DEMO BOARD TEST REPORT

Universal Input -5V/200mA Output Buckboost Regulator Using KP3110

FEATURES

- High Precision -5V Default Output
- Integrated with 500V MOSFET and High Voltage Startup Circuit
- Ultra Low System BOM Cost Buck Solution
- On/Off Peak Current Mode Control
- Less than 50mW Standby Power
- Built-in 31kHz Oscillator with Frequency Shuffling
- Built-in Soft Start
- Very Low VDD Operation Current
- Built-in Protections:
  - Over Load Protection (OLP)
  - On-Chip Thermal Shutdown (OTP)
  - Cycle-by-Cycle Current Limiting (OCP)
  - Leading Edge Blanking (LEB)
  - VDD UVLO

INTRODUCTION

KP3110 is a low cost, highly integrated PWM power switch for non-isolated buck and buck-boost applications. KP3110 combines a 500V power MOSFET with On/Off Peak Current Control Mode. KP3110 has built-in green mode control for light and zero loadings, which can achieve less than 50mW standby power.

The Demo Board of KP3110-D03 is typically designed for the application of -5V/200mA with universal input (90-265Vac, 60/50Hz). Besides the multi-protection function, KP3110-D03 demo also has very good efficiency, line & load regulation, low standby power loss and meets the EN55032 Class B conducted and radiated EMI requirement.

APPLICATIONS

- **Electric Cooker, Fan, Hair Straightener.**

DEMO BOARD SEPCIFICATION

Description	Symbol	Min	Type	Max	Unit	Note
Input Voltage	Vin	90		265	Vac	
Output Voltage	Vout		-5		Vdc	
Output Current	Iout		200		mA	
Output Power	Pout			1	W	
Efficiency	η	60	65		%	Typical value tested at 230Vac/50Hz
Standby Power Consumption	Pst			50	mW	@265Vac
Startup Time	Tst			50	ms	Tested at 90Vac/60Hz
Surge		1			kV	Typical value tested at 230Vac/50Hz

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

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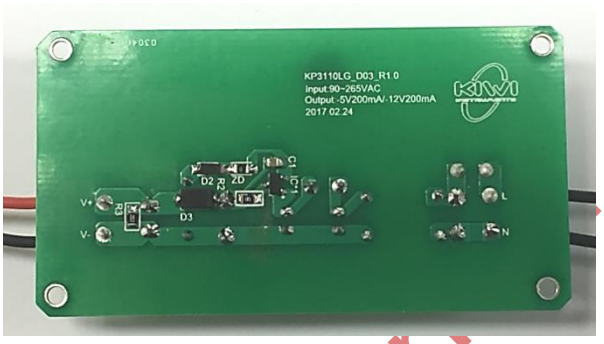
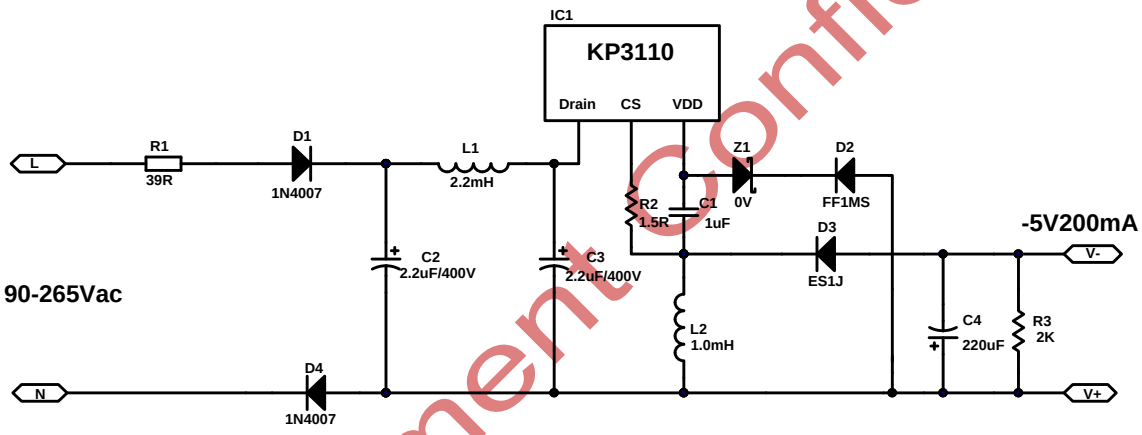
Demo Board of KP3110-Buckboost-D03



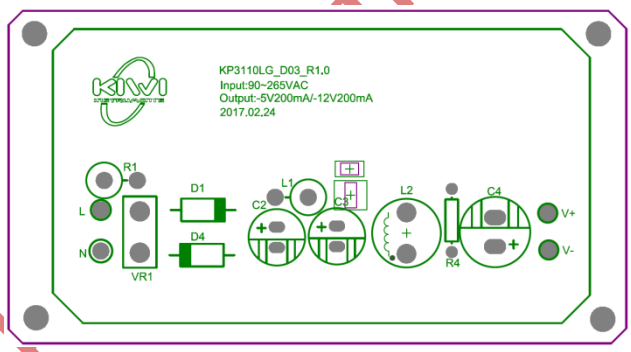
Board Size(in mm): L x W x H=74 x 40 x 16

Schematic

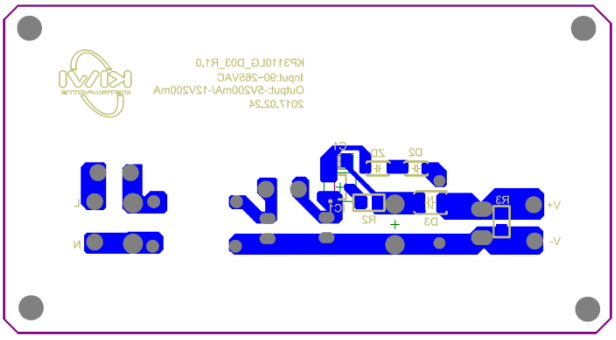


Printed Circuit Board Layout

Top Layer



Bottom Layer



Circuit Description

The demo board of KP3110-D03 is designed with Non-isolated Buckboost topology, which simplifies the circuit and saves BOM cost. Additionally the demo board can achieve high efficiency, low standby power loss and good Line & Load regulation.

1. Input Rectification and EMI filtering

The circuit input stage is composed by the components of R1, D1, D4, L1, C2 and C3. R1 provides the inrush current limitation in the event of component failure or a short circuit. L1, C2 and C3 together provide the differential and common mode EMI filtering. The value of C2 and C3 also determine the Surge Test performance. D1 and D4 rectify AC input to DC value.

2. KP3110 Operation

KP3110 combines a high voltage power MOSFET switch with power controller in one chip. It is optimized for off-line non-isolated buck or buck-boost applications for small home appliances and linear regulator replacement. The IC utilizes the ON/OFF current mode PWM control to regulate a 5V default output with high precision and lowest components count.

The current limit circuit samples the voltage on R2. When the sampled differential voltage exceeds the internal threshold, the power MOSFET is turned off for the remainder of that cycle. An internal leading edge blanking circuit is built in. During this blanking period (300ns, typical), the cycle-by-cycle current limiting comparator is disabled and cannot switch off the GATE driver

PWM switching frequency in KP3110 is fixed to 31 kHz. To improve system EMI performance, KP3110 operates the system with +-5% frequency shuffling around setting frequency. The practical system switching frequency is determined by the load condition and the comparison of VDD voltage over output reference, which cause system works in the pulse-skipping mode.

3. Output Voltage Regulation

IC1, D3, C4 and L2 compose the typical Buckboost converter. D2, Z1 and C1 are used as the Output Voltage Detection Circuit when L in demagnetization stage. The IC utilizes the ON/OFF current mode PWM control to regulate a -5V default output with high precision and lowest components count.

Bill of Material

No.	Designator	Value	Description	Package	Manufacturer	Part Number
1	C1	1uF	Ceramic Cap, 25V X7R	0805	TDK	C2012X7R1E105K
2	C2	2.2uF	Electrolytic Cap, 400V,6.3*12	TH	Any	
3	C3	2.2uF	Electrolytic Cap, 400V,6.3*12	TH	Any	
4	C4	220uF	Electrolytic Cap, 50V,8*11.5	TH	Jianghai	ECR1HBK101M□□080011
5	D1	1KV/1A	1.0 Amp Silicon Rectifiers	DO41	Any	1N4007
6	D2	1KV/1A	Fast Recovery Rectifiers	SOD123	YEA SHIN	FF1MS
7	D3	600V/1A	1.0 Amp Surface Mount Super-Fast Recovery Rectifiers	SMA	Lision Tech	ES1J
8	D4	1KV/1A	1.0 Amp Silicon Rectifiers	DO41	Any	1N4007
9	IC1	KP3110	High Performance Low Cost Off-line PWM Power Switch	SOT23-3	Kiwi instruments	KP3110LGA
10	L1	2.2mH	Color Code Inductor, Isat=0.15mA,0510	TH	Any	
11	L2	1mH	WE-TI Inductor, Isat=0.30A,Rdc=1.67Ω,8*10	TH	Wurth Elektronik	744772102
12	R1	39R	Fuse Resistor,1W	TH	Any	
13	R2	1.5R	Film Resistor, 1%	0805	Yageo	RC0805JR-071R5L
14	R3	2K	Film Resistor, 5%	0805	Yageo	RC0805JR-072KL

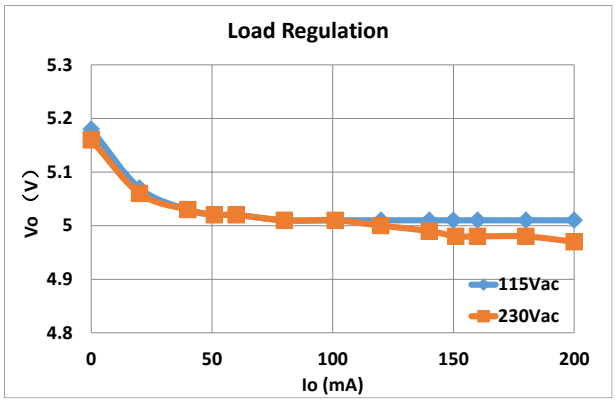
Test Result

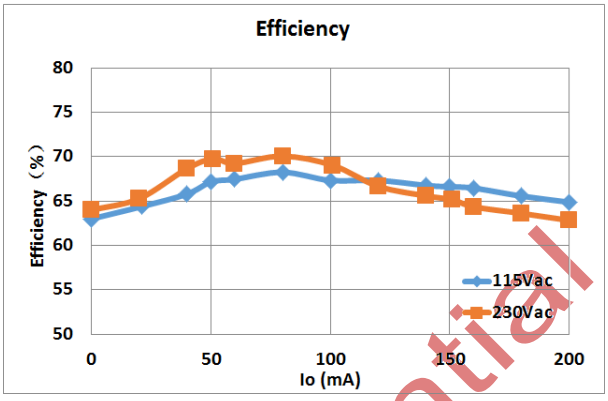
1. Load & Line Regulation

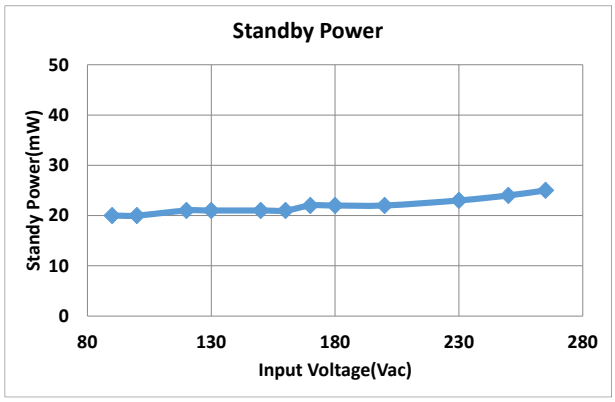
Vin(Vac)	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Load Reg.
90	5.18	5.09	5.06	5.04	5.04	5.03	5.03	5.03	5.03	5.03	5.03	3.00%
115	5.18	5.07	5.03	5.02	5.01	5.01	5.01	5.01	5.01	5.01	5.01	3.40%
230	5.16	5.06	5.03	5.02	5.01	5.01	5.00	4.99	4.98	4.98	4.97	3.80%
265	5.16	5.08	5.05	5.04	5.03	5	4.98	4.97	4.95	4.94	4.93	4.60%
Line Reg.	0.40%	0.60%	0.60%	0.40%	0.60%	0.60%	1.00%	1.20%	1.60%	1.80%	2.00%	

2. Efficiency and Standby Power Loss

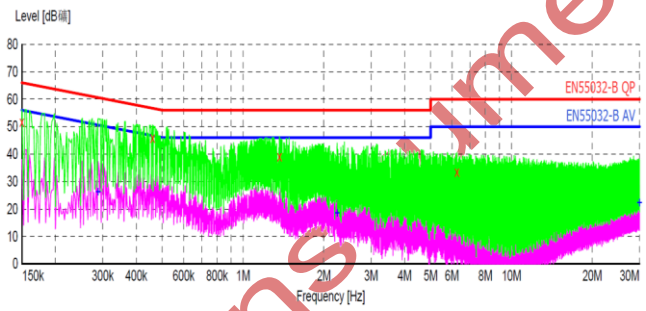
Vin	Load Ratio	Io_cal(mA)	Io(mA)	Vo	Pin	Efficiency	平均效率	Standby Loss
90Vac	25%	50	50	5.05	0.376	67.17%	66.50%	20mW
	50%	100	100	5.03	0.747	67.34%		
	75%	150	150	5.03	1.133	66.61%		
	100%	200	200	5.03	1.551	64.88%		
115Vac	25%	50	50	5.02	0.371	67.65%	67.22%	21mW
	50%	100	100	5.01	0.725	69.10%		
	75%	150	150	5.01	1.125	66.80%		
	100%	200	200	5.01	1.534	65.32%		
230Vac	25%	50	50	5.02	0.367	68.39%	66.08%	23mW
	50%	100	100	5.01	0.733	68.35%		
	75%	150	150	4.98	1.154	64.73%		
	100%	200	200	4.97	1.582	62.83%		
265Vac	25%	50	50	5.05	0.376	67.15%	64.01%	25mW
	50%	100	100	5	0.762	65.65%		
	75%	150	150	4.96	1.186	62.74%		
	100%	200	200	4.93	1.629	60.52%		



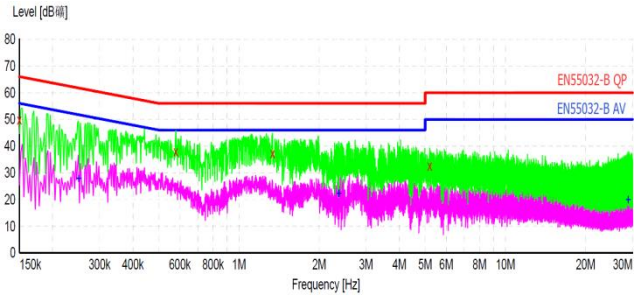




3. EMC Test Result (Test Condition: Vin=120VAC/60Hz, Vout=-5V, Io=200mA)

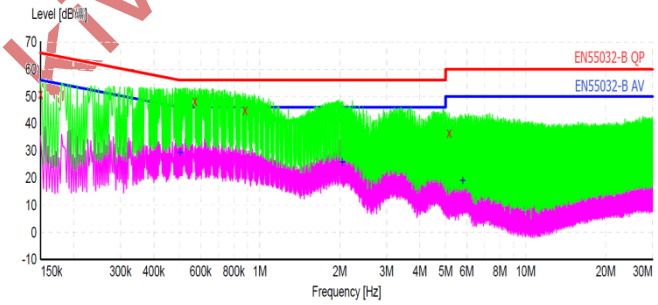


Conduction EMI---LINE

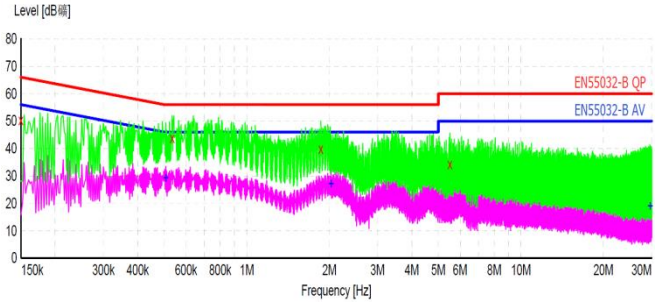


Conduction EMI---NEUTRAL

4. EMC Test Result (Test Condition: Vin=230VAC/50Hz, Vout=-5V, Io=200mA)

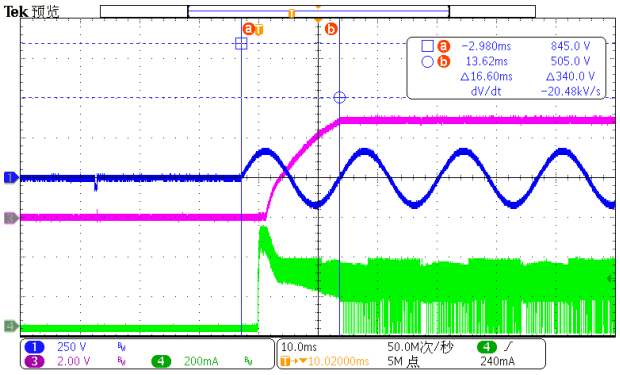


Conduction EMI---LINE



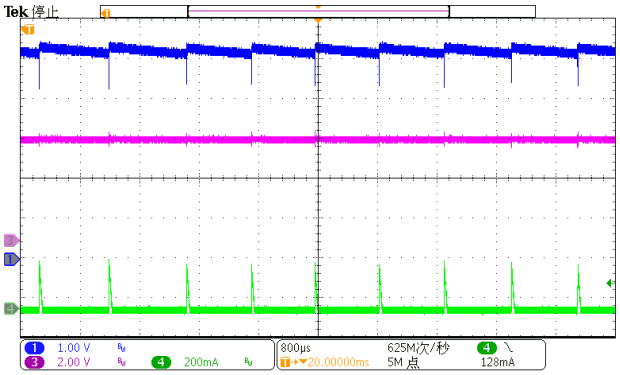
Conduction EMI---NEUTRAL

5. Operation Curves (Test Condition: Vin=120VAC/60Hz, Vout=-5V, Io=200mA)

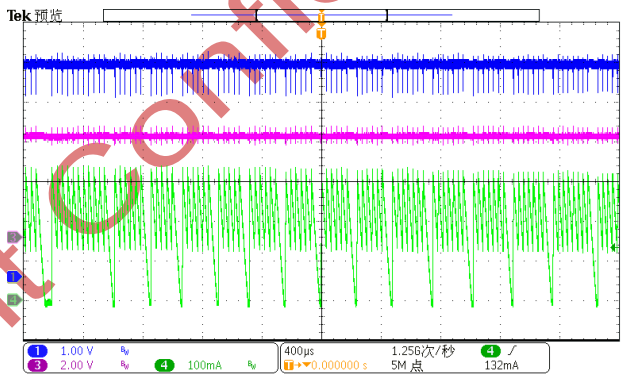


System Startup Time
(CH1-VINAC, CH2-VO,CH4-IL)

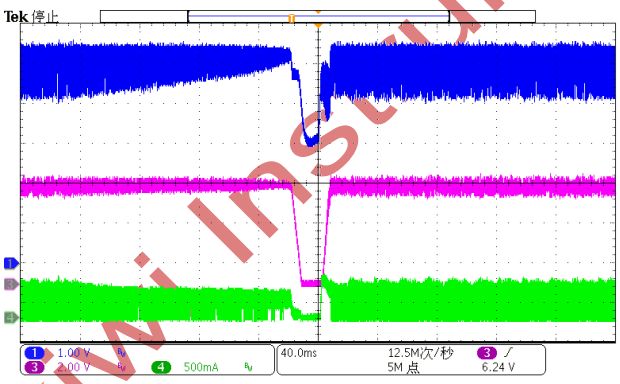
System Shut Down
(CH1-VDD, CH2-VO,CH4-IL)



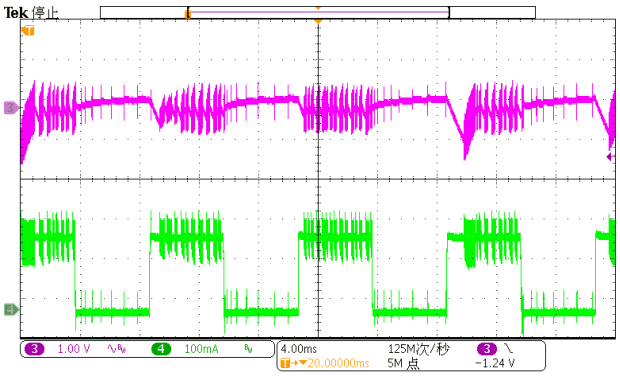
System Steady State(No Load)
(CH1-VDD, CH2-VO,CH4-IL)



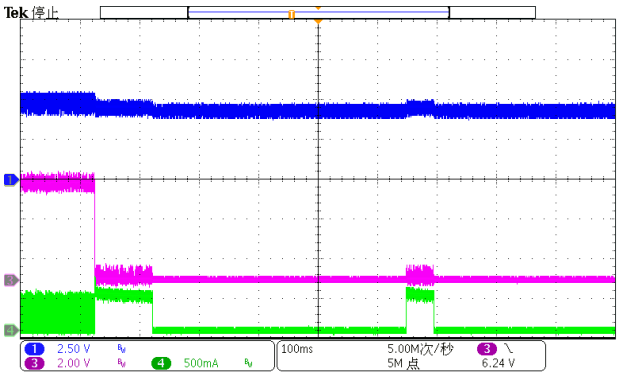
System Steady State(Full Load)
(CH1-VDD, CH2-VO,CH4-IL)



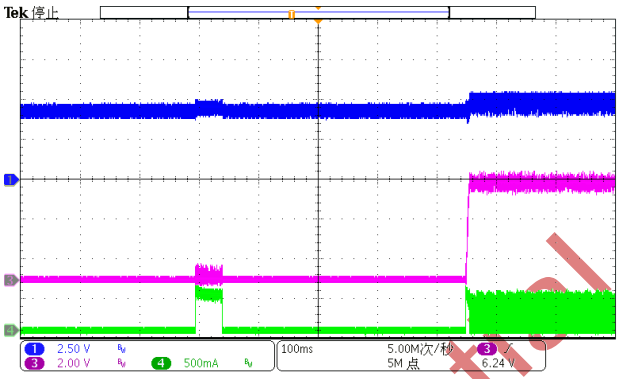
Fast Power On/Off
(CH1-VDD, CH2-VO,CH4-IL)



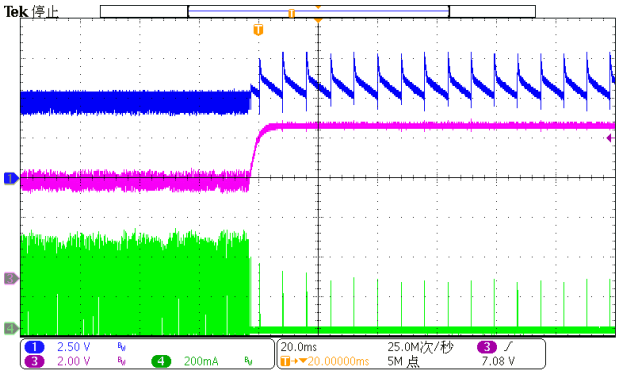
Load Transient(50mA-200mA,0.5A/us)
(CH2-Vo ripple, CH4-Io)



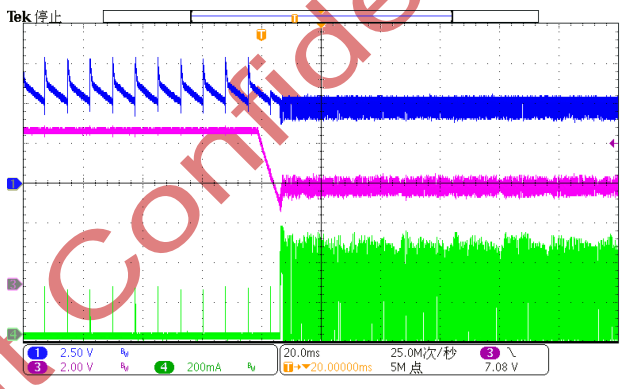
Short Load Protection
(CH1-VDD, CH2-VO,CH4-IL)



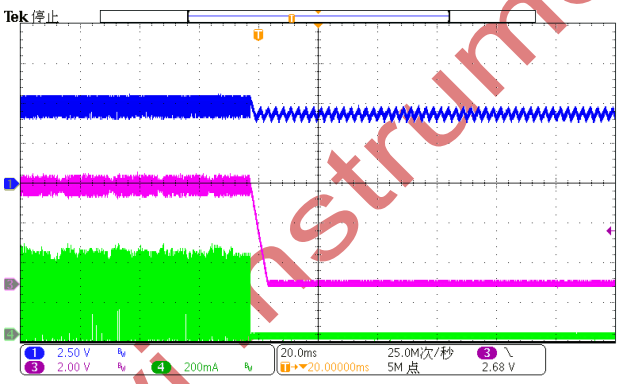
Short Load Protection Recovery
(CH1-VDD, CH2-VO,CH4-IL)



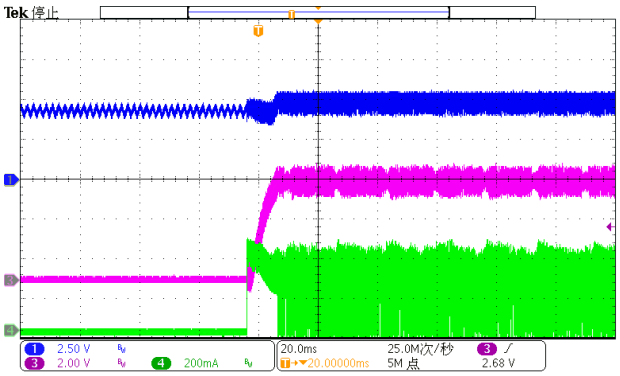
Over Voltage Protection
(CH1-VDD, CH2-VO,CH4-IL)



Over Voltage Protection Recovery
(CH1-VDD, CH2-VO,CH4-IL)

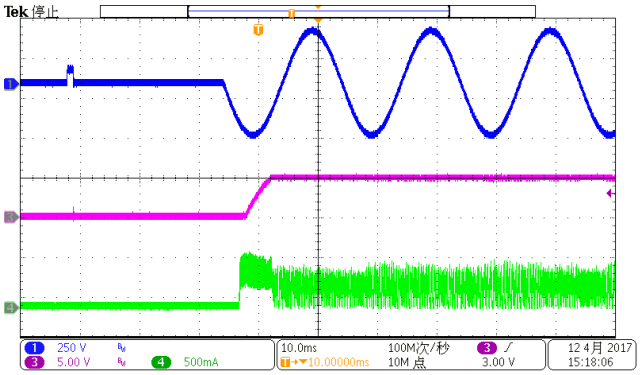


Over Temperature Protection
(CH1-VDD, CH2-VO,CH4-IL)

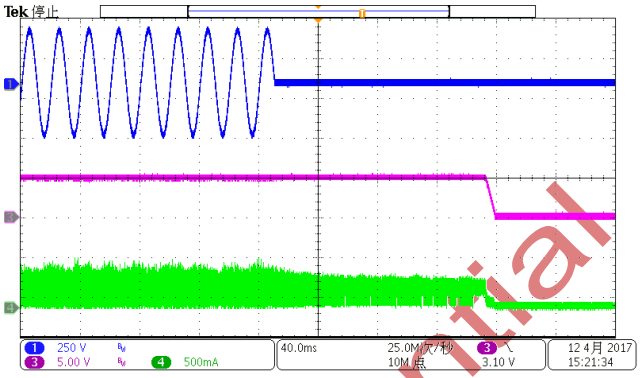


Over Temperature Protection Recovery
(CH1-VDD, CH2-VO,CH4-IL)

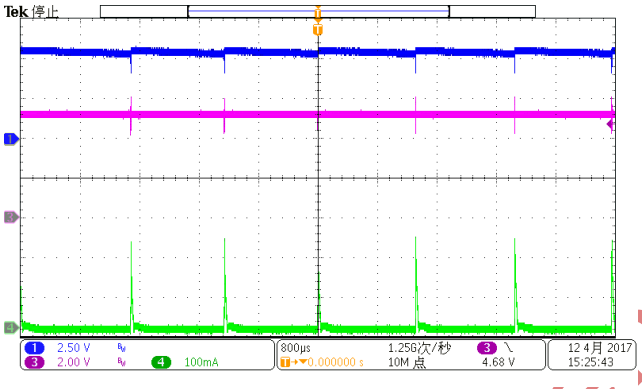
6. Operation Curves (Test Condition: Vin=230VAC/50Hz, Vout=-5V, Io=200mA)



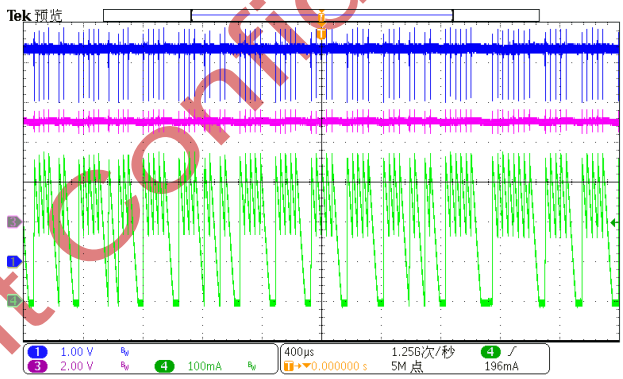
System Startup Time
(CH1-VINAC, CH2-VO,CH4-IL)



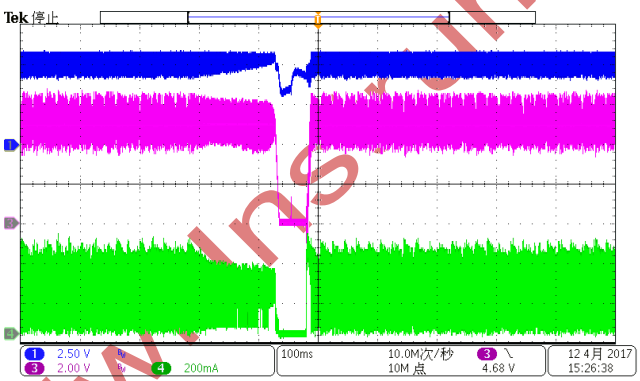
System Shut Down
(CH1-VINAC, CH2-VO,CH4-IL)



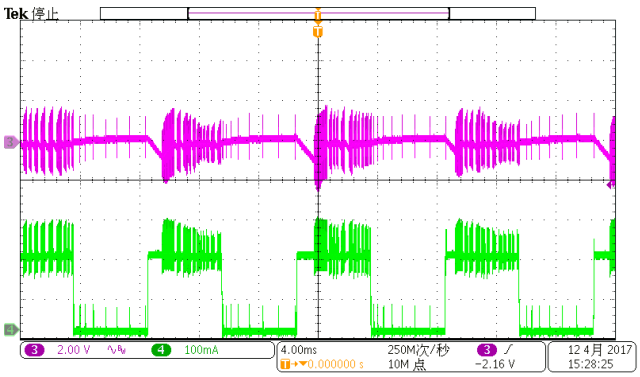
system Steady State(No Load)
(CH1-VDD, CH2-VO,CH4-IL)



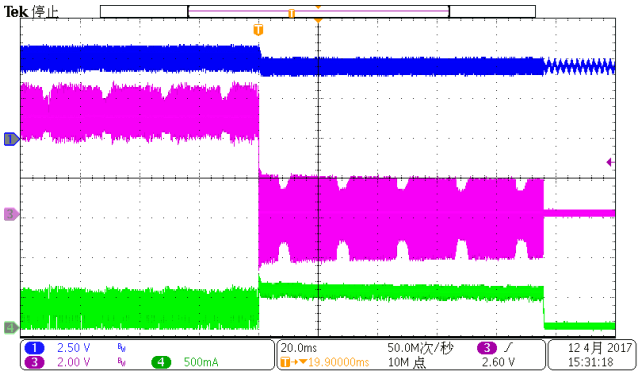
System Steady State(Full Load)
(CH1-VDD, CH2-VO,CH4-IL)



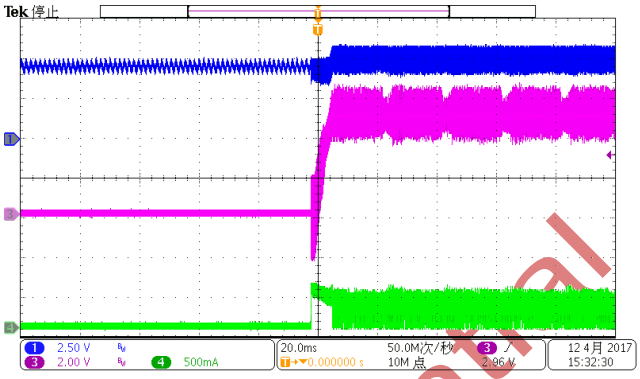
Fast Power ON/OFF
(CH1-VDD, CH2-VO,CH4-IL)



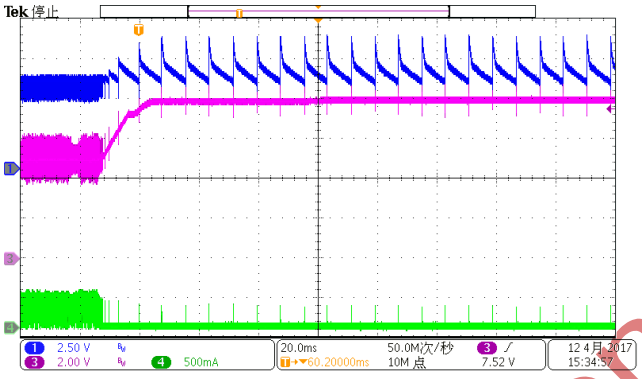
Load Transient(50mA-200mA,0.5A/us)
(CH2-Vo ripple, CH4-Io)



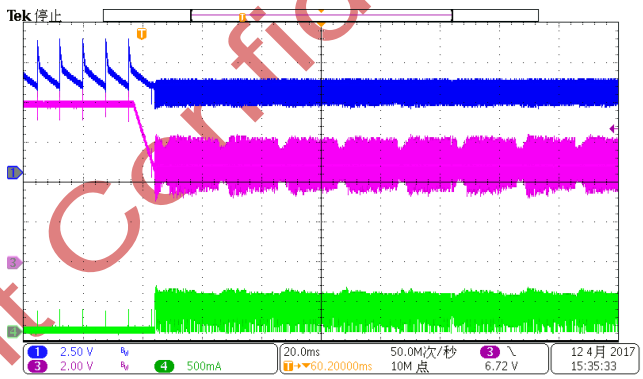
Short Load Protection
(CH1-VDD, CH2-VO,CH4-IL)



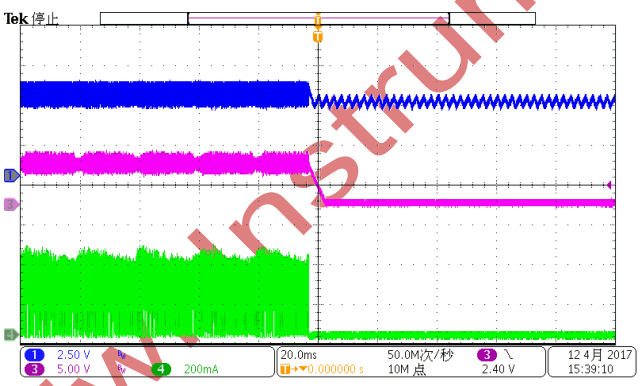
Short Load Protection Recovery
(CH1-VDD, CH2-VO,CH4-IL)



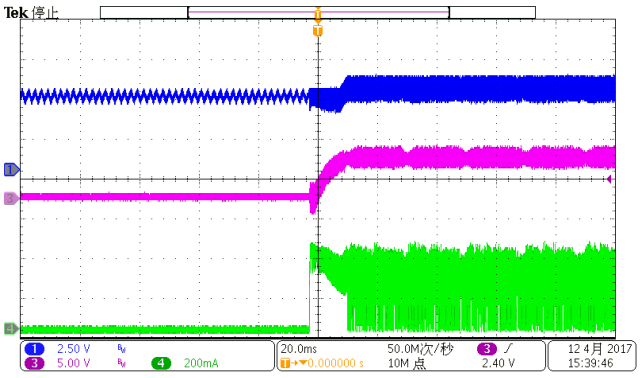
Over Voltage Protection
(CH1-VDD, CH2-VO,CH4-IL)



Over Voltage Protection Recovery
(CH1-VDD, CH2-VO,CH4-IL)



Over Temperature Protection
(CH1-VDD, CH2-VO,CH4-IL)



Over Temperature Protection Recovery
(CH1-VDD, CH2-VO,CH4-IL)

Test Setup Guide

1. Connect the “V+” and “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.

Revision History

DATE	REV	DESCRIPTION
2017/04/27	1.0	First Release

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