



DEMO BOARD TEST REPORT

High Performance Low Cost 12V1.5A Adapter using PSR DCM CC/CV Regulator KP2123

FEATURES

- Primary-Side-Control without Opto-Coupler or Secondary Feedback Circuit
- Constant Current and Constant Voltage Output
- High Average Efficiency >86%
- Low standby power<70mW
- $\pm 5\%$ CC and CV Regulation
- Programmable Cable Drop Compensation (CDC) in PSR CV Mode
- Build in Protections:
 - Over Load Protection (OLP)
 - Short Load Protection (SLP)
 - On-Chip Thermal Shutdown (OTP)
 - Cycle-by-Cycle Current Limiting (OCP)
 - Leading Edge Blanking (LEB)
 - VDD UVLO

APPLICATIONS

- STB Power Supply

DEMO BOARD SEPCIFICATION

Description	Symbol	Min.	Typ.	Max.	Unit	Note
Input Voltage	Vin	90		265	Vac	50/60Hz
Output Voltage	Vout		12		Vdc	
Output Current	Iout		1.5	1.8	A	
Total Output Power	Pout		18		W	
Ripple & Noise	Vripple			150	mVp-p	Board End, 20MHz Bandwidth
System Average Efficiency	η	>86.1			%	22AWG,1.5m Line End @ 115Vac/60Hz & 230Vac/50Hz
Standby Power Consumption	Pst			70	mW	@265Vac
Startup Time	Tst			3	s	Tested at 90Vac/60Hz
CE/RE Margin		6/5			dB	EN55022 Class B
Surge Test		2			kV	Differential Mode @ 230Vac/50Hz
ESD(Contact/Air Discharge)				8/15	kV	On each output terminals; +/-
EFT		± 1			kV	@ 230Vac/50Hz
Safety		Designed to meet UL60950				
Operating Ambient		0		40	°C	
Operating Humidity		5		95	%R.H.	

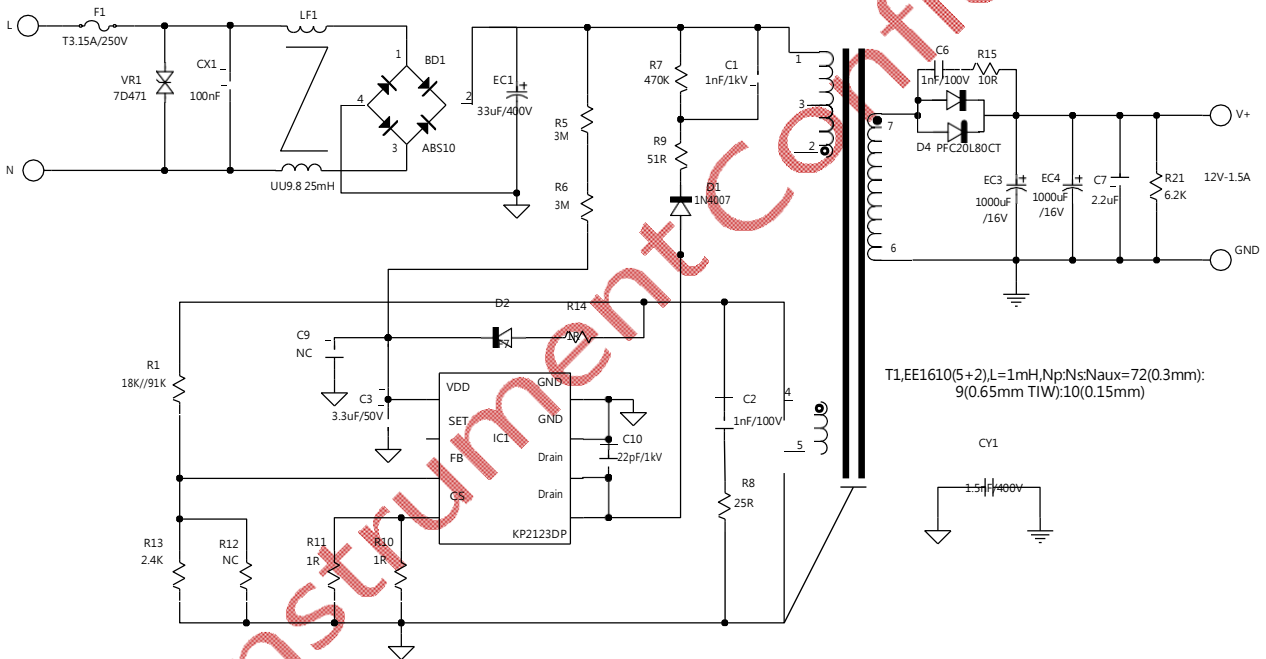
The table above shows the minimum acceptable performance of the design. Actual performance is listed in the results section.

Demo Board of KP2123DP-D01-R1.0



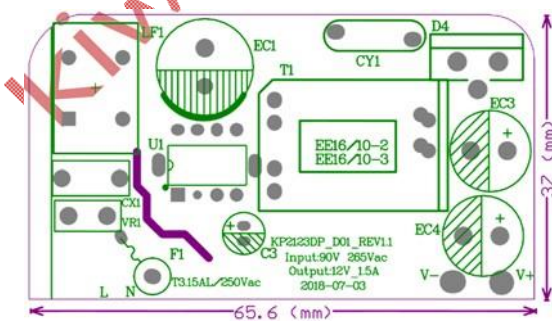
Board Size(in mm): L x W x H=65.6 x 37 x 23

Schematic

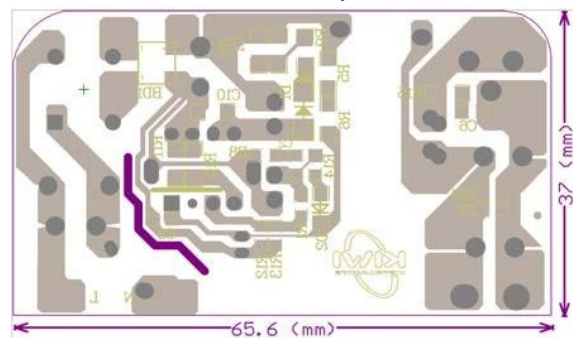


Printed Circuit Board Layout

Top Layer



Bottom Layer





Circuit Description

The Demo Board of KP2123DP-D01 is configured in a single stage flyback topology, which combines a high-performance DCM PSR regulator KP2123DP. KP2123DP-D01 is typically designed for the application of STB power supply with universal input (90-265Vac, 50/60Hz). Additionally, the demo board can achieve high efficiency, low standby power loss and precise constant current and constant voltage control (CC/CV).

1. Input Rectification and EMI filtering

The circuit input stage is composed by the components of F1, VR1, CX1, LF1 and BD1. F1, VR1, CX1 and LF1 provide the inrush current limitation and Surge protection in the event of component failure, Surge or short circuit event. CX1, LF1 and EC1 are used to guarantee conducted and Radiated EMI to meet EN55022B Standard. The bridge diode of BD1 rectifies the AC input to DC output, which is followed by a bulk capacitor EC1.

2. DCM CV/CC Regulator KP2123DP Operation

IC1 is KP2123DP, which is a high-performance DCM Primary Side Regulation (PSR) Regulator with high precision CV/CC control ideal for STB Power Supply applications.

R5, R6, R14, D2, C3 are used as VDD power supply for KP2123. R1, R12 and R13 are resistor divider for detecting output voltage by sampling FB Pin voltage on primary winding voltage. R10 and R11 are sensing resistors to set CC current. R7, R9, C1, D1 compose RCD snubber circuit to depress the drain-source voltage spike.



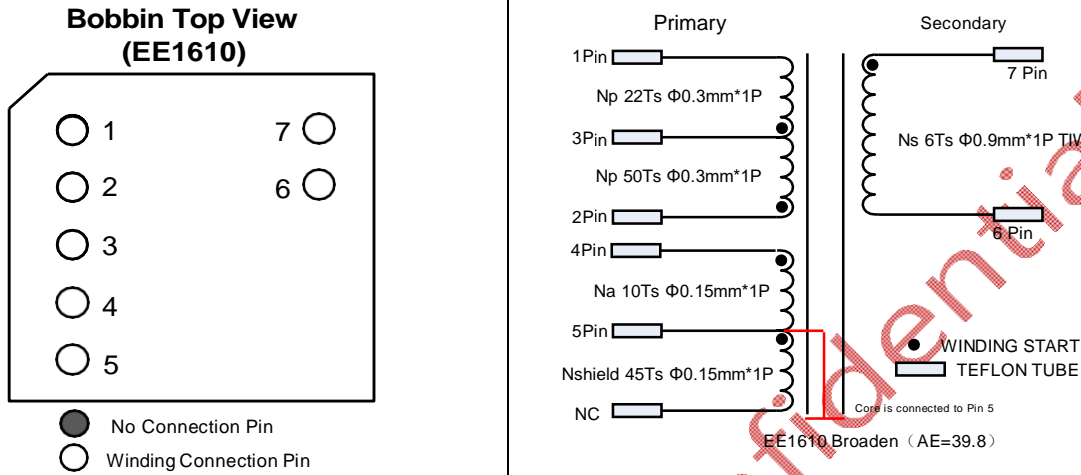
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Bill of Material

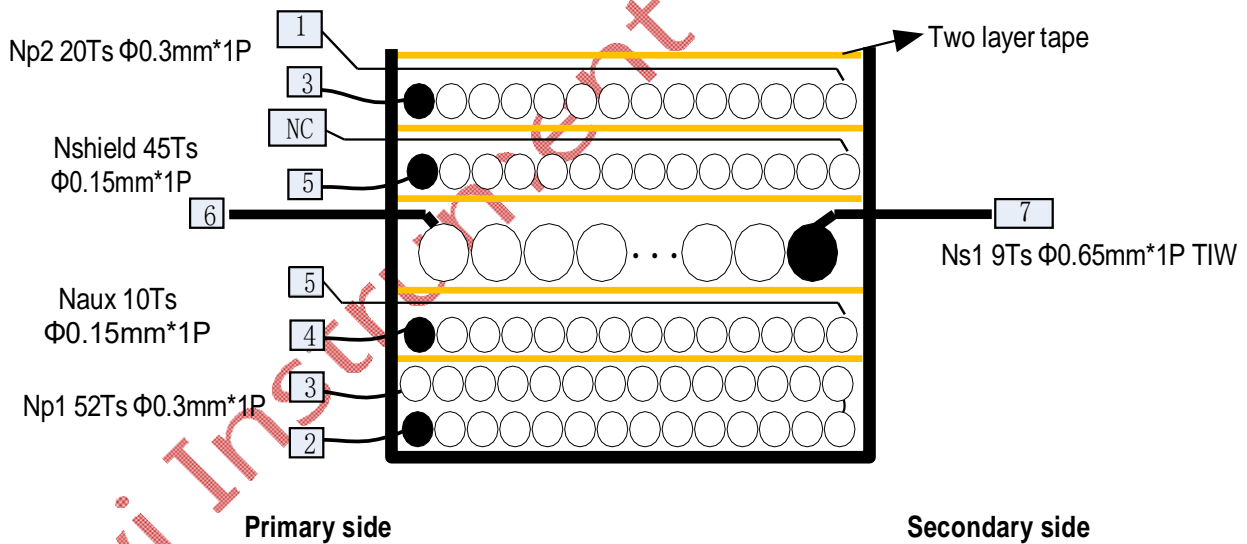
No.	Designator	Value	Description	Package	Manufacturer	Part Number
1	BD1	1kV/1A	Diode Bridge	ABS	Any	ABS10
2	C1	1nF/1kV	Ceramic Cap, 1kV X7R	1206	Murata	
3	C2	1nF/100V	Ceramic Cap, 100V X7R	0805	Murata	
4	C3	3.3uF	Electrolytic Cap, 50V,5*11.5	TH	Any	
5	C6	1nF/100V	Ceramic Cap, 100V X7R	0805	Murata	
6	C7	2.2uF	Ceramic Cap, 50V X7R	0805	Murata	
7	C10	22pF/1KV	Ceramic Cap, 1kV X7R	1206	Murata	
8	CX1	100nF	MKP62,275Vac~X2,P=10mm,T=8mm	TH	Fala	
9	CY1	1.5nF/400V	CD/Y1 Y5U Cap,400VAC,P=10mm,T=5.0mm	TH	STE	
10	D1	1kV/1A	1.0 AMP SILICON RECTIFIERS	SMA	Any	1N4007
11	D2	F7	Fast Recovery Rectifiers	SOD123	YEA SHIN	FF1MS
12	D4	20A/80V	Dual Schottky Barrier Diode	TO-220	PFC	PFC20L80CT
13	EC1	33uF/400V	Electrolytic Cap, 400V,13*20	TH	JFEN	
14	EC3	1000uF	Electrolytic Cap, 16V,10*16	TH	Aishi	
15	EC4	1000uF	Electrolytic Cap, 16V,10*16	TH	Aishi	
16	F1	T3.15A/250V	Fuse 250V/3.15A	TH	Any	
17	LF1	25mH	UU9.8,L=25mH,D=0.3mm	UU9.8	Any	
18	R1	15k	Film Resistor, 5%	0805	Yageo'	
19	R5	3M	Film Resistor, 5%	1206	Yageo'	
20	R6	3M	Film Resistor, 5%	1206	Yageo	
21	R7	470K	Film Resistor, 5%	1206	Yageo	
22	R8	25R	Film Resistor, 5%	0805	Yageo	
23	R9	51R	Film Resistor, 5%	805	Yageo	
24	R10	1R	Film Resistor, 1%	1206	Yageo	
25	R11	1R	Film Resistor, 1%	1206	Yageo	
26	R13	2.4K	Film Resistor, 5%	0805	Yageo	
27	R14	1R	Film Resistor, 5%	0805	Yageo	
28	R15	10R	Film Resistor, 5%	0805	Yageo	
29	R21	6.2K	Film Resistor, 5%	0805	Yageo	
30	VR1	7D471	Varistor · 7D471	TH	STE	
31	R21	6.2K	Film Resistor, 5%	0805	Yageo	
32	VR1	7D471	Varistor · 7D471	TH	STE	
33	IC1	KP2123DP	PSR DCM CC/CV Regulator	DIP-8	Kiwi	

Transformer Manufacture Guide

1. Electrical Diagram



2. Winding Diagram





3. Winding Order

Number	Winding	Layer	Start	End	Wire Size	Turns	Note
1	Np1	Primary	2	3	0.3d*1P	52T	Dense
2	Np2	Auxiliary	4	5	0.15d*1P	10T	Spread
3	Ns1	Secondary	7	6	0.6d*1P	9T	Dense
4	Np3	Shield	5	-	0.15d*1P	45T	Dense
5	Np4	Primary	3	1	0.3d*1P	22T	Dense

4. Electrical Specification

Items	Test Condition	Test Pin	Specification
Primary Inductance	Measured at 40kHz, 1.0 VRMS	Pins 1 - 2, all other windings open,	1.0mH±5%
Primary Leakage Inductance	Measured at 40kHz, 1.0 VRMS	Pins 1 - 2, all other windings shorted,	15uH Max
HI-POT HV Test	3000Vac/50Hz, One minute	Primary to Secondary	3000Vac,5mA
	1500Vac/50Hz, One minute	Primary to Core	1500Vac,5mA
	1500Vac/50Hz, One minute	Secondary to Core	1500Vac,5mA
Insulation Resistance	500Vdc	All windings to core	100M Ω Min
	500Vdc	Between windings	100M Ω Min
DC Resistance	-	Pins 1 -2	1R Max

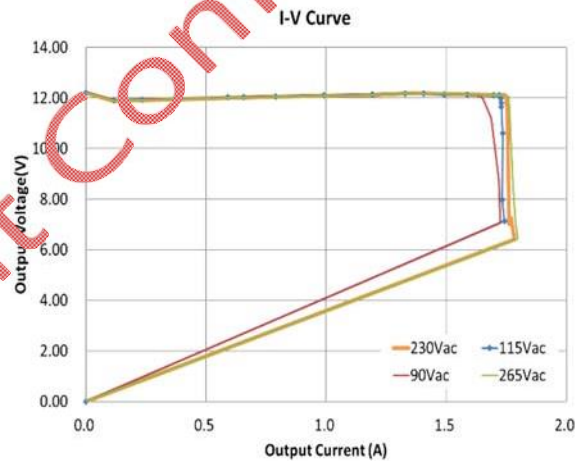
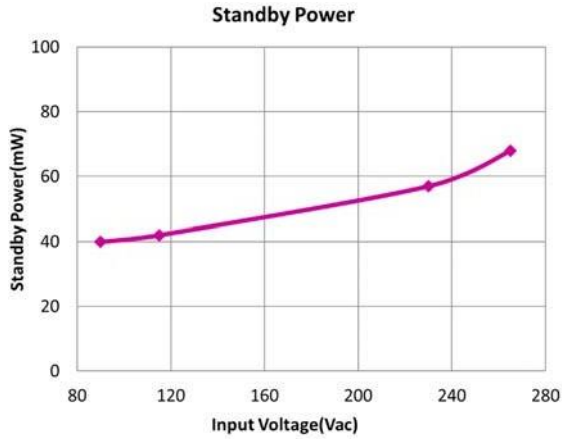
5. Transformer BOM

Items	Description
1	Core: EE16 Broaden, PC44 or equivalent, AE=39.8
2	Bobbin: EE1610, 5+2 Pin
3	Wire: Φ0.3mm, 2UEW, Class B
4	Wire: Φ0.15mm, 2UEW, Class B
5	Triple Insulation Wire: Φ0.65mm TIW
6	Tape: 10mm(W)×0.06mm(TH)



Test Result

1. Test Data---I-V Curve, Efficiency and Standby Power



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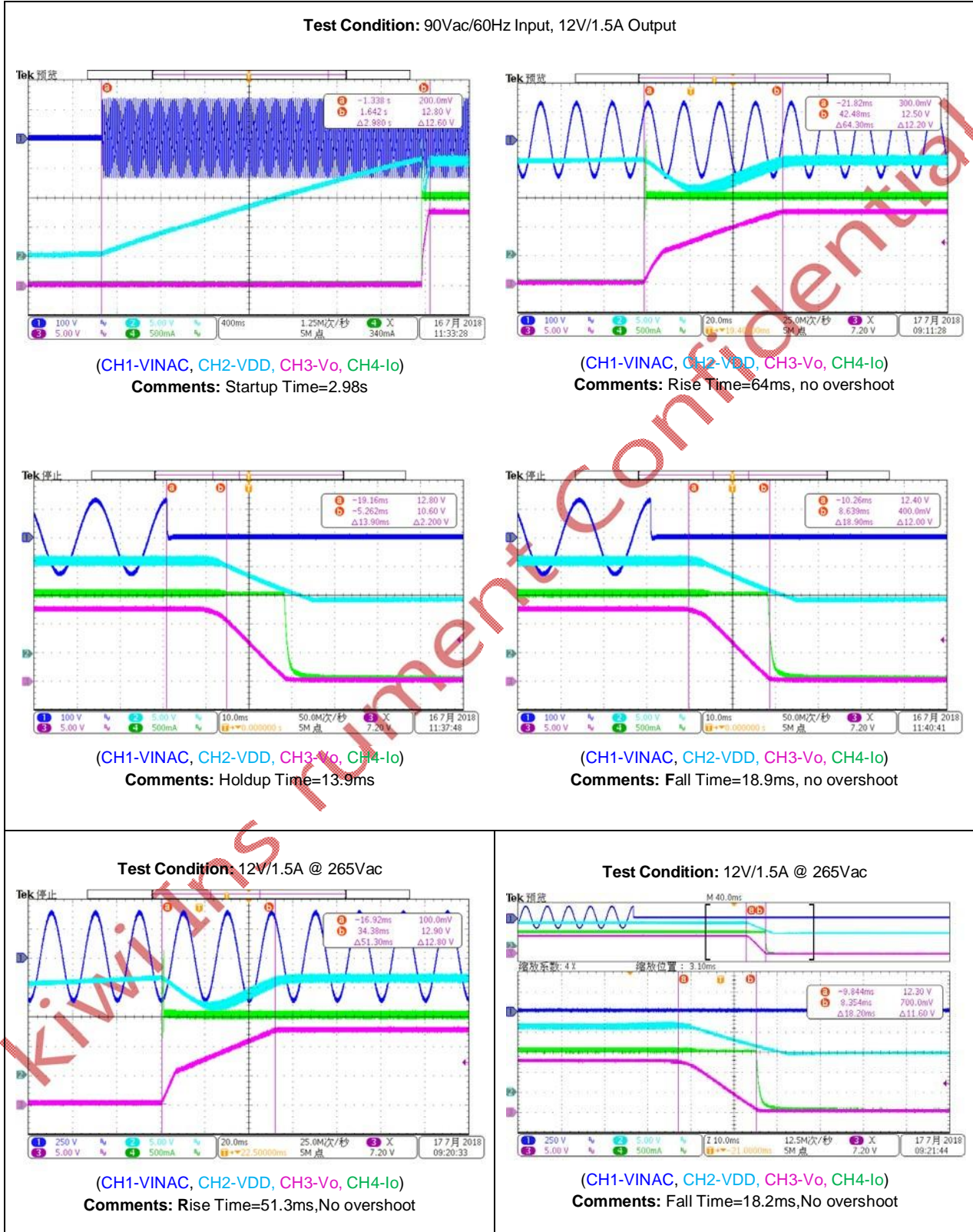
Input Power			Board End					Line End						
Vin(Vac)	Fline(Hz)	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Eff(%)	Eff_AVG(%)	Vout(V)	Iout(A)	Pout(W)	Eff(%)	Eff_AVG(%)	CoC V5(%)	Pno(mW)
90	60	2.07	11.94	0.15	1.79	86.52	/	11.91	0.15	1.79	86.30	/	75.45	40
		5.16	12.04	0.375	4.52	87.50	86.68	11.96	0.375	4.49	86.92	85.40	85.45	
		10.5	12.19	0.75	9.14	87.07		12.05	0.75	9.04	86.07			
		16.08	12.34	1.125	13.88	86.33		12.12	1.125	13.64	84.79			
		21.73	12.43	1.5	18.65	85.80		12.14	1.5	18.21	83.80			
115	60	2.07	11.94	0.15	1.79	86.52	/	11.91	0.15	1.79	86.30	/	75.45	42
		5.13	12.04	0.375	4.52	88.01	87.74	11.96	0.375	4.49	87.43	86.41	85.45	
		10.41	12.2	0.75	9.15	87.90		12.05	0.75	9.04	86.82			
		15.85	12.35	1.125	13.89	87.66		12.12	1.125	13.64	86.03			
		21.35	12.44	1.5	18.66	87.40		12.15	1.5	18.23	85.36			
230	50	2.15	11.93	0.15	1.79	83.23	/	11.89	0.15	1.78	82.95	/	75.45	57
		5.22	12.03	0.375	4.51	86.42	87.46	11.95	0.375	4.48	85.85	86.13	85.45	
		10.43	12.19	0.75	9.14	87.66		12.04	0.75	9.03	86.58			
		15.79	12.34	1.125	13.88	87.92		12.11	1.125	13.62	86.28			
		21.24	12.44	1.5	18.66	87.85		12.15	1.5	18.23	85.81			
265	50	2.18	11.91	0.15	1.79	81.95	/	11.89	0.15	1.78	81.81	/	75.45	68
		5.28	12.02	0.375	4.51	85.37	86.84	11.94	0.375	4.48	84.80	85.53	85.45	
		10.5	12.18	0.75	9.14	87.00		12.04	0.75	9.03	86.00			
		15.86	12.33	1.125	13.87	87.46		12.1	1.125	13.61	85.83			
		21.32	12.44	1.5	18.66	87.52		12.15	1.5	18.23	85.48			

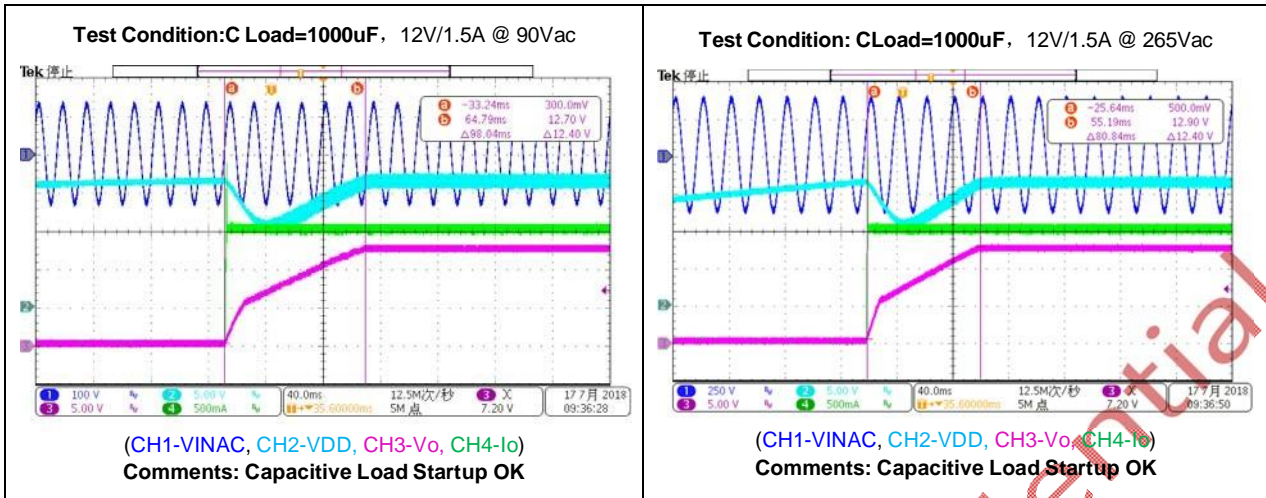
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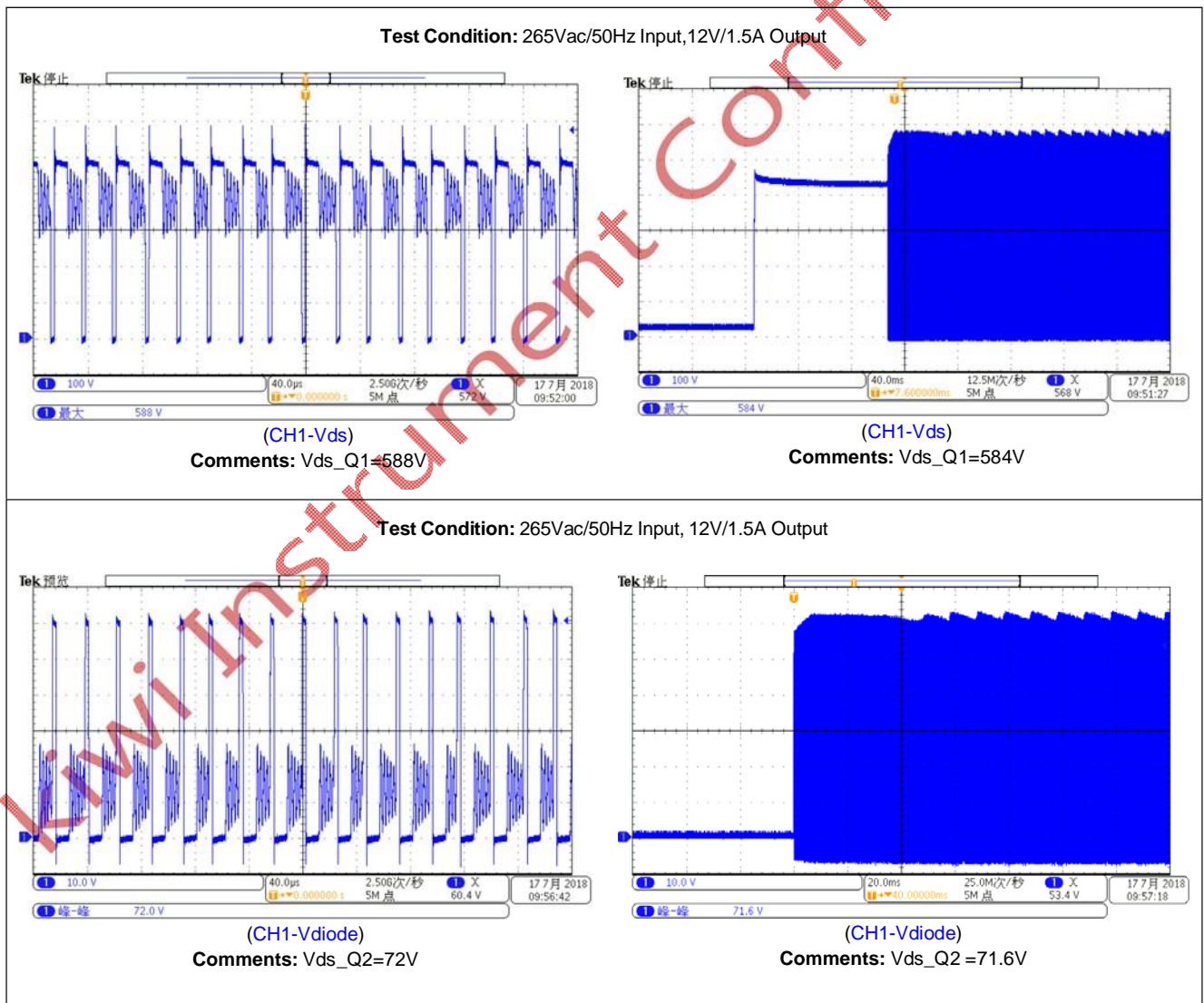
2. Operation Curves

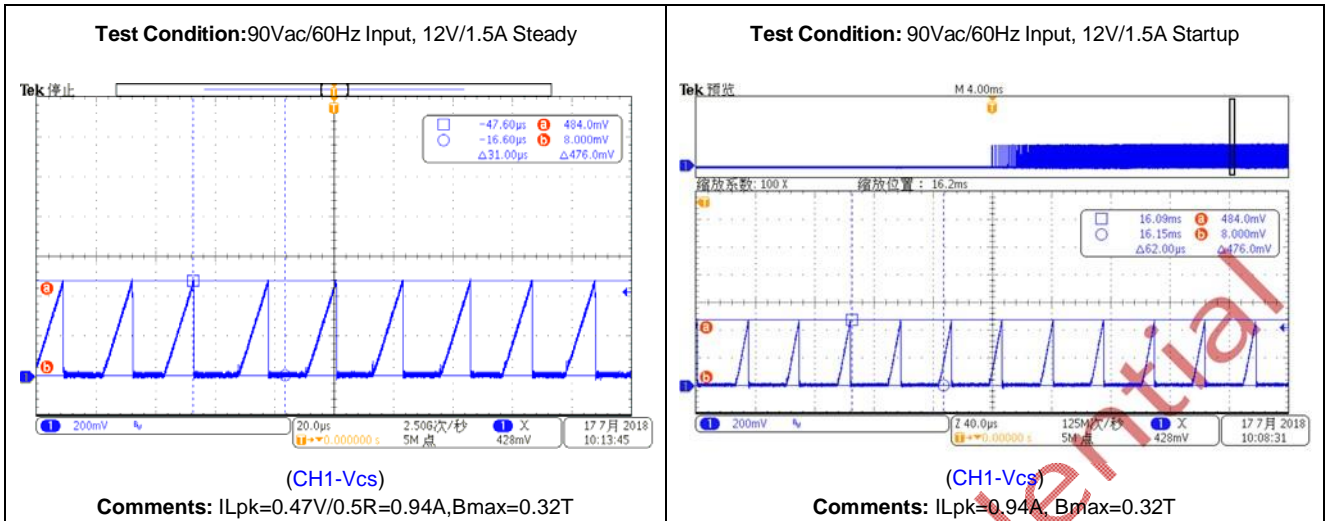
1) Startup and Shutdown Test



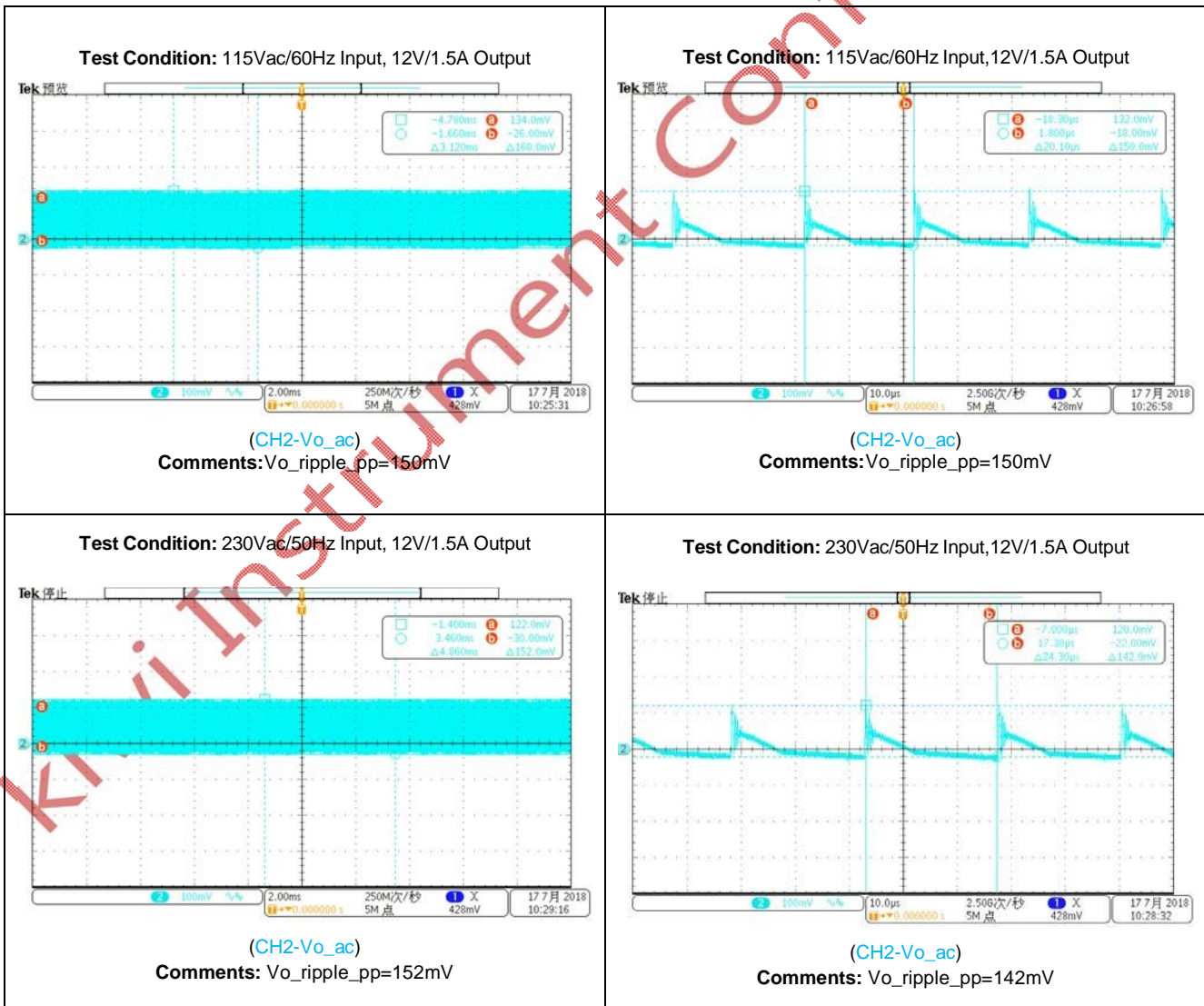


2) Device Maximum Rating Test



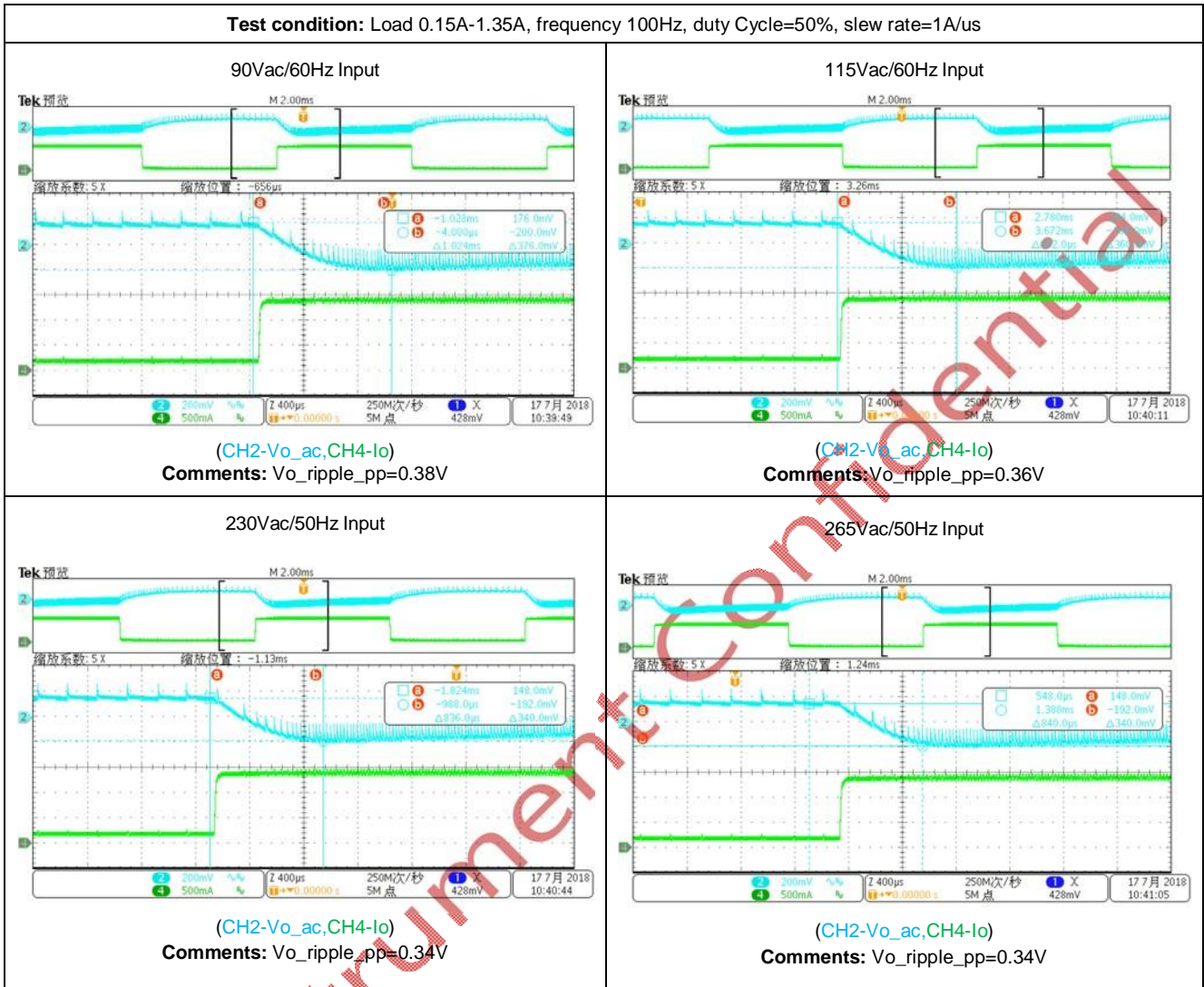


3) Output Ripple Test



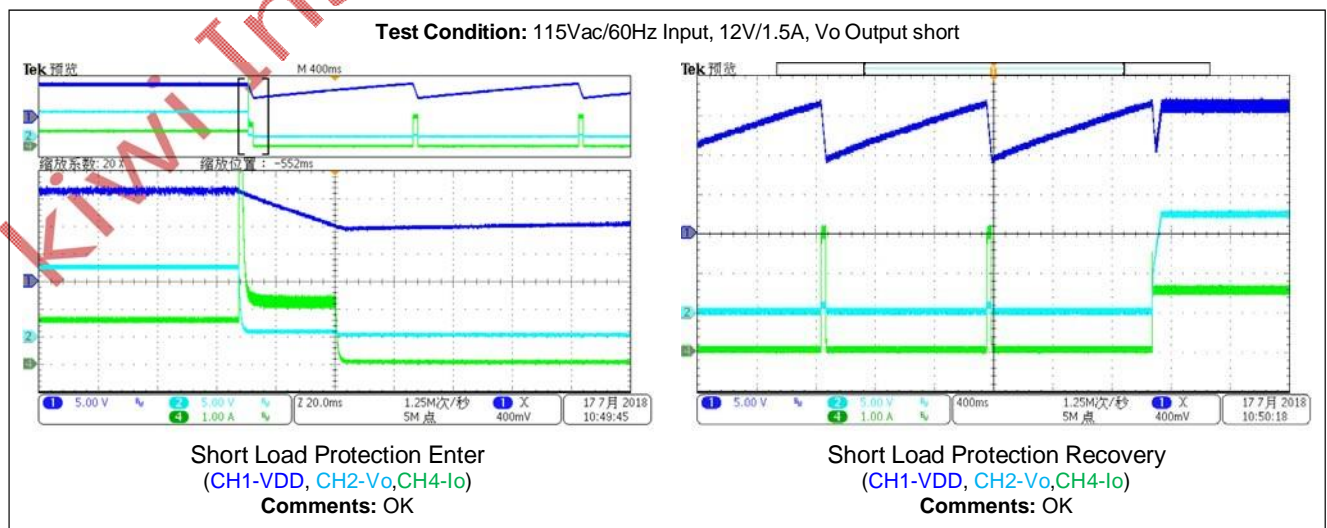
4) Load Transient Test

Test condition: Load 0.15A-1.35A, frequency 100Hz, duty Cycle=50%, slew rate=1A/us



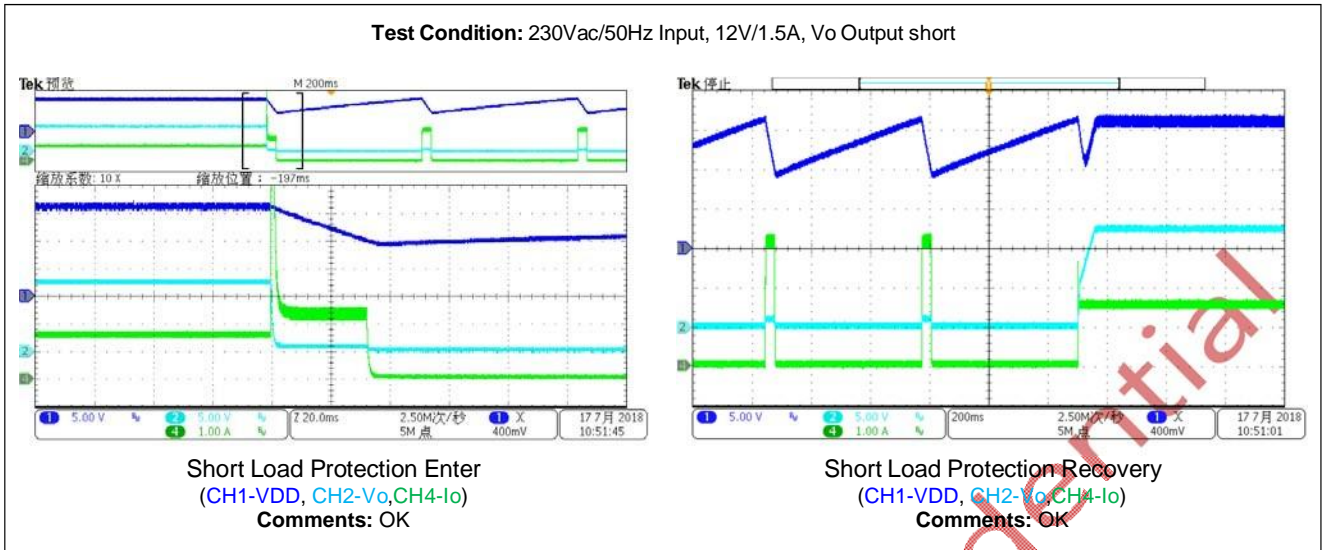
5) Over Load Protection Test

Test Condition: 115Vac/60Hz Input, 12V/1.5A, Vo Output short

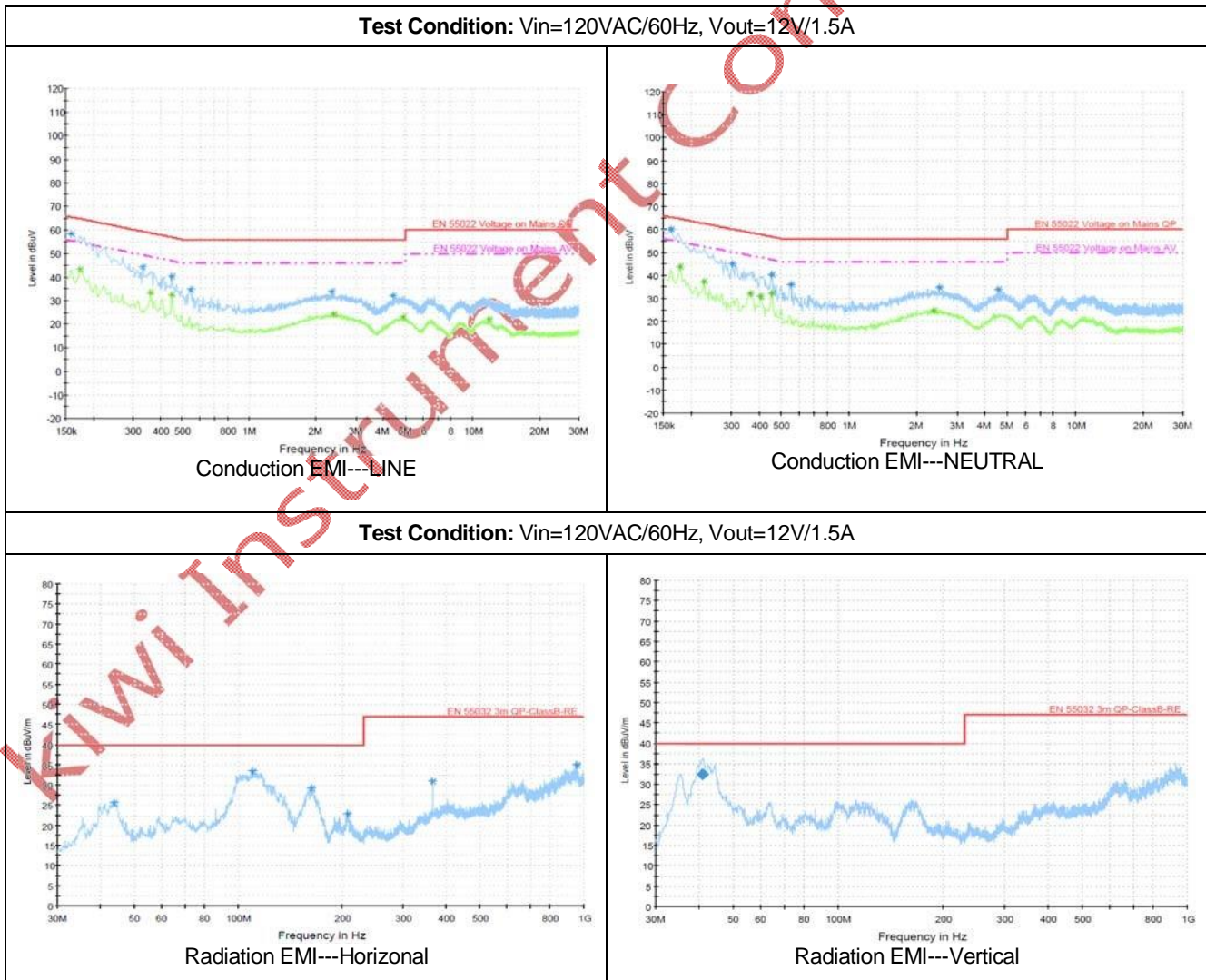




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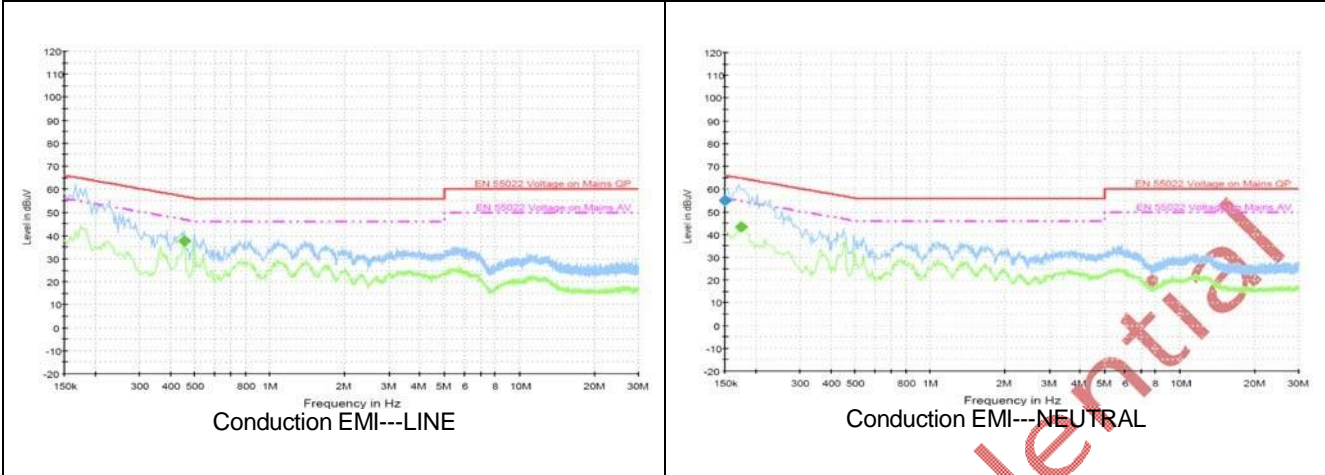
3. EMC Test Result



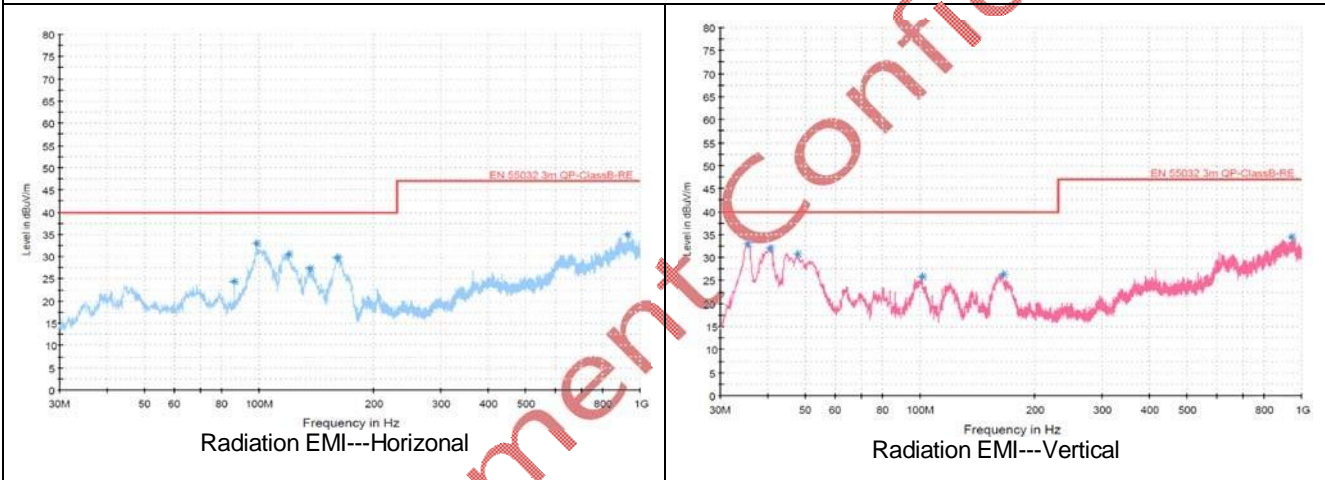


**Demo Board Test Report --- 12V1.5A Off-line Adapter Using PSR
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Test Condition: Vin=230VAC/50Hz, Vout=12V/1.5A



Test Condition: Vin=230VAC/50Hz, Vout=12V/1.5A



4. Thermal Test

90Vac/60Hz, 265Vac/50Hz; 12V/1.5A output; Burn-in 1Hour @ confined container and steady environment with no airflow. Test container's inside ambient temperature (Ta) while device thermal checking.

Component	90Vac		265Vac	
	Ta (Container's inside Temp.) =40 °C		Ta (Container's inside Temp.) Ta=43°C	
	Tc(°C)	Trise(°C)	Tc(°C)	Trise(°C)
Bulk Cap	91.8	51.8	85.1	42.1
PFC20L80	99.4	59.4	103.6	60.6
KP2123DP	108.7	68.7	103.4	60.4
Transformer Core	99.3	59.3	104.1	61.1





5. Surge Test

Line to Line 2kV surge testing was completed according to IEC61000-4-5. Input voltage was set at 230VAC/50Hz. Output was loaded at full load and operation was verified following each surge event. Each injection phase below is tested with 5 times and hold for 60seconds before next one.

Input Voltage (VAC)	Surge Level (V)	Injection Location	Injection Phase (°)	Test Result (Pass/Fail)
230Vac/50Hz	+2000	L to N	0	Pass
	+2000	L to N	90	Pass
	+2000	L to N	180	Pass
	+2000	L to N	270	Pass
	-2000	L to N	0	Pass
	-2000	L to N	90	Pass
	-2000	L to N	180	Pass
	-2000	L to N	270	Pass

6. ESD Test

Input 220Vac/50Hz, Output 12V-1.5A. Discharge 10 times on each output terminals at each test voltage according to IEC61000-4-2..

Air Discharge		Contact Discharge	
Test Voltage (kV)	Air Discharge	Test Voltage (kV)	Contact Discharge
13	Pass	6	Pass
-13	Pass	-6	Pass
14	Pass	7	Pass
-14	Pass	-7	Pass
15	Pass	8	Pass
-15	Pass	-8	Pass



7. EFT Test

Input 220Vac/50Hz, Output 12V-1.5A. According to IEC61000-4-4, set EFT pulse as 15ms operation time with every 300ms cycle, Trise=50ns, Thold=50ns, Operation frequency Fsw=5kHz.

Input Voltage (VAC)	EFT Peak Voltage (V)	Injection Location	Frequency(kHz)	Test Result (Pass/Fail)
230Vac/50Hz	+1000	L to N	5	Pass
	+1000	L to N	5	Pass
	-1000	N to L	5	Pass
	-1000	N to L	5	Pass

8. Voltage Dip Test

Input 220Vac/50Hz, Output 12V-1.5A. Set voltage dips test according to IEC61000-4-11:2017 as below.

CLASS	Test Level and duration for voltage dips(50 Hz/60 Hz)				
CALSS 3	0% during 1/2 cycle	0% during 1 cycle	40% during 10/12 cycle	70% during 25/30 cycle	80% during 250/300 cycle
25/30 means 25 cycles for 50Hz Test, 30 cycles for 60Hz Test.					

Test Result is classified as below:

A: Normal performance within limits specified by the manufacturer, requestor or purchaser;

B: Temporary loss of function or degradation of performance, which ceases after the disturbance ceases, and from which the equipment under test recovers its normal performance, without operation intervention;

C: Temporary loss of function or degradation of performance, the correction of which requires operator intervention;

D: Loss of function or degradation of performance which is not recoverable, owing to damage to hardware or software, or loss of data.

Test Result: A (A/B/C/D)



Test Setup Guide

1. Connect the "V+", "V-" terminal to the positive and negative end of the load.
2. Set the AC Power Source between 90VAC and 265VAC.
3. Connect the AC Power Source terminal to the "L" and "N" terminals on the Demo Board
4. Turn on the AC Power Source to make system startup; and Turn off the AC Power Source to make system shutdown.

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Revision History

DATE	REV	DESCRIPTION
2018/07/17	1.0	First Release

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