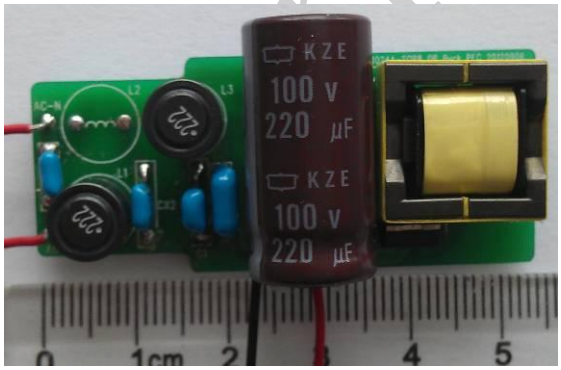
OZ8022T Test Report

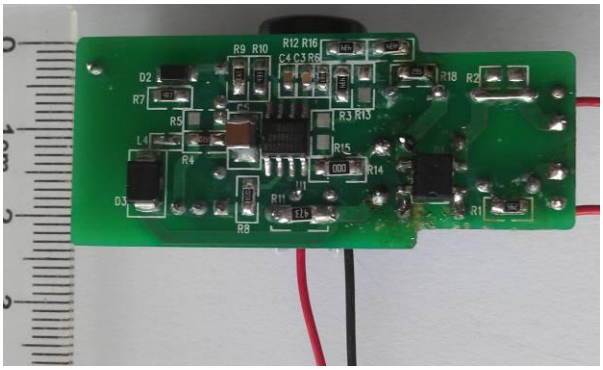
Based on 10.8W LED Application

90-264Vac Input, 54V/200mA Lighting

Key Features:

- 3-level analog dimming control using a wall switch
- Excellent LED current regulation
- High power factor at full load (>0.93 over the universal input range)
- High efficiency up to 91%
- Direct powered by rectified off-line voltage
- Protections with auto-recovery





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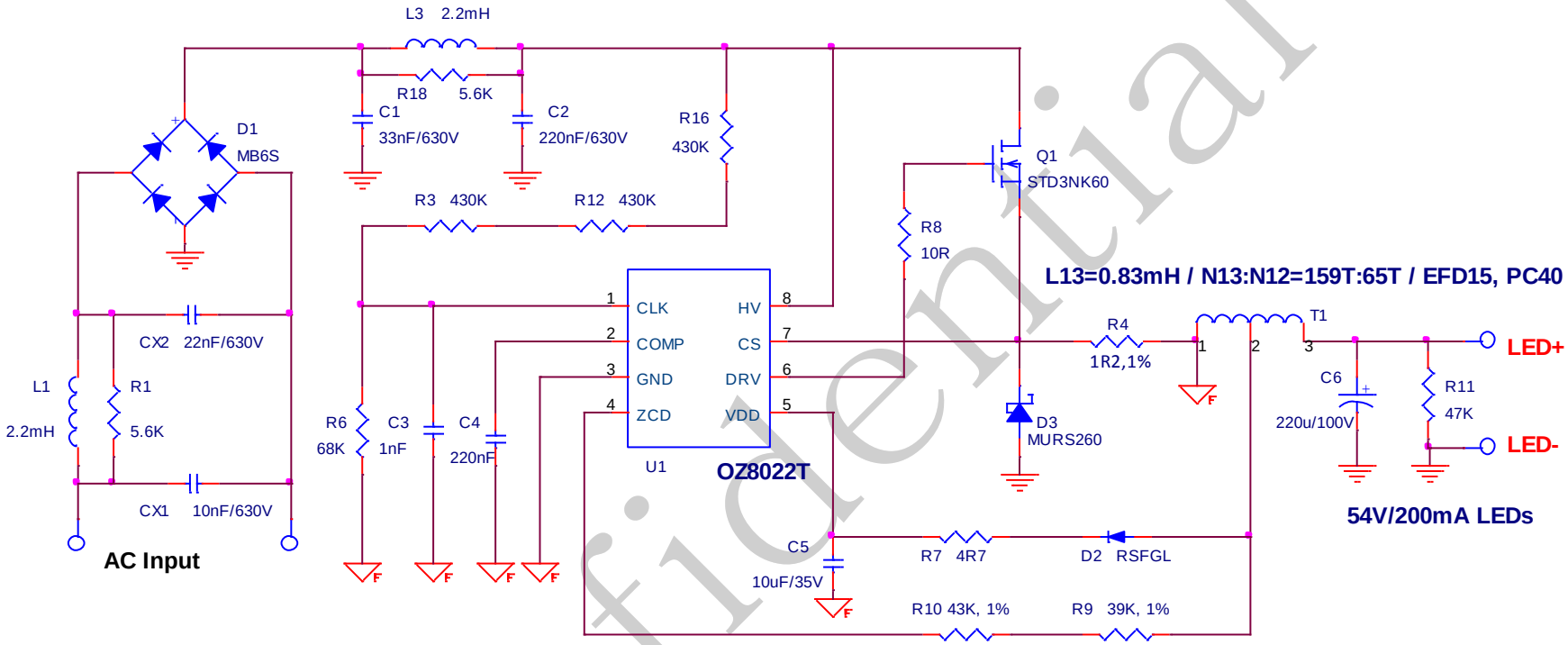
Test conditions

If it is not specified express, the Nominal 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 87III Fluke 289C
3	Precision Power Analyzer		YOKOGSAWA WT3000
4	Oscilloscope	4 channel, 300MHz	Tektronix, TDS 3034B
5	EMI Test Receiver		KH3939

0.1 Schematic



Note: 1. Transformer T1 specification

1) Bobbin: EFD15
2) Core material: PC40 (TDK)
3) Magnetizing inductance: Around 0.83mH
4) N13 : N12 = 159T : 65T

0.2 BOM List

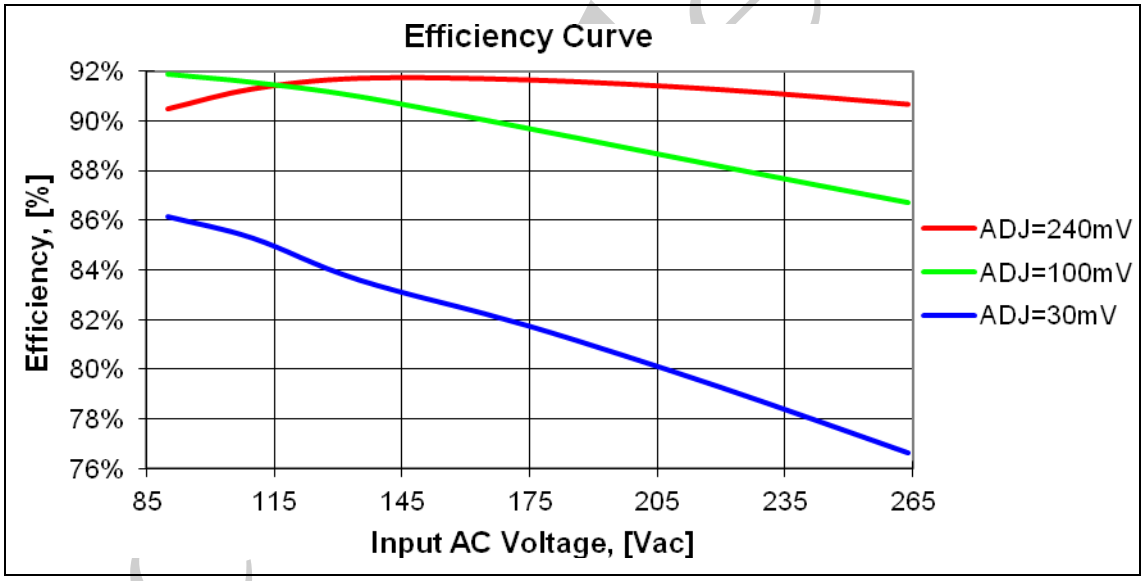
	Quantity	Designator	Description
1	1	CX1	10nF / 630V / X7R/ Radial / By Murata
2	1	CX2	22nF / 630V / X7R/ Radial / By Murata
3	1	C1	33nF / 630V / X7R/ Radial / By Murata
4	1	C2	220nF / 630V /X7R / Radial / By Murata
5	1	C3	1nF / 25V / X7R / 0603 / By Murata
6	1	C4	220nF / 25V / X7R / 0603 / By Murata
7	1	C5	10uF / 35V / X7R / 1210 / By Murata
8	1	C6	220uF / 100V / Aluminum Electrolytic
9	1	D1	MB6S / 0.5A, 600V / SOIC-4 / Bridge Rectifier
10	1	D2	RSFJL / 0.5A, 600V / Sub SMA / Fast Recovery Rectifier
11	1	D3	MURS260 / 2A, 600V / SMB / Fast Recovery Rectifier
12	2	L1 ,L3	2.2mH / Radial Leaded Wire Wound Inductor / By Wurth
13	1	Q1	STD3NK60 / 2.4A, 600V / TO-251
14	2	R1, R18	5.6Kohm / 5% / 0805
15	3	R3,R12,R16	430Kohm / 5% / 0805
16	1	R4	1.2ohm / 1% / 0805
17	1	R6	68Kohm / 5% / 0603
18	1	R7	4.7ohm / 5% / 0805
19	1	R8	10ohm / 5% / 0805
20	1	R9	39Kohm / 1% / 0805
21	1	R10	43Kohm / 1% / 0805
22	1	R11	47Kohm / 5% / 1206
23	1	T1	0.83mH / EFD15 / PC40
24	1	U1	OZ8022T / O2micro / SOP8
			Conclusion: Total 28 components

1. Efficiency

Change Vin from 90Vac to 264Vac based on variable LED load, measure the efficiency.

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

		90Vac	110Vac	135Vac	175Vac	220Vac	264Vac
ADJ=240mV	Pin, [W]	11.560	11.550	11.540	11.580	11.640	11.720
	V_{LED}, [V]	53.530	53.420	53.330	53.260	53.200	53.160
	I_{LED}, [mA]	195.4	197.4	198.5	199.3	199.7	199.9
	EFF_{LED}, [%]	**90.48%**	**91.30%**	**91.73%**	**91.66%**	**91.27%**	**90.67%**
ADJ=100mV	Pin, [W]	4.537	4.585	4.644	4.725	4.820	4.902
	V_{LED}, [V]	49.620	49.670	49.700	49.730	49.750	49.760
	I_{LED}, [mA]	84.0	84.5	85.0	85.2	85.4	85.4
	EFF_{LED}, [%]	**91.87%**	**91.54%**	**90.97%**	**89.67%**	**88.15%**	**86.69%**
ADJ=30mV	Pin, [W]	1.507	1.540	1.582	1.622	1.675	1.735
	V_{LED}, [V]	47.030	47.100	47.140	47.190	47.210	47.240
	I_{LED}, [mA]	27.6	27.9	28.1	28.1	28.1	28.2
	EFF_{LED}, [%]	**86.16%**	**85.30%**	**83.61%**	**81.75%**	**79.28%**	**76.65%**



2. LED Current Accuracy vs. Vin

Change Vin from 90Vac to 264Vac based on variable LED load, measure the LED current.

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

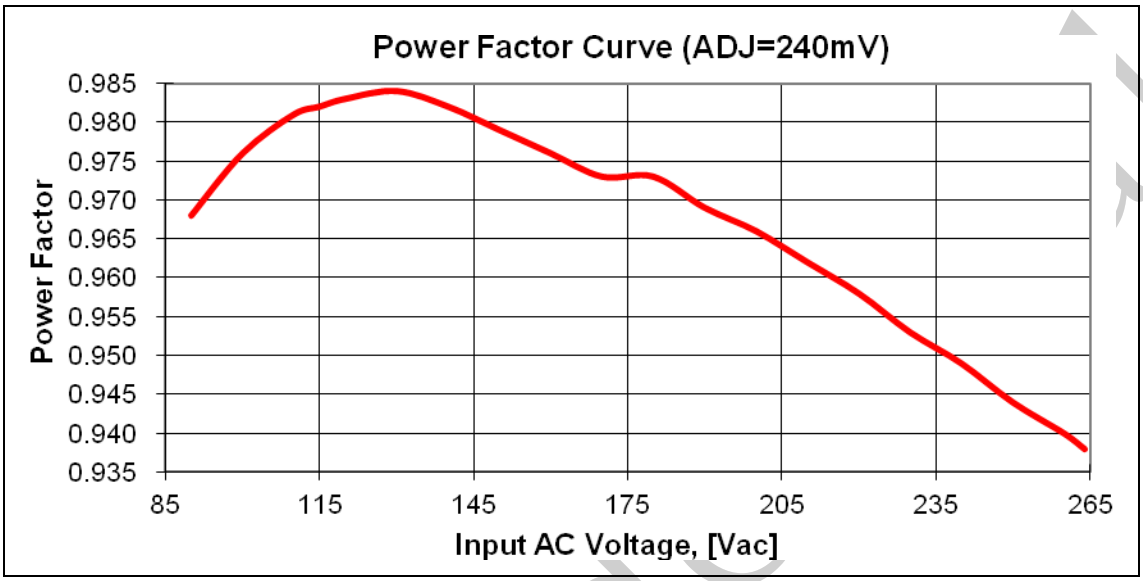
		90Vac	110Vac	135Vac	175Vac	220Vac	264Vac
ADJ=240mV	I_{LED}, [mA]	195.4	197.4	198.5	199.3	199.7	199.9
	Acc, [%]	**-2.15%**	**-1.15%**	**-0.60%**	**-0.20%**	**0.00%**	**0.10%**
ADJ=100mV	I_{LED}, [mA]	84.0	84.5	85.0	85.2	85.4	85.4
	Acc, [%]	**-1.64%**	**-1.05%**	**-0.47%**	**-0.23%**	**0.00%**	**0.00%**
ADJ=30mV	ILED, [mA]	27.6	27.9	28.1	28.1	28.1	28.2
	Acc, [%]	**-1.85%**	**-0.85%**	**-0.25%**	**-0.11%**	**0.00%**	**0.07%**

3. Power Factor and THD Test

Change Vin from 90Vac to 264Vac based on variable LED load, measure the power factor.

Vin, [Vac]	Line Frequency, [Hz]	**Power Factor**		
		ADJ=240mV	ADJ=100mV	ADJ=30mV
90	60	0.968	0.966	0.882
100	60	0.976	0.960	0.852
110	60	0.981	0.956	0.838
115	60	0.982	0.954	0.826
120	60	0.983	0.951	0.822
130	60	0.984	0.945	0.796
140	60	0.982	0.936	0.772
150	60	0.979	0.926	0.764
160	60	0.976	0.916	0.743
170	60	0.973	0.904	0.717
180	50	0.973	0.900	0.722
190	50	0.969	0.890	0.712
200	50	0.966	0.880	0.703
210	50	0.962	0.873	0.684
220	50	0.958	0.865	0.673
230	50	0.953	0.854	0.667
240	50	0.949	0.843	0.659
250	50	0.944	0.836	0.648
260	50	0.940	0.825	0.638
264	50	0.938	0.821	0.636

Vin, [Vac]	Line Frequency, [Hz]	THD		
		ADJ=240mV	ADJ=100mV	ADJ=30mV
90	60	**25.554%**	**23.864%**	**38.445%**
110	60	**18.351%**	**22.579%**	**35.312%**
220	50	**16.548%**	**25.117%**	**46.502%**
264	50	**19.197%**	**28.677%**	**48.503%**



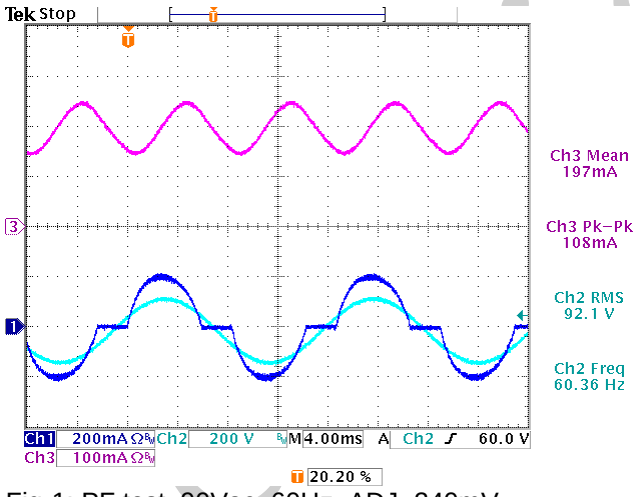


Fig-1: PF test, 90Vac, 60Hz, ADJ=240mV
Ch1-I_{AC}, Ch2-V_{AC}, Ch3-I_{LED}

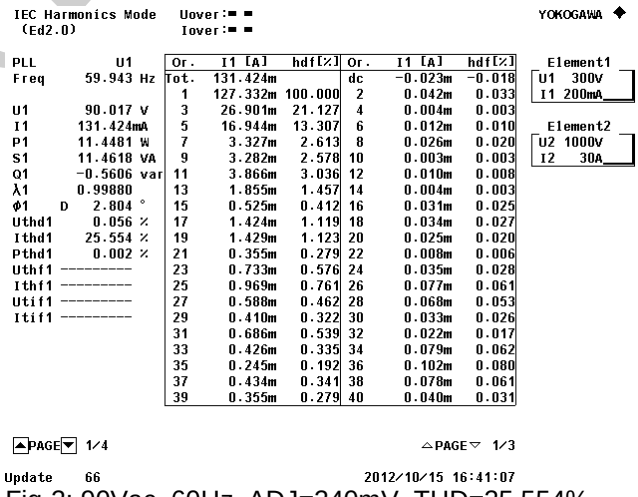


Fig-2: 90Vac, 60Hz, ADJ=240mV, THD=25.554%.

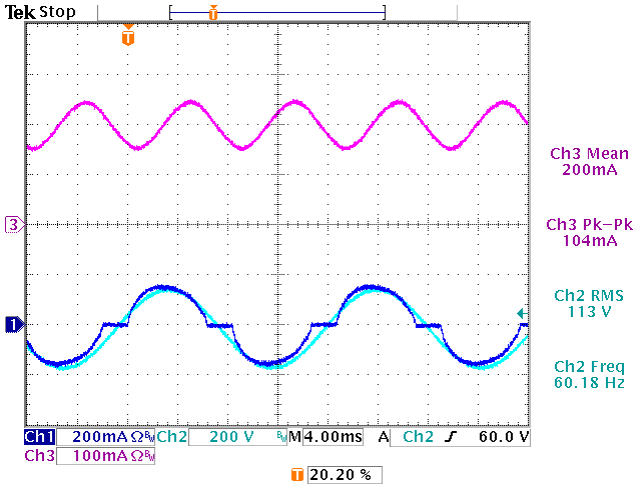
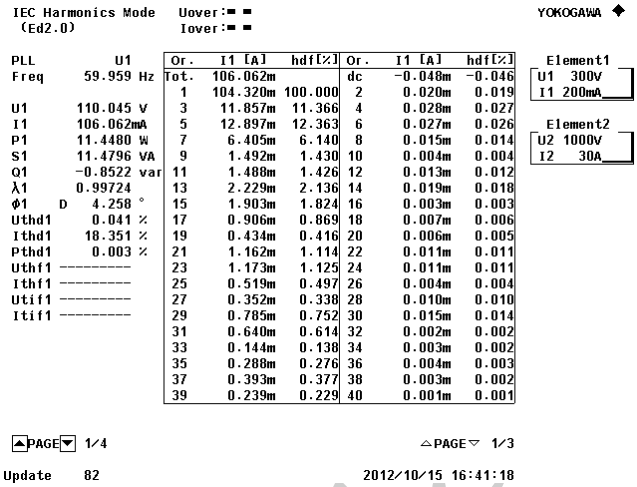


Fig-3: PF test, 110Vac, 60Hz, ADJ=240mV
Ch1-I_{AC}, Ch2-V_{AC}, Ch3-I_{LED}



Or.	I1 [A]	hdf[%]	Or.	I1 [A]	hdf[%]
Tot.	106.062m		dc	-0.048m	-0.046
1	104.320m	100.000	2	0.020m	0.019
3	11.857m	11.366	4	0.028m	0.027
5	12.897m	12.363	6	0.027m	0.026
7	6.405m	6.140	8	0.015m	0.014
9	1.492m	1.430	10	0.004m	0.004
11	1.488m	1.426	12	0.013m	0.012
13	2.229m	2.136	14	0.019m	0.018
15	1.903m	1.824	16	0.003m	0.003
17	0.906m	0.869	18	0.007m	0.006
19	0.434m	0.416	20	0.006m	0.005
21	1.162m	1.114	22	0.011m	0.011
23	1.173m	1.125	24	0.011m	0.011
25	0.519m	0.497	26	0.004m	0.004
27	0.352m	0.338	28	0.010m	0.010
29	0.785m	0.752	30	0.015m	0.014
31	0.640m	0.614	32	0.002m	0.002
33	0.144m	0.138	34	0.003m	0.002
35	0.288m	0.276	36	0.004m	0.003
37	0.393m	0.377	38	0.003m	0.002
39	0.239m	0.229	40	0.001m	0.001

Fig-4: 110Vac, 60Hz, ADJ=240mV, THD=18.351%.

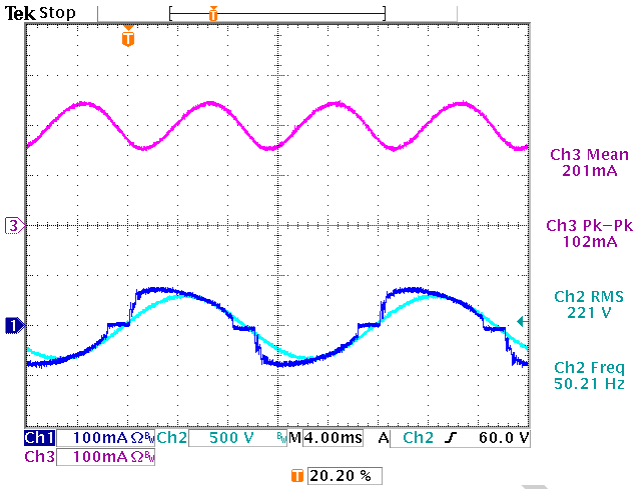
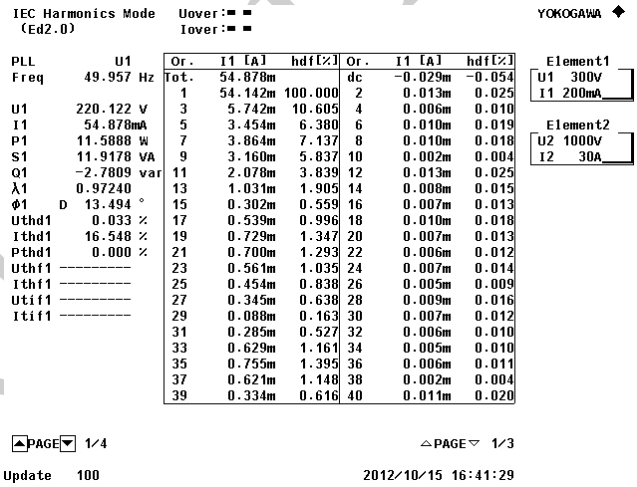


Fig-5: PF test, 220Vac, 50Hz, ADJ=240mV
Ch1-I_{AC}, Ch2-V_{AC}, Ch3-I_{LED}



Or.	I1 [A]	hdf[%]	Or.	I1 [A]	hdf[%]
Tot.	54.878m		dc	-0.029m	-0.054
1	54.142m	100.000	2	0.013m	0.025
3	5.742m	10.605	4	0.006m	0.010
5	3.454m	6.380	6	0.010m	0.019
7	3.864m	7.137	8	0.010m	0.018
9	3.160m	5.837	10	0.002m	0.004
11	2.078m	3.839	12	0.013m	0.025
13	1.031m	1.905	14	0.008m	0.015
15	0.302m	0.559	16	0.007m	0.013
17	0.539m	0.996	18	0.010m	0.018
19	0.729m	1.347	20	0.007m	0.013
21	0.700m	1.293	22	0.006m	0.012
23	0.561m	1.035	24	0.007m	0.014
25	0.454m	0.838	26	0.005m	0.009
27	0.345m	0.638	28	0.009m	0.016
29	0.088m	0.163	30	0.007m	0.012
31	0.285m	0.527	32	0.006m	0.010
33	0.629m	1.161	34	0.005m	0.010
35	0.755m	1.395	36	0.006m	0.011
37	0.621m	1.148	38	0.002m	0.004
39	0.334m	0.616	40	0.011m	0.020

Fig-6: 220Vac, 50Hz, ADJ=240mV, THD=16.548%.

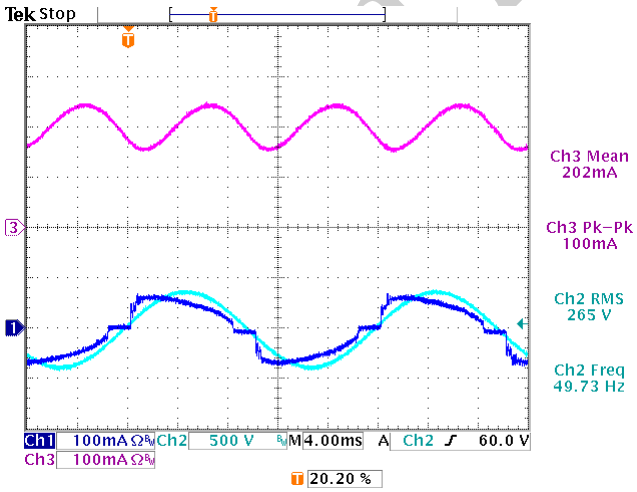
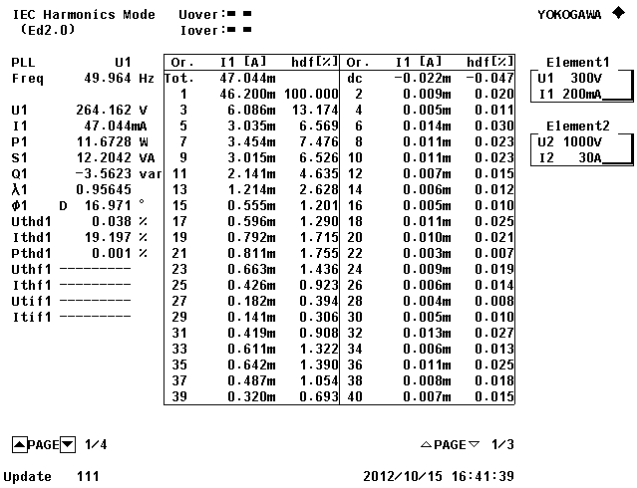


Fig-7: PF test, 264Vac, 50Hz, ADJ=240mV
Ch1-I_{AC}, Ch2-V_{AC}, Ch3-I_{LED}



Or.	I1 [A]	hdf[%]	Or.	I1 [A]	hdf[%]
Tot.	47.044m		dc	-0.022m	-0.047
1	46.200m	100.000	2	0.009m	0.020
3	6.086m	13.174	4	0.005m	0.011
5	3.035m	6.569	6	0.014m	0.030
7	3.454m	7.476	8	0.011m	0.023
9	3.015m	6.526	10	0.011m	0.023
11	2.141m	4.635	12	0.007m	0.015
13	1.214m	2.628	14	0.006m	0.012
15	0.555m	1.201	16	0.005m	0.010
17	0.596m	1.290	18	0.011m	0.025
19	0.792m	1.715	20	0.010m	0.021
21	0.811m	1.755	22	0.003m	0.007
23	0.663m	1.436	24	0.009m	0.019
25	0.426m	0.923	26	0.006m	0.014
27	0.182m	0.394	28	0.004m	0.008
29	0.141m	0.306	30	0.005m	0.010
31	0.419m	0.908	32	0.013m	0.027
33	0.611m	1.322	34	0.006m	0.013
35	0.642m	1.390	36	0.011m	0.025
37	0.487m	1.054	38	0.008m	0.018
39	0.320m	0.693	40	0.007m	0.015

Fig-8: 264Vac, 50Hz, ADJ=240mV, THD=19.197%.

4. LED Ripple Current

Change Vin from 90Vac to 264Vac based on LED load, measure the LED ripple current.

I_{LED} Ripple,[mA]	90Vac	110Vac	220Vac	264Vac
ADJ=240mV	**108**	**104**	**102**	**100**
ADJ=100mV	36	37	39	38
ADJ=30mV	10.4	10.8	10.8	10

5. Dimming Function Testing

Change Vin from 90Vac to 264Vac based on variable LED load, test dimming function.

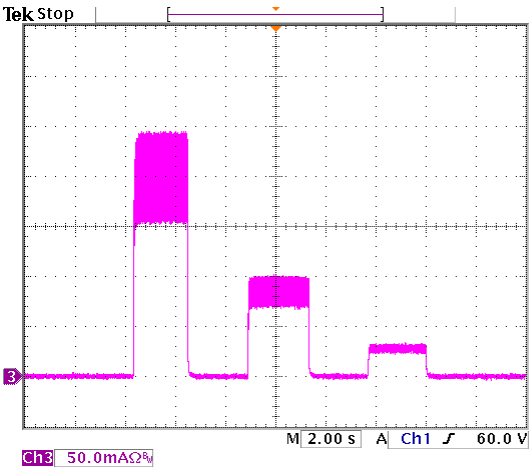


Fig-9: Dimming, 110Vac, Ch3-I_{LED}

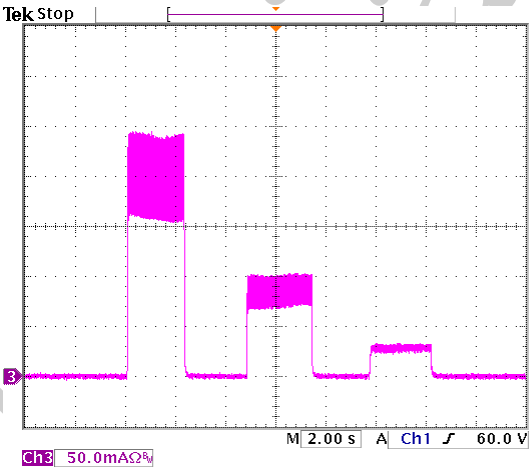


Fig-10: Dimming, 220Vac, Ch3-I_{LED}

6. Turn-on Characteristics

Change Vin from 90Vac to 264Vac based on rated (ADJ=240mV) LED load, measure the turn-on delay time and the output peak current.

Note: 1. Delay time: The interval from system turned-on to when the LED string is lightened.

ADJ=240mV	90Vac	110Vac	220Vac	264Vac
Delay time, [ms]	288	218	135	130
I_{LED}_peak, [mA]	244	240	242	240

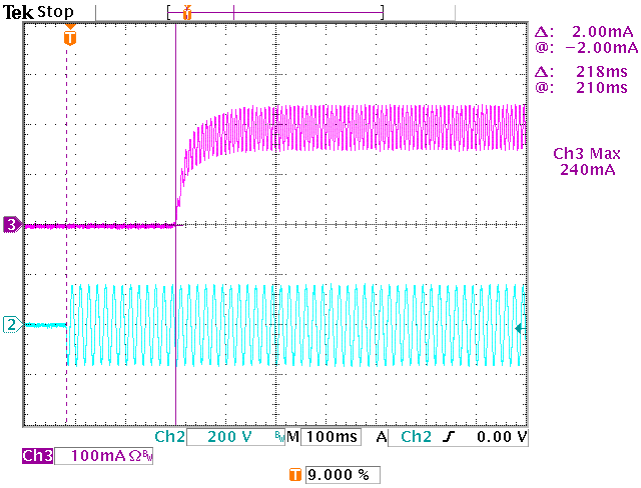


Fig-11: Start-up, 110Vac, ADJ=240mV
Ch2-V_{AC}, Ch3-I_{LED}

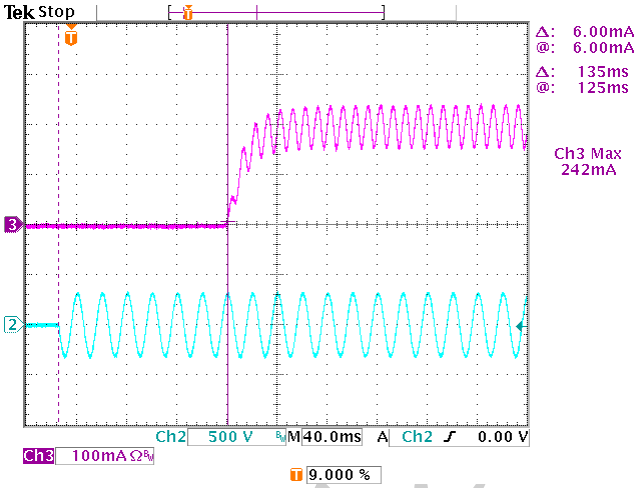


Fig-12: Start-up, 220Vac, ADJ=240mV
Ch2-V_{AC}, Ch3-I_{LED}

7. Turn-off Characteristics

Change Vin from 90Vac to 264Vac based on rated (ADJ=240mV) LED load, measure the output peak current.

ADJ=240mV	90Vac	110Vac	220Vac	264Vac
I_{LED}_peak, [mA]	242	240	242	240

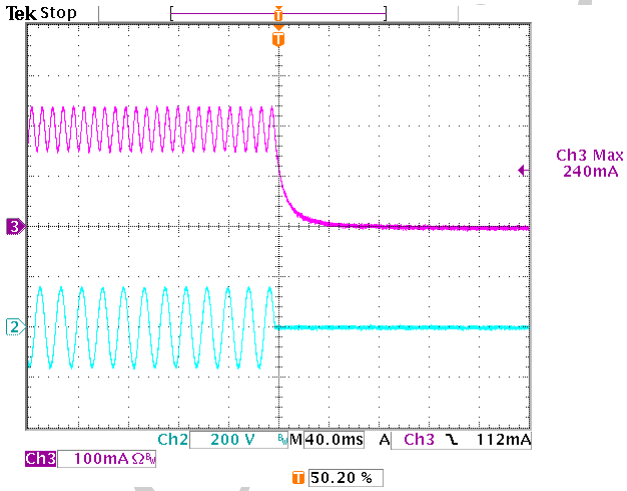


Fig-13: Shut down, 110Vac, Ch2-V_{AC}, Ch3-I_{LED}

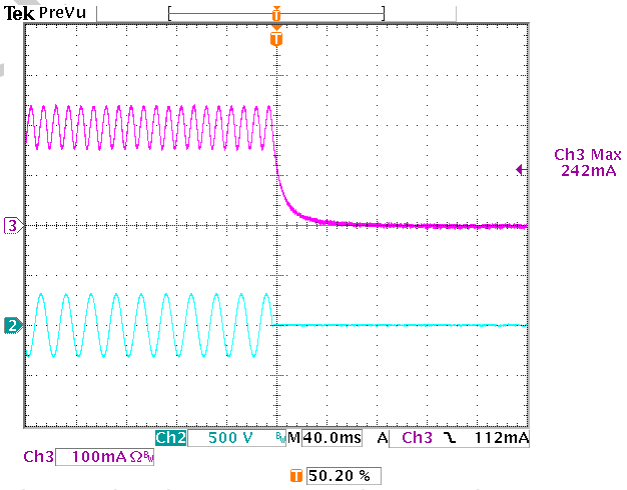


Fig-14: Shut down, 220Vac, Ch2-V_{AC}, Ch3-I_{LED}

8. Open LED (OVP) Protection

Open the LED string during normal operation, measure the OVP threshold and input power.

ADJ=240mV	90Vac	110Vac	220Vac	264Vac
Vout_peak, [V]	66.8	66.4	66.4	66.0
Pin after OVP, [mW]	143	152	236	276
Recovery or not, [Y/N]	Y	Y	Y	Y

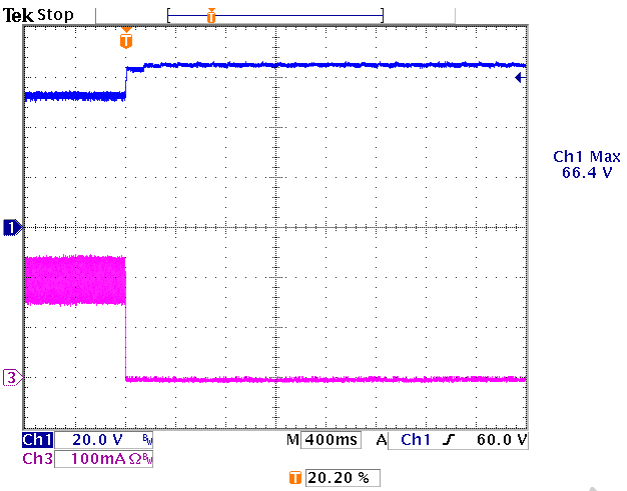


Fig-15: OVP, 110Vac, Ch1-V_{OUT}, Ch3-I_{LED}

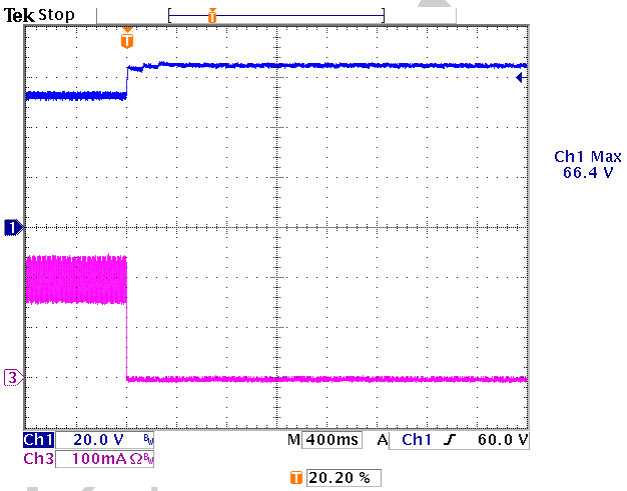


Fig-16: OVP, 220Vac, Ch1-V_{OUT}, Ch3-I_{LED}

9. All of the LED Short Protection (SCP)

Short the output during normal operation.

ADJ=240mV	90Vac	110Vac	220Vac	264Vac
Pin after SCP, [mW]	837	1012	1595	1784
Recovery or not, [Y/N]	Y	Y	Y	Y

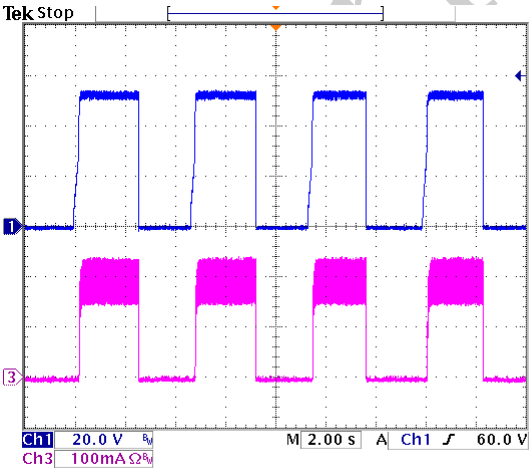


Fig-17: SCP, 110Vac, Ch1-V_{OUT}, Ch3-I_{LED}

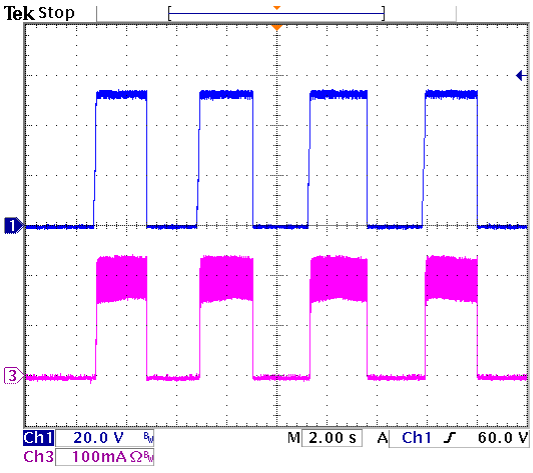


Fig-18: SCP, 220Vac, Ch1-V_{OUT}, Ch3-I_{LED}

10. Conducted EMI Test

EMI TEST REPORT

parameter

Organization:	O2MICRO	Operator:		EUT:	
Place:	CD	Time:	2012/10/15/16:31	Test equipment:	KH3939
Detector:	PK+AV	Test-time(ms):	30	SN:	1139237
Limit:	EN55015	Transductor(PK/AV):	PK-1 / AV-1		
Remark:					

freq, step

Start(MHz)	End(MHz)	Step(MHz)
0.009	0.150	0.001
0.150	2.000	0.002
2.000	10.000	0.010
10.000	30.000	0.025

scan result

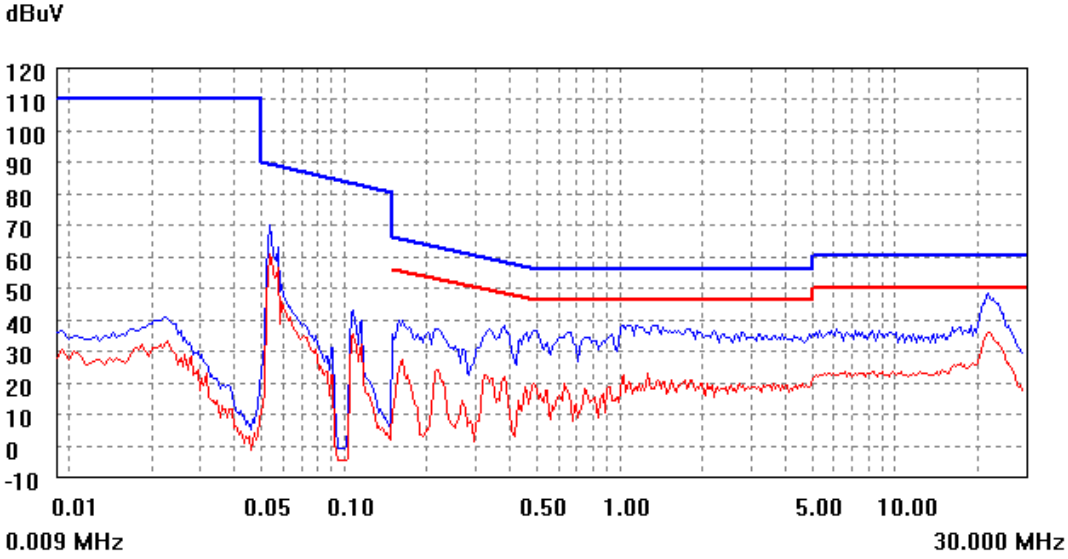


Fig-19: Conducted EMI Test at Line, 110Vac, 60Hz and EN55015 Limits

EMI TEST REPORT

parameter

Organization:	O2MICRO	Operator:		EUT:	
Place:	CD	Time:	2012/10/15/16:39	Test equipment:	KH3939
Detector:	PK+AV	Test-time(ms):	30	SN:	1139237
Limit:	EN55015	Transductor(PK/AV):	PK-1 / AV-1		
Remark:					

freq, step

Start(MHz)	End(MHz)	Step(MHz)
0.009	0.150	0.001
0.150	2.000	0.002
2.000	10.000	0.010
10.000	30.000	0.025

scan result

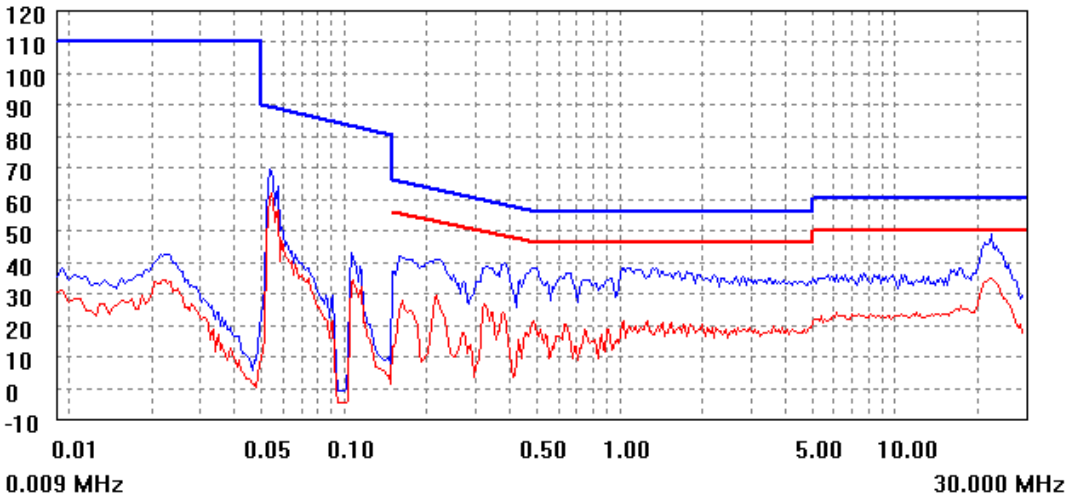


Fig-20: Conducted EMI Test at Neutral, 110Vac, 60Hz and EN55015 Limits

EMI TEST REPORT

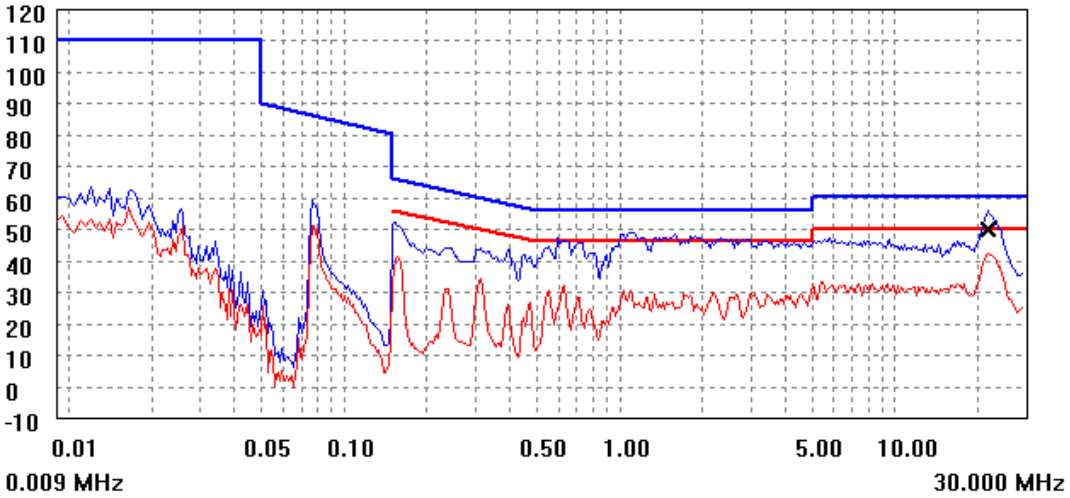
parameter

Organization:	O2MICRO	Operator:		EUT:	
Place:	CD	Time:	2012/10/15/16:19	Test equipment:	KH3939
Detector:	PK+AV	Test-time(ms):	30	SN:	1139237
Limit:	EN55015	Transductor(PK/AV):	PK-1 / AV-1		
Remark:					

freq, step

Start(MHz)	End(MHz)	Step(MHz)
0.009	0.150	0.001
0.150	2.000	0.002
2.000	10.000	0.010
10.000	30.000	0.025

scan result



final test

(QP)	freq(MHz)	lev(dBuV)	Lim(dBuV)	Δ(lev-Lim)
	21.928	49.9	60.0	-10.1

Fig-21: Conducted EMI Test at Line, 220Vac, 50Hz and EN55015 Limits

EMI TEST REPORT

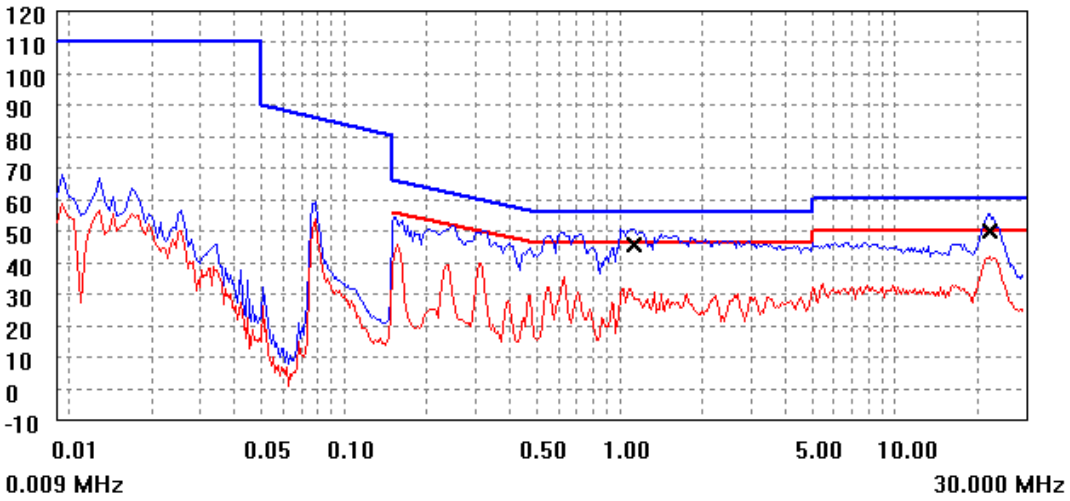
parameter

Organization:	O2MICRO	Operator:		EUT:	
Place:	CD	Time:	2012/10/15/16:23	Test equipment:	KH3939
Detector:	PK+AV	Test-time(ms):	30	SN:	1139237
Limit:	EN55015	Transductor(PK/AV):	PK-1 / AV-1		
Remark:					

freq, step

Start(MHz)	End(MHz)	Step(MHz)
0.009	0.150	0.001
0.150	2.000	0.002
2.000	10.000	0.010
10.000	30.000	0.025

scan result



final test

(QP)	freq(MHz)	lev(dBuV)	Lim(dBuV)	Δ(lev-Lim)
	1.133	45.5	56.0	-10.5
	21.987	49.6	60.0	-10.4

Fig-22: Conducted EMI Test at Neutral, 220Vac, 50Hz and EN55015 Limits

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