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AP3970 For 12V 1A charge Solution

General Design Specification:

Ø AC Input Range 90-264Vac

Ø DC Output 12V, 1A

Ø Meet “<150mW” No-Load standby Power Consumption Requirement

Ø Meet “EPA_2.0” Requirement

Key Performance



Item	Spec	Test Conditions	Test Data	Result
Output Voltage	11.4~12.6V	90~264Vac @ 0~1A	11.97~12.40V	Pass
Ripple	<150mVp-p	90~264Vac @ 0~1A	70~112mVp-p	Pass
Standby Power	<150mW	230Vac @ 0A	110mW	Pass
Dynamic	10.8~13.2V	90~264Vac @ 0.1~0.9A 5mS 0.5A/uS	11.28~12.36V	Pass
EMC	EN55022B	115Vac 230Vac@ 1A	>10dB	Pass

Specification



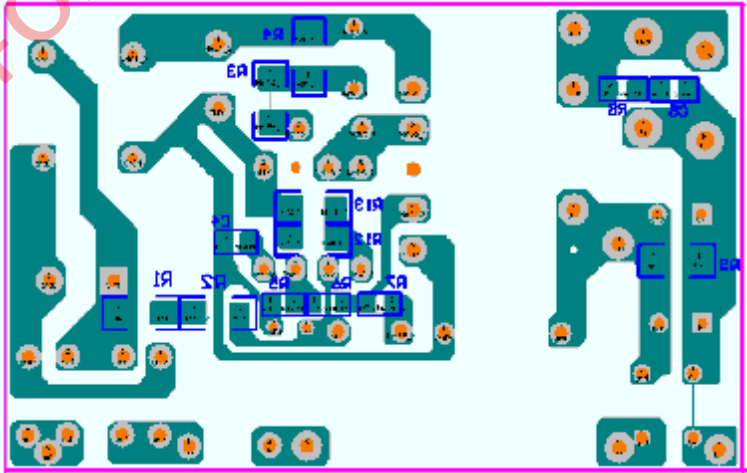
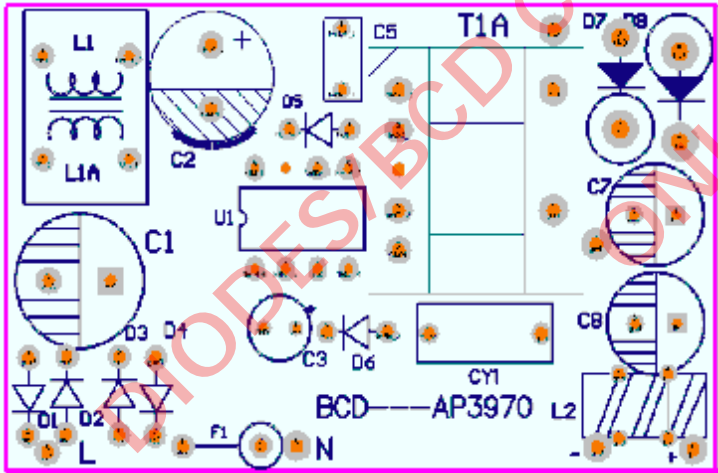
Description	Min	Type	Max	Units	Conditions
Input					
Voltage	90		264	VAC	
Frequency	47	50/60	63	Hz	
No-Load Input Power (230Vac)			150	mW	
Output					
Output Voltage	11.4	12	12.6	V	
Output Current	0		1	A	
Output Power		12		W	
Output Ripple Voltage			150	mVp-p	I _{out} =1A @ 25°C, 20MHzbandwidth
Output Over Current Protection	1		1.25		Hiccup, Auto Restart
Ambient Temperature			40	°C	
Efficiency					
Average Efficiency (EPS 2.0)				72.8%	Measured at end of output DC-Cable, 115Vac & 230Vac @ 25°C
EMI	Pass EN55022 Class B with 10dB Margin				

Test Equipment

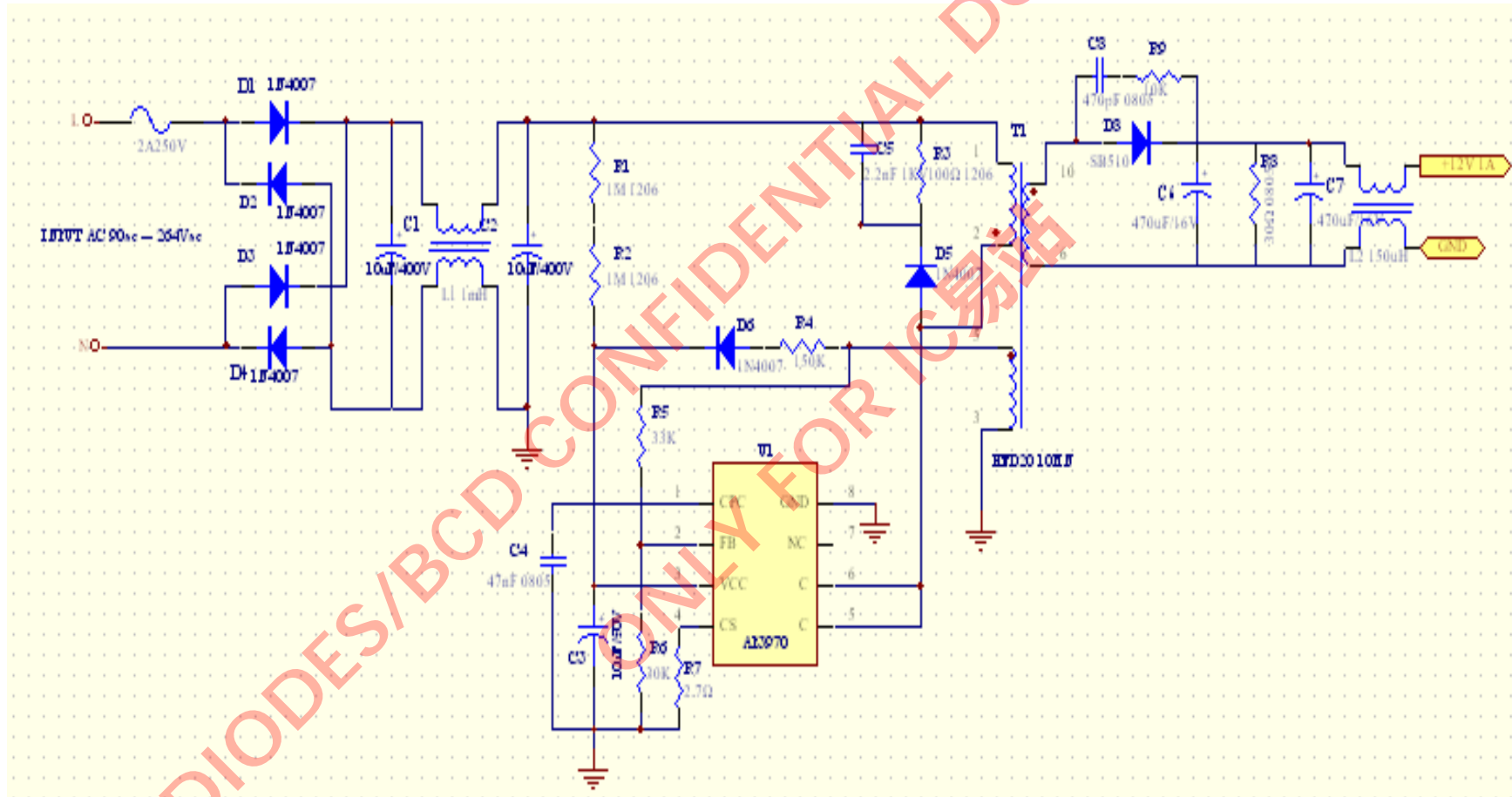


Item	Model
AC Source	Chroma 61602
Power Meter	YOKOGAWA WT210
Electronic Load	Chroma 63100
Oscilloscope	YOKOGAWA DLM2024 2.5GS/s 200MHz
Digit Multimeter	Agilent 34410A
Data Acquisition	Agilent 34970A

PCB Layout



Schematic Circuit

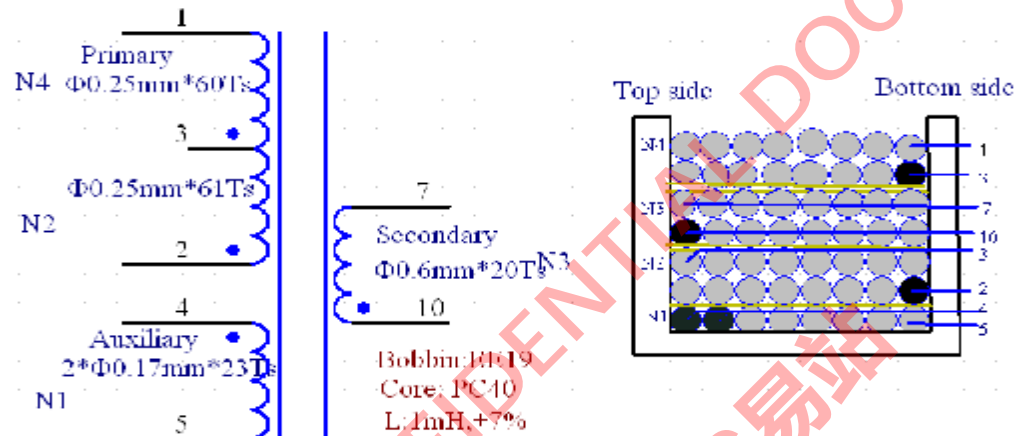


Bill Of Material



NO.	Spec.	Position	NO.	Spec.	Position
1	47nF/50V \pm 15% 0805 X7R Ceramic	C4	14	AP3970 DIP-8	U1
2	470PF/50V \pm 15% 0805 X7R Ceramic	C8	15	10uF 400V 8*14mm Electrolytic	C1, C2
3	1.0M Ω \pm 5% 1206 1/4W	R1, R2	16	10uF 50V 5*10mm Electrolytic	C3
4	100 Ω \pm 5% 1206 1/4W	R3	17	470uF 16V 8*12mm Electrolytic	C6, C7
5	150k Ω \pm 5% 1206 1/4W	R4	18	2.2nF 1000V Ceramic	C5
6	16.9k Ω \pm 5% 0805 1/8W	R5	19	EE-19	T1
7	36K Ω \pm 1% 0805 1/8W	R6	20	UU9.8 33mH	L1
8	2.7 Ω \pm 1% 0805 1/8W (NC)	R7	21	150uH T9*5*3	L2
9	30 Ω \pm 1% 0805 1/8W	R8	22	2A250V	F1
10	5.1K Ω \pm 1% 0805 1/8W	R9	23	Y Capacitor 222/250v	CY1
11	1.1 Ω \pm 5% 0805 1/8W	R12,R13	24		
12	SR510	D8	25		
13	1N4007 1A 1000V	D1,D2,D3, D4,D5,D6	26		

Transformer Specification



Winding	Process Specification	Pin configuration		Cylinder number(Ts)	Direction
		start	finish		
N1	UEW 0.17mm * 2	4	5	23	RIGHT
1 layers of Polyester Yellow tape, T=0.05 mm					
N2	UEW 0.25mm * 1	2	3	61	RIGHT
2 layers of Polyester Yellow tape, T=0.05 mm					
N3	TEX-E 0.6mm(Triple insulated wire)	10	7	20	RIGHT
2 layers of Polyester Yellow tape, T=0.05 mm					
N4	UEW 0.25mm * 1	3	1	60	RIGHT
1 layers of Polyester Yellow tape, T=0.05 mm					
Tinned first times					
Assembling the core and curing					
Cut Pin 3、6、8、9					

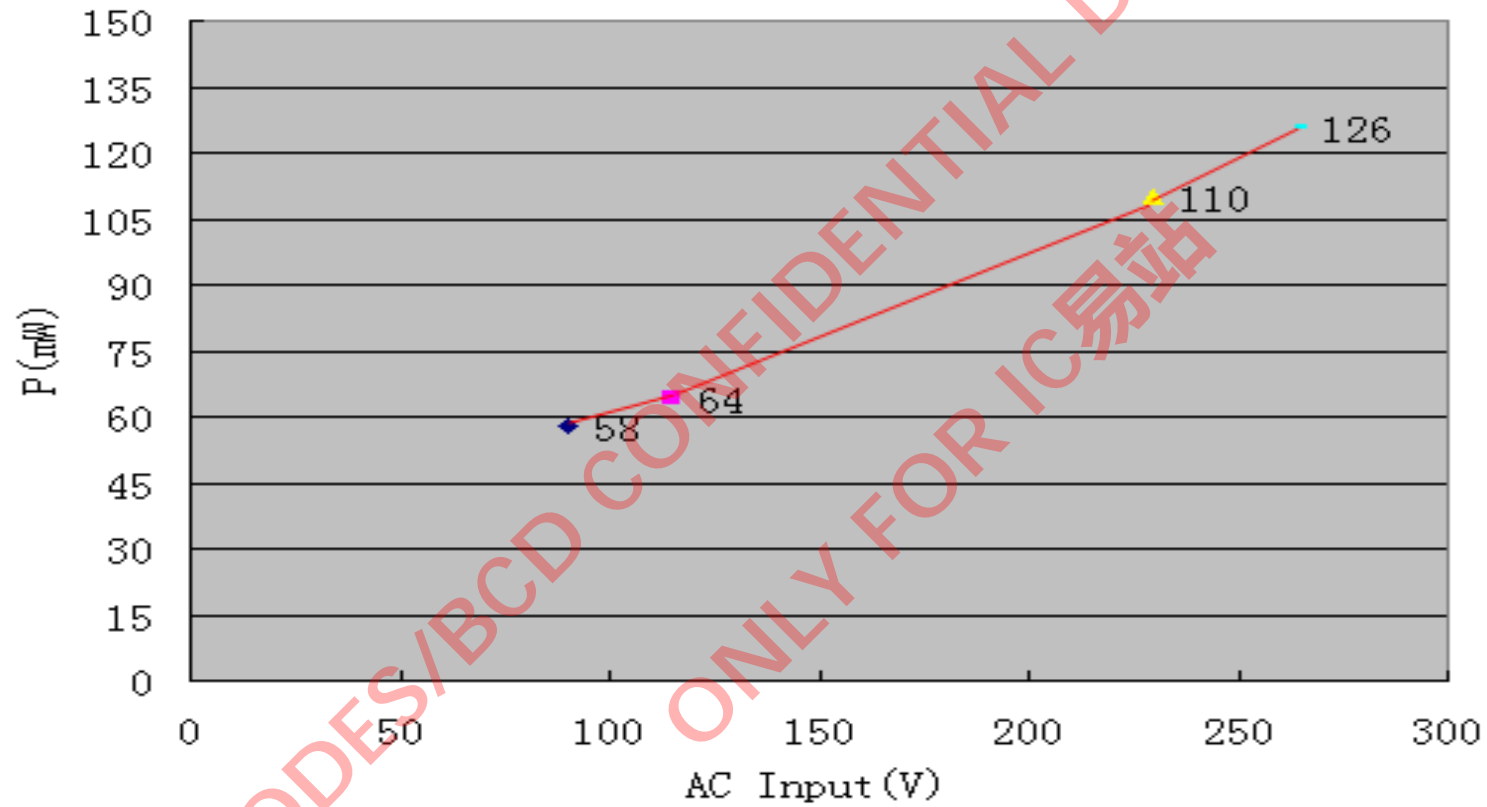
Regulation, Ripple, OCP and Efficiency



V _{IN} (V)	P _{IN} (W)	V _{OUT} (V)	I _O (A)	Ripple (mV)	P _{OUT} (W)	η	OCP	Average η	SPEC.
90V/60Hz	3.70	11.97	0.25	70	2.99	80.81%	1.25	81.62%	EPS2.0 72.8%
	7.36	12.04	0.50	102	6.02	81.80%			
	11.14	12.17	0.75	105	9.13	81.96%			
	15.04	12.32	1.00	104	12.32	81.91%			
115V/60Hz	3.73	12.03	0.25	75	3.01	80.70%	1.24	82.01%	
	7.37	12.07	0.50	112	6.04	81.95%			
	11.07	12.20	0.75	110	9.15	82.66%			
	14.94	12.36	1.00	105	12.36	82.73%			
230V/50Hz	3.82	12.01	0.25	74	3.00	78.53%	1.22	81.67%	
	7.36	12.08	0.50	105	6.04	82.07%			
	11.06	12.22	0.75	107	9.17	82.91%			
	14.91	12.40	1.00	109	12.40	83.16%			
264V/50Hz	3.89	12.01	0.25	76	3.00	77.12%	1.21	80.95%	
	7.42	12.08	0.50	108	6.04	81.40%			
	11.13	12.23	0.75	106	9.17	82.39%			
	14.95	12.39	1.00	103	12.39	82.88%			

* Note: Output Voltage measured at end of PCB

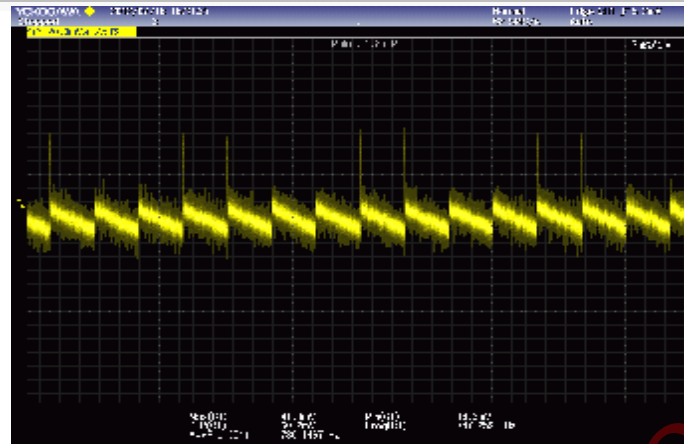
Standby Power



Output Ripple & Noise

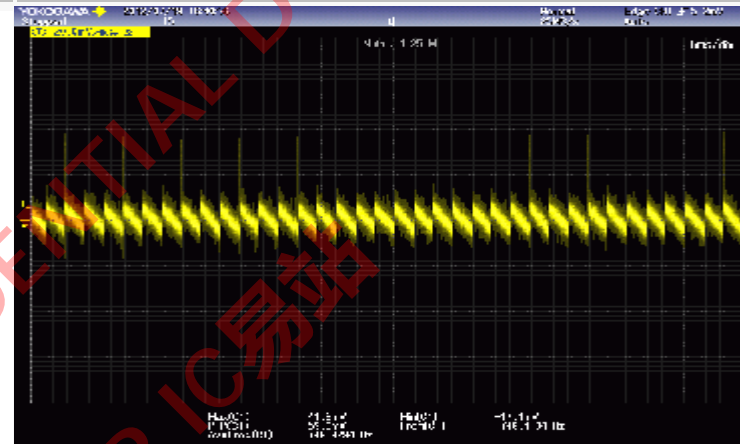


90Vac No Load



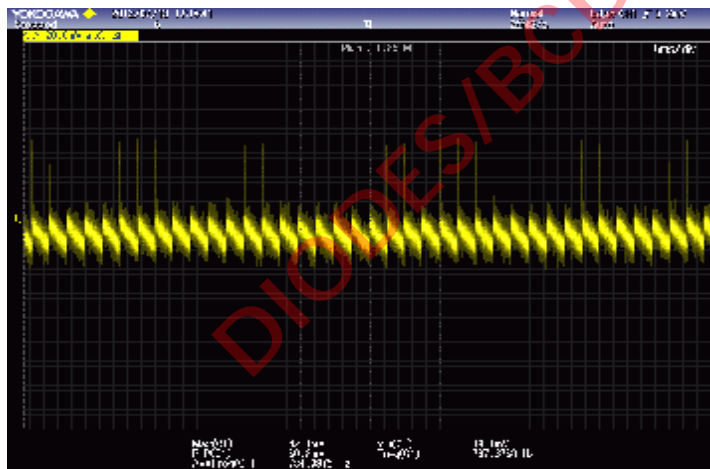
60.2mV

115Vac No Load



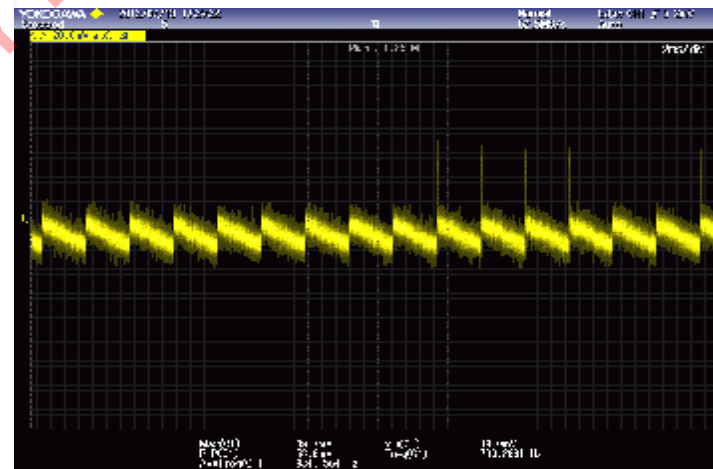
59mV

230Vac No Load



60.2mV

264Vac No Load

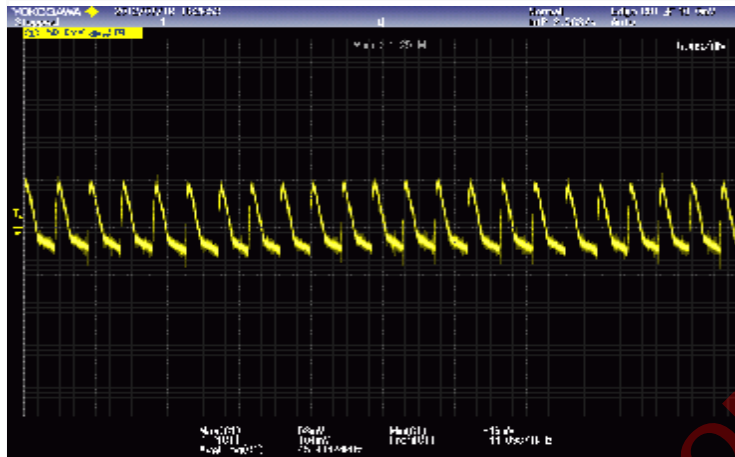


58.6mV

Output Ripple & Noise

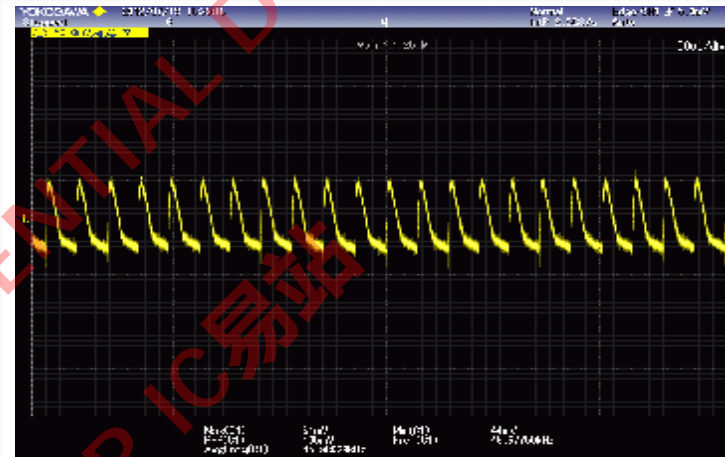


90Vac Full Load



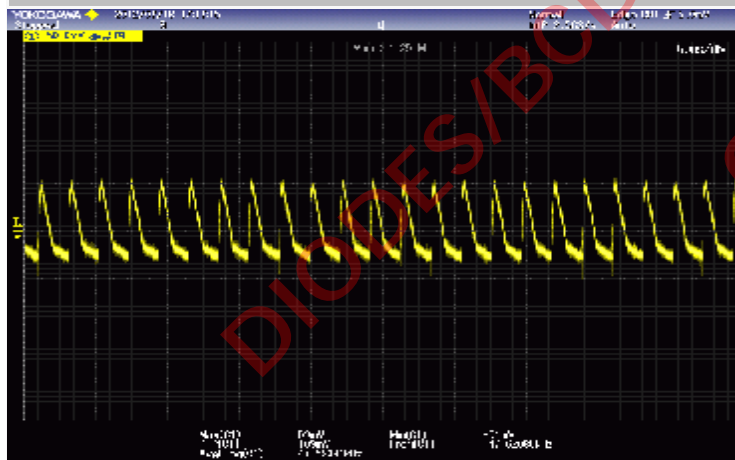
104mV

115Vac Full Load



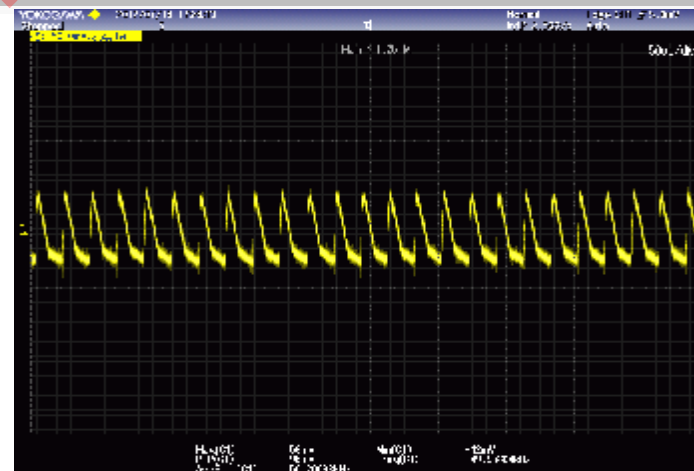
105mV

230Vac Full Load



109mV

264Vac Full Load

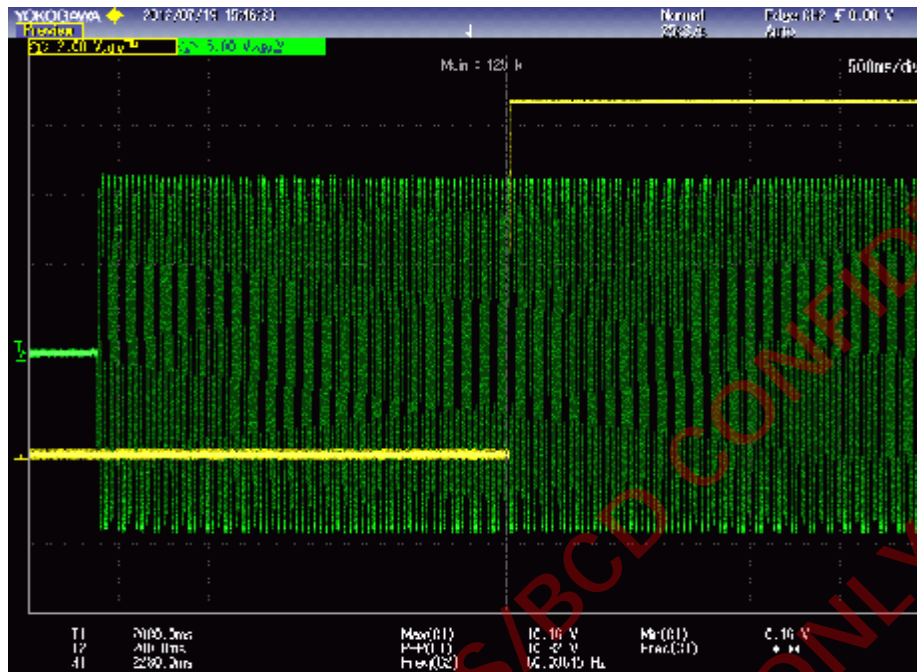


98mV

Turn On Delay Time

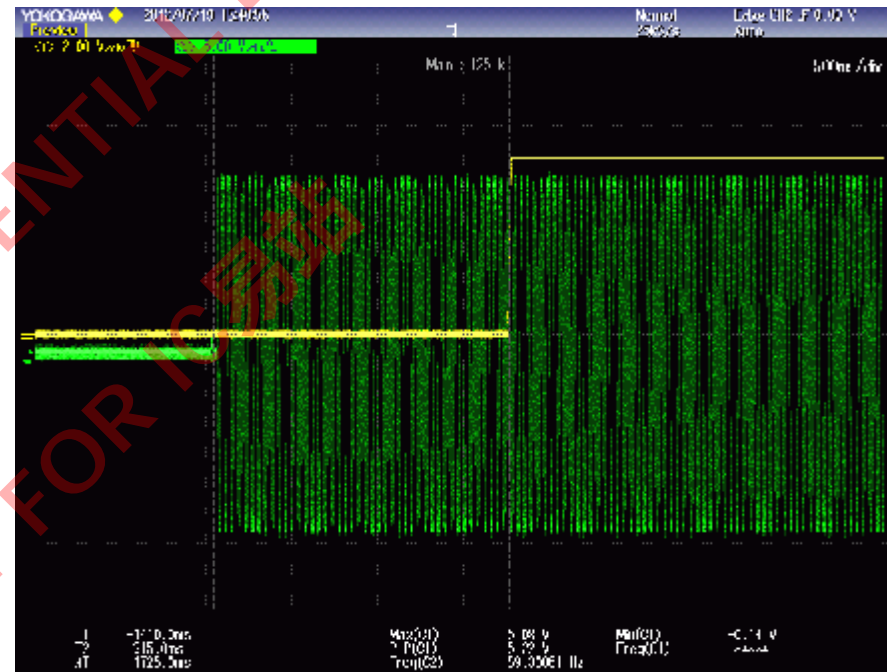


90Vac No Load



$T_{\text{DELAY}}: 2.280\text{S}$

90Vac Full Load

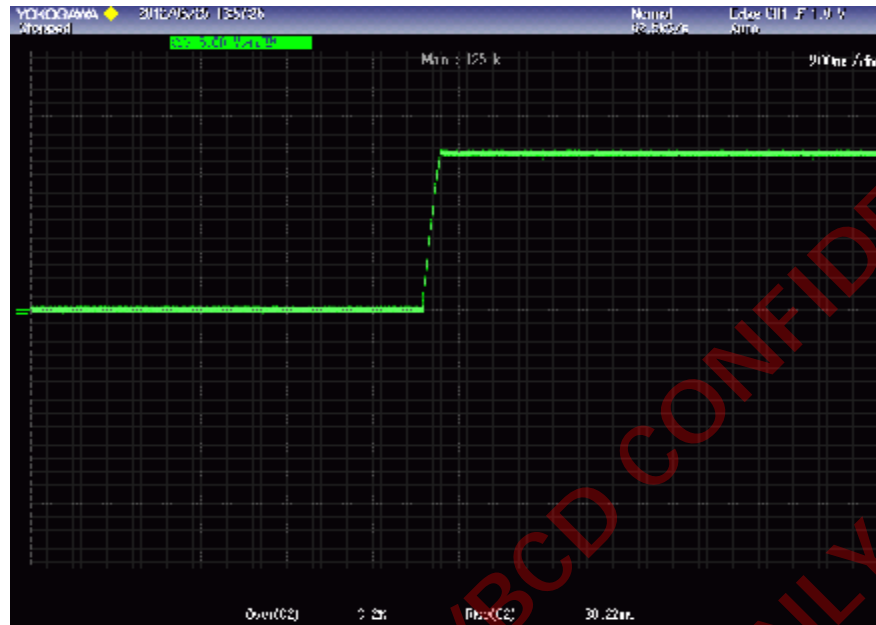


$T_{\text{DELAY}}: 1.725\text{S}$

Output Rise Time

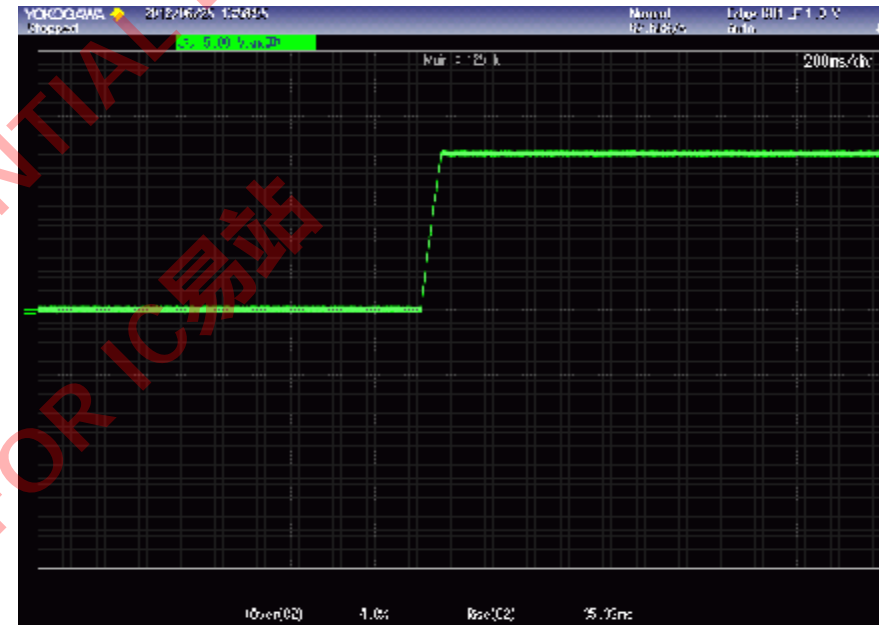


115Vac Full Load



Trise: 30.22mS

230Vac Full Load

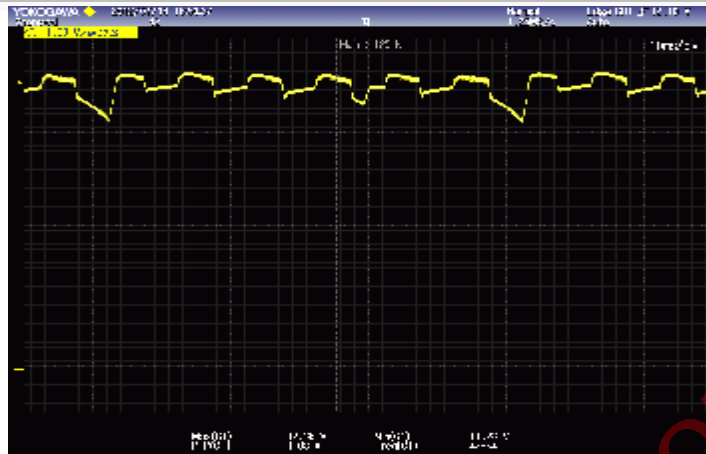


Trise: 35.33mS

Dynamic

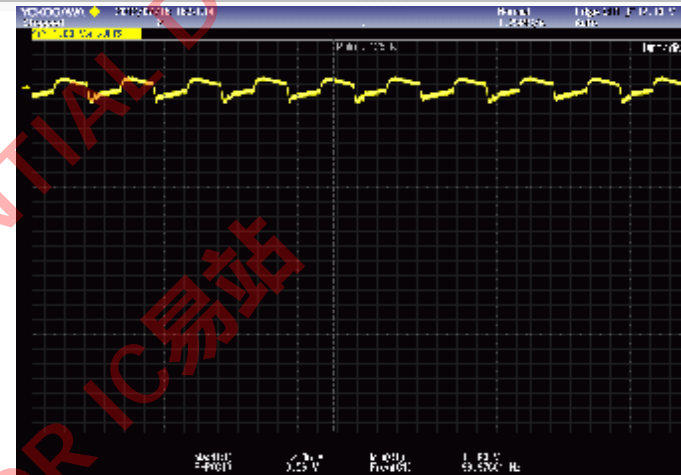


90Vac 10%~90%~10% 5mS 0.5A/uS



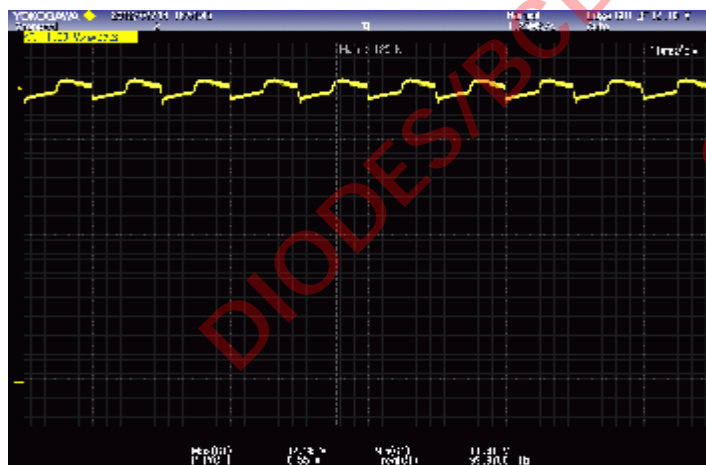
Vomin
12.36
Vomax
11.28

115Vac 10%~90%~10% 5mS 0.5A/uS



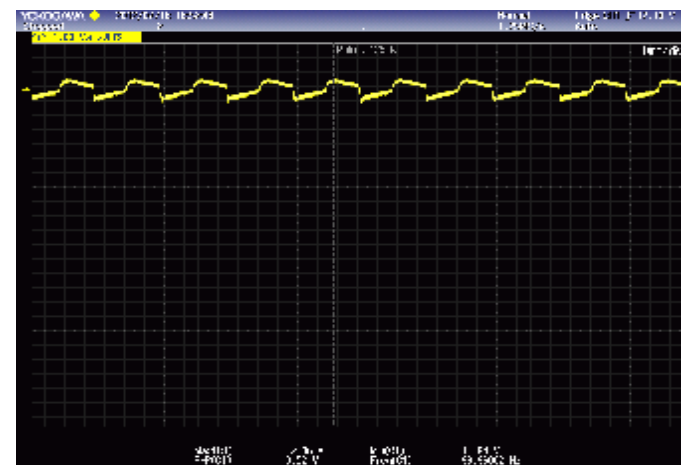
Vomin
12.36
Vomax
11.80

230Vac 10%~90%~10% 5mS 0.5A/uS



Vomin
12.36
Vomax
11.81

264Vac 10%~90%~10% 5mS 0.5A/uS



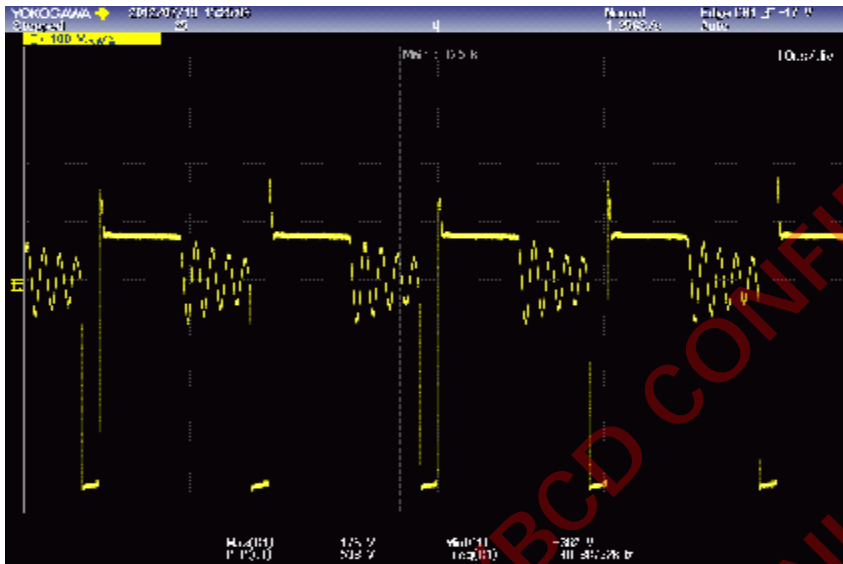
Vomin
12.36
Vomax
11.84

BJT Voltage Stress



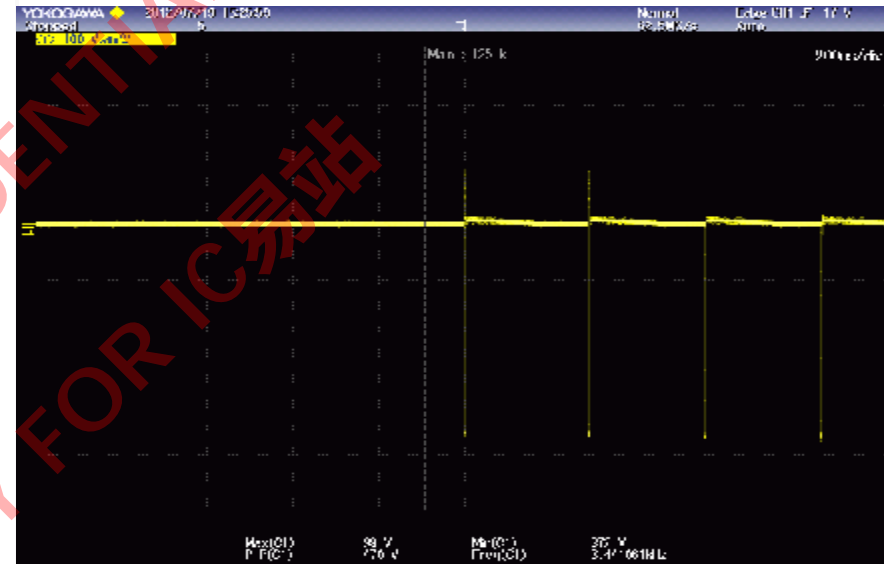
264Vac Full Load

Vcemax: 538V



264Vac Short

Vcemax: 470V



Primary Side Power Switcher for Off-line SMPS

AP3968/69/70/70S

Absolute Maximum Ratings (Note 2)

Parameter	Symbol	Value	Unit
Supply Voltage	V _{CC}	-0.3 to 22	V
FB Input Voltage	V _{FB}	-1 to 10	V
Collector-emitter Voltage	V _{CEBO}	700	V

Schottky Voltage Stress

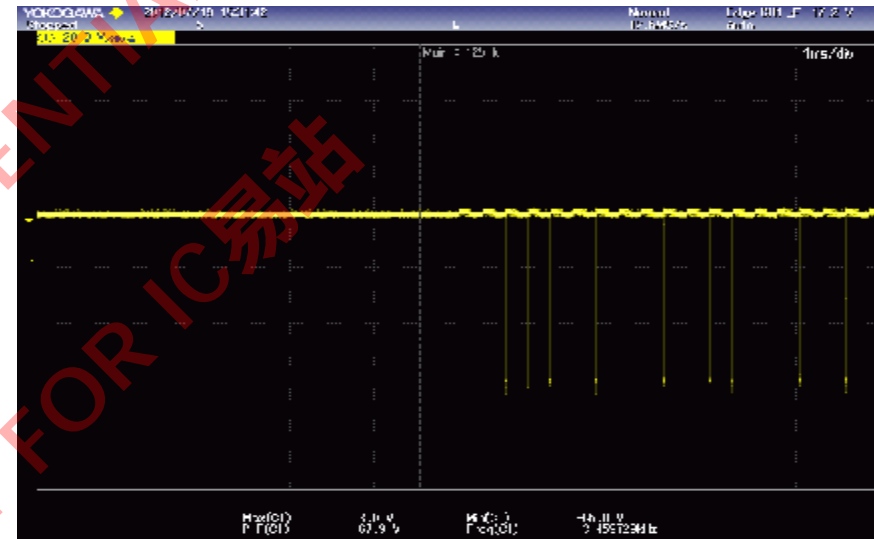
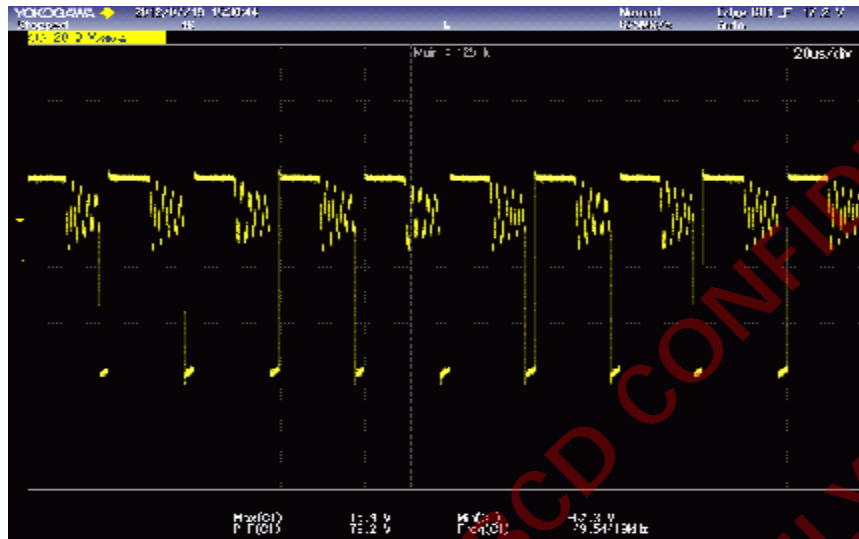


264Vac Full Load

$V_{MAX}: 78.2V$

264Vac Short

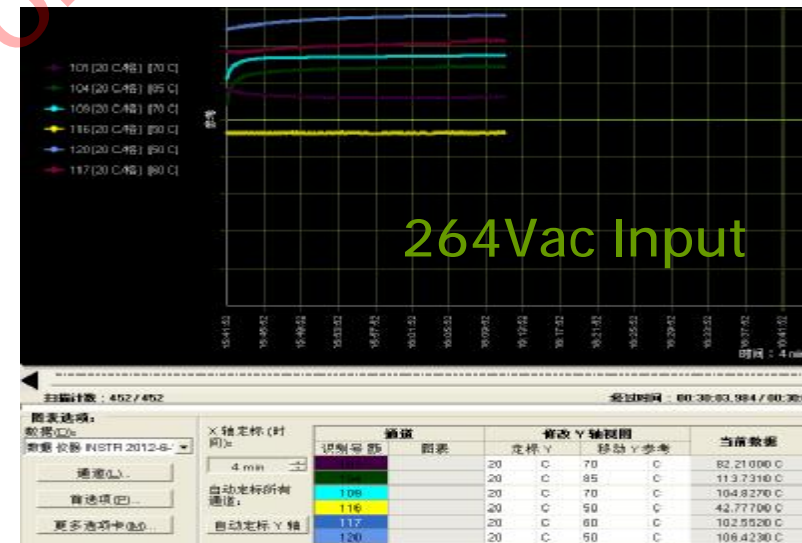
$V_{MAX}: 67.9V$



Temperature Rise



Location	Rated temp (°C)	90V/AC (°C)	264V/AC (°C)	T _{MAX} (°C)	Utilization ratio
C2	105	88.13	82.21	88.13	83.93%
IC(AP3970)	150	107.08	104.83	107.08	71.39%
Coil	130	104.60	106.42	106.42	81.86%
Core	130	100.72	102.55	102.55	78.88%
Schottky	150	110.76	113.73	113.73	75.82%
Ambient temperature		42.46	42.78	42.78	

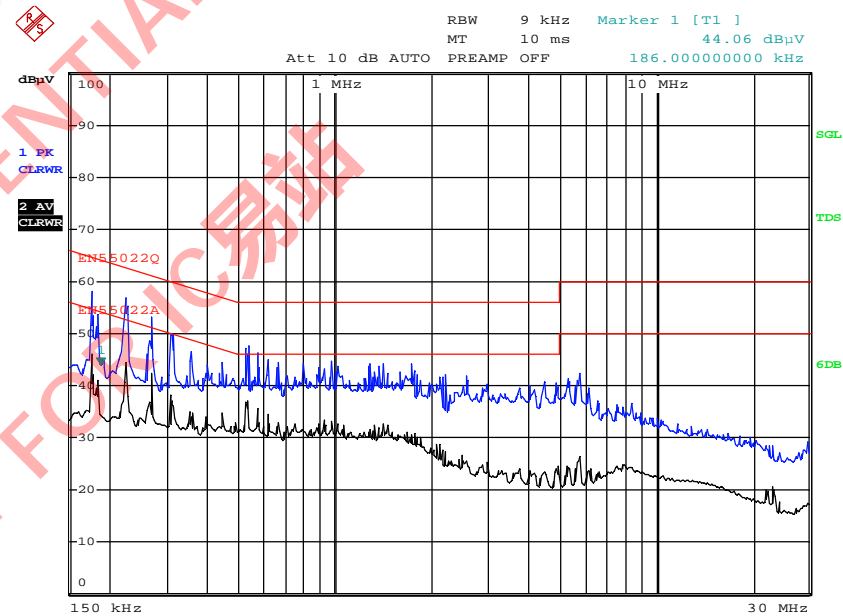
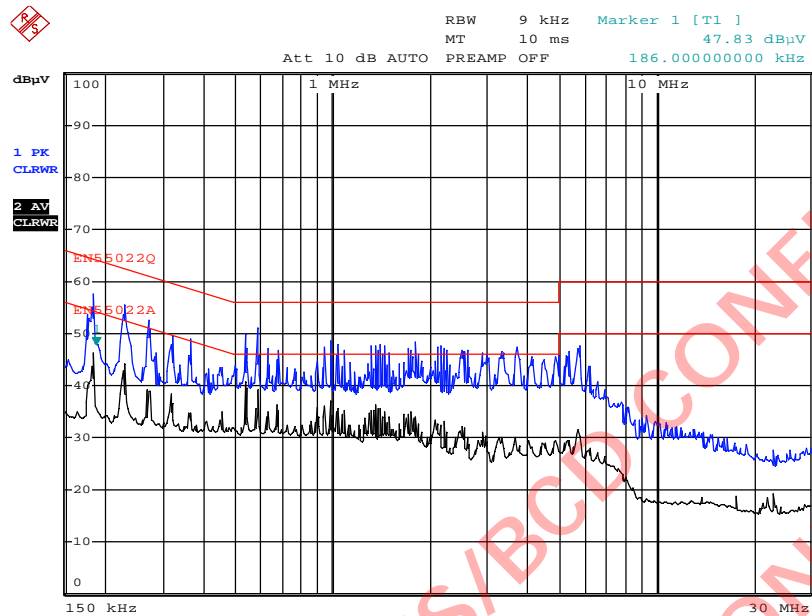


Conduction



230Vac Full Load L

230Vac Full Load N



Date: 18.JUL.2012 03:23:02

Date: 18.JUL.2012 03:21:17

Margin: >10dB

Margin: :>10dB



Thank You!!!