live LED connection
- Very low output current ripple – 0.5%
- Small SOT23-6 IC package



SOT23-6

Applications

- LED T8 tube drivers
- High frequency CC LED drivers up to 40W
- Pin compatible with RED2402

Order code

Part Number	Package	Packaging
RED2422AL-TR7	SOT23-6	Tape and reel

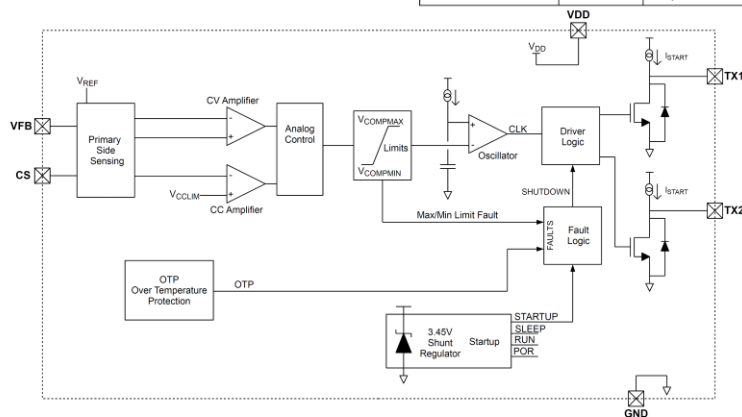


Figure 1: Block diagram



RED2422 LED LLC Controller

Device Pins

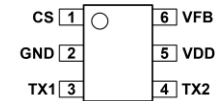
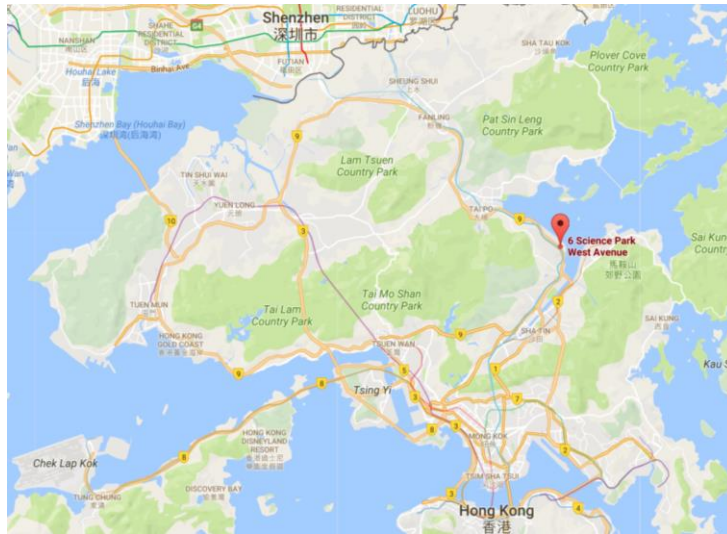


Figure 2: SOT23-6 pin connections (top view)

Pin Functions

Pin #	Name	Function
1	CS	PSR Current Sense input provides output current regulation and cycle-by-cycle over-current protection. The CS pin is connected to the half-bridge current sense resistor
2	GND	Chip ground.
3	TX1	Output to control transformer.
4	TX2	Output to control transformer.
5	VDD	IC Power Supply pin – nominally 3.45V
6	VFB	PSR Feedback input for output voltage regulation. Connect to primary sense winding.

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