



AP1682 38V/450mA 原边控制PFC LED驱动方案



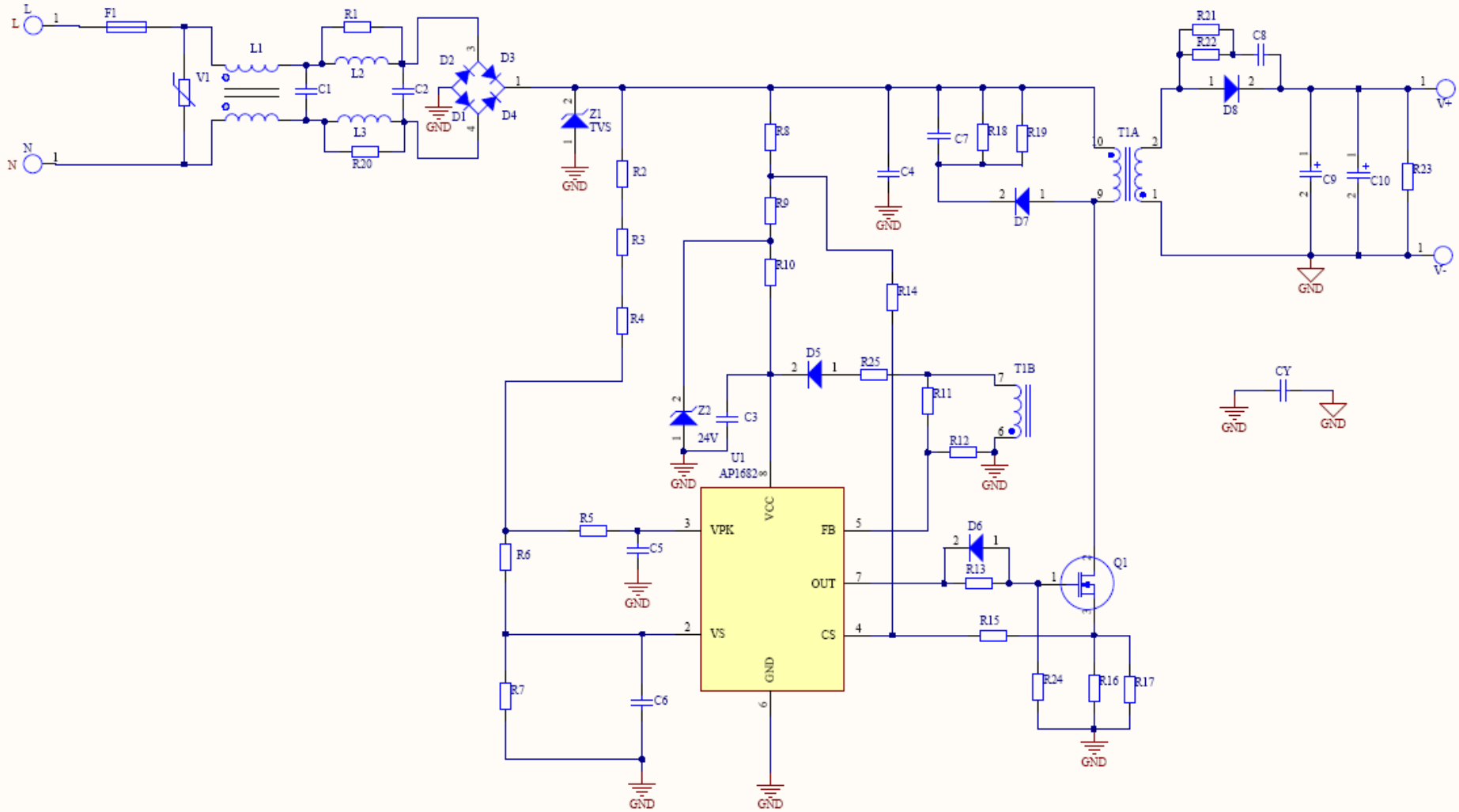
BCD SEMICONDUCTOR
MANUFACTURING LIMITED

LED Business Line

Date: 2012-11-15

AP1682隔离全电压38V/450mA T8样板

描述	最小值	典型值	最大值	单位	测试条件
输入					
输入电压	85	120/230	265	VAC	
频率	47	50/60	63	Hz	
功率因数	0.9				满载
THD			10	%	
输出					
输出电压	34	38	42	V	
输出电流		450		mA	
输出电流纹波			160	mA	
输出功率		17		W	
输出起动时间		0.28		s	
效率					
		86		%	满载
安规					
EMI	Pass EN55022 Class B with 6dB Margin				
Surge Test	IEC61000-4-5 Class 3				
ESD	IEC6100-4-2 Class 4				



Designator	Description	Package	Component Supplier	QTY	Price
R1,R20	5.1K/5%/1206	1206		2	0.02
R2,R3,R4	510K/1%/1206	1206		3	0.03
R5	330K/1%/0603	0603		1	0.01
R6	3.6K/1%/0603	0603		1	0.01
R7	12.1K/1%/0603	0603		1	0.01
R8	510K/5%/1206	1206		1	0.01
R9	300K/5%/1206	1206		1	0.01
R10	150K/5%/1206	1206		1	0.01
R11	47.5K/1%/0603	0603		1	0.01
R12	10K/1%/0603	0603		1	0.01
R13	100R/5%/0603	0603		1	0.01
R14	3M/5%/1206	1206		1	0.01
R15	3K/1%/0603	0603		1	0.01
R16	1.3R/1%/1206	1206		1	0.01
R17	1.5R/1%/1206	1206		1	0.01
R18,R19	300K/5%/1206	1206		2	0.02
R21,R22	200R/5%/1206	1206		1	0.01
R23	51K/5%/1206	1206		1	0.01
R24	10K/5%/0805	0805		1	0.01
R25	51R/5%/1206	1206		1	0.01
C1,C2	100nF/275Vac/ XCAP			2	0.3
C3	2.2uF/50V/X7R/ 1206	1206		1	0.05

C4	150nF/630Vdc/film CL21X	10mm		1	0.1
C5	330nF/25V/X7R/0603	0603		1	0.05
C6	470pF/25V/X7R/0603	0603		1	0.05
C7	1nF/1000V/X7R/1206	1206		1	0.05
C8	220pF/1000V/X7R/1206	1206		1	0.05
C9	330uF/63V/Ecap/10*25MM	10*25mm	yongming	1	0.3
C10	330uF/63V/Ecap/10*25MM	10*25mm	yongming	1	0.3
CY	2.2nF/275Vac/Y cap	10mm		1	0.15
L1	30uH		KEE	1	0.2
L2,L3	2.2mH/0810	8*10mm		2	0.3
F1	FUSE/1A/250V/8*4			1	0.5
Z1	P4SMA440A/SMA	SMA		1	0.4
T1	EDR2609	430uH		1	3.2
D1,D2, D3,D4	1N4007/SMA	SMA		4	0.4
D5	BAV20WS-7- F/SOD323/VISHAY	SOD-323	VISHAY	1	0.05
D6	1N4148/SOD323/ONSEMI	SOD-323	ONSEMI	1	0.03
D7	FR107/SMA	SMA		1	0.06
D8	ES3E,3A 300V(Trr=35ns)	SMC		1	0.3
Q1	8N65/D2pak	D2pak	ST Semi	1	2.3
V1	Varistor,07D471K			1	0.1
Z2	Zener 27V,PDZ27B/SOD323	SOD-323		1	0.04
U1	BCD AP1682	S0-8	BCD Semi	1	1.65
PCB	263mm*15mm			1	1.97
Total				54	13.14

➤ 骨架、磁芯

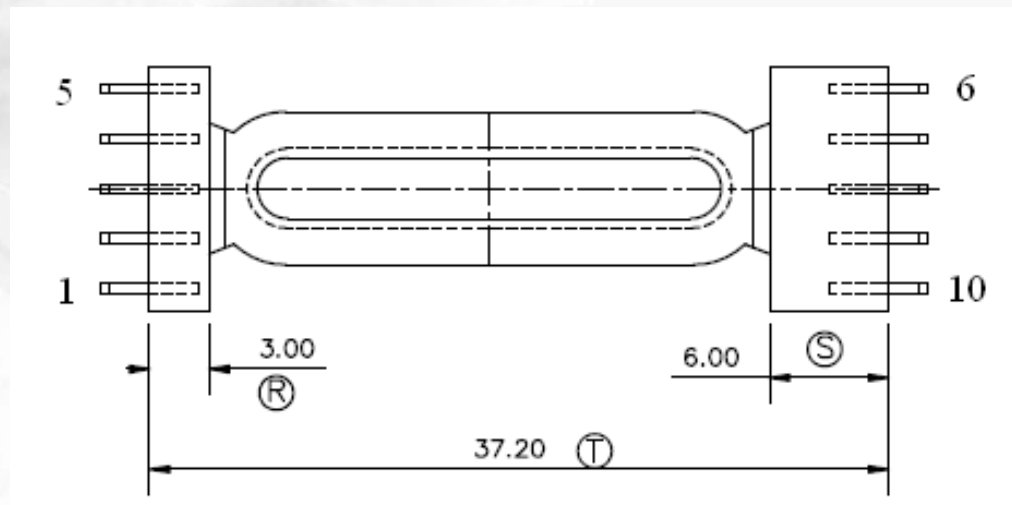
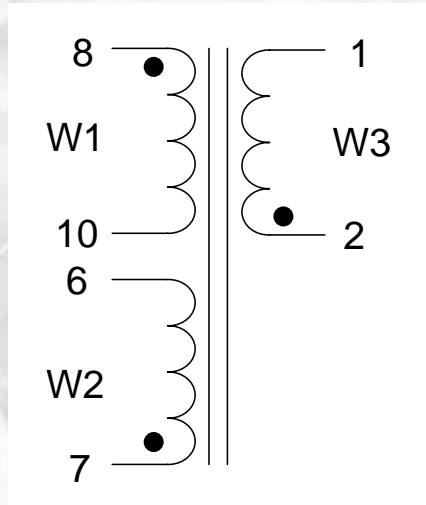
骨架: EDR2610, 10+10P

磁芯: PC44

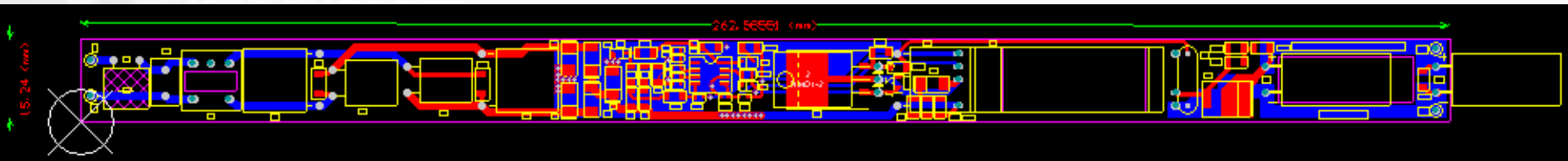
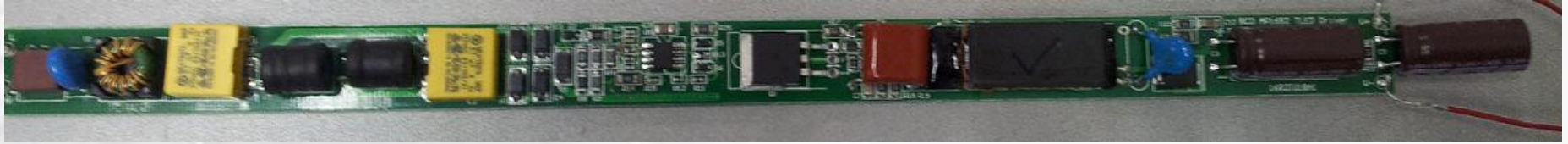
➤ 变压器参数

1. 原边电感量(Pin8-Pin10, 其他绕组开路): $L_p=0.43\text{mH}$, $\pm 5\% @ 1\text{kHz}$
2. 原边绕组匝数(Pin8-Pin10): $N_p=39\text{Ts}$
3. 辅助绕组匝数(Pin7-Pin6): $N_p=9\text{Ts}$
4. 副边绕组匝数(Pin2-Pin1): $N_A=19\text{Ts}$

➤ 绕线连接图、绕制方法

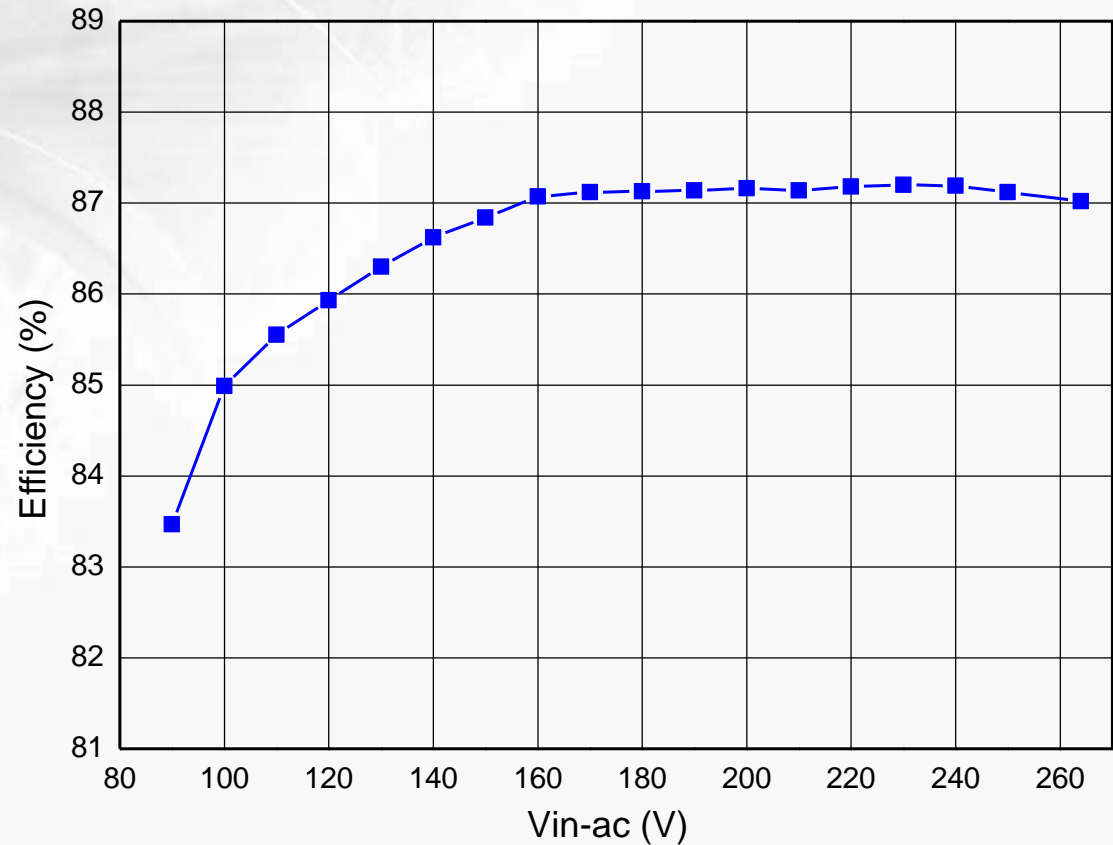


顺序	绕组名称	绕制说明
1	原边绕组WD1	单根 $\Phi 0.21\text{mm}$ 漆包线, 由8脚起绕, 39圈, 2层, 收于10脚
2	绝缘胶带	加2层绝缘胶带
3	辅助绕组WD2	单根 $\Phi 0.1\text{mm}$ 漆包线, 由7脚起绕, 9圈, 收于6脚
4	绝缘胶带	加2层绝缘胶带
5	副边绕组WD3	单根 $\Phi 0.25\text{mm}$ 漆包线, 由2脚起绕, 19圈, 收于1脚
6	绝缘胶带	加2层绝缘胶带
注: 严格控制每个绕组层数, 顺线圈方向包一层铜皮, 铜皮接6脚		



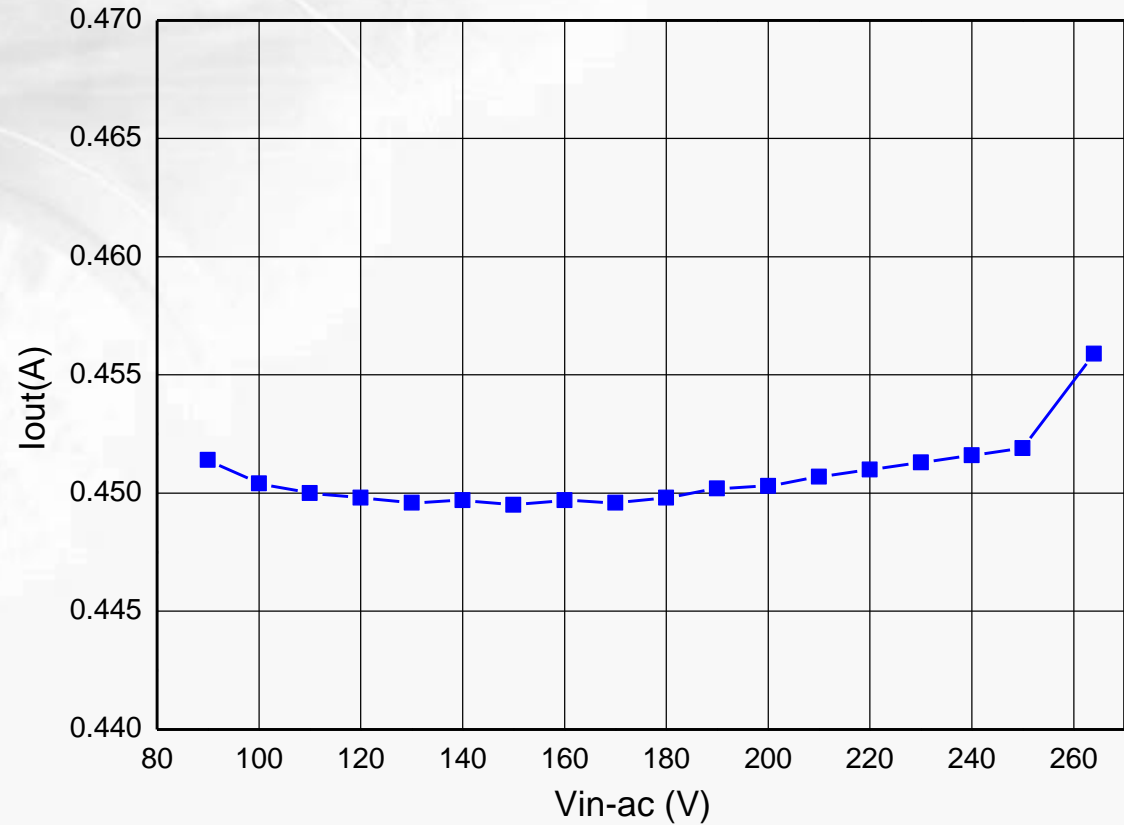
➤ 效率测试

Vin (V)	效率(%)
85	83.47
100	84.99
110	85.55
120	85.93
130	86.30
140	86.62
150	86.84
160	87.07
170	87.12
180	87.13
190	87.14
200	87.16
210	87.14
220	87.18
230	87.20
240	87.19
250	87.12
265	87.02



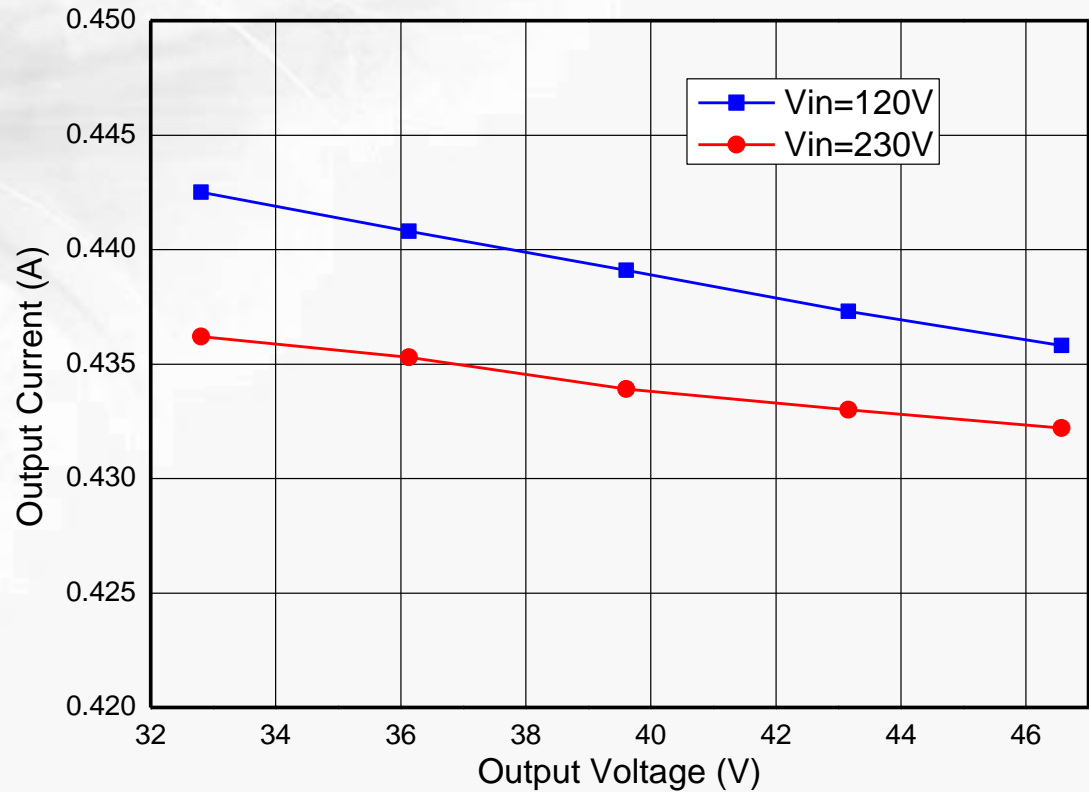
➤ 输出电流线性调整率

Vin (V)	输出电流(A)
85	0.4514
100	0.4504
110	0.45
120	0.4498
130	0.4496
140	0.4497
150	0.4495
160	0.4497
170	0.4496
180	0.4498
190	0.4502
200	0.4503
210	0.4507
220	0.451
230	0.4513
240	0.4516
250	0.4519
265	0.4521



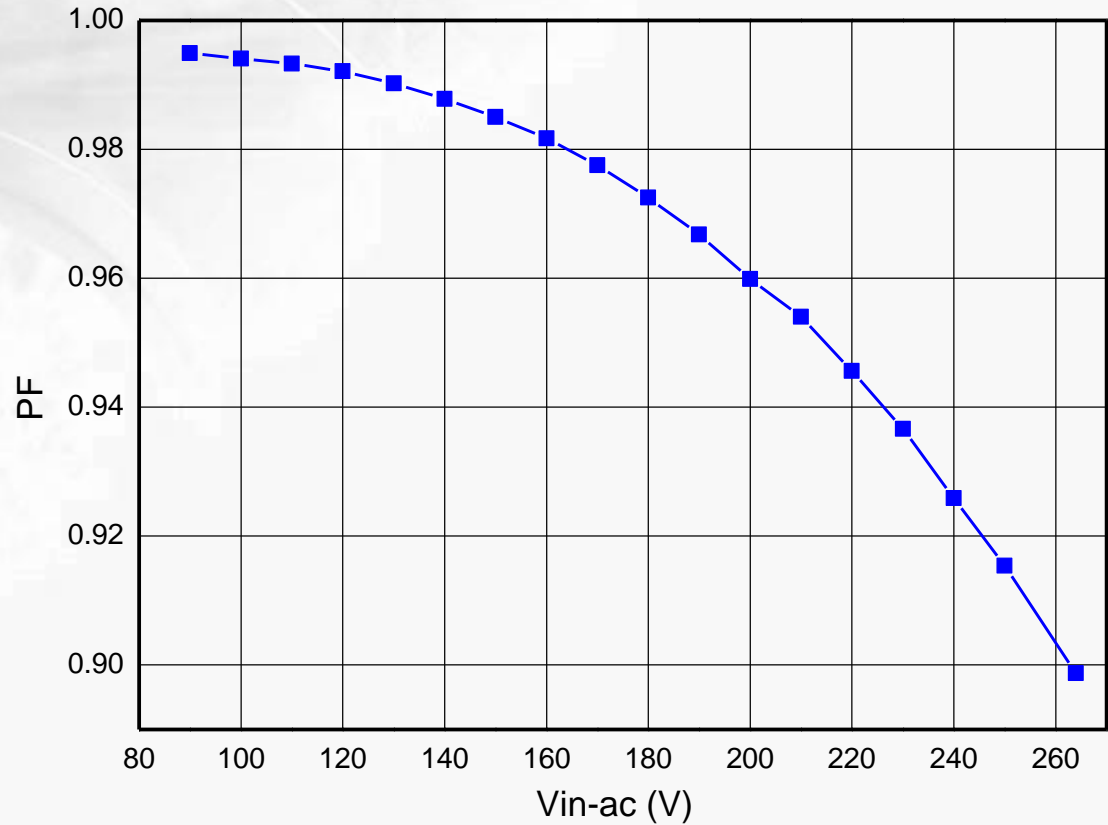
➤ 输出电流负载调整率

Vin (V)	输出电压(V)	输出电流(A)
120	46.57	0.4358
	43.16	0.4373
	39.61	0.4391
	36.13	0.4408
	32.81	0.4425
230	46.48	0.4322
	43.2	0.433
	39.63	0.4339
	36.2	0.4353
	32.81	0.4362



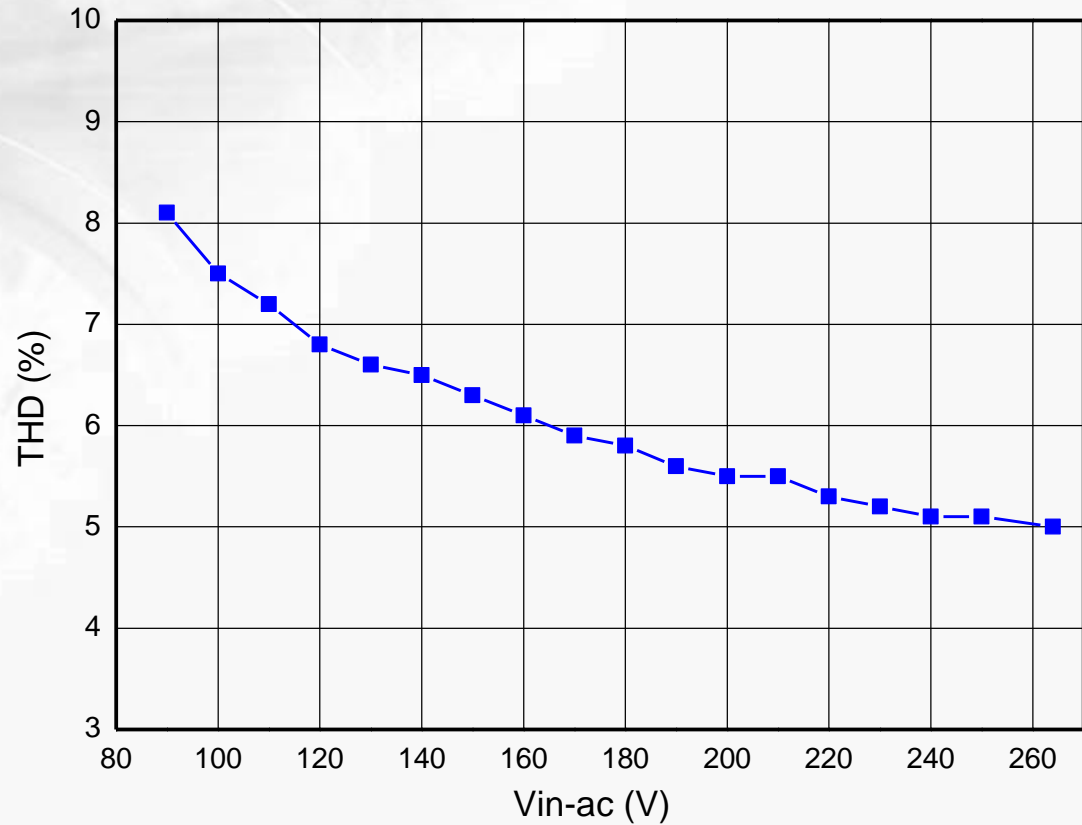
➤ 功率因数(PF)

Vin (V)	功率因数
85	0.9949
100	0.9941
110	0.9933
120	0.9921
130	0.9902
140	0.9878
150	0.985
160	0.9817
170	0.9775
180	0.9725
190	0.9668
200	0.9599
210	0.954
220	0.9456
230	0.9366
240	0.9259
250	0.9154
265	0.8987



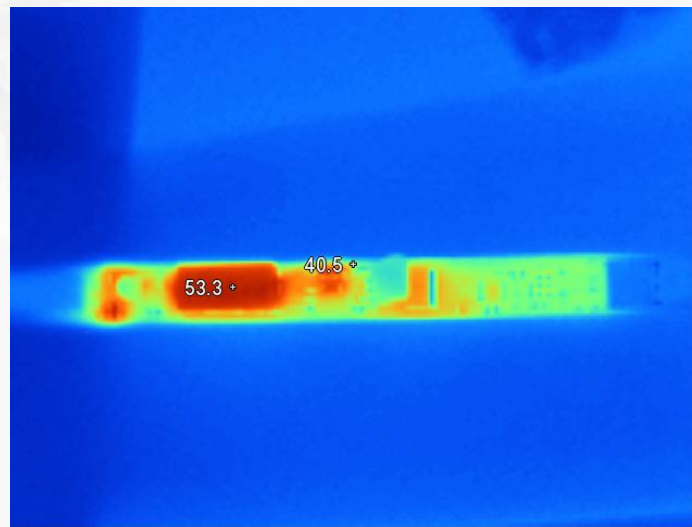
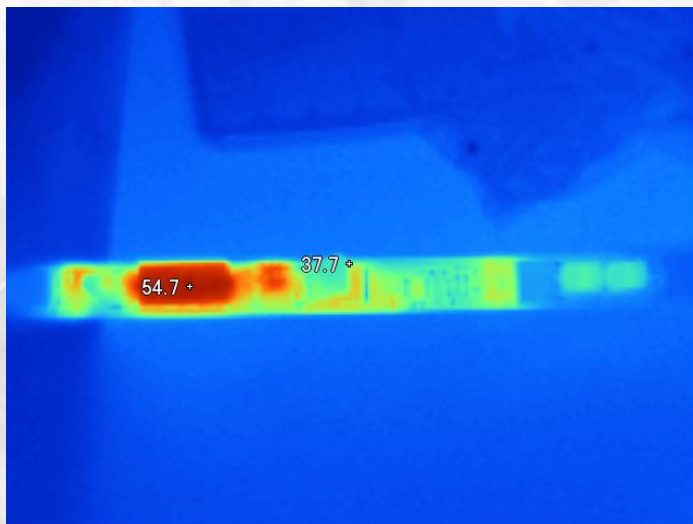
➤ 总谐波含量(THD)

Vin (V)	总谐波含量(%)
85	8.1
100	7.5
110	7.2
120	6.8
130	6.6
140	6.5
150	6.3
160	6.1
170	5.9
180	5.8
190	5.6
200	5.5
210	5.5
220	5.3
230	5.2
240	5.1
250	5.1
265	5

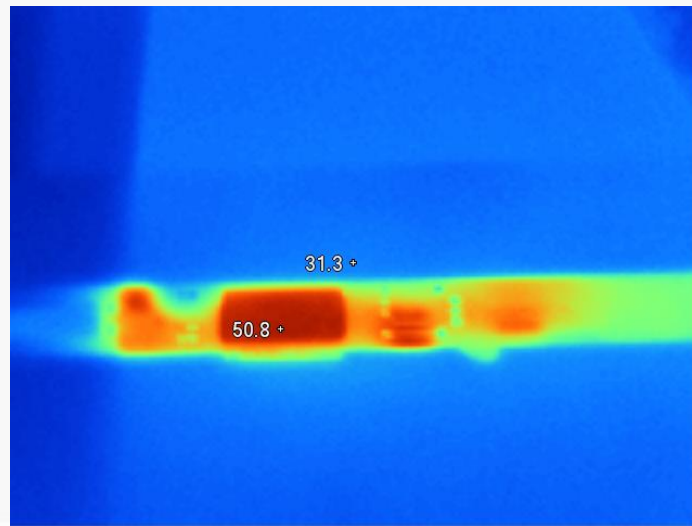
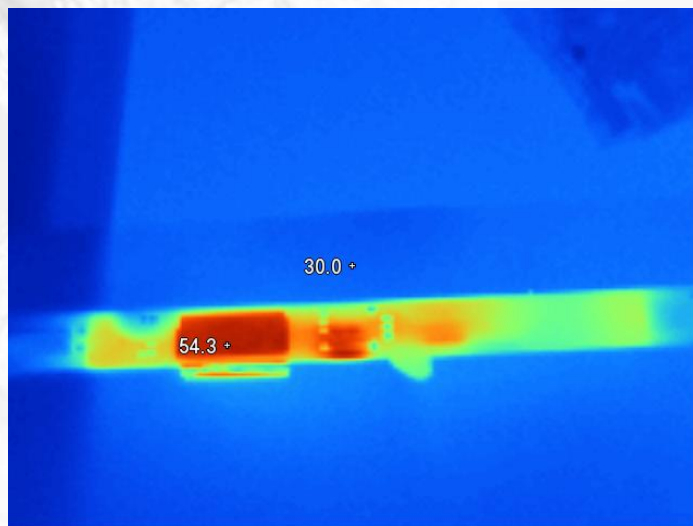


➤ 温度测试($T_A=25^\circ\text{C}$)

Top
Board



Bottom
Board

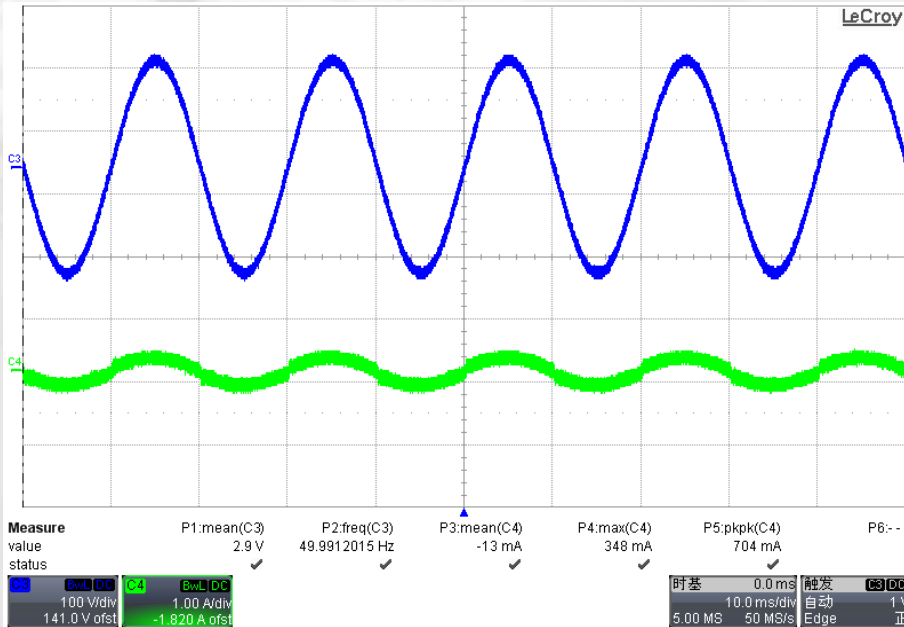


Vin=120V/50Hz @ Full Load

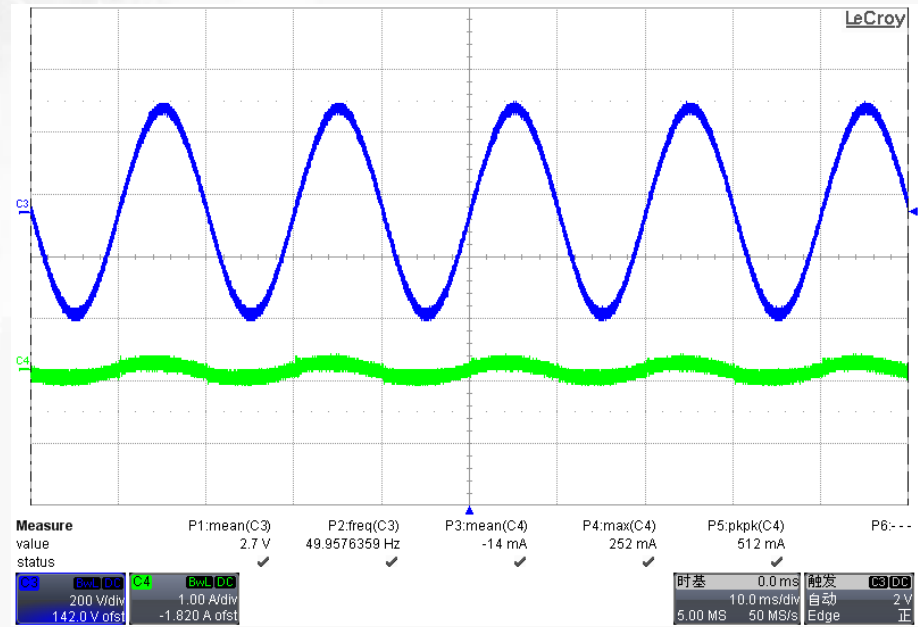
Vin=230V/50Hz @ Full Load

➤ 输入电流波形

Vin lin



Vin=120V/50Hz @ Full Load

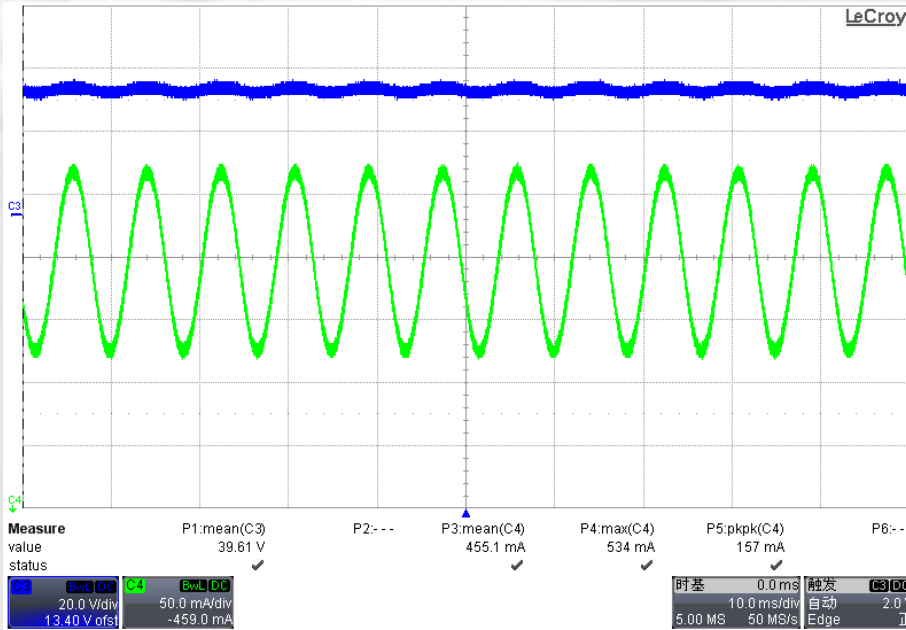


Vin=230V/50Hz @ Full Load

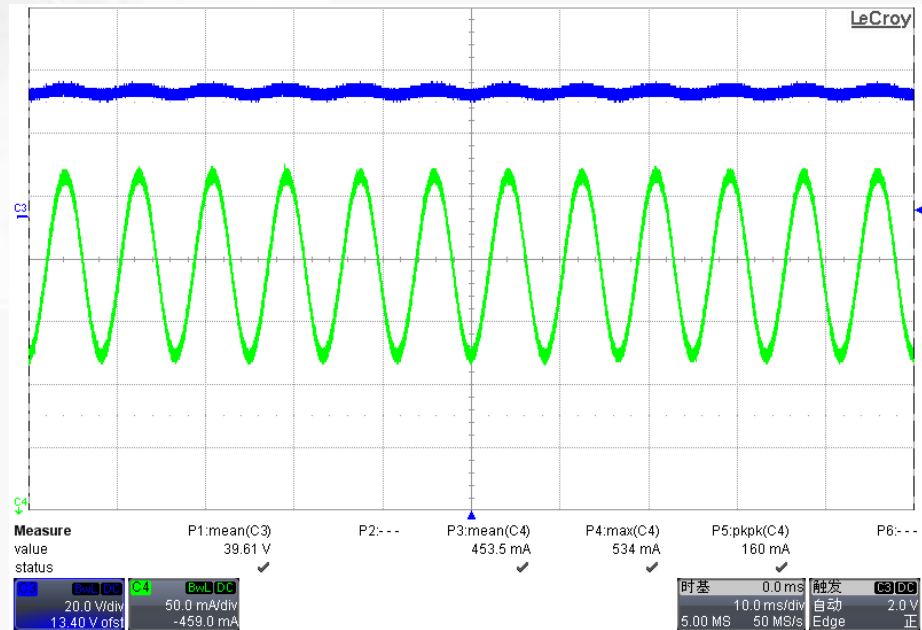
➤ 输出电流波形

Vout

Iout



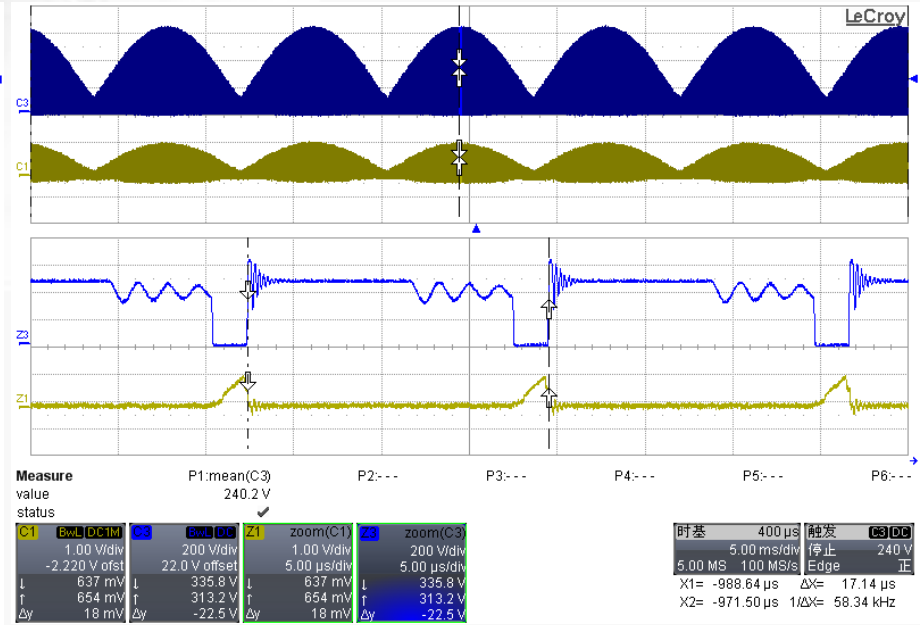
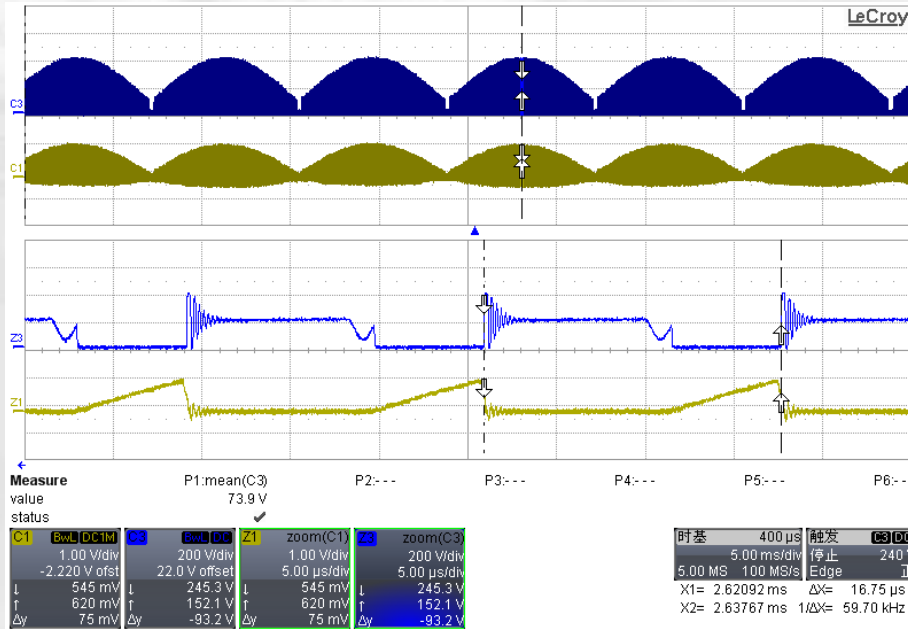
Vin=120V/50Hz @ Full Load



Vin=230V/50Hz @ Full Load

➤ Mosfet V_{DS} 波形

V_{DS}
 V_{CS}

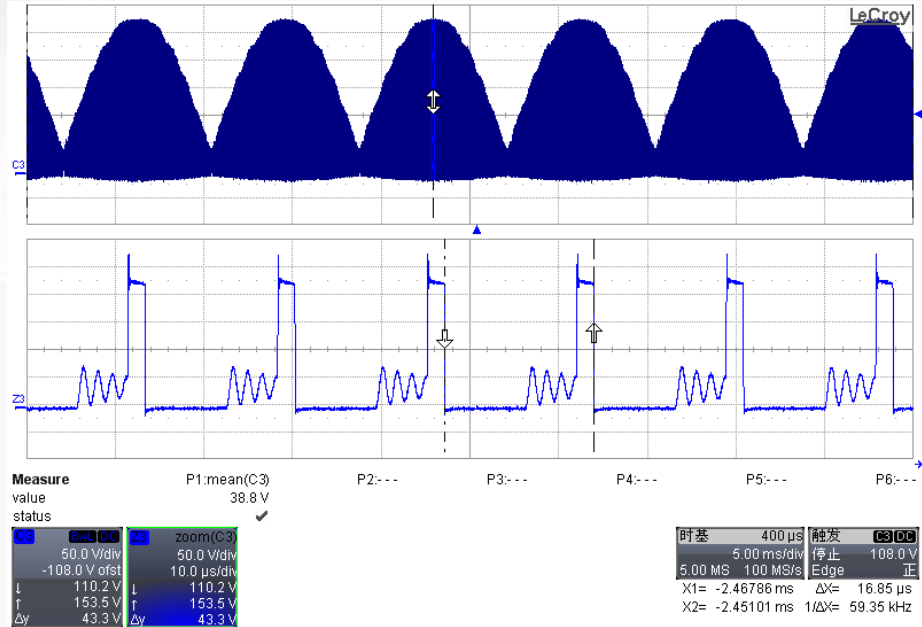
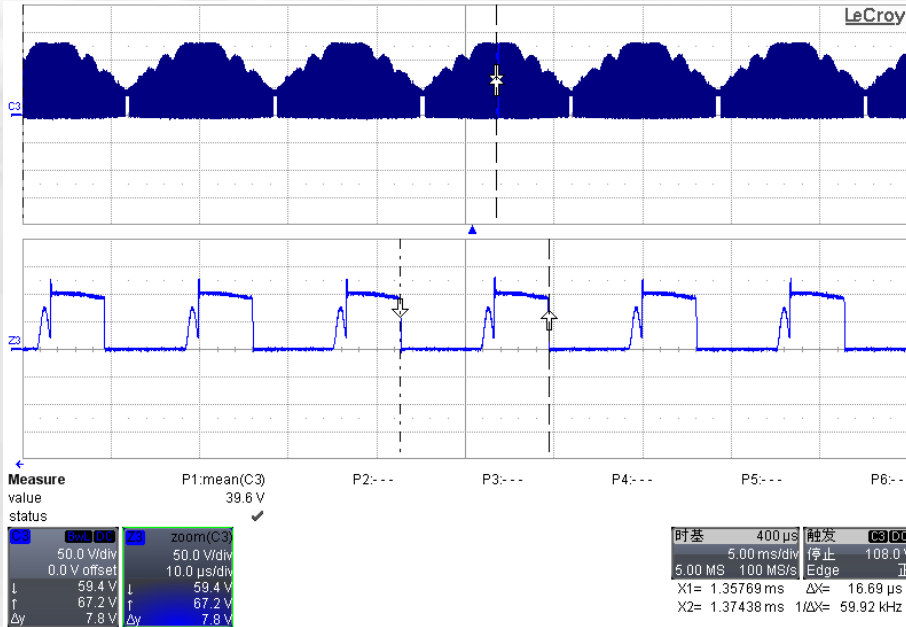


Vin=85V/50Hz @ Full Load

Vin=265V/50Hz @ Full Load

➤ 输出二极管反向电压波形

V_R



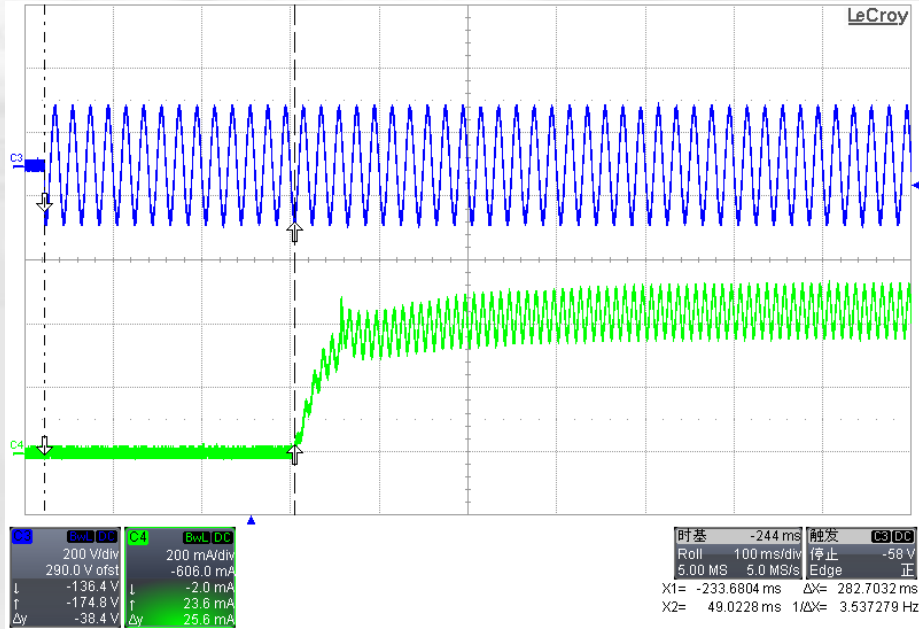
Vin=85V/50Hz @ Full Load

Vin=265V/50Hz @ Full Load

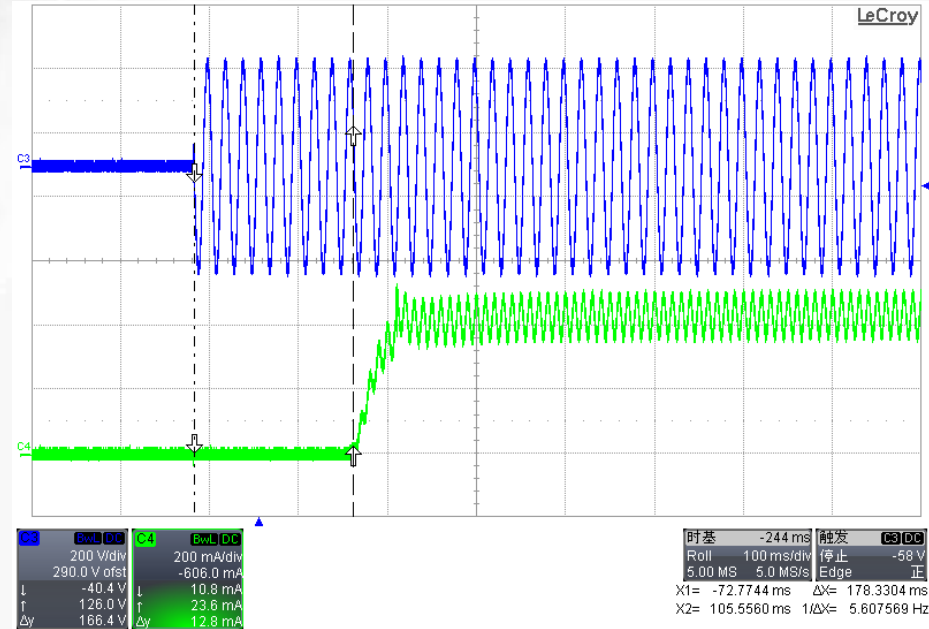
➤ 起动波形

Vin

Iout

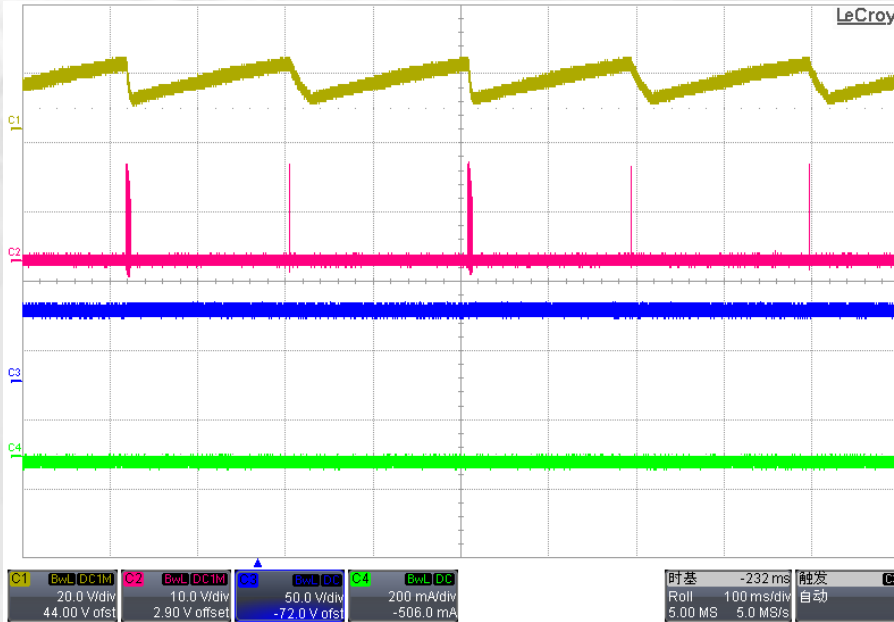


Vin=120V/50Hz @ Full Load
Start up time: 283ms

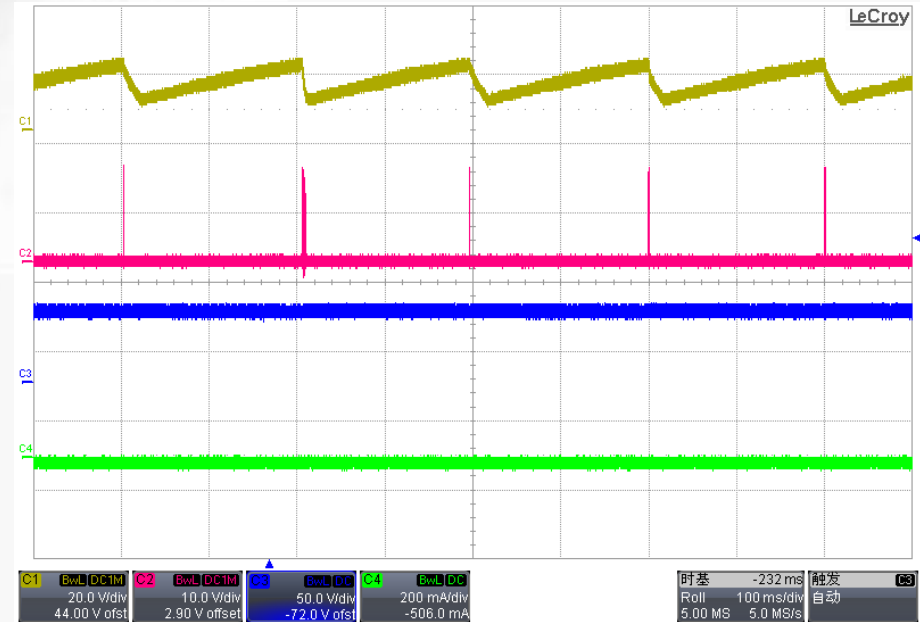


Vin=230V/50Hz @ Full Load
Start up time: 178ms

➤ 负载开路波形

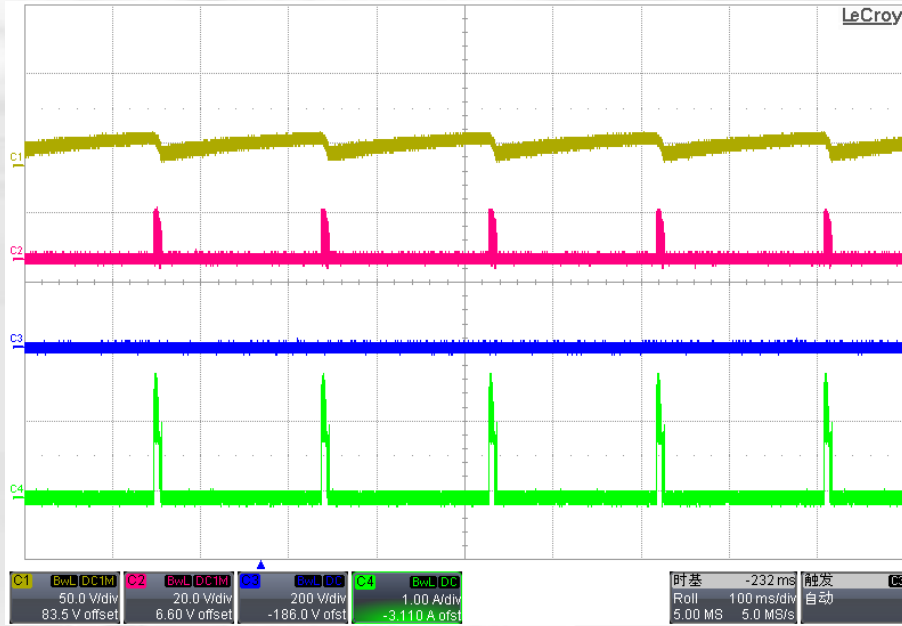


$V_{in}=120V/50Hz @ \text{No Load}$

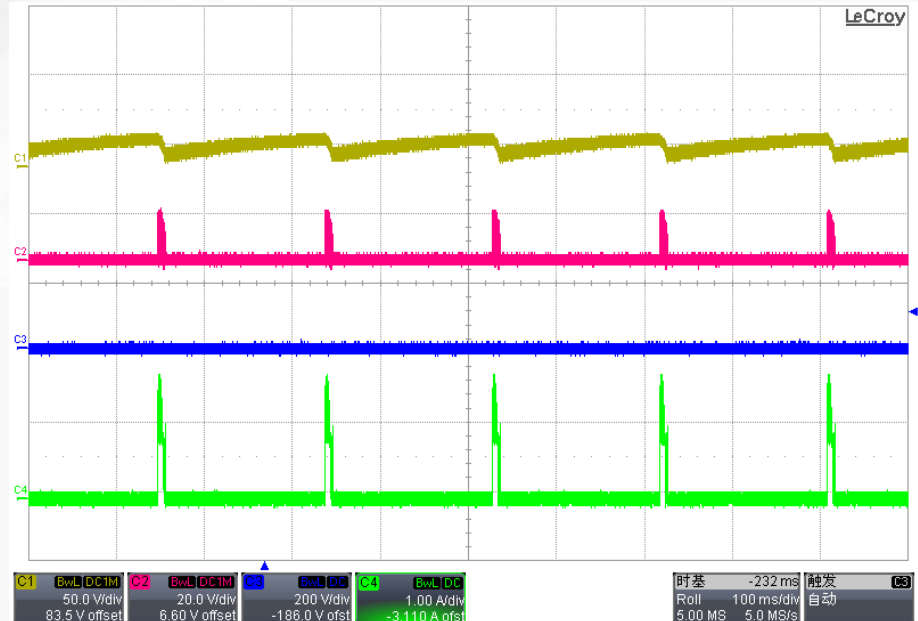


$V_{in}=230V/50Hz @ \text{No Load}$

➤ 输出短路保护



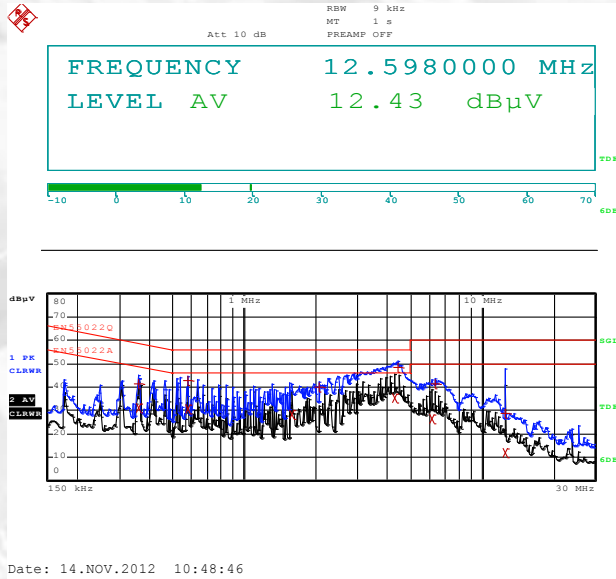
$V_{in}=120V/50Hz$ @ Output Short



$V_{in}=230V/50Hz$ @ Output Short

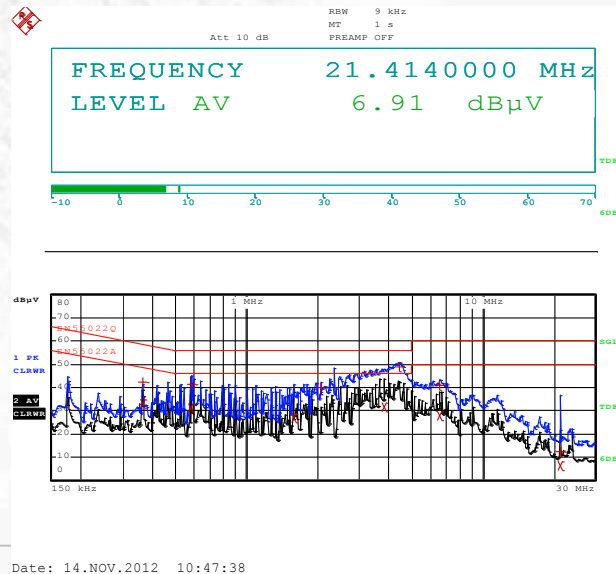
➤ 传导EMI @ 120VAC/50Hz--Full Load

Line Terminal



EDIT PEAK LIST (Final Measurement Results)			
TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
Trace1:	EN55022Q		
Trace2:	EN55022A		
Trace3:	---		
1 Quasi Peak	358 kHz	41.38	-17.38
2 Average	358 kHz	30.89	-17.88
1 Quasi Peak	578 kHz	42.65	-13.34
2 Average	578 kHz	30.47	-15.52
2 Average	1.582 MHz	28.07	-17.92
1 Quasi Peak	2.062 MHz	39.83	-16.16
2 Average	4.326 MHz	35.48	-10.51
1 Quasi Peak	4.438 MHz	48.29	-7.71
2 Average	6.21 MHz	26.49	-23.50
1 Quasi Peak	6.394 MHz	41.44	-18.55
1 Quasi Peak	12.598 MHz	28.99	-31.00
2 Average	12.598 MHz	11.84	-38.16

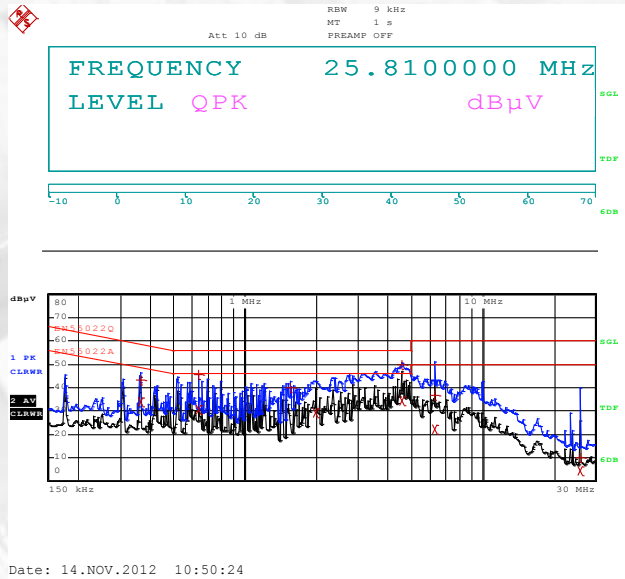
Neutral Terminal



EDIT PEAK LIST (Final Measurement Results)			
TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
Trace1:	EN55022Q		
Trace2:	EN55022A		
Trace3:	---		
1 Quasi Peak	362 kHz	42.24	-16.44
2 Average	362 kHz	33.08	-15.59
2 Average	578 kHz	30.91	-15.08
1 Quasi Peak	582 kHz	41.39	-14.60
2 Average	1.586 MHz	26.70	-19.29
1 Quasi Peak	2.062 MHz	39.80	-16.19
2 Average	3.842 MHz	31.73	-14.26
1 Quasi Peak	4.438 MHz	48.91	-7.08
1 Quasi Peak	6.574 MHz	40.77	-19.22
2 Average	6.574 MHz	27.91	-22.08
1 Quasi Peak	21.414 MHz	12.33	-47.66
2 Average	21.414 MHz	6.49	-43.50

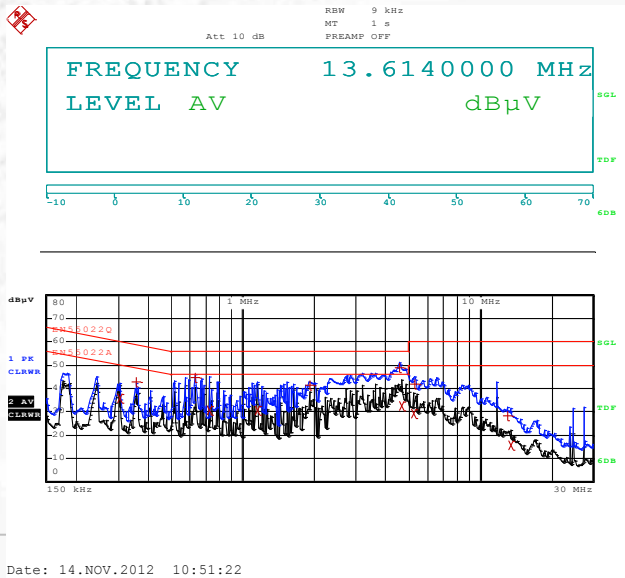
➤ 传导EMI @ 230VAC/50Hz--Full Load

Line Terminal



EDIT PEAK LIST (Final Measurement Results)			
Trace1:	EN55022Q		
Trace2:	EN55022A		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1 Quasi Peak	362 kHz	43.47	-15.20
2 Average	362 kHz	33.98	-14.69
1 Quasi Peak	638 kHz	45.38	-10.61
2 Average	638 kHz	30.87	-15.12
1 Quasi Peak	1.554 MHz	39.77	-16.23
2 Average	1.994 MHz	29.25	-16.74
1 Quasi Peak	4.598 MHz	49.59	-6.40
2 Average	4.598 MHz	34.27	-11.72
1 Quasi Peak	6.326 MHz	36.59	-23.40
2 Average	6.326 MHz	22.21	-27.78
2 Average	25.806 MHz	4.44	-45.55
1 Quasi Peak	25.81 MHz	9.83	-50.16

Neutral Terminal



EDIT PEAK LIST (Final Measurement Results)			
Trace1:	EN55022Q		
Trace2:	EN55022A		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
2 Average	302 kHz	35.95	-14.23
1 Quasi Peak	354 kHz	42.78	-16.08
1 Quasi Peak	630 kHz	44.68	-11.31
2 Average	726 kHz	30.71	-15.28
2 Average	1.15 MHz	30.56	-15.43
1 Quasi Peak	1.934 MHz	41.48	-14.51
1 Quasi Peak	4.594 MHz	48.94	-7.06
2 Average	4.71 MHz	32.33	-13.66
2 Average	5.262 MHz	29.01	-20.98
1 Quasi Peak	5.306 MHz	41.98	-18.01
1 Quasi Peak	13.15 MHz	28.37	-31.62
2 Average	13.614 MHz	15.61	-34.38

描述	最小值	典型值	最大值	单位	测试结果
输入					
输入电压	85	120/230	265	VAC	
频率	47	50/60	63	Hz	
功率因数	0.9				>0.93
THD			8.1	%	
输出					
输出电压	36	40	44	V	
输出电流		450		mA	
输出电流纹波			160	mA	
输出功率		17		W	
输出起动时间		0.28		s	0.18s at Vin=230V
效率					
满载		86		%	87.2% at Vin=230V
安规					
EMI	Pass EN55022 Class B with 6dB Margin				通过
Surge Test	IEC61000-4-5 Class 3				通过
ESD	IEC6100-4-2 Class 4				通过