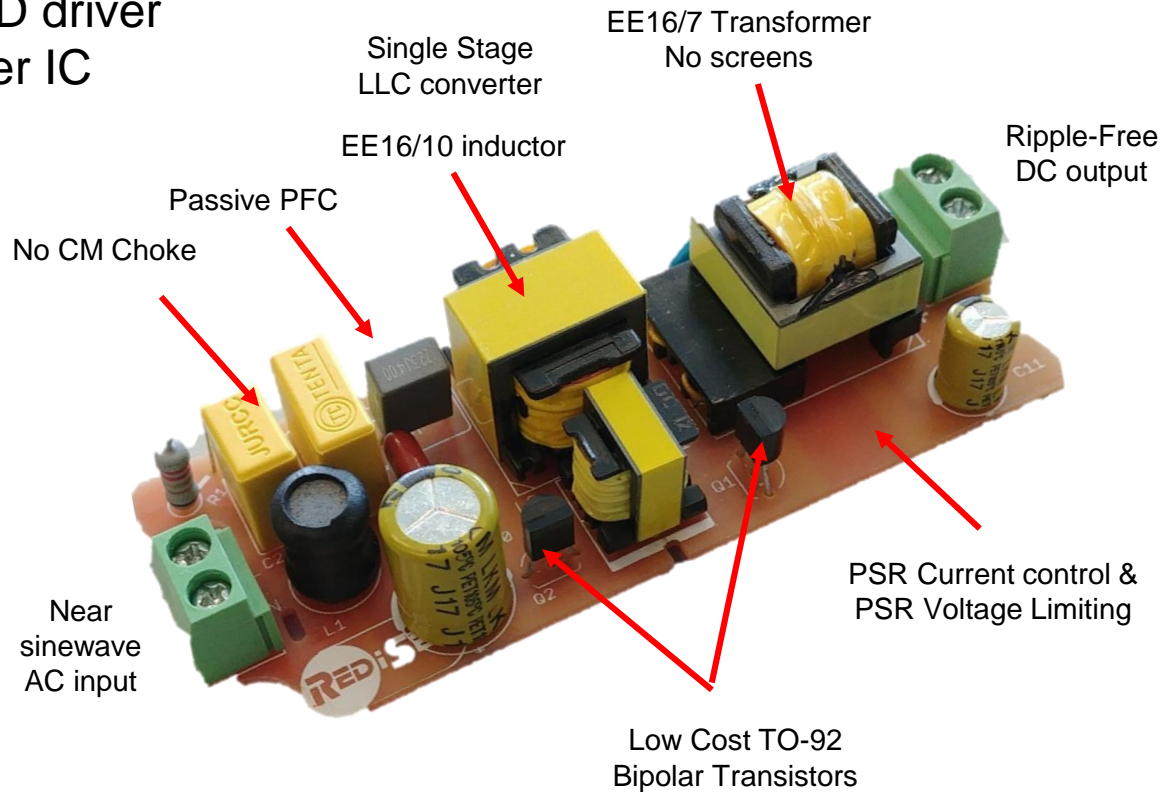
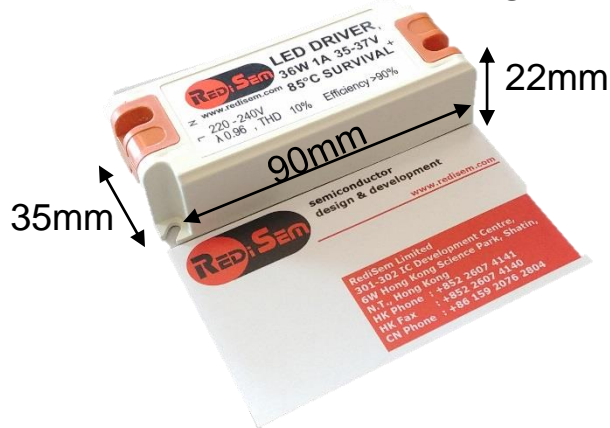




RED2432

36W 1000mA LED Driver Design Report

- Low-cost Flicker-free CC LED driver
- RED2432 SOT23-6 Controller IC
- Efficiency 90.6%
- High Power Factor >0.9
- 1.0A 35-37V output
- Thermal foldback
- Low EMI – no CM choke
- Optimized for Panel Light

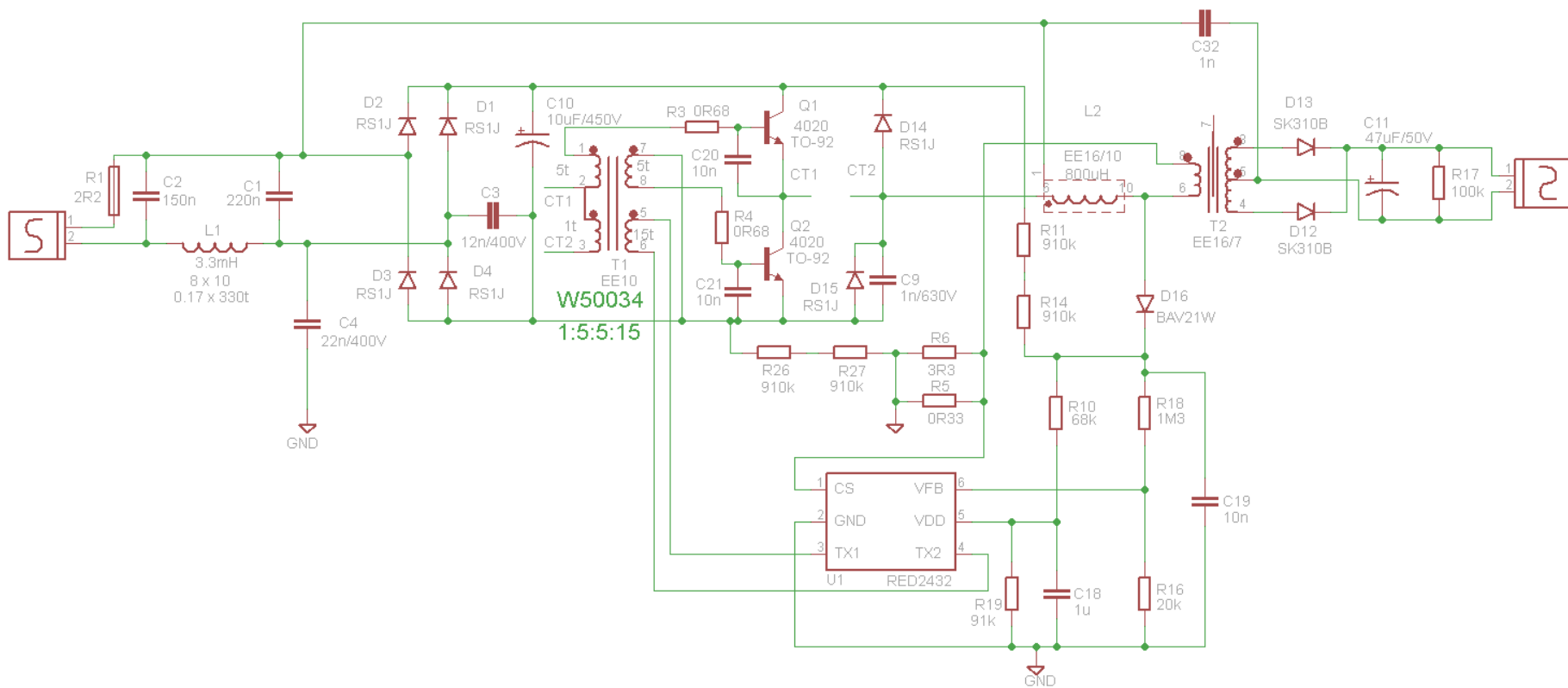


Specifications



Specification	Value	Test condition
Input voltage 50Hz	198 - 264VAC	Functional specifications
Input functional range	170 - 320VAC	5 minute survival
Output voltage	35 - 37V	198 - 264VAC
Output current	1A \pm 5%	198 - 264VAC
LF Ripple (Flicker)	<0.2%	230VAC, 37VDC
Harmonic compliance IEC 61000-3-2	220 - 240VAC	35-37V DC
Total Ripple	< ?%	230VAC, 37VDC
Time to light	< 100ms	230VAC, 37VDC
Efficiency	> 90%	230VAC, 37VDC
Power factor	> 0.97	230VAC, 37VDC
THD	< 13%	230VAC, 37VDC
No-load voltage	< 46V	264VAC
Protection	Overtemperature, short circuit, open circuit, thermal foldback	
EMI test	3dB margin	LED and Driver floating
Surge	1kV DM	
Ambient Temperature	-20 to 40°C	

Schematic



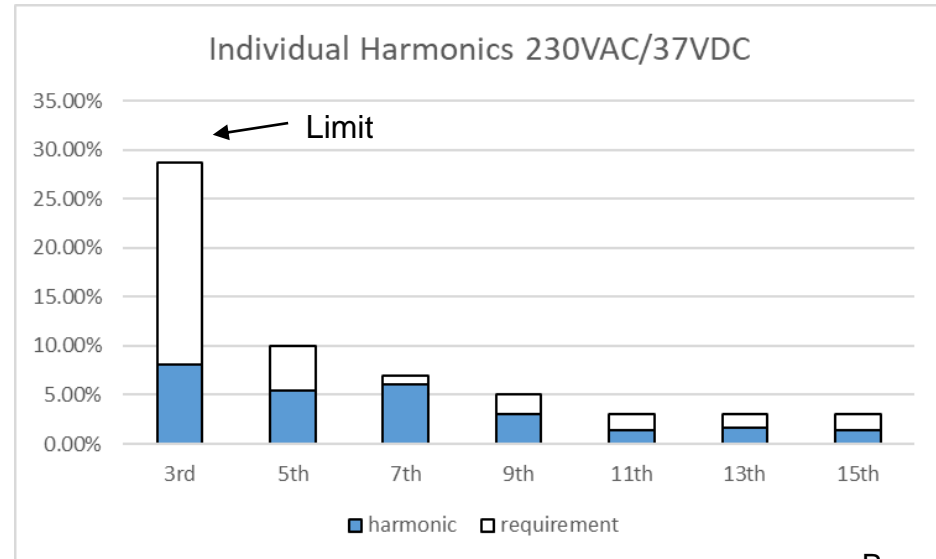
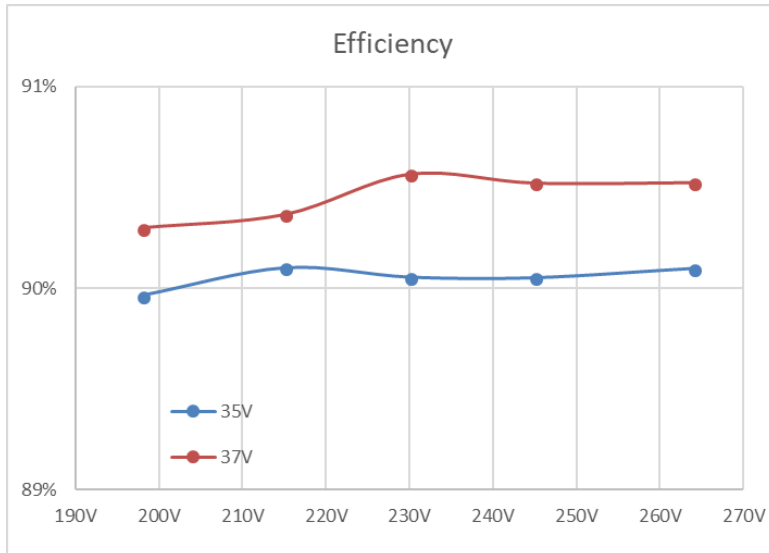
Code	Value	Description	Qty	Supplier
C1	220n	X2 MKP 20% 275VAC	1	
C2	150n	X2 MKP 20% 275VAC	1	
C3	12n	MKP 5% 400VDC	1	Faratronic
C4	22n	MKP 5% 400VDC	1	Faratronic
C9	1n	1206 NPO 5% 500VDC	1	Murata
C10	10u	ELEC 20% 450VDC	1	
C11	47u	ELEC 20% 50VDC	1	
C19	10n	0805 X7R 10% 100VDC	1	
C18	1u	0805 X7R 10% 16VDC	1	
C20 21	10n	0805 X7R 10% 16VDC	2	
C32	1n	Y-CAP	1	
D1,2,3,4,14,15	RS1J	SMA Fast Diode 600VDC	6	TSC
D12,D13	SK310B	Schottky Diode, 100V 3A	2	
D16	BAV21W	MiniMELF	1	
L1	3.3mH	8x10x4 Drum Core	1	
L2	800uH	Main Inductor EE16/10	1	
R1	2R2	Fuse resistor 2R2	1	
R3,4	0R68	0805 0.06W 1.0%	2	
R5	3R9	1206 0.25W 1.0%	1	
R6	0R33	1206 0.25W 1.0%	1	
R11,R14,26,27	910k	1206 0.25W 1.0%	4	
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	3DD4020	NPN (Ts=2-2.5us) TO-92 3A	2	WuXi HuaJing
T1	EE10	Base Drive: 15:5:5:1 turns	1	
T2	EE16/7	Output Transformer	1	
U1	RED2432	Low Ripple LED controller IC	1	RediSem
TOTAL			44	

Test Results



Output Voltage	35V					37V				
Input voltage	198V	215V	230V	245V	264V	198V	215V	230V	245V	264V
Output current	1004mA	1005mA	1005mA	1006mA	1006mA	1005mA	1005mA	1006mA	1006mA	1007mA
Input Power	39.06	39.04	39.06	39.10	39.08	41.18	41.15	41.10	41.12	41.16
Output Power	35.14	35.18	35.18	35.21	35.21	37.19	37.19	37.22	37.22	37.26
Efficiency	90.0%	90.1%	90.1%	90.1%	90.1%	90.3%	90.4%	90.6%	90.5%	90.5%
Power Factor	0.975	0.973	0.963	0.950	0.931	0.968	0.971	0.966	0.956	0.938
THD	9.8%	8.6%	14.0%	19.6%	25.9%	15.2%	11.4%	12.5%	17.0%	23.5%
Ripple (Flicker) @36V	1.11%	0.36%	0.30%	0.25%	0.23%					

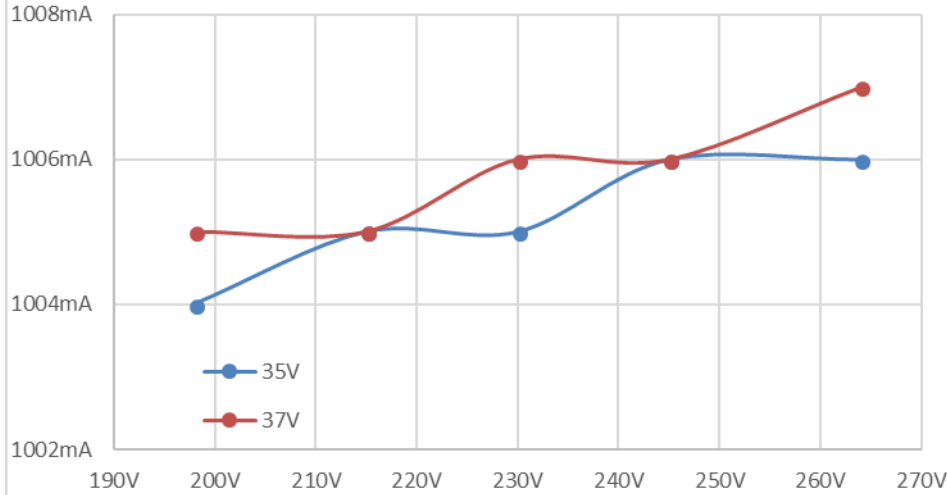
Test	Result	Condition
Peak no-load Voltage	46.00V	230VAC
Time To light	78ms	230VAC



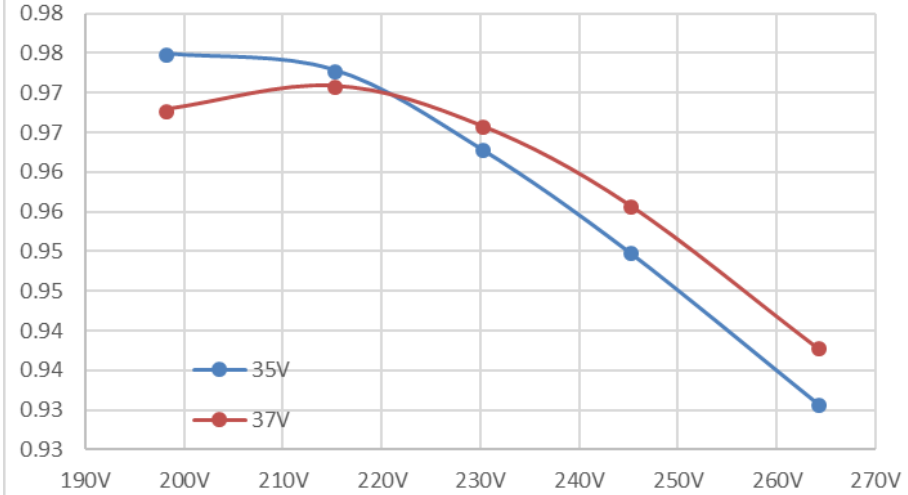
Test Results



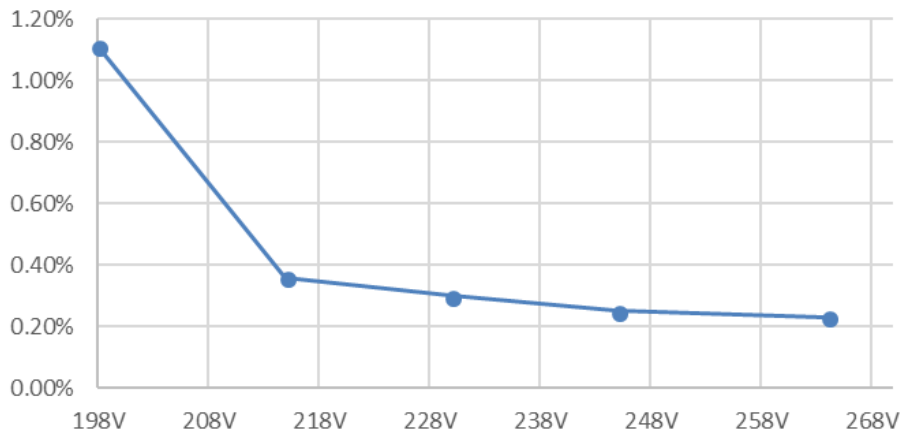
Current Regulation



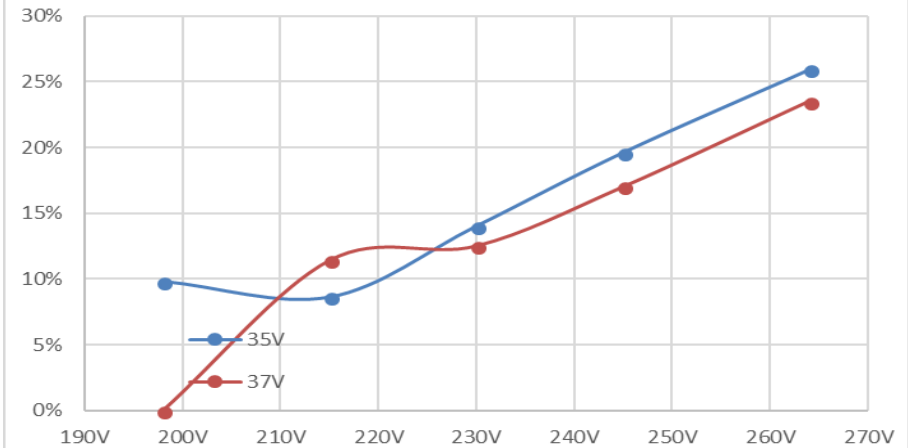
PF



Flicker @36V



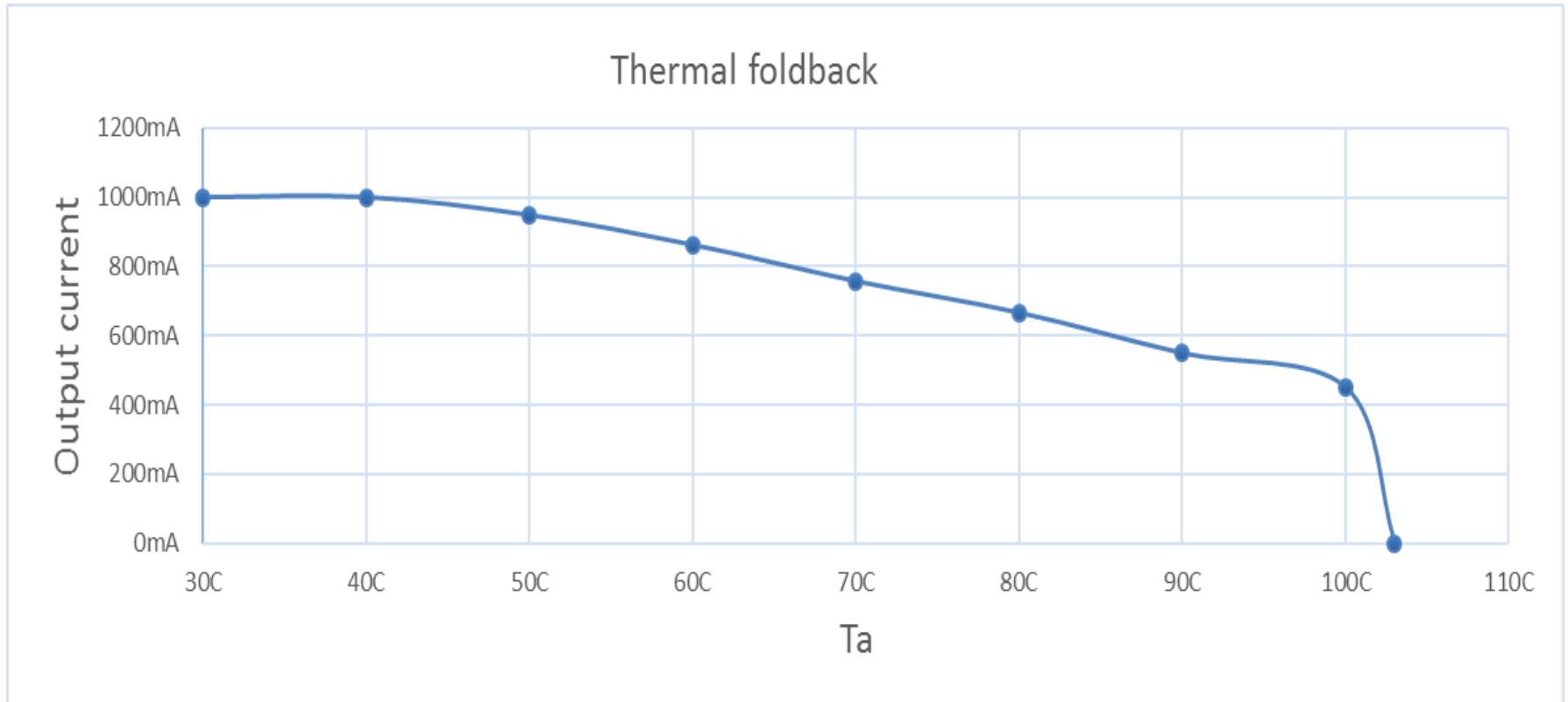
THD



Thermal foldback



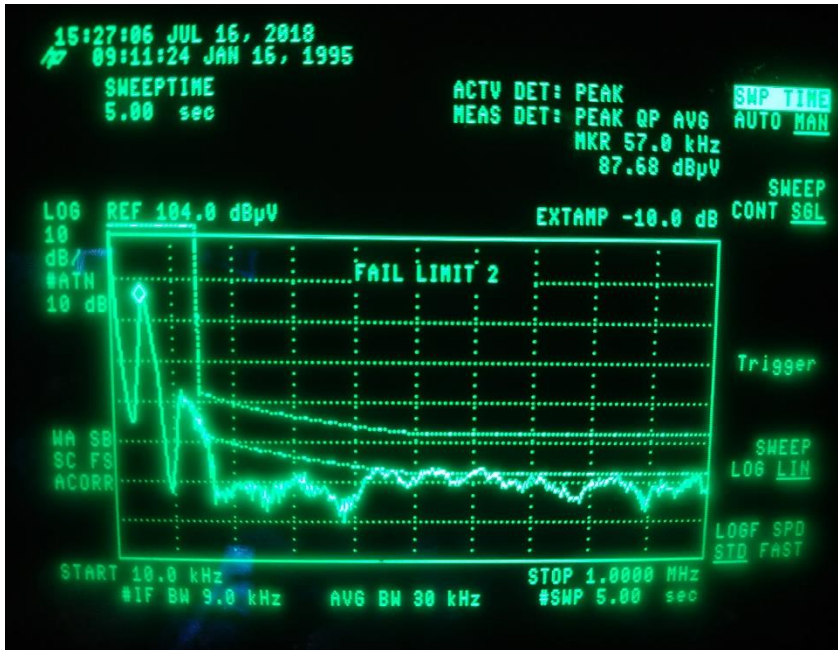
Ambient	30C	40C	50C	60C	70C	80C	90C	100C	103C
Output current	1000mA	1000mA	948mA	862mA	757mA	666mA	549mA	450mA	0mA



Test Results – EMI & Surge

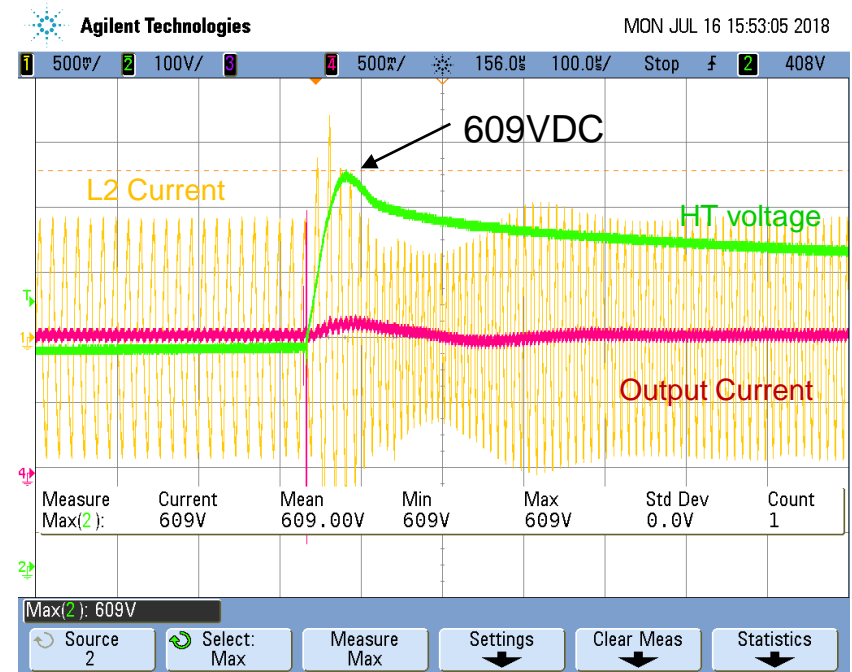


>3dB Margin EMI Pass



Conducted EMI 10k~1MHz
Driver and LED floating

1kV surge pass with margin



Plot of HT bus voltage and L2
(resonant) current during 1kV surge
with fuse resistor 230VAC/36VDC

Test Results - Thermals

Test condition:

In a box in a heated oven

Ta = 50C

Thermal Results (cased)	198V 37V	264V 35V
Ta	40C	40C
Q1	115C	107C
Q2	111C	102C
L2 core	103C	111C
L2 winding	104C	113C
T2 core	107C	105C
T2 winding	108C	108C

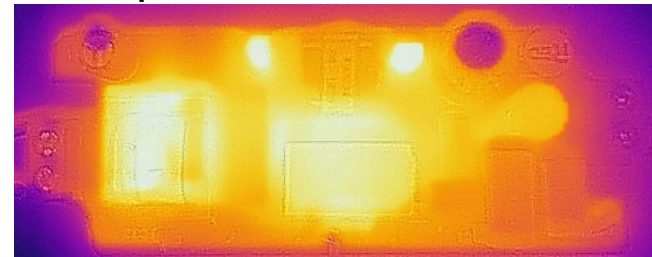


Test condition:

Open on the bench



Top side Thermal

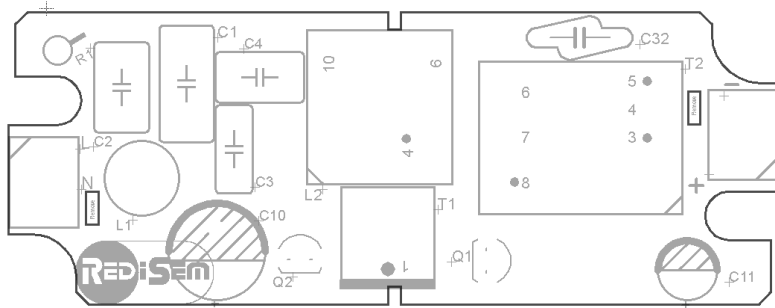


Bottom side Thermal

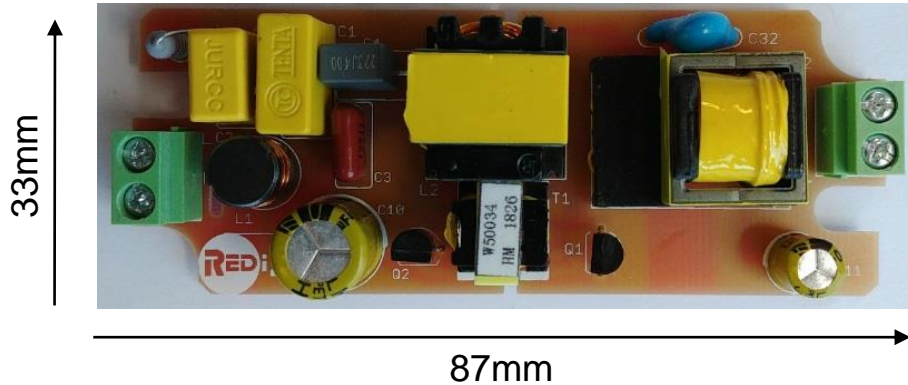
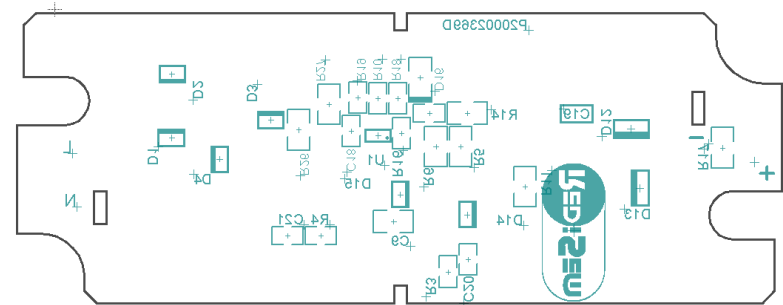
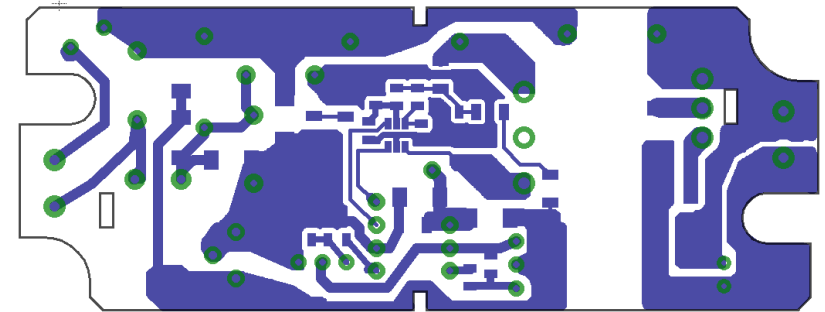


PCB layout

Top Side

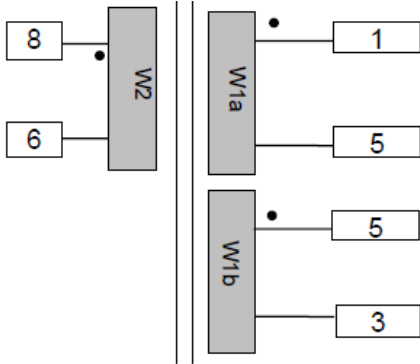


Bottom Side

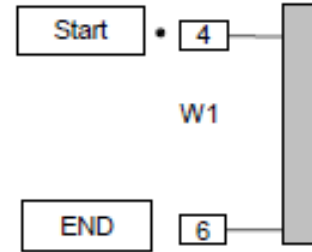


- Single sided PCB
- 1mm thick
- 1 Oz copper

Wound components



Transformer	
Core type	EE16/7
Material	P45



Inductor	
CoreType	EE16/10
Material	YR48D
Value	800uH

Winding	Turns	Start Pin	End Pin	Wire	Layers	Type	Purpose
W1a	23	1	5	0.32mm	1	ECW	Secondary
Tape	1						
W1b	23	5	3	0.32mm	1	ECW	Secondary
Tape	1						
W2	44	8	6	0.35mm	3	TEX-E	Primary

Winding	Turns	Wire	Inductance
W1	95T	0.1mm x 14strands	800uH +/- 3% ECW Grade 2

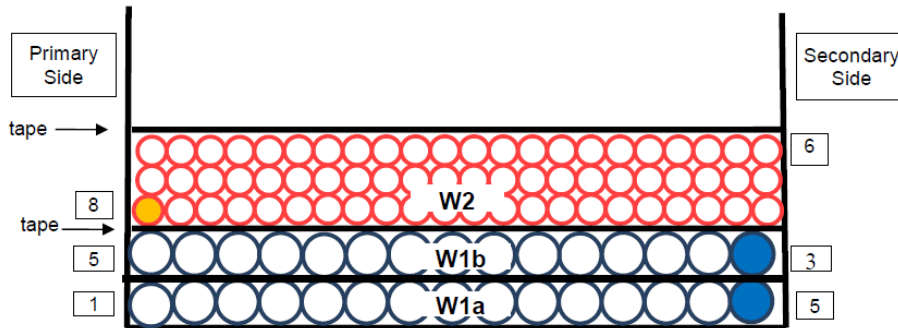


Figure 2: Transformer Winding Arrangement

● Winding start

Basedrive Transformer



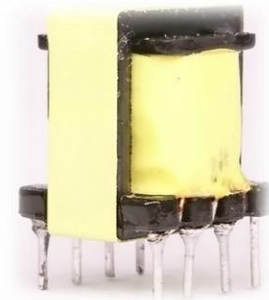
RediSem recommends ACME A062 T9x5x4

- Complete wound & varnished base-drive transformer
- Made to RediSem specs
- Qualified and tested turn-key solution



EE10 option for in-house manufacturing

- Base-drive transformer using EE10 core
- Contact RediSem for design information





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

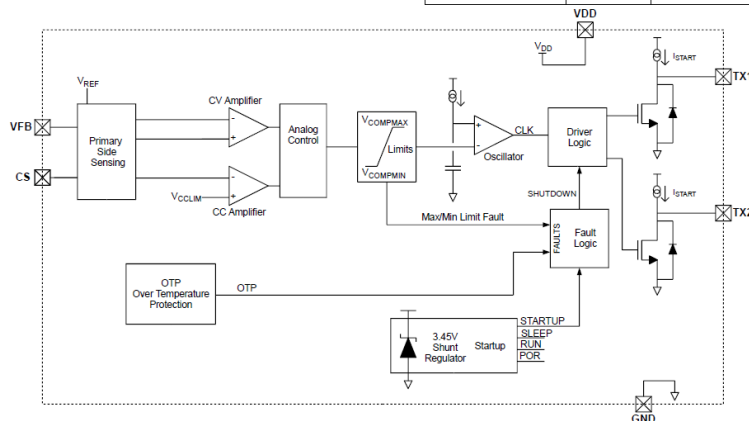


Figure 1: Block diagram



RED2422 LED LLC Controller

Device Pins

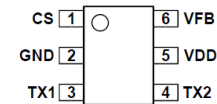
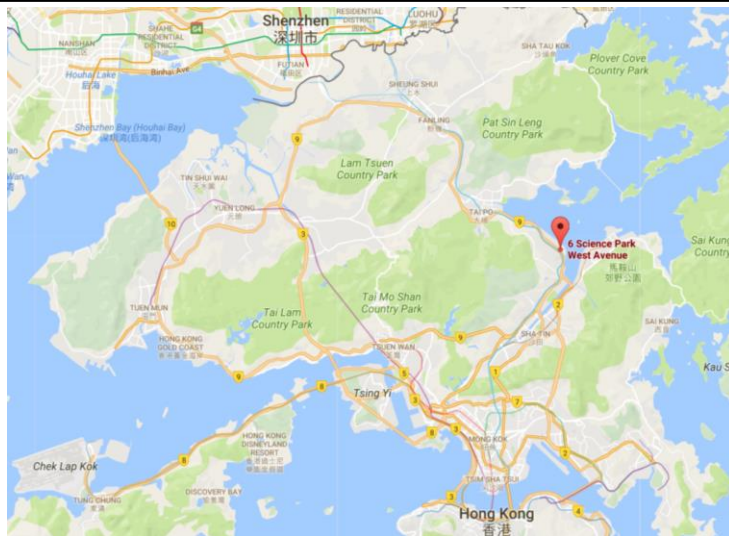


Figure 2: SOT23-6 pin connections (top view)

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.

Contact details



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