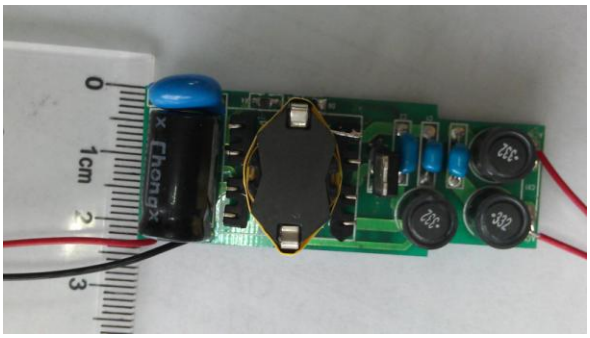
OZ8027T Flyback PFC Test Report

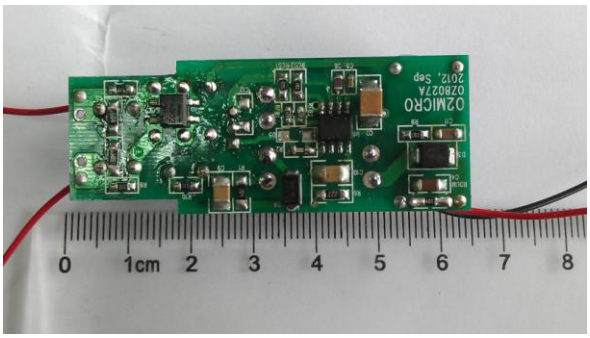
Based on 7W LED Bulb Application

85-265Vac Input, 23V/300mA Output

Key Features:

- ♦ Excellent LED current regulation;
- ♦ Low cost with primary control;
- ♦ High power factor;
- ♦ Fast startup time;
- ♦ Protections with auto-recovery;





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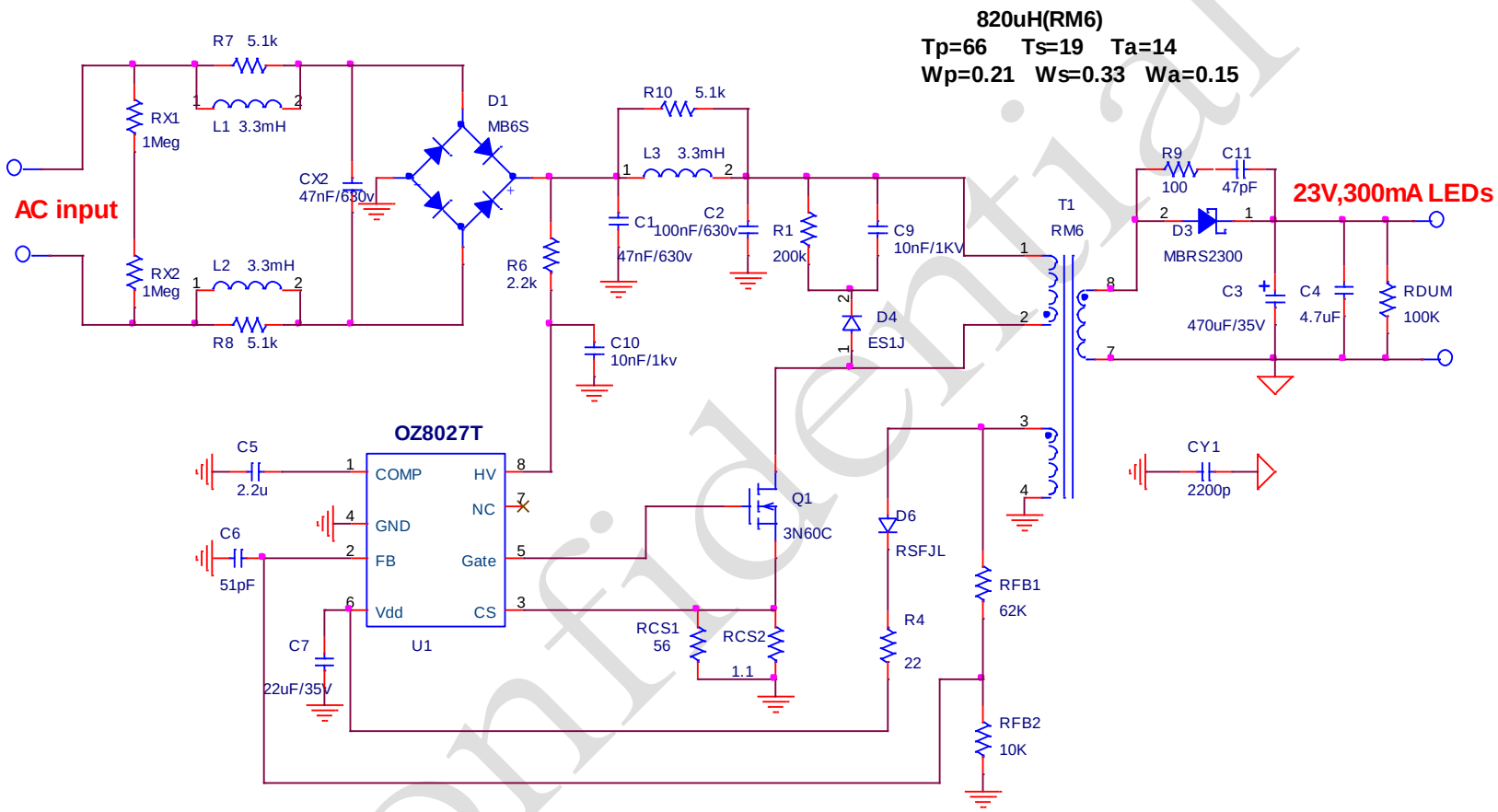
Test conditions

If it is not specified express, the normal testing conditions suppose:
-Ambient Temperature: 25℃

List of the main test equipment

Item	Test Equipment	Main Features	Recommended
1	AC Source		Chroma 61602
2	Multimeter		Fluke 87 Fluke 189
3	Digital Power Meter		HIOKI 3332
4	Oscilloscope	4 channel, 100MHz	Tektronix, DPO3014
5	Power analyzer	WT3000	YOKOGAWA
6	EMI test receiver	9KHZ~300MHZ	KH3909

1. Schematic



Note: 1. Transformer T1 specification

1) Bobbin: RM6,add faraday shielding between primary and secondary
2) Core material: PC40
3) Magnetizing inductance: Around 820uH
4) Np : Ns: Na = 66T : 19T : 14T

2. BOM List

Item	Quantity	Designator	Description
1	2	C1,CX2	47nF / 630V / Film/ Radial
2	1	C2	100nF / 630V / Film/ Radial
3	1	C3	470uF / 35V / Aluminum Electrolytic
4	1	C4	4.7uF / 50V / X7R / 1210 / By Murata
5	1	C5	2.2uF / 16V / X7R / 0603 / By Murata
6	1	C6	51pF / 16V / X7R / 0603 / By Murata
7	1	C7	22uF / 35V / X7R / 2010 / By Murata
8	2	C9,C10	10nF / 1KV / X7R / 1210
9	1	C11	47pF / 1KV / X7R / 1210
10	1	D1	MB6S / 0.5A, 600V / SMD / Bridge Rectifier
11	1	D3	MBRS2300 / 2A /300V
12	1	D4	ES1J / 1A, 600V / Fast Recovery Rectifier
13	1	D6	RSFJL/0.5A,600V / Fast Recovery Rectifier
14	1	CY1	2KV/2.2nF
15	3	L1,L2,L3	3.3mH / Radial Leaded Wire Wound Inductor
16	1	Q1	3N60C / 3A, 600V / TO-251
17	1	R1	200K / 5% / 1206
18	1	R4	22 ohm / 5% / 0805
19	1	R6	2.2K, 5% / 1206
20	2	R7,R8	5.1K/ 5% / 0805
21	1	R9	100ohm, 5% / 1206
22	1	R10	5.1K/ 5% / 0805
23	1	RCS1	1.1ohm/ 1% / 0805
24	1	RCS2	56ohm / 1% / 0805
25	2	RX1,RX2	1M / 5% / 1206
26	1	RFB1	62K / 1% / 0603
27	1	RFB2	10K / 1% / 0603
28	1	RDUM1	100K/ 5% / 0805
29	1	T1	820uH / RM6 / PC40
30	1	U1	OZ8027T / O2micro / SOP8
			Conclusion: Total 36 components

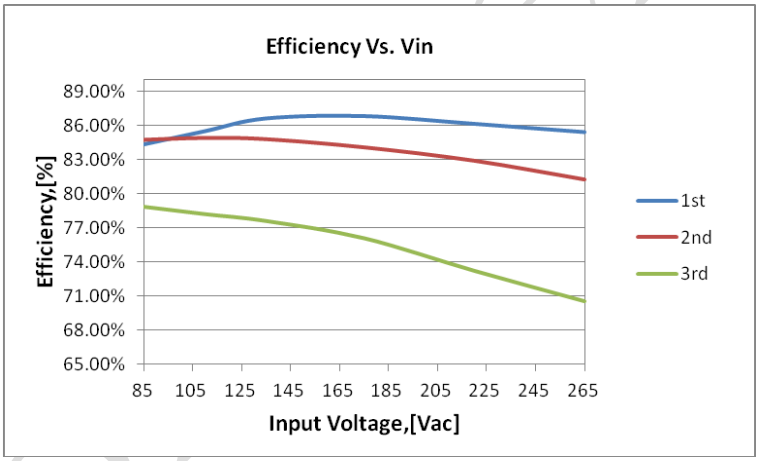
3. Electrical Characteristic

3.1. Efficiency

Change Vin from 85Vac to 265Vac based on rated LED load, measure the efficiency.

$$EFF_{LED},[\%] = \frac{V_{LED} \times I_{LED}}{P_{IN}} \times 100\%$$

	Dimming level	Vin(Vac)	85	110	135	175	220	265
With 7*300mA LEDs	1st	Pin[W]	7.856	7.674	7.603	7.580	7.649	7.667
		ILED(mA)	305.4	305.2	305.0	304.8	304.7	304.9
		VLED[V]	21.69	21.50	21.60	21.60	21.63	21.48
		EFF_LED[%]	**84.32%**	**85.51%**	**86.65%**	**86.86%**	**86.16%**	**85.42%**
	2nd	Pin[W]	2.876	2.871	2.868	2.893	2.943	3.024
		ILED(mA)	122.3	122.2	122.1	122.2	122.6	123.2
		VLED[V]	19.92	19.94	19.91	19.90	19.90	19.95
		EFF_LED[%]	**84.71%**	**84.87%**	**84.76%**	**84.06%**	**82.90%**	**81.28%**
	3rd	Pin[W]	0.678	0.699	0.720	0.754	0.815	0.893
		ILED(mA)	28.8	29.4	30.0	30.8	32.0	33.7
		VLED[V]	18.56	18.59	18.62	18.62	18.64	18.68
		EFF_LED[%]	**78.84%**	**78.19%**	**77.58%**	**76.06%**	**73.19%**	**70.49%**



3.2. LED Current Accuracy vs. Vin

Change Vin from 85Vac to 265Vac based on rated LED load, measure the LED current.

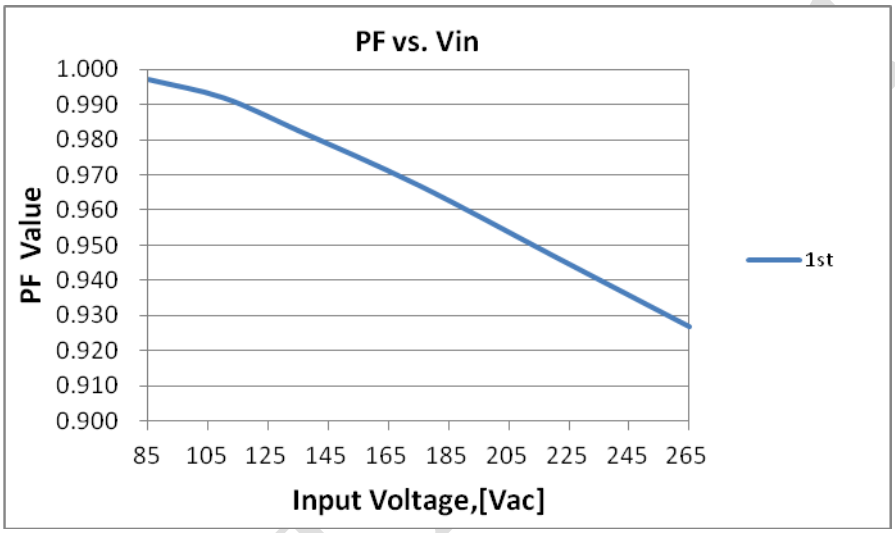
$$ACC,[\%] = \frac{I_{LED} - I_{LED\_220Vac}}{I_{LED\_220Vac}} \times 100\%$$

	Dimming level	Vin(Vac)	85	110	135	175	220	265
With 7*300mA LEDs	1st	ILED(mA)	305.4	305.2	305.0	304.8	304.7	304.9
		ACC, [%]	**0.23%**	**0.16%**	**0.10%**	**0.03%**	**0.00%**	**0.07%**
	2nd	ILED(mA)	122.3	122.2	122.1	122.2	122.6	123.2
		ACC, [%]	**-0.24%**	**-0.33%**	**-0.41%**	**-0.33%**	**0.00%**	**0.49%**
	3rd	ILED(mA)	28.8	29.4	30.0	30.8	32.0	33.7
		ACC, [%]	**-10.00%**	**-8.13%**	**-6.25%**	**-3.75%**	**0.00%**	**5.31%**

3.3. Power Factor test

Change Vin from 85Vac to 265Vac, measure the power factor.

	Vin, [Vac]	Line Frequency, [Hz]	Power Factor		
			1st	2nd	3rd
With 7*300mA LEDs	85	60	**0.997**	0.985	0.862
	110	60	**0.992**	0.954	0.778
	135	60	**0.983**	0.914	0.710
	175	50	**0.967**	0.895	0.662
	220	50	**0.947**	0.842	0.587
	265	50	**0.927**	0.806	0.544



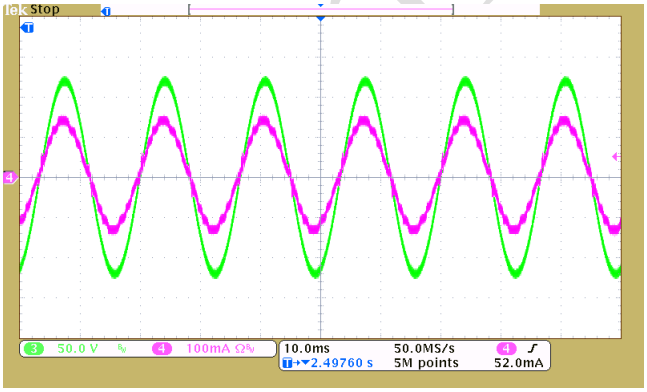


Fig-1: PF test, 85Vac, 60Hz, Ch3-V_{AC}, Ch4-I_{LED}

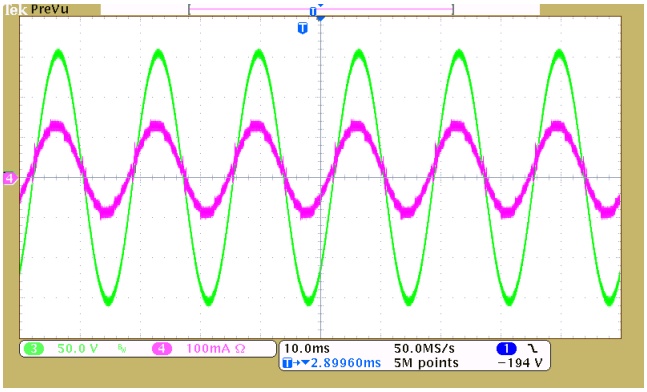


Fig-2: PF test, 110Vac, 60Hz, Ch3-V_{AC}, Ch4-I_{LED}

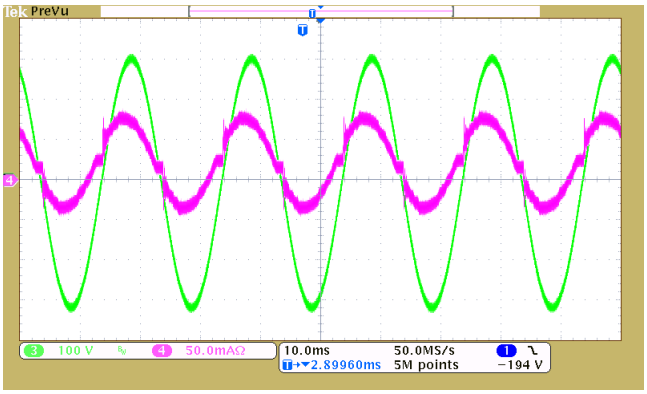


Fig-3: PF test, 220Vac, 50Hz, Ch3-V_{AC}, Ch4-I_{LED}

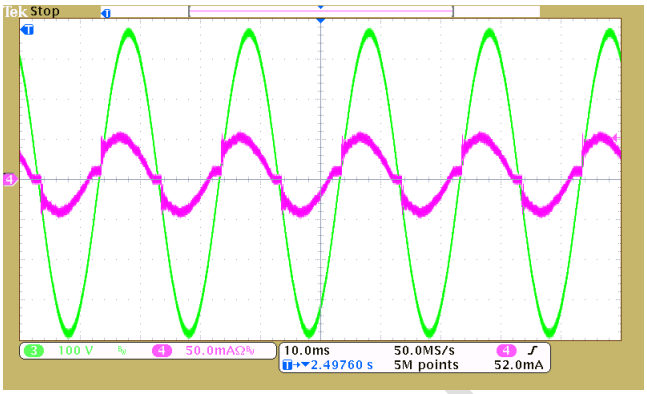


Fig-4: PF test, 265Vac, 50Hz, Ch3-V_{AC}, Ch4-I_{LED}

3.4. THD and Harmonics Test

	Vin, [Vac]	Line Frequency, [Hz]	THD[%]		
			1st	2nd	3rd
With 7*300mA LEDs	85	60	**5.4%**	13.9%	19.3%
	110	60	**6.3%**	16.8%	31.1%
	135	60	**7.0%**	7.1%	37.7%
	175	50	**7.3%**	16.0%	39.0%
	220	50	**8.7%**	9.1%	39.7%
	265	50	**12.2%**	29.6%	37.7%

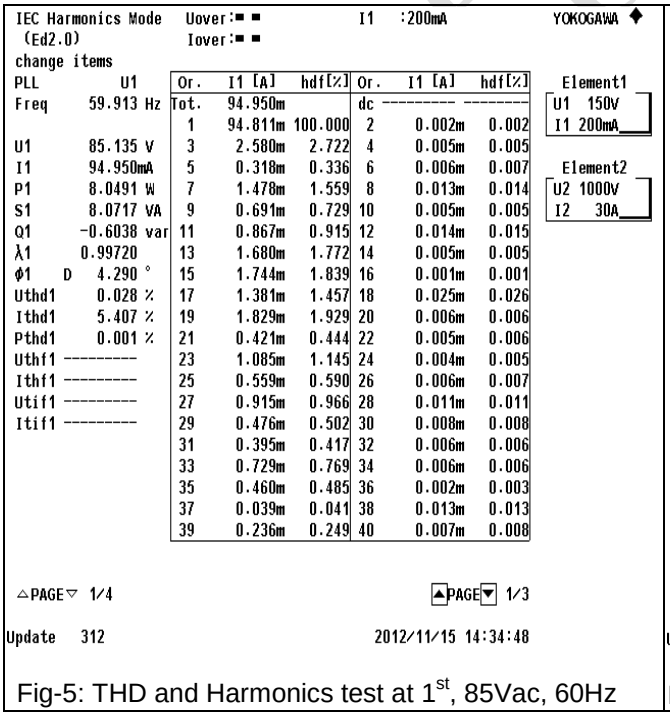


Fig-5: THD and Harmonics test at 1st, 85Vac, 60Hz

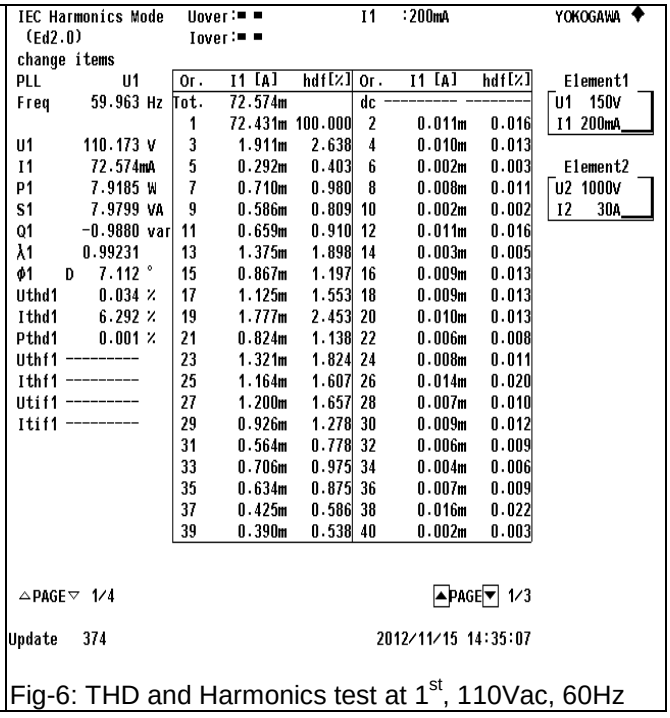


Fig-6: THD and Harmonics test at 1st, 110Vac, 60Hz

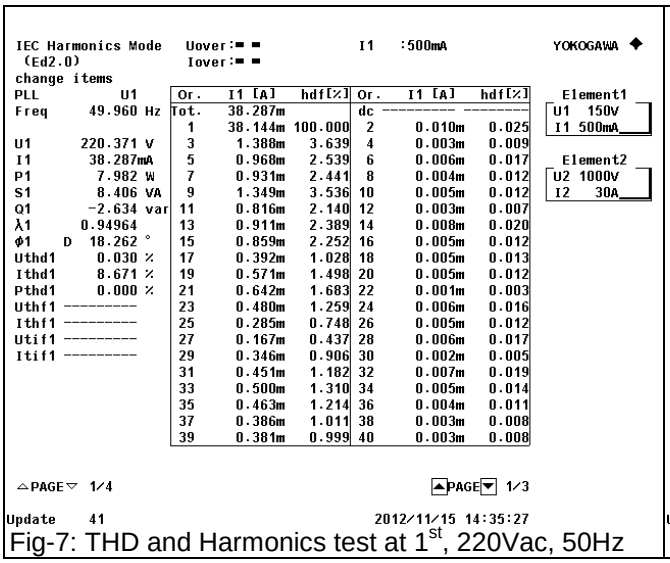


Fig-7: THD and Harmonics test at 1st, 220Vac, 50Hz

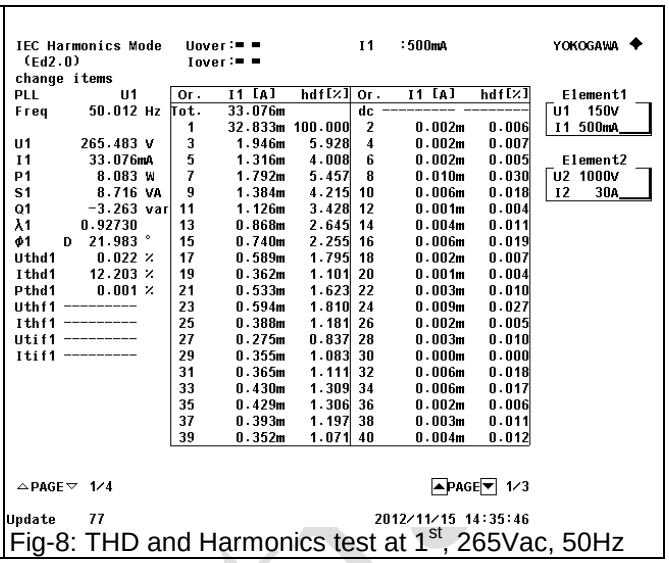


Fig-8: THD and Harmonics test at 1st, 265Vac, 50Hz

3.5. Operating Frequency and Ripple Test

Change Vin from 85Vac to 265Vac based on variable LED load, measure the operating frequency and complete the table below.

Vin, [Vac]	Line Frequency, [Hz]	Output current ripple Ipp(mA)
85	60	**236**
110	60	**236**
220	50	**260**
265	50	**252**

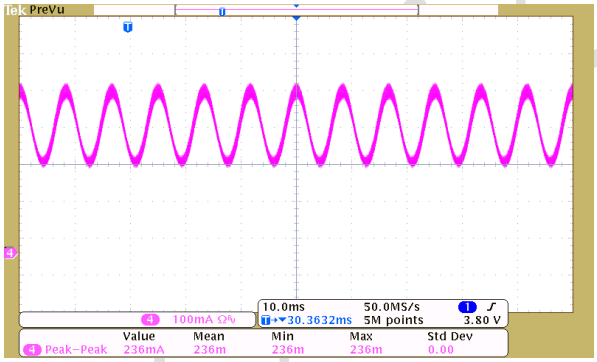


Fig-9: ripple, 85Vac, Ch4-ILED

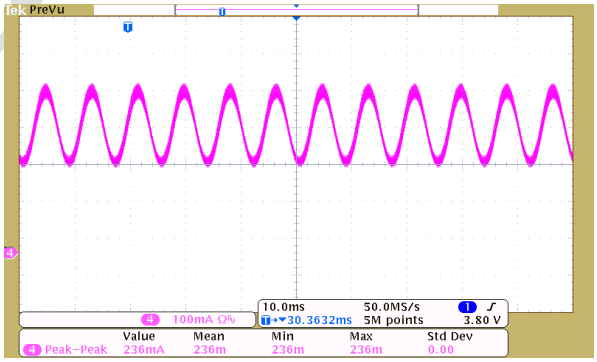


Fig-10: ripple, 110Vac, Ch4-ILED

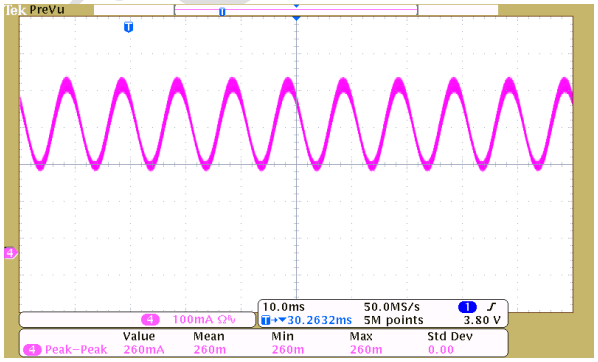


Fig-11: ripple, 220Vac, Ch4-ILED

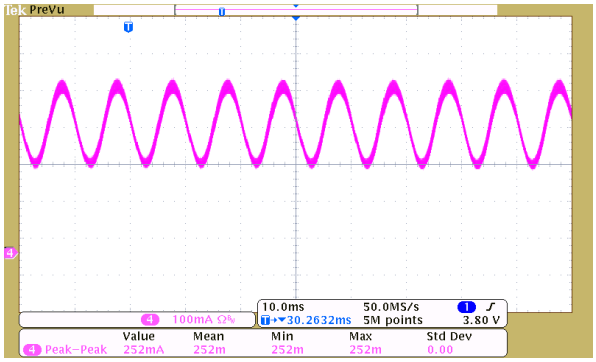


Fig-12: ripple, 265Vac, Ch4-ILED

3.6. Turn-On Characteristics

Change Vin from 85Vac to 265Vac, measure the turn-on delay time.

Vin, [Vac]	Line Frequency, [Hz]	Startup time, [ms]
85	60	**330**
110	60	**292**
220	50	**164**
265	50	**136**

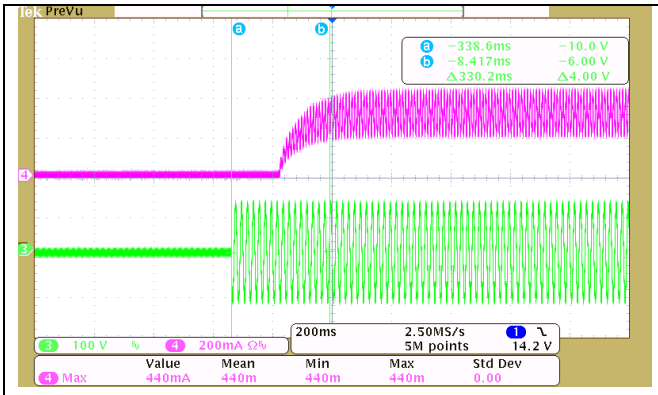


Fig-13: Turn-on, 85Vac
Ch3-VAC Ch4-ILED

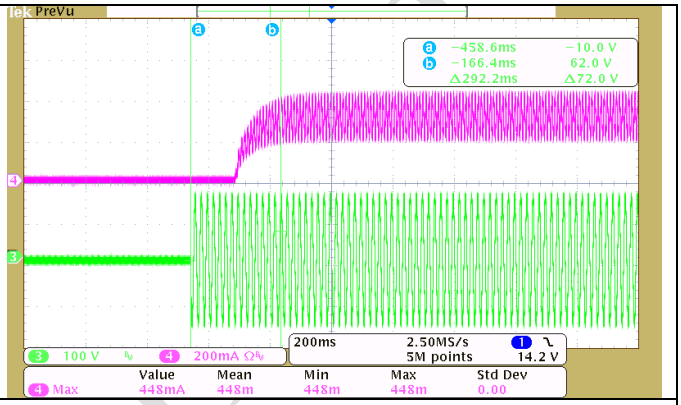


Fig-14: Turn-on, 110Vac
Ch3-VAC Ch4-ILED

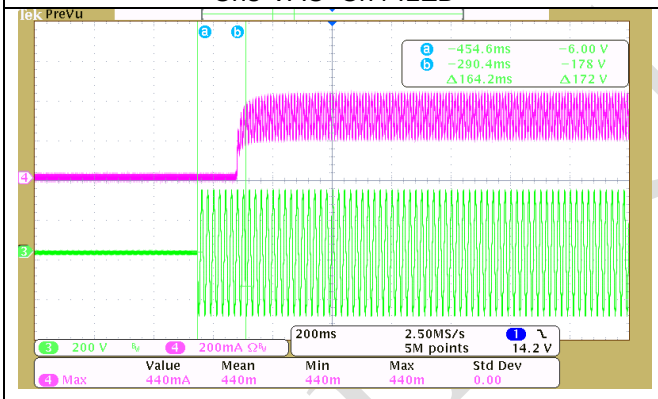


Fig-15: Turn-on, 220Vac
Ch3-VAC Ch4-ILED

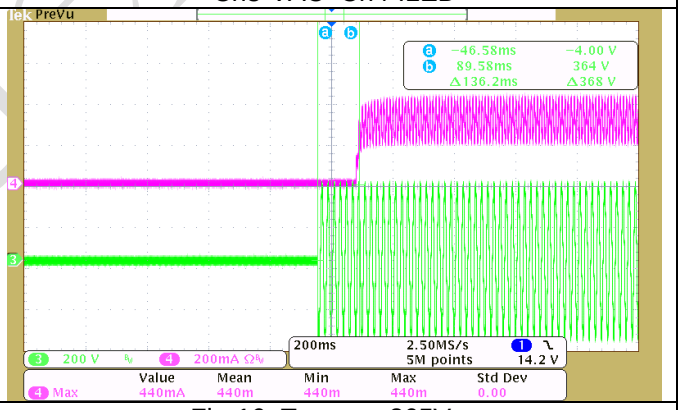


Fig-16: Turn-on, 265Vac
Ch3-VAC Ch4-ILED

3.7. Turn-off Characteristics

Change Vin from 85Vac to 265Vac based on rated LED load, measure the holdup time.

Vin, [Vac]	Line Frequency, [Hz]	Holdup time, [ms]
85	60	**16.33**
110	60	**20.16**
220	50	**20.16**
265	50	**14.16**

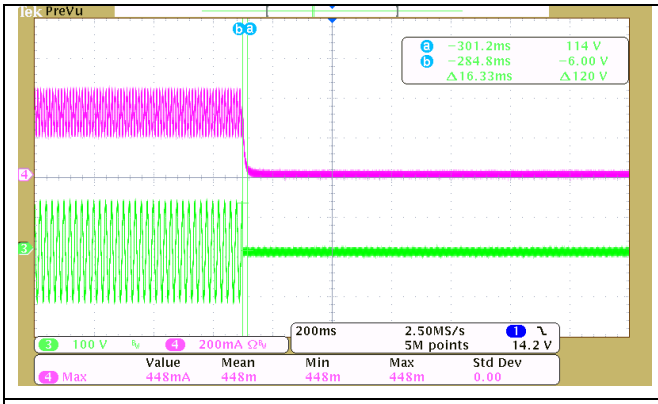


Fig-17: Turn-off, 85Vac
Ch3-VAC Ch4-ILED

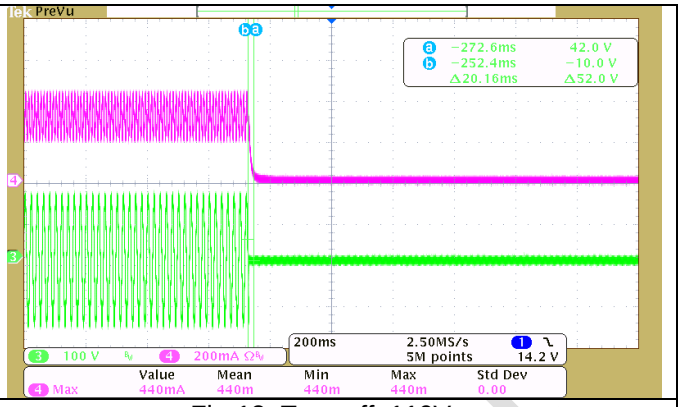


Fig-18: Turn-off, 110Vac
Ch3-VAC Ch4-ILED

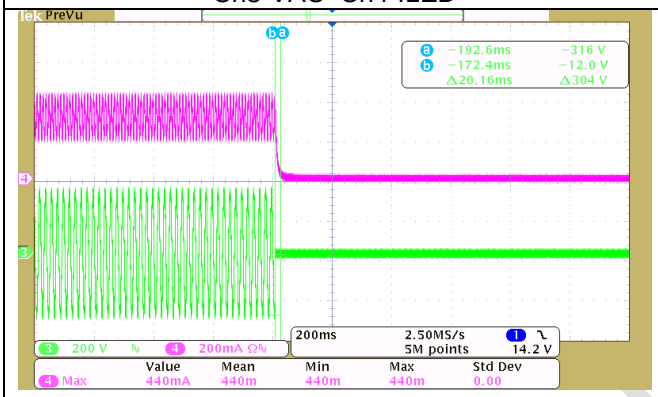


Fig-19: Turn-off, 220Vac
Ch3-VAC Ch4-ILED

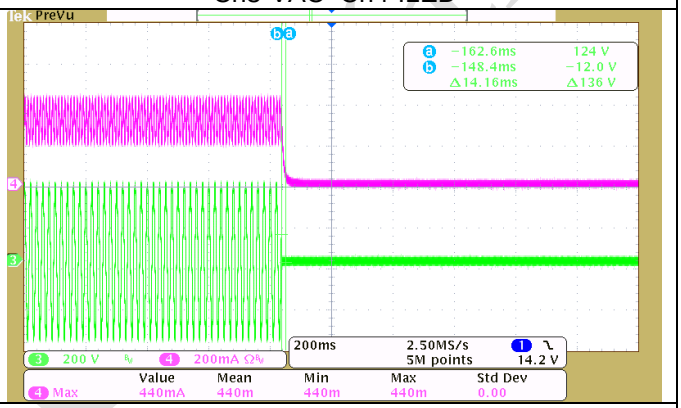


Fig-20: Turn-off, 265Vac
Ch3-VAC Ch4-ILED

3.8. Dimming Function Testing

Change Vin from 85Vac to 265Vac based on variable LED load, test dimming function.

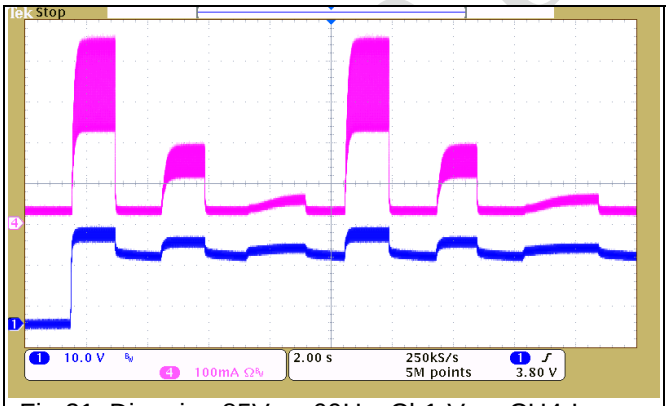


Fig-21: Dimming 85Vac, 60Hz, Ch1-$V_{gate,}$ CH4-I_{LED}

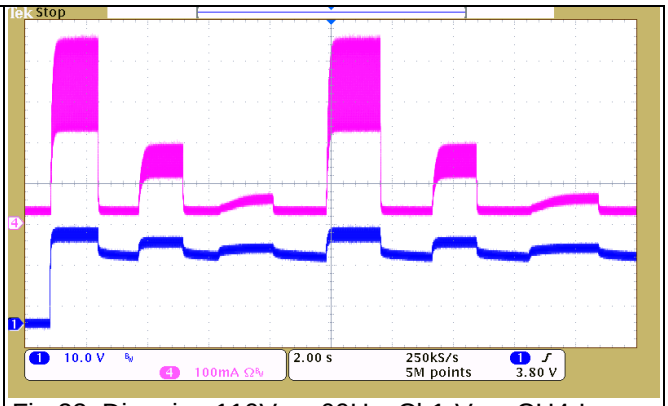


Fig-22: Dimming 110Vac, 60Hz, Ch1-$V_{gate,}$ CH4-I_{LED}

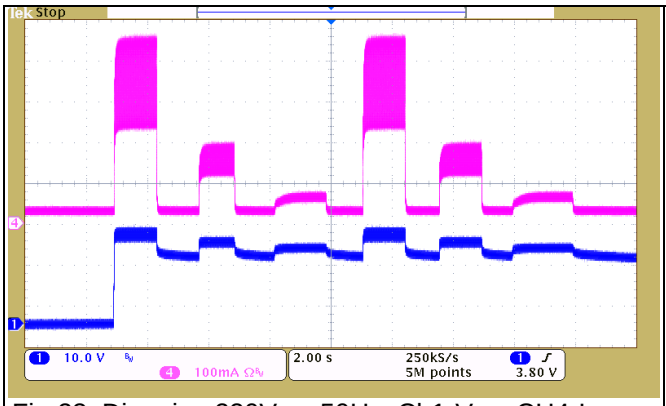


Fig-23: Dimming 220Vac, 50Hz, Ch1-V_{gate}, CH4-I_{LED}

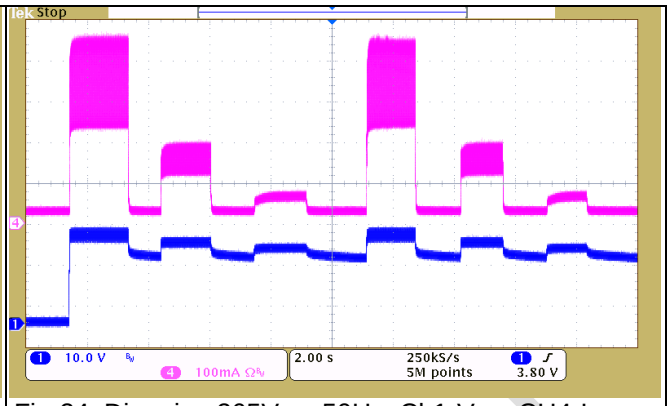


Fig-24: Dimming 265Vac, 50Hz, Ch1-V_{gate}, CH4-I_{LED}

3.9. Open LED(OVP) protection

Open LED during normal operation and complete the table below.

With 7*300mA LEDs	Vac, [Vac]	85	110	220	265
	Vout_peak, [V]	35.4	34.6	33.8	33.8
	Pin after OVP, [mW]	129	141	276	337
	Recovery or not, [Y/N]	Y	Y	Y	Y

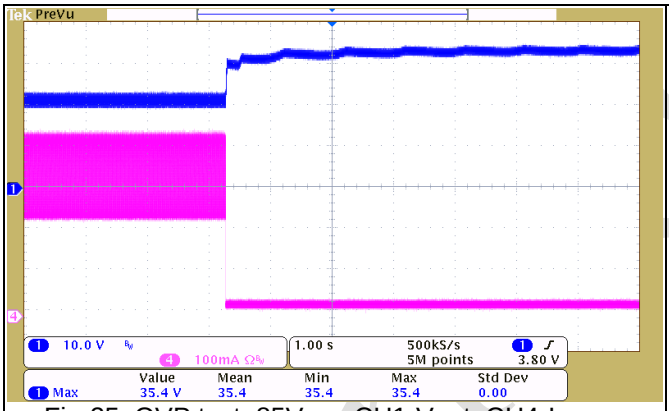


Fig-25: OVP test, 85Vac_ CH1-Vout, CH4-I_{LED}

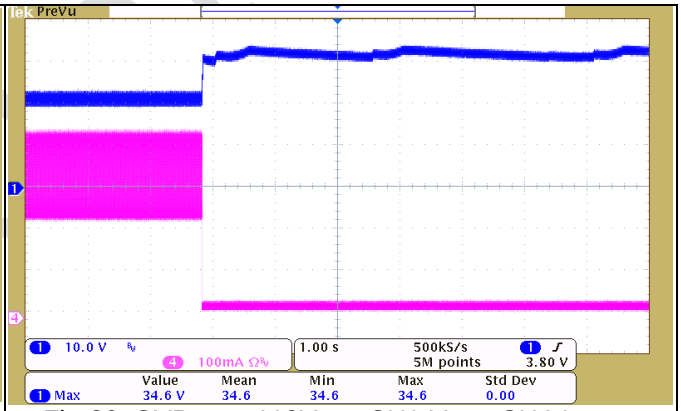


Fig-26: OVP test, 110Vac_ CH1-Vout, CH4-I_{LED}

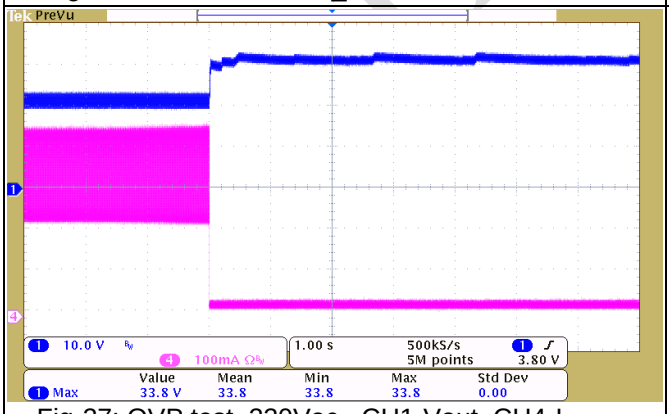


Fig-27: OVP test, 220Vac_ CH1-Vout, CH4-I_{LED}

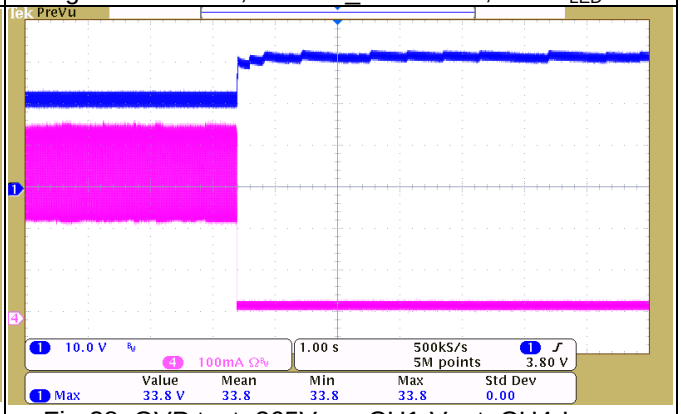


Fig-28: OVP test, 265Vac_ CH1-Vout, CH4-I_{LED}

3.10. All of the LED Short Protection (SCP)

Short the output during normal operation then release.

With 7*300mA LEDs	Vac, [V]	85	110	220	265
	Pin after SCP, [mW]	160	199	255	305
	Recovery or not, [Y/N]	Y	Y	Y	Y

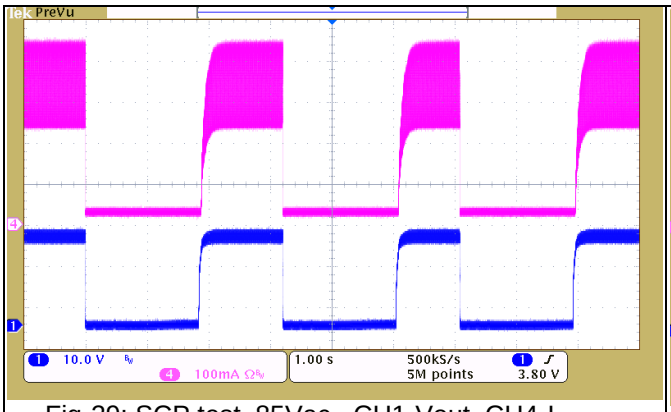


Fig-29: SCP test, 85Vac_ CH1-Vout, CH4-I_{LED}

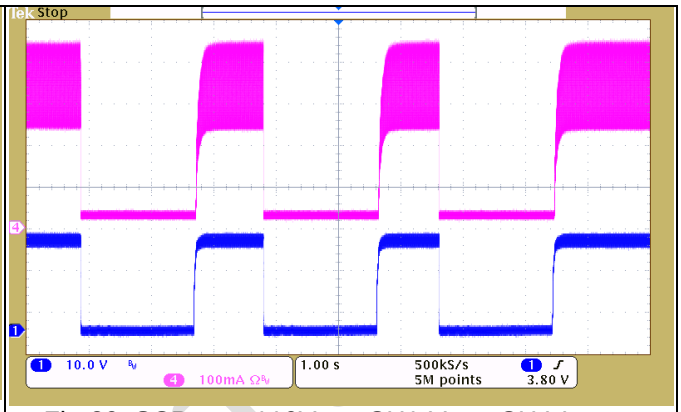


Fig-30: SCP test, 110Vac_ CH1-Vout, CH4-I_{LED}

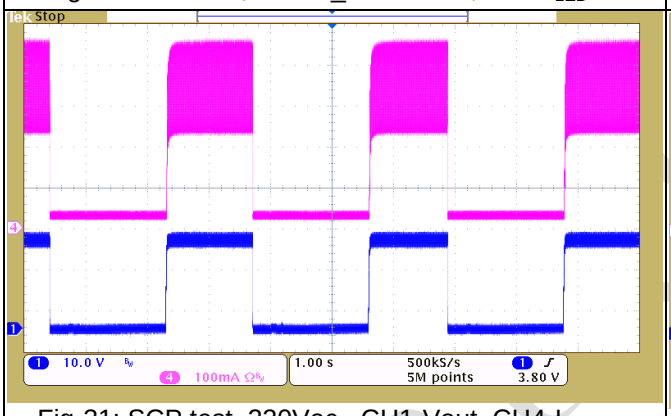


Fig-31: SCP test, 220Vac_ CH1-Vout, CH4-I_{LED}

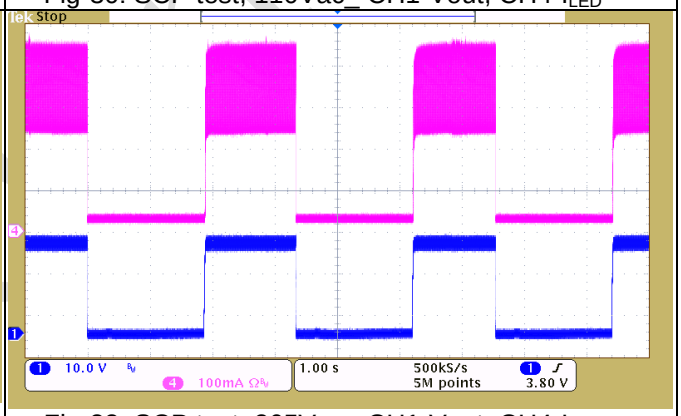


Fig-32: SCP test, 265Vac_ CH1-Vout, CH4-I_{LED}

4. EMI (CONDUCTION) PERFORMANCE

4.1. Conduction_110Vac

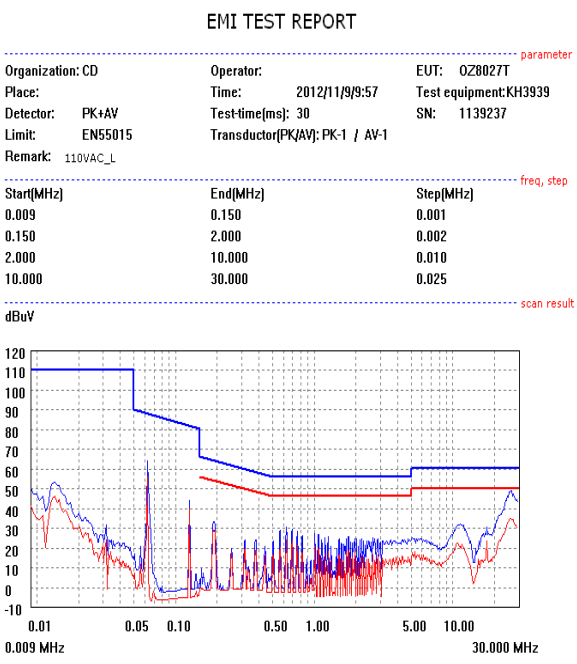


Fig-33: Conduction test at 110Vac_L

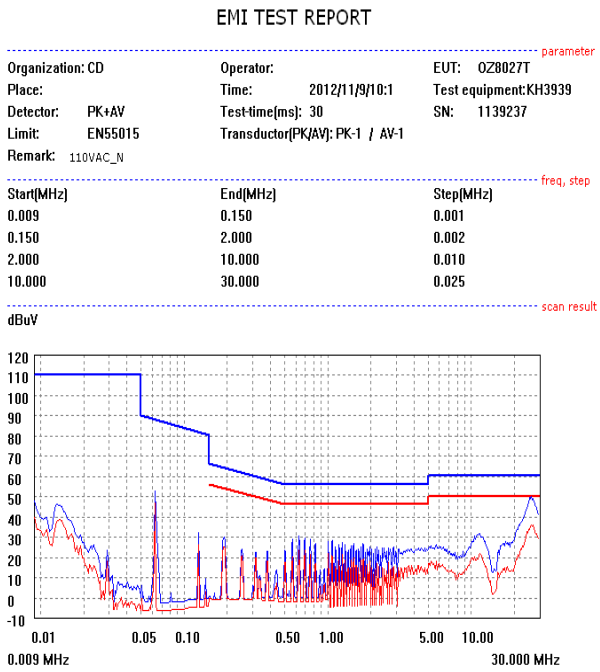


Fig-34: Conduction test at 110Vac_N

110Vac conduction test result: >**-6dB margin**

4.2. Conduction_220Vac

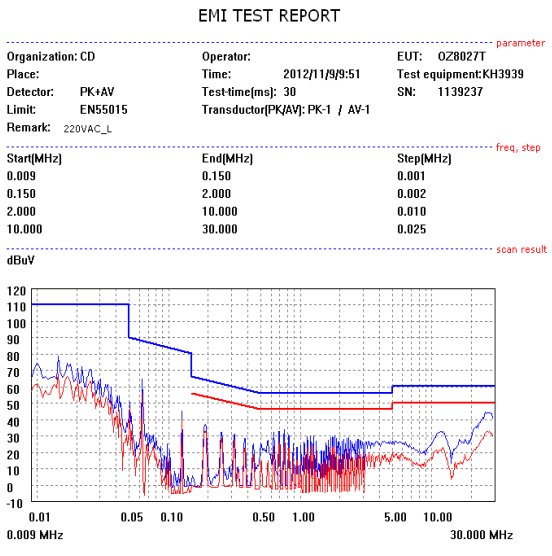


Fig-35: Conduction test at 220Vac_L

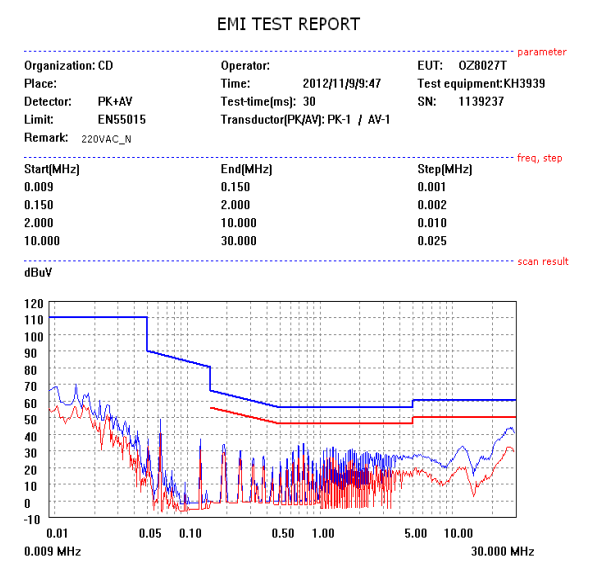


Fig-36: Conduction test at 220Vac_N

220Vac conduction test result: > **-6dB margin**

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