

# AP1690 EV Report



BCD SEMICONDUCTOR  
MANUFACTURING LIMITED

Product Number:	AP1690
Project Number:	
Package:	SOIC-8
Wafer Lot Number:	

System Engineer: Li Junlei  
Project Leader:  
Date: 2013-04-19

AP1690 evaluation at 120Vac dimming board



# 样板规格

## AP1690 可调光 55V/200mA 样板

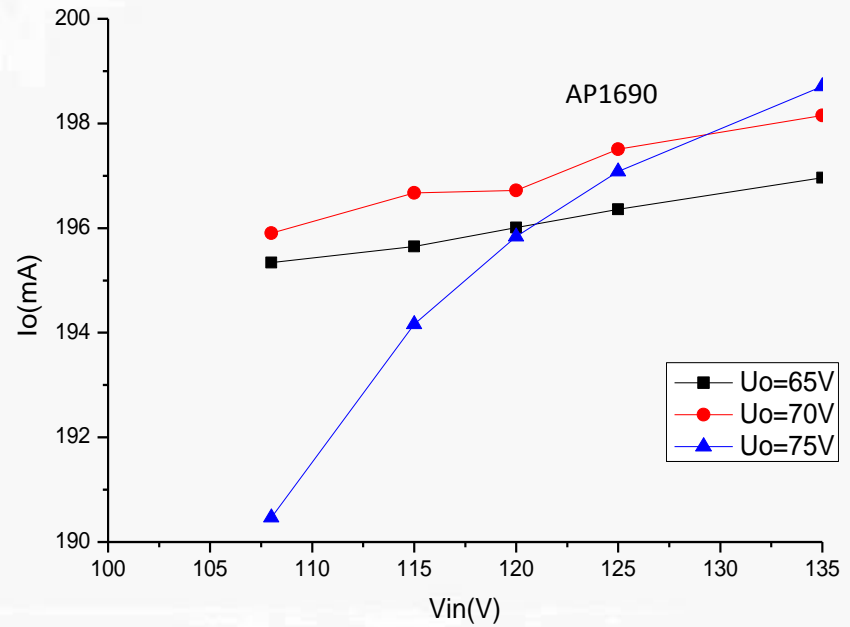
描述	最小值	典型值	最大值	单位	测试结果
输入					
输入电压	108	120	132	VAC	
频率	47	50/60	63	Hz	
功率因数					
THD			37	%	
输出					
输出电压		55		V	
输出电流		200		mA	
输出电流纹波		68		mA	
线性调整率		<2%			
负载调整率		<2.5%			
输出起动时间		0.353		s	at Vin=108V
效率		81.0		%	at Vin=120V
空载功耗		0.65		W	at Vin=120V
短路功耗		0.8		W	at Vin=120V
安规					
EMI	Pass EN55015 Class B with 6dB Margin				
Surge Test					
ESD					

U <sub>o</sub> =50V (AP1690)						
V <sub>in</sub> (V)	PF	THD	Pin(W)	U <sub>o</sub> (V)	I <sub>o</sub> (mA)	efficiency
108	0.9905	6.96	12.212	49.648	195.34	79.42%
115	0.9887	7.25	12.007	49.623	195.65	80.86%
120	0.9872	7.6	11.919	49.611	196.01	81.59%
125	0.9857	7.9	11.84	49.612	196.36	82.28%
135	0.9824	8.59	11.753	49.621	196.96	83.16%
U <sub>o</sub> =55V						
V <sub>in</sub> (V)	PF	THD	Pin(W)	U <sub>o</sub> (V)	I <sub>o</sub> (mA)	efficiency
108	0.9916	6.98	13.89	56.071	195.9	79.08%
115	0.9901	7.16	13.696	56.045	196.67	80.48%
120	0.9888	7.39	13.575	56.028	196.12	80.94%
125	0.9876	7.61	13.495	56.018	197.51	81.99%
135	0.9848	8.12	13.353	56.021	198.15	83.13%
U <sub>o</sub> =60V						
V <sub>in</sub> (V)	PF	THD	Pin(W)	U <sub>o</sub> (V)	I <sub>o</sub> (mA)	efficiency
108	0.9924	7.13	15.003	61.95	190.47	78.65%
115	0.9912	7.13	15.03	62.045	194.16	80.15%
120	0.9902	7.24	15.013	62.04	195.84	80.93%
125	0.9891	7.35	14.975	62.049	197.08	81.66%
135	0.9866	7.86	14.877	62.087	198.71	82.93%

## ➤ LED current Line regulation

Vin (V)	Io (mA)		
	Uo=50V	Uo=55V	Uo=65V
108	195.34	195.9	190.47
115	195.65	196.67	194.16
120	196.01	196.72	195.84
125	196.36	197.51	197.08
135	196.96	198.15	198.71
		1.15%	

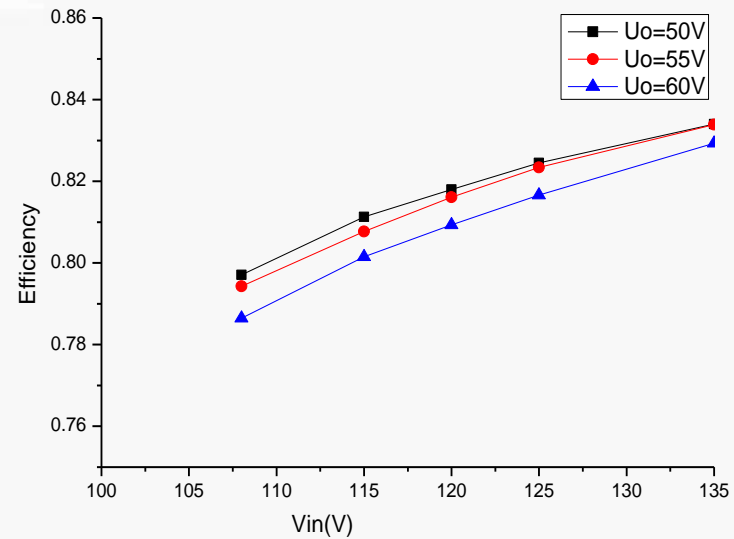
Line regulation <5%@Full load.



## ➤ efficiency

Vin(V)	Efficiency		
	Uo=50V	Uo=55V	Uo=65V
108	79.42%	79.08%	78.65%
115	80.86%	80.48%	80.15%
120	81.59%	80.94%	80.93%
125	82.28%	81.99%	81.66%
135	83.16%	83.13%	82.93%

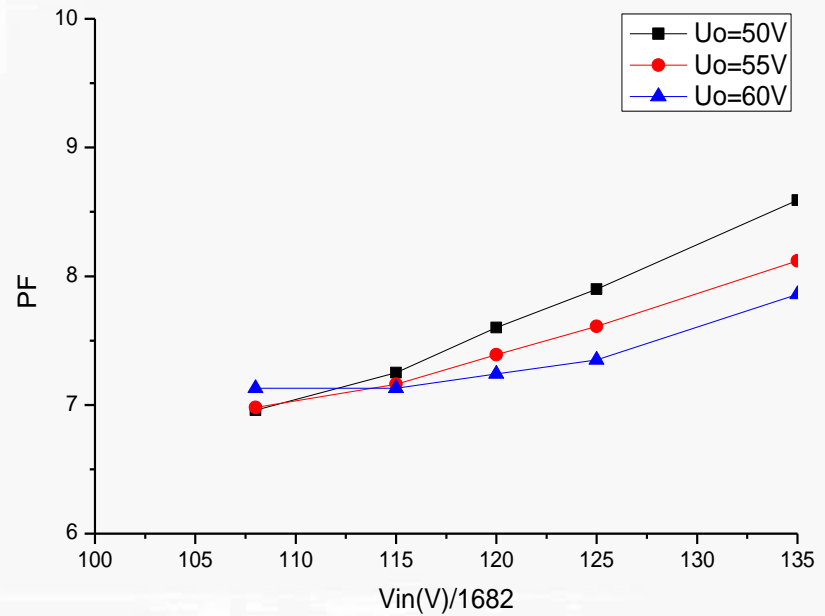
Efficiency >79.08% @Full load.



## THD

Vin(V)	THD		
	Uo=50V	Uo=55V	Uo=65V
108	6.96	6.98	7.13
115	7.25	7.16	7.13
120	7.6	7.39	7.24
125	7.9	7.61	7.35
135	8.59	8.12	7.86

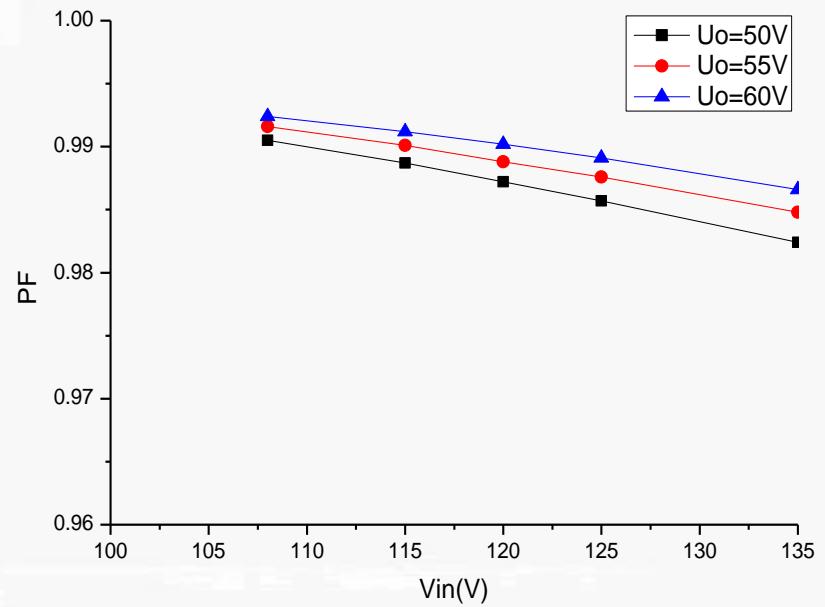
THD<10@Full load



## ➤ PF

Vin(V)	PF		
	Uo=50V	Uo=55V	Uo=65V
108	0.9905	0.9916	0.9924
115	0.9887	0.9901	0.9912
120	0.9872	0.9888	0.9902
125	0.9857	0.9876	0.9891
135	0.9824	0.9848	0.9866

PF>0.98@Full load

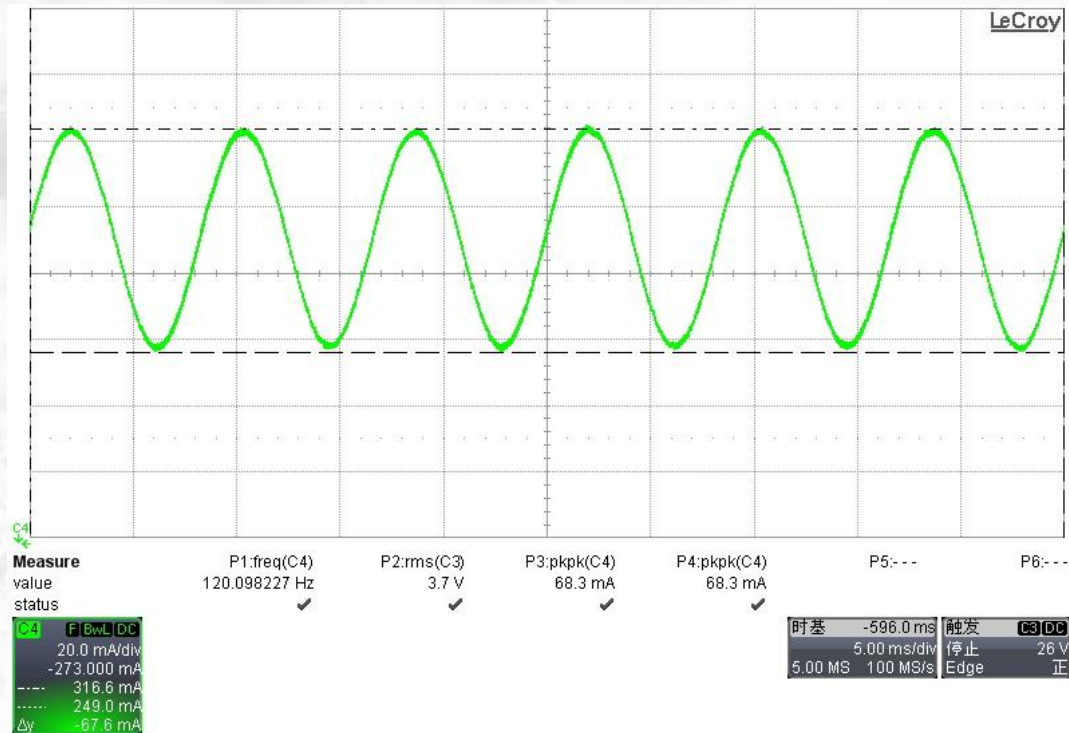




## Dimmer dimming range

Dimmer Type	Io (mA)		Dimming percentage		Flicker effect
	min	max	min	max	
LEVITON Cat. NO. TU106	0.35	187.6	0.0016	0.925	无闪烁
LUTRON DIVA. DV-600P	3.85	190	0.0191	0.940	无闪烁
LEVITON Cat. NO. 6633-P	0.39	200.1	0.0019	0.990	无闪烁
LUTRON GLR02-E07814	2.06	190.0	0.0102	0.941	无闪烁
COOPER	2.26	201.5	0.0112	0.997	无闪烁
LEVITON CAT. NO. 6683	0	202	0	1	无闪烁
LUTRON DV-603PG	2.57	169.5	0.0127	0.839	无闪烁
LUTRON GLT07-C06912	3.71	190.8	0.0184	0.944	无闪烁
LUTRON AY-600P	7.41	191.8	0.0367	0.949	无闪烁
LUTRON T28	0	188.7	0	0.934	无闪烁
LEVITON CAT. NO. VPI06	0	190.3	0	0.942	无闪烁
LUTRON TG-600P-AC	12.3	191.4	0.0609	0.947	无闪烁
COOPER CAT. NO. 9539	4.42	179.4	0.0219	0.887	无闪烁
LEVITON CAT. NO. 6613-P	1.61	199.5	0.0079	0.987	无闪烁
LEVITON 1G2011	0	202	0	1	无闪烁
LUTRON GLS02-D05801	1.24	191.2	0.0061	0.946	无闪烁

## ➤ LED Current ripple

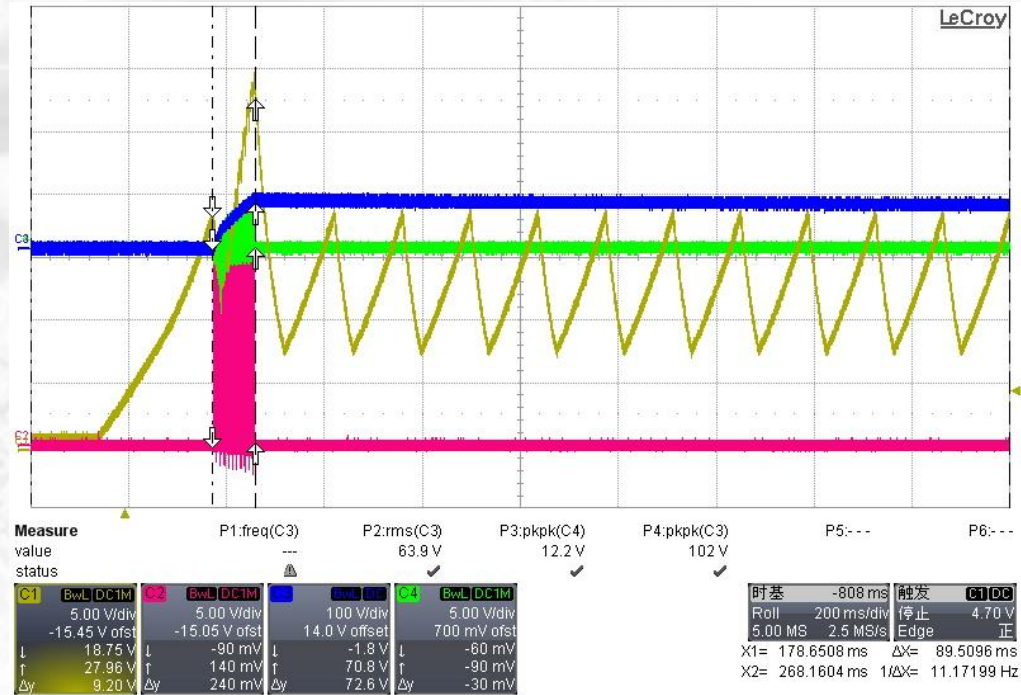


LED ripple current:68.3mA

Vin=120v/60Hz @ Full Load

➤ LED open

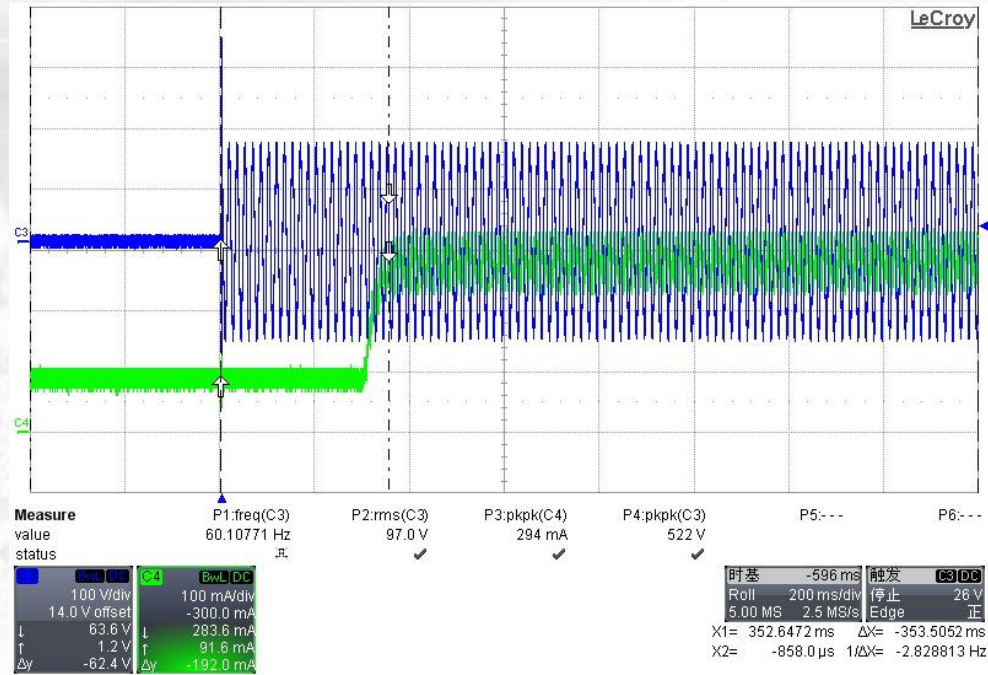
Vcc
Vgate
vfb
Vo



**Vin=120V/60Hz @ No Load**  
**Protection time:89.5ms**

➤ Start-up

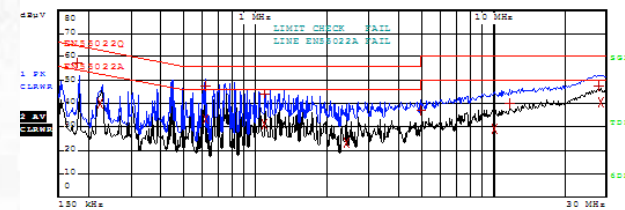
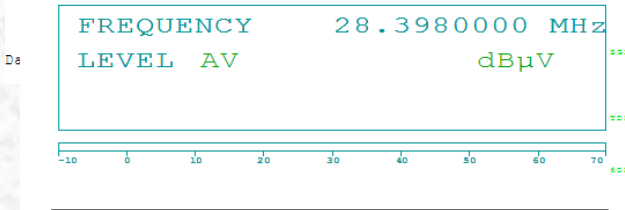
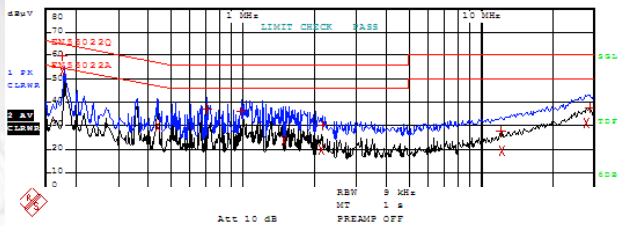
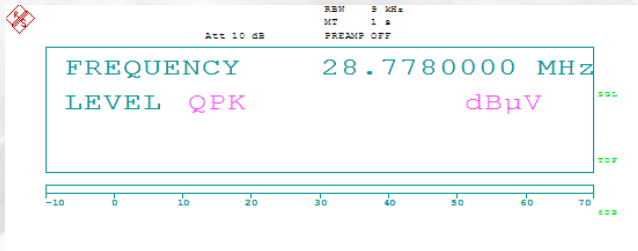
Vin Io



Vin=208V/50Hz @ Full Load  
Start up time: 353ms.

## EMI conduction test

Line Terminal



Date: 19.APR.2013 15:06:50

EDIT PEAK LIST (Final Measurement Results)			
Trace1:	EN55022Q		
Trace2:	EN55022A		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1 Quasi Peak	178 kHz	59.86	-4.71
2 Average	178 kHz	53.13	-1.44
2 Average	438 kHz	29.48	-17.61
1 Quasi Peak	706 kHz	37.19	-18.80
1 Quasi Peak	986 kHz	36.48	-19.51
2 Average	1.488 MHz	23.42	-22.57
2 Average	2.134 MHz	20.10	-25.89
1 Quasi Peak	2.158 MHz	29.98	-26.01
1 Quasi Peak	12.186 MHz	27.78	-32.21
2 Average	12.302 MHz	19.21	-30.78
2 Average	27.966 MHz	30.99	-19.00
1 Quasi Peak	28.778 MHz	37.75	-22.24

EDIT PEAK LIST (Final Measurement Results)			
Trace1:	EN55022Q		
Trace2:	EN55022A		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1 Quasi Peak	182 kHz	57.21	-7.17
2 Average	226 kHz	40.10	-12.49
1 Quasi Peak	614 kHz	47.41	-8.58
2 Average	614 kHz	33.52	-12.47
1 Quasi Peak	1.094 MHz	44.05	-11.94
2 Average	1.094 MHz	31.17	-14.82
2 Average	2.434 MHz	23.19	-22.80
1 Quasi Peak	4.978 MHz	36.96	-19.03
2 Average	10.222 MHz	29.33	-20.66
1 Quasi Peak	11.802 MHz	40.19	-19.80
1 Quasi Peak	27.846 MHz	47.32	-12.67
2 Average	28.398 MHz	40.51	-9.48

- PF>0.9 is ok.
- Efficiency >80% is ok.
- THD<10% is ok.
- Line regulation <2.5% is ok
- Load regulation <5% is ok
- Short protection is ok
- Over output voltage protection is ok
- Start up time<0.5s is ok
- EMI meets EN55022
- Dimming compatibility is ok



# AP1690 evaluation at 230Vac dimming board



# Demo board spec

## AP1690 dimmable 70V/120mA demo

描述	最小值	典型值	最大值	单位	测试结果
<b>Input</b>					
Input voltage	208	230	253	VAC	
frequency	47	50	53	Hz	
Power factor					
THD				%	
<b>Output</b>					
Output voltage		70		V	
LED current		120		mA	
LED ripple current			47	mA	
Line regulation		<2%			
Load regulation		<5%			
Start-up time		0.659		s	at Vin=208V
Efficiency		81%		%	at Vin=230V
Open led input power		1.4		W	at Vin=230V
Short led input power		1.15		W	at Vin=230V
<b>EMC\$Safety</b>					
EMI	Pass EN55015 Class B with 6dB Margin				
Surge Test					
ESD					



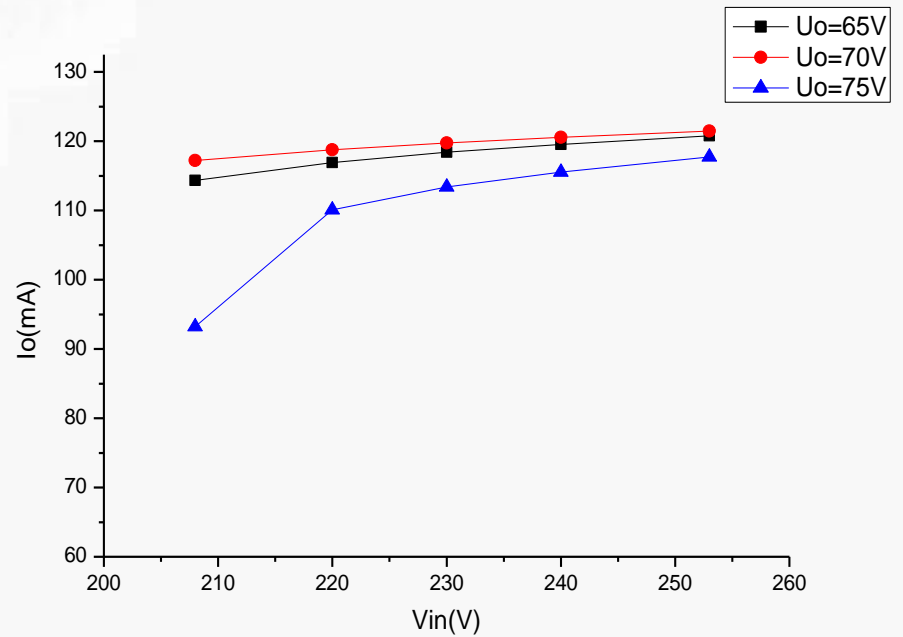
# Electrical characteristics

U <sub>o</sub> =65V						
V <sub>in</sub> (V)	PF	THD	P <sub>in</sub> (W)	U <sub>o</sub> (V)	I <sub>o</sub> (mA)	efficiency
208	0.9417	16.329	9.21	64.892	117.24	82.61%
220	0.9351	17.6	9.4412	64.906	118.78	81.66%
230	0.9321	18.7	9.5652	64.932	119.73	81.28%
240	0.9273	20	9.726	64.93	120.57	80.49%
253	0.9219	21.501	10.018	64.925	121.46	78.72%
U <sub>o</sub> =70V						
V <sub>in</sub> (V)	PF	THD	P <sub>in</sub> (W)	U <sub>o</sub> (V)	I <sub>o</sub> (mA)	efficiency
208	0.9455	15.8	9.7236	70.755	114.33	83.19%
220	0.9396	16.28	10.001	70.839	116.9	82.80%
230	0.9348	17.543	10.197	70.896	118.41	82.33%
240	0.9311	18.71	10.406	70.935	119.53	81.48%
253	0.9259	20.092	10.656	70.982	120.79	80.46%
U <sub>o</sub> =75V						
V <sub>in</sub> (V)	PF	THD	P <sub>in</sub> (W)	U <sub>o</sub> (V)	I <sub>o</sub> (mA)	efficiency
208	0.9364	18.39	8.576	75.151	93.24	81.71%
220	0.9405	16.921	10.123	76.131	110.11	82.81%
230	0.9363	17.452	10.495	76.291	113.38	82.42%
240	0.9322	18.995	10.775	76.384	115.54	81.91%
253	0.9276	19.18	11.119	76.485	117.73	80.98%

## ➤ LED current Line regulation

Vin (V)	Io (mA)		
	Uo=65V	Uo=70V	Uo=74V
208	114.33	117.24	93.24
220	116.9	118.78	110.11
230	118.41	119.73	113.38
240	119.53	120.57	115.54
253	120.79	121.46	117.73
Line regulation		3.53%	

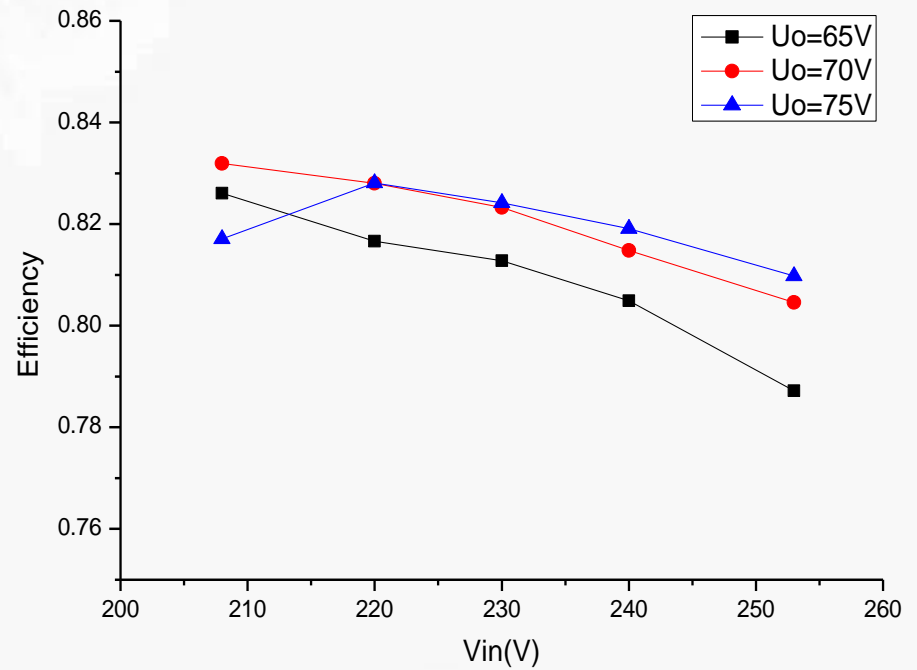
Line regulation <5%@Full load.



## ➤ efficiency

Vin (V)	Efficiency		
	Uo=65V	Uo=70V	Uo=74V
208	82.61%	83.19%	81.71%
220	81.66%	82.80%	82.81%
230	81.28%	82.33%	82.42%
240	80.49%	81.48%	81.91%
253	78.72%	80.46%	80.98%

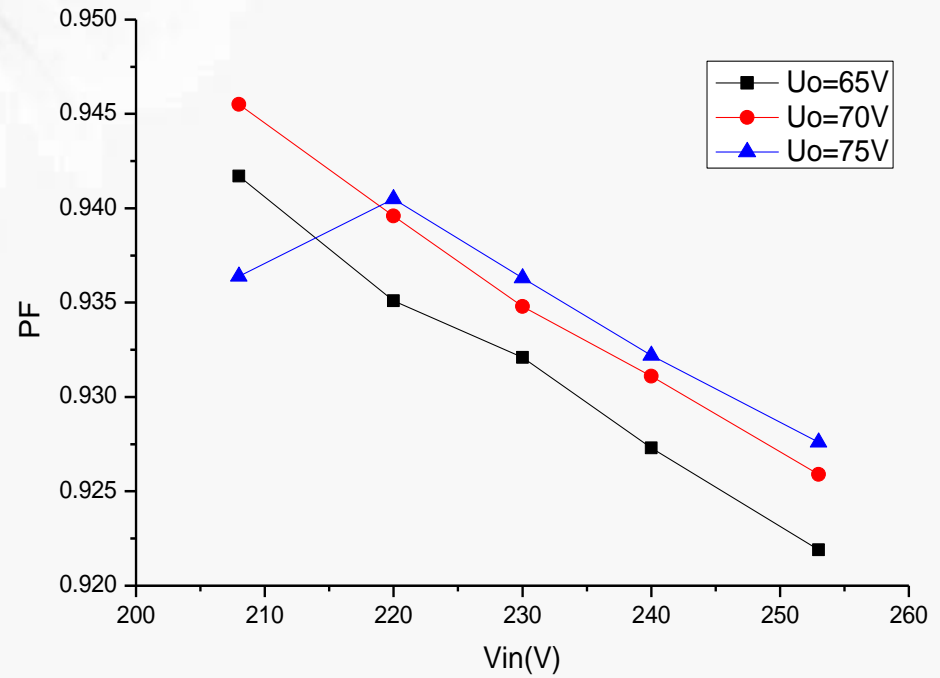
Efficiency >80% @Full load.



## ➤ PF

Vin(V)	PF		
	Uo=65V	Uo=70V	Uo=74V
208	0.9417	0.9455	0.9364
220	0.9351	0.9396	0.9405
230	0.9321	0.9348	0.9363
240	0.9273	0.9311	0.9322
253	0.9219	0.9259	0.9276

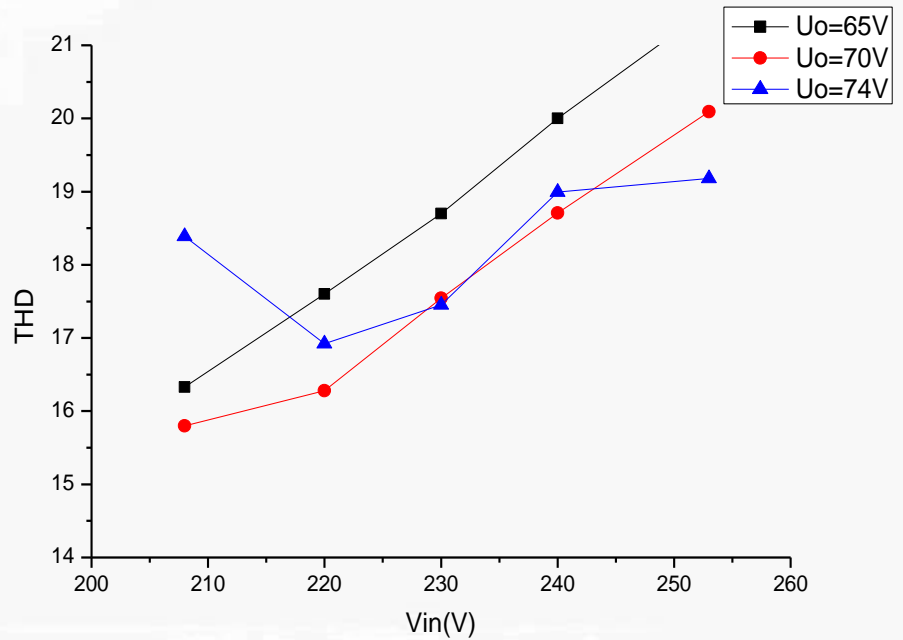
PF>0.92@Full load



# THD

Vin(V)	THD		
	Uo=65V	Uo=70V	Uo=74V
208	16.329	15.8	18.39
220	17.6	16.28	16.921
230	18.7	17.543	17.452
240	20	18.71	18.995
253	21.501	20.092	19.18

THD < 30%

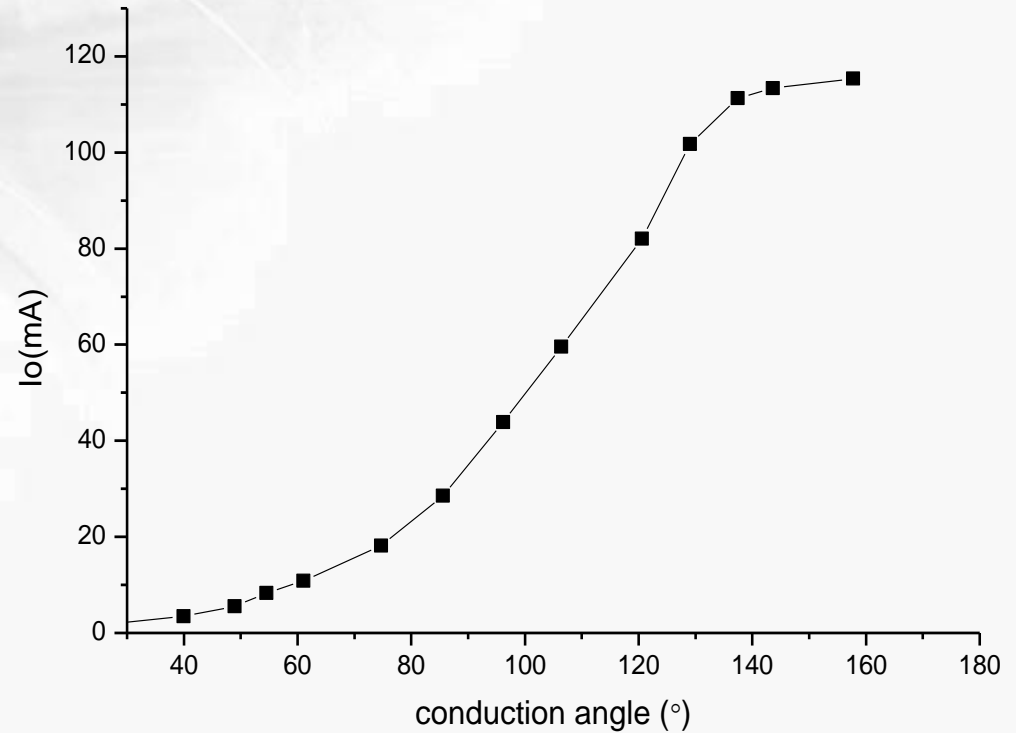


➤ dimmer compatibility and dimming range

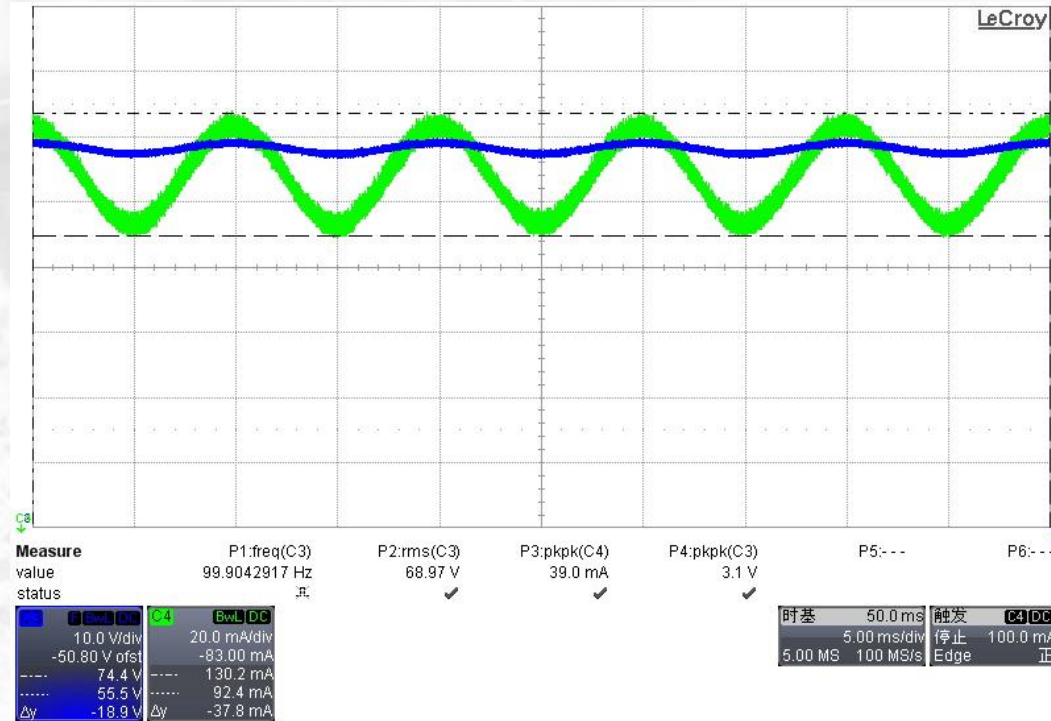
Dimmer type	I <sub>o</sub> (mA)		dimming percentage		Flicker or not?
	min	max	min	max	
SIEMENS (无其他标识)	1.6	115.48	1.33%	96.23%	NO
TCL	6.79	118.14	5.66%	98.45%	NO
CLIPSAL 32V 500 series C. S. /433/S	0	114.25	0.00%	95.21%	NO
KIFANSIM (起帆西蒙)	13.13	115	10.94%	95.83%	NO
松下电工信息仪器 WMS549	13.6	118.51	11.33%	98.76%	NO
KIFANSIM (起帆西蒙)	2.37	117.76	1.98%	98.13%	NO
SCHNEIDER ELECTRIC E3031HD	2.6	122	2.17%	101.67%	NO
上海松日电工	4.27	117.46	3.56%	97.88%	NO
BUSCH-DIMMER, CE	6.96	117.31	5.80%	97.76%	NO
BUSCH-DIMMER, 2247U, CE	3.5	122	2.92%	101.67%	NO
BUSCH-DIMMER, 2247U, CE	10.67	122	8.89%	101.67%	NO
BUSCH-DIMMER 6513 U-102, CE, 后切 dimmer	9.19	118.39	7.66%	98.66%	NO

## ➤ dimming curve

conduction angle (°)	I <sub>o</sub> (mA)
157.734	115.36
143.64	113.36
137.466	111.27
129.078	101.75
120.6	82.08
106.38	59.56
96.21	43.86
85.572	28.52
74.7	18.17
61.02	10.87
54.522	8.34
48.96	5.51
39.96	3.5
27.9	2



➤ LED Current ripple



LED ripple current:39mA

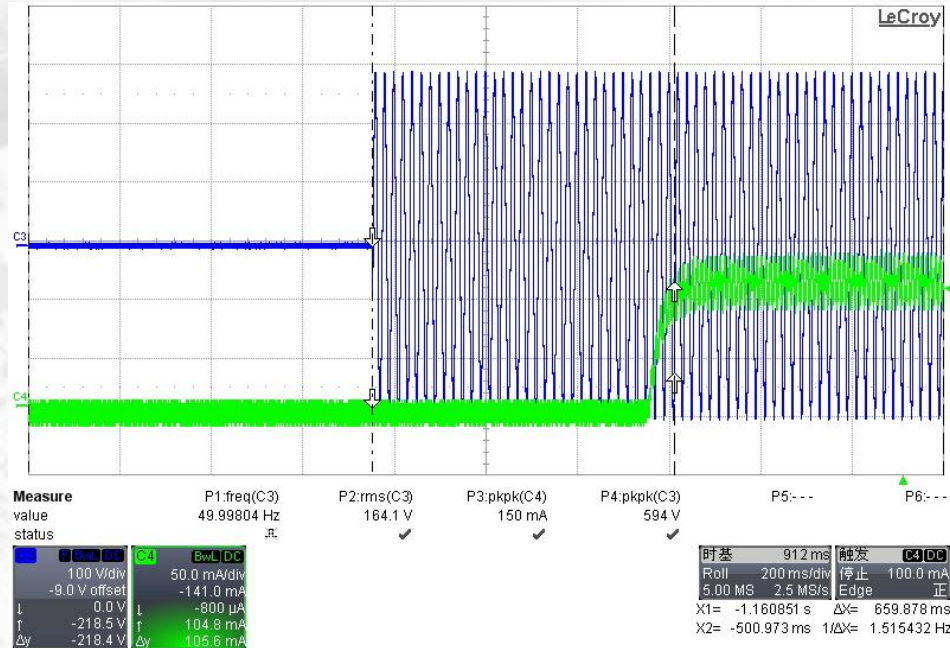
Vin=230V/50Hz @ Full Load



➤ Start-up

Vin

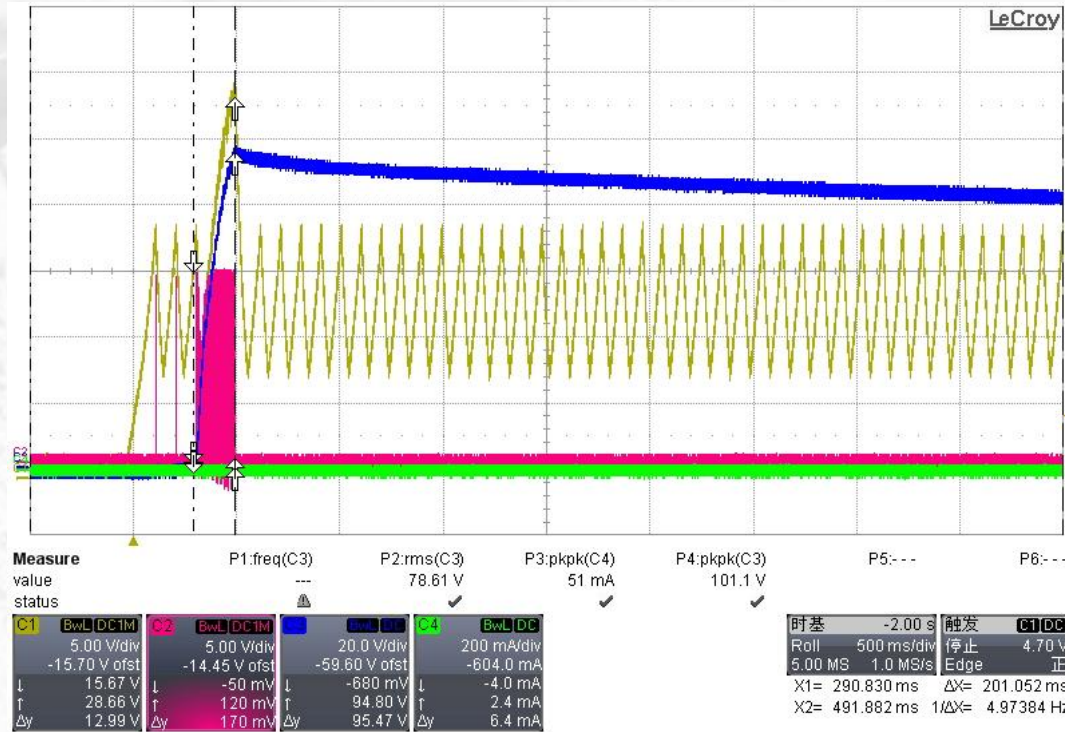
Io



Vin=208V/50Hz @ Full Load  
 Start up time: 659ms  
 Ps:AP1682 Start up time:668ms.

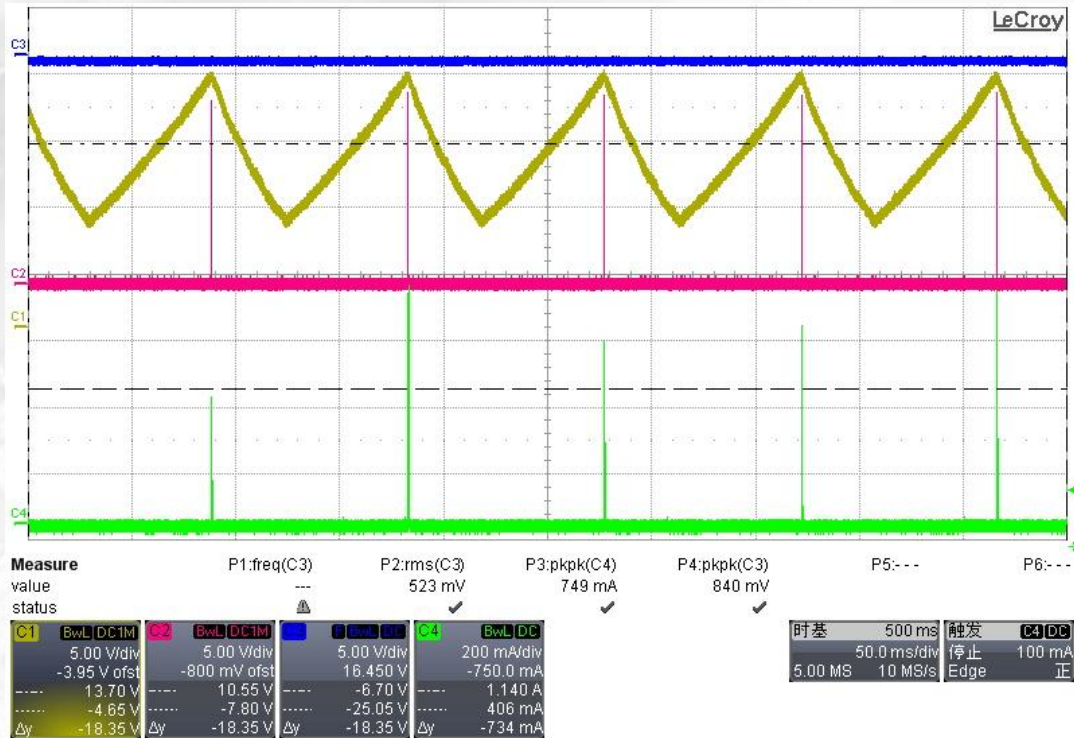
➤ LED open

Vcc	Vgate	Io	Vo
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Vin=230V/50Hz @ No Load  
Protection time:201.052ms

➤ LED short

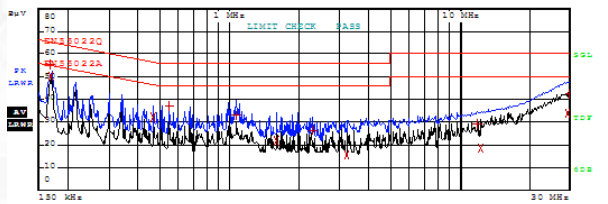
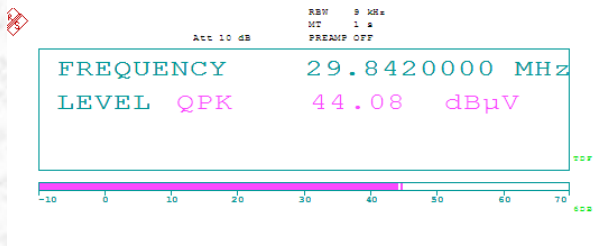
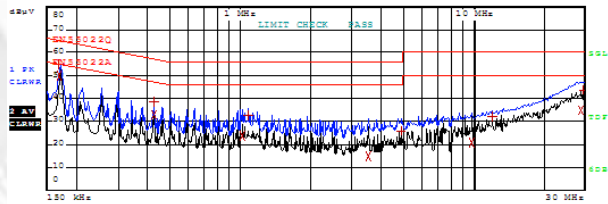
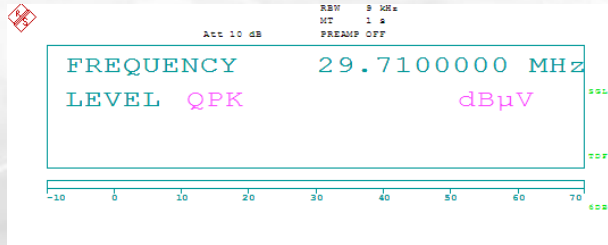


Vin=230V/50Hz @ Output Short

## ➤ EMI conduction test

Pass EN55015 Class B with 6dB Margin

Line Terminal



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EDIT PEAK LIST (Final Measurement Results)			
TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
Trace1:	EN55022Q		
Trace2:	EN55022A		
Trace3:	---		
1 Quasi Peak	170 kHz	55.14	-9.81
2 Average	170 kHz	49.93	-5.02
1 Quasi Peak	422 kHz	38.67	-18.73
2 Average	422 kHz	32.86	-14.54
2 Average	1.03 MHz	23.43	-22.56
1 Quasi Peak	1.082 MHz	32.54	-23.45
2 Average	3.55 MHz	14.74	-31.25
1 Quasi Peak	4.874 MHz	26.17	-29.83
2 Average	9.846 MHz	20.64	-29.35
1 Quasi Peak	12.086 MHz	31.89	-28.10
2 Average	28.778 MHz	34.90	-15.10
1 Quasi Peak	29.71 MHz	43.81	-16.18

EDIT PEAK LIST (Final Measurement Results)			
TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
Trace1:	EN55022Q		
Trace2:	EN55022A		
Trace3:	---		
1 Quasi Peak	170 kHz	55.63	-9.33
2 Average	170 kHz	50.27	-4.68
2 Average	466 kHz	32.09	-14.49
1 Quasi Peak	550 kHz	37.02	-18.97
1 Quasi Peak	1.074 MHz	32.84	-23.15
2 Average	1.61 MHz	21.55	-24.44
1 Quasi Peak	2.31 MHz	26.53	-29.46
2 Average	3.222 MHz	15.47	-30.52
1 Quasi Peak	11.87 MHz	29.31	-30.68
2 Average	12.234 MHz	18.46	-31.53
2 Average	29.438 MHz	34.05	-15.94
1 Quasi Peak	29.842 MHz	42.35	-17.64

- PF>0.9 is ok.
- Efficiency >81% is ok.
- THD<30% is ok.
- Line regulation <2.5% is ok
- Load regulation <6% is ok
- Short protection is ok
- Over output voltage protection is ok
- Start up time is ok
- EMI meets EN55022
- Dimming compatibility is ok