DEMO BOARD TEST REPORT

Universal Input High Performance Dual Output 8W Buck Regulator Using KP3211

FEATURES

- High Precision 18V& 5V Dual Output
- Integrated with 650V MOSFET and High Voltage Startup Circuit
- Ultra-Low System BOM Cost Buck Solution
- Multi-Mode Control with Audio Noise Free Operation
- Less than 70mW Standby Power
- Green Mode Operation for High Efficiency
- Good Line and Load Regulation
- Built-in Soft Start
- Build in Protections:
  - Over Load Protection (OLP)
  - Cycle-by-Cycle Current Limiting (OCP)
  - Output OVP
  - VDD OVP,UVLO & Clamp
  - On-Chip Thermal Shutdown (OTP)

INTRODUCTION

KP3211 is a high performance Switch Mode Power Supply Switcher for low power off-line application with minimum components in typical buck solution. The multi-mode PWM control is integrated to simplify circuit design and achieve good line &load regulation without audio noise generated. The peak current limit changes according to the real load condition for low standby power in no load.

The Demo Board of KP3211-D01 is typically designed for the application of 18V/400mA&5V/100mA with universal input (90-265Vac, 60/50Hz).Besides the multi-protection function, this demo also has very good efficiency, line & load regulation, low standby power loss and meets the EN55022-ClassB conducted and radiated EMI requirement.

APPLICATIONS

- **Electric Cooker, Fan, Home Appliance**

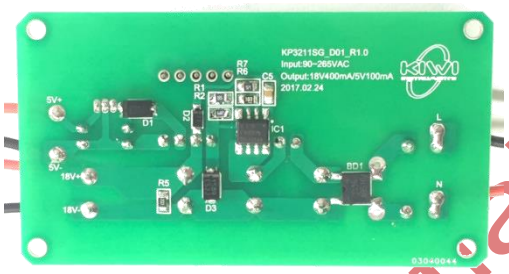
Description	Symbol	Min.	Typ.	Max.	Unit	Note
Input Voltage	Vin	90		265	Vac	50/60Hz
Output Voltage1	Vout1	17.5	18	18.3	Vdc	
Output Voltage2	Vout2		5		Vdc	5V LDO Regulator
Output Current1	Iout1		400	450	mA	Output1 OCP Current >450mA
Output Current2	Iout2		100		mA	
Total Output Power	Pout		7.7		W	
System Efficiency	η	>75			%	@Full Load
Standby Power Consumption	Pst			55	mW	@265Vac
Startup Time	Tst			60	ms	Tested at 90Vac/60Hz
Surge Test		2			kV	Typical differential surge value tested at 230Vac/50Hz

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

Kiwi Instruments Confidential

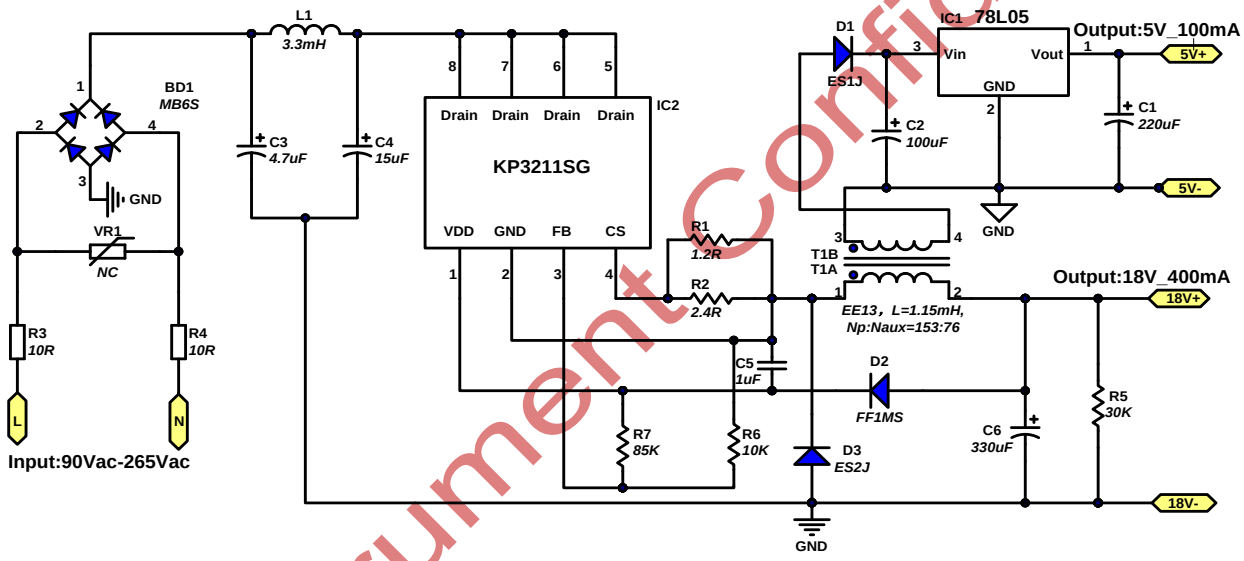
Kiwi Instruments Corp.
Tel: +86-18681585060 E-mail: wyq@cokinic.com
www.cokinsemi.com

Demo Board of KP3211-D01-R1.0



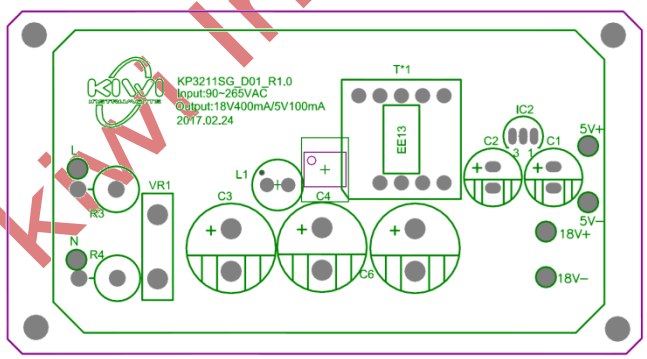
Board Size(in mm): L x W x H=74 x 40 x 16

Schematic

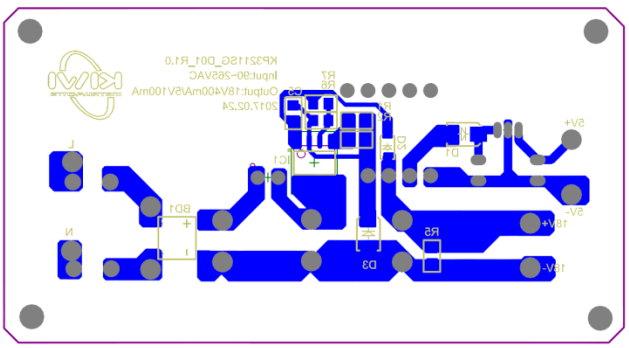


Printed Circuit Board Layout

Top Layer



Bottom Layer



Kiwi Instrument Confidential

Circuit Description

The demo board of KP3211-D01 is designed with Non-isolated Buck 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 of the components of R3, R4, BD1, L1, C3 and C4. R3 and R4 provide the inrush current limitation in the event of component failure or short circuit. L1, C3 and C4 together provide the differential and common mode EMI filtering. The value of C3 and C4 also determine the Surge Test performance. The bridge diode of BD1 rectifies the AC input to DC output, which is followed by anEMI Filter Circuit.

2. KP3211 Operation

KP3211 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 in small home appliances. The IC utilizes the multi-mode PWM control to regulate an 18V output with high precision, lowest components count and no audio noise generated.

The current limit circuit samples the voltage on R1 and 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

To meet the tight requirement of averaged system efficiency and no load power consumption, a hybrid of frequency modulation (FM) and amplitude modulation (AM) is adopted in KP3211. Around the full load, the system operates in FM mode. When normal to light load conditions, the IC operates in FM+AM mode to achieve excellent regulation and high efficiency. When the system is near zero loading, the IC operates in FM again for standby power reduction. In this way, the no-load consumption can be less than 70mW.

3. Output Voltage Regulation

IC2, T1, C6 and D3 compose the typical Buck converter. D2 and C5 are used as the Output Voltage Detection Circuit when T1 in demagnetization stage. The IC utilizes the multi-mode PWM control to regulate an 18V output with high precision, lowest components count and no audio noise generated. In addition, the main inductor coupling Winding rectification generates the 5V LDO Output.

Kiwi Instrument Confidential

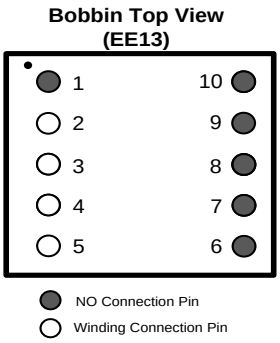
Bill of Material

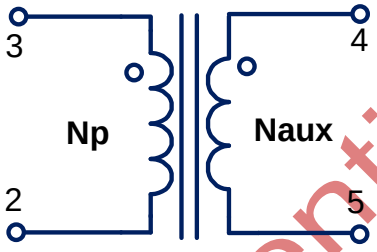
No.	Designator	Value	Description	Package	Manufacturer	Part Number
1	BD1	600V/0.5A	SINGLE PHASE SILICON BRIDGE,600V/0.5A	SMD	Any	MB6S
2	C1	220uF	Electrolytic Cap, 10V,6.3*11.5	TH	凯泽电子	
3	C2	100uF	Electrolytic Cap, 25V,6.3*11.5	TH	jianghai	
4	C3	4.7uF	Electrolytic Cap, 400V,8*12	TH	Any	
5	C4	15uF	Electrolytic Cap, 400V,8*12	TH	Any	
6	C5	1uF	Ceramic Cap, 25V X7R	0805	TDK	
7	C6	330uF	Electrolytic Cap, 50V,10*20	TH	jianghai	
8	D1	600V/1A	1.0 AMP Surface Mount Super-Fast Recovery Rectifiers	SMA	Lision Tech	ES1J
9	D2	1KV/1A	Fast Recovery Rectifiers	SOD123	YEA SHIN	FF1MS
10	D3	600V/2A	2.0 AMP Surface Mount Super-Fast Recovery Rectifiers	SMA	Lision Tech	ES2J
11	L1	3.3mH	Color Ring Inductor, Isat=0.16A, 0510	TH	Any	
12	R1	1.2R	Film Resistor, 5%	0805	Yageo	
13	R2	2.4R	Film Resistor, 5%	0805	Yageo	
14	R3	10R	Fuse Power Resistor,1W	TH	Any	
15	R4	10R	Fuse Power Resistor,1W	TH	Any	
16	R5	40k	Film Resistor, 5%	0805	Yageo	
17	R6	10k	Film Resistor, 5%	0805	Yageo	
18	R7	85k	Film Resistor, 5%	0805	Yageo	
19	T1	Inductor	EE13-Horizontal, Lp=1.15mH,Np:Naux=153(0.3mm):76(0.2mm)	EE13-Horizonal	Any	
20	VR1	NC	NC	NC	NC	
21	IC1	78L05	LDO,5V,100mA	TO-92	Any	
22	IC2	KP3211SG	High Performance Low Cost Off-line PWM Power Switch	SOP8	Kiwi instruments	KP3211SG

Kiwi Instrument Confidential

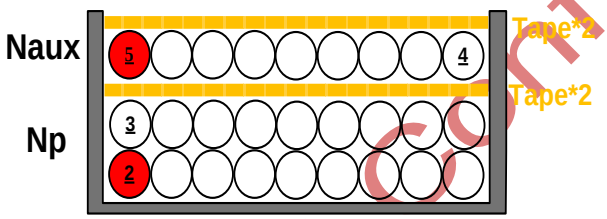
Inductor Manufacture Guide

1. Electrical Diagram





2. Winding Diagram



3. Winding Order

Number	Winding	Layer	Start	End	Wire Size	Turns	Note
1	Np	Primary	2	3	0.3d*1P	153T	紧密绕制
2	Tape					2T	
3	Naux	Auxiliary	5	4	0.2d*1P	76T	紧密绕制
4	Tape					2T	

4. Electrical Specification

Items	Test Condition	Test Pin	Standard
Primary Inductance	measured at 40kHz, 2.0 VRMS	Pins2 – 3; other windings open	1.15mH±5%
Leakage Inductance			
HI-POT HV Test			
Insulation Resistance			
DC Resistance			

Kiwi Instrument Confidential

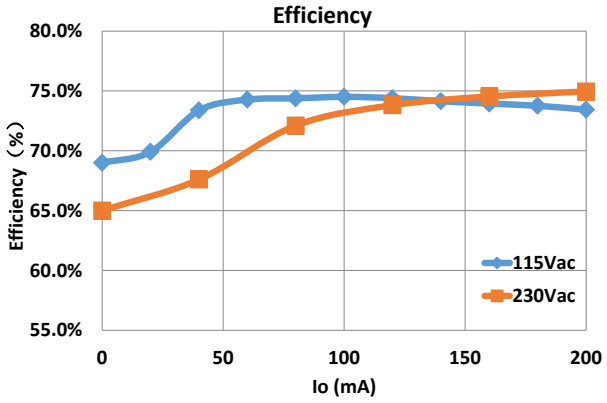
5. Materials

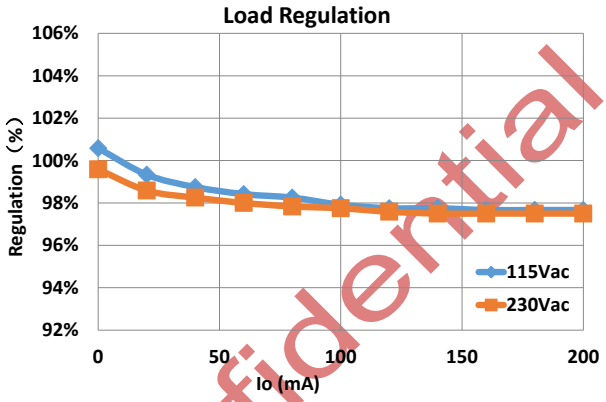
Materials	Descriptions	Remark
Bobbin	EE13, Horizontal, 5/5	
Core	EE13, PC40	
Wire	0.3ϕ/0.2ϕ 2UEW 130℃	
Tape	3M 1350# Polyester Film	

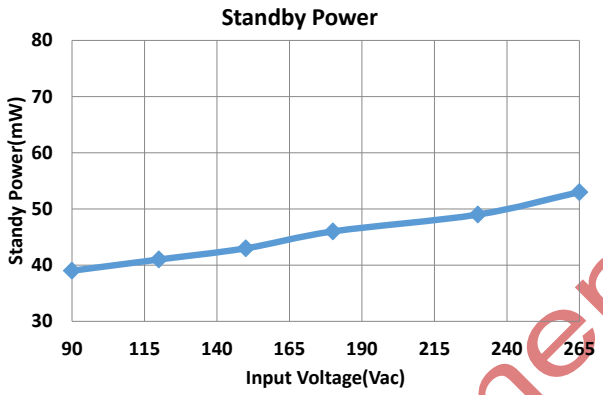
Kiwi Instrument Confidential

Test Result

1. Test Data---18V Load Efficiency(5V No Load),18V Load Regulation(5V No Load)and System Standby Power Loss.





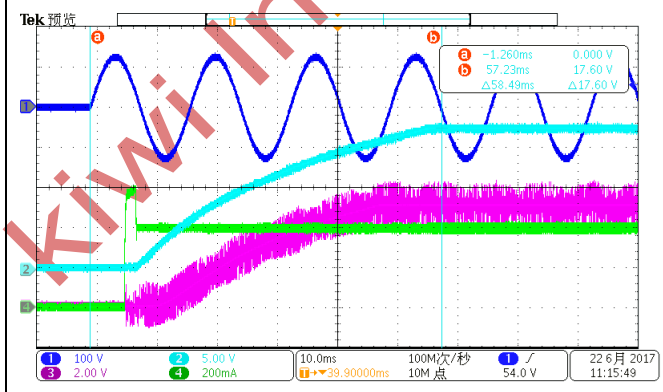


Kiwi Instrument Confidential

2. Operation Curves

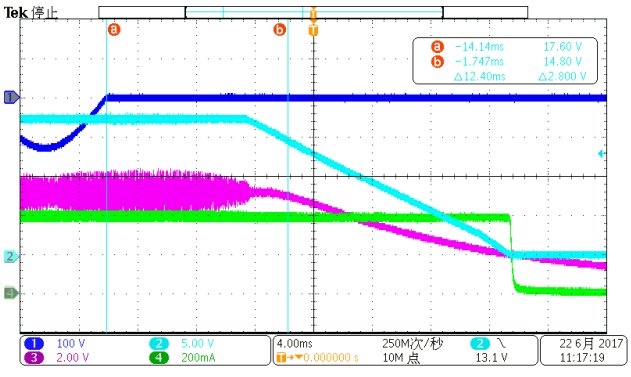
1) Startup and Shutdown Test

Test Condition: 90Vac/60Hz Input, 18V/0.4A 5V/0.1A Output



(CH1-VINAC, CH2-Vo1,CH3-Vo2,CH4-Io)

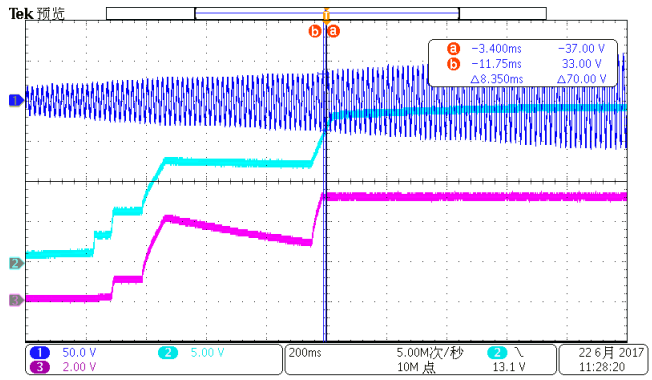
Comments: Startup Time=58ms and No Output Voltage Overshoot



(CH1-VINAC, CH2-Vo1,CH3-Vo2,CH4-Io)

Comments: Holdup Time=~12ms

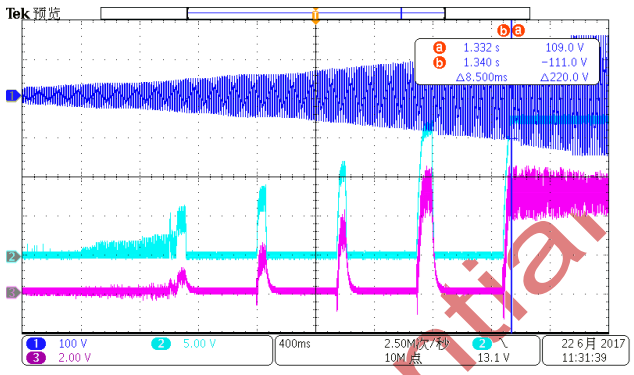
Test Condition: No Load



(CH1-VINAC,CH2-Vo1,CH3-Vo2)

Comments: Vinac Turn Up Voltage=26Vac

Test Condition: Full Load

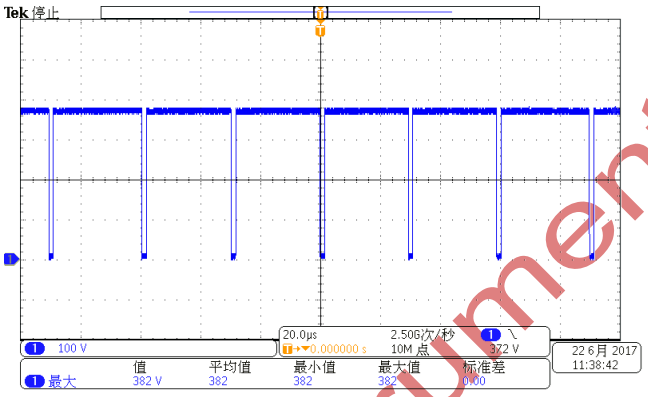


(CH1-VINAC, CH2-Vo1,CH3-Vo2)

Comments: Vinac Turn Up Voltage=78Vac

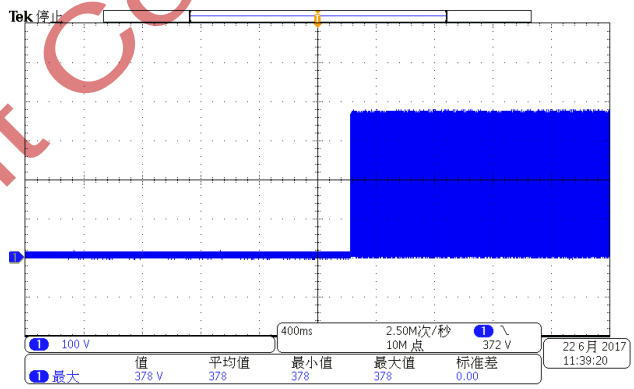
2) Device Maximum Rating Test

Test Condition: 265Vac/50Hz Input, 18V/0.4A 5V/0.1A Output



(CH1-Vds)

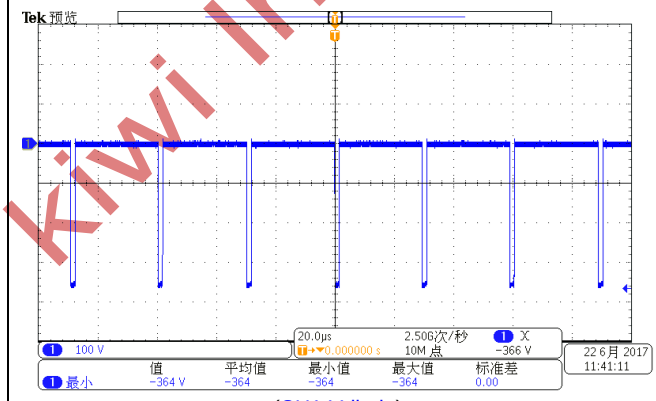
Comments: Vds_max=382V



(CH1-Vds)

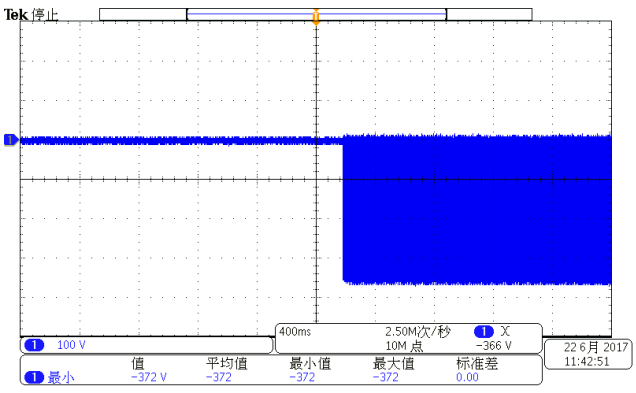
Comments: Vds_max=378V

Test Condition: 265Vac/50Hz Input, 18V/0.4A 5V/0.1A Output



(CH1-Vdiode)

Comments: Vdiode=364V

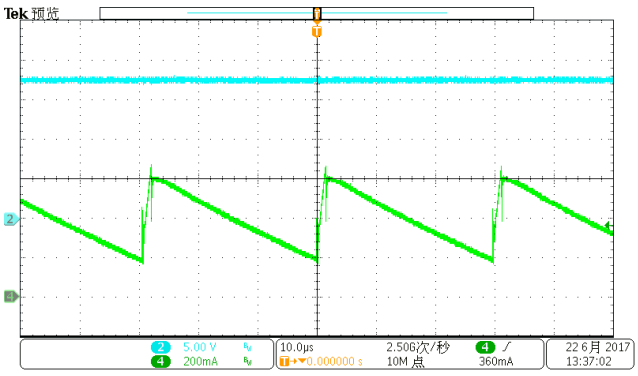


(CH1-Vdiode)

Comments: Vdiode =372V

Kiwi Instrument Confidential

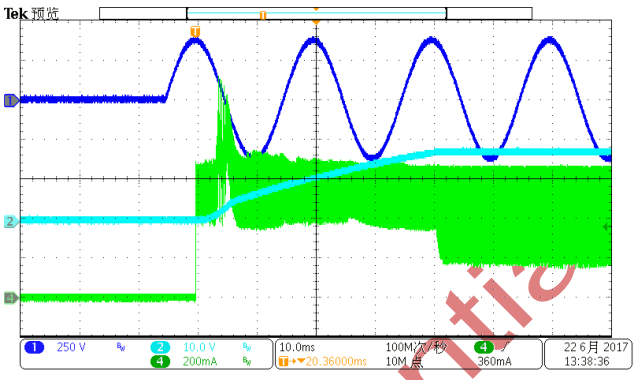
Test Condition: 265Vac/50Hz Input, 18V/0.4A 5V/0.1A Steady



(CH2-Vo1,CH4-IL)

Comments: ILpk=0.6A

Test Condition: 265Vac/50Hz Input, 18V/0.4A 5V/0.1A Startup

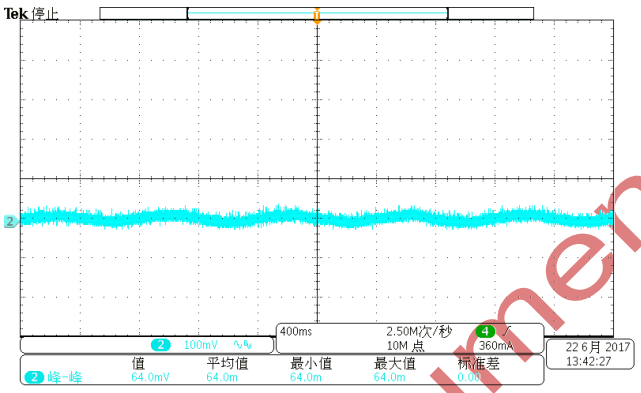


(CH1-VINAC, CH2-Vo1,CH4-IL)

Comments: ILpk=1.1A

3) Output Ripple Test

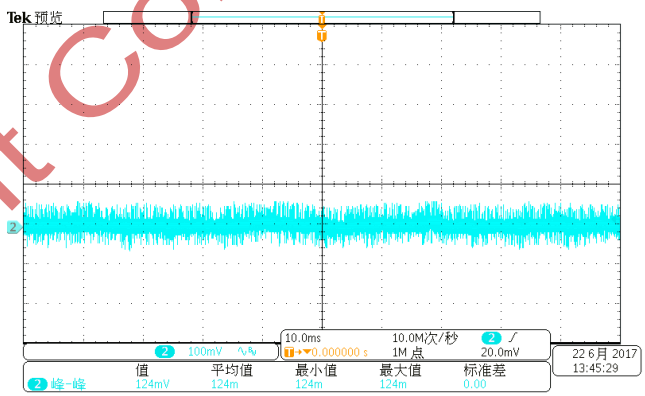
Test Condition: 115Vac/60Hz Input, 18V/0A 5V/0A Output



(CH2-Vo1_ac)

Comments: Vo1_ripple_pp=64mV

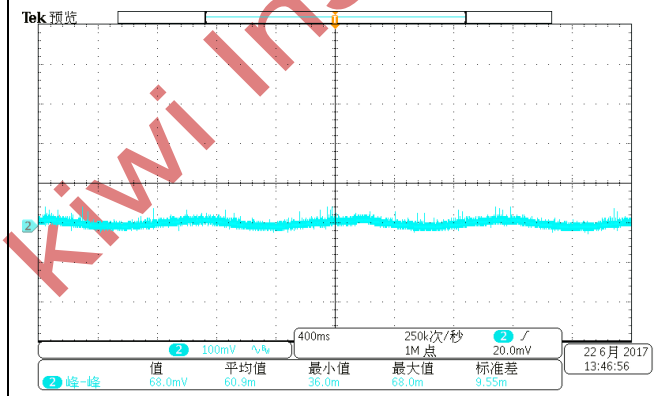
Test Condition: 115Vac/60Hz Input,18V/0.4A 5V/0.1A Output



(CH2-Vo1_ac)

Comments: Vo1_ripple_pp=124mV

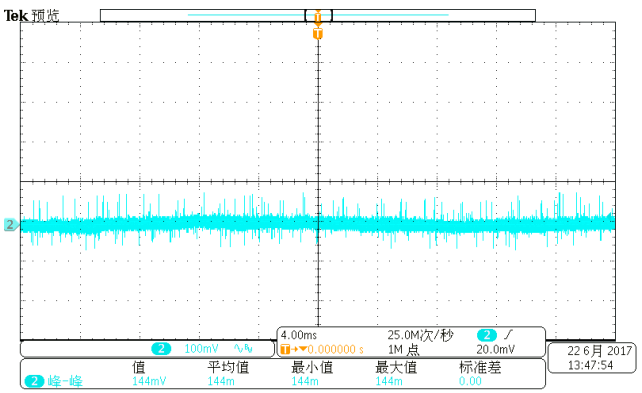
Test Condition: 230Vac/50Hz Input, 18V/0A 5V/0A Output



(CH2-Vo1_ac)

Comments: Vo_ripple_pp=68mV

Test Condition: 230Vac/50Hz Input, 18V/0.4A 5V/0.1A Output



(CH2-Vo1_ac)

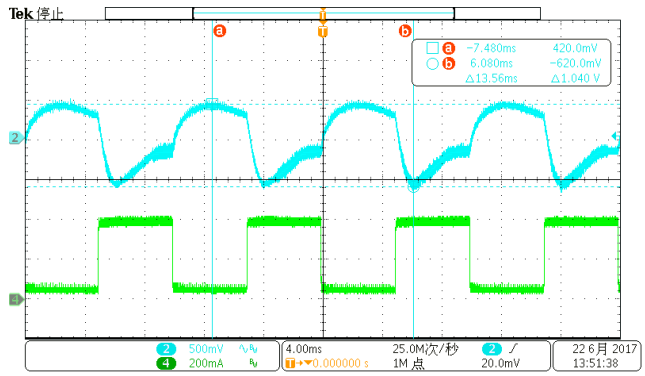
Comments: Vo_ripple_pp=144mV

Kiwi Instrument Confidential

4) Load Transient Test

Test condition: Load 50-400mA, frequency 100Hz, duty Cycle=50%, slew rate=500mA/us

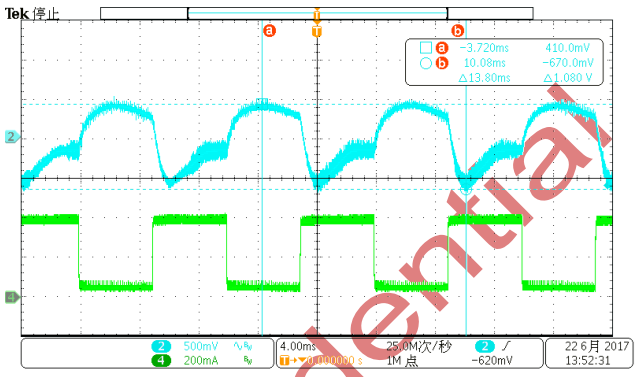
90Vac/60Hz Input



(CH2-Vo1_ac,CH4-Io)

Comments: Vo1_ripple_pp=1.04V

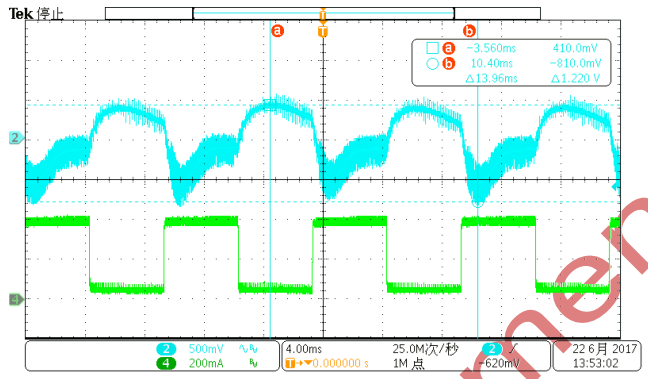
115Vac/60Hz Input



(CH2-Vo1_ac,CH4-Io)

Comments: Vo1_ripple_pp=1.08V

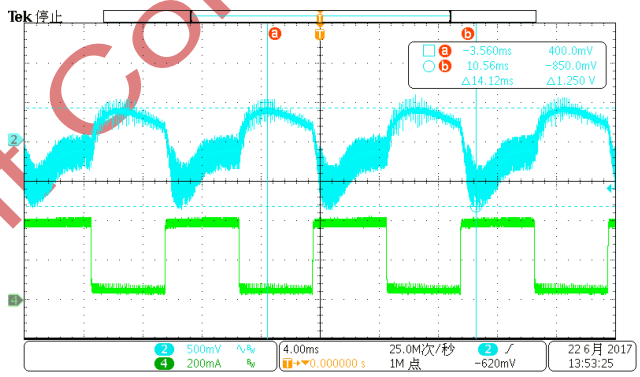
230Vac/50Hz Input



(CH2-Vo1_ac,CH4-Io)

Comments: Vo1_ripple_pp=1.22V

265Vac/50Hz Input

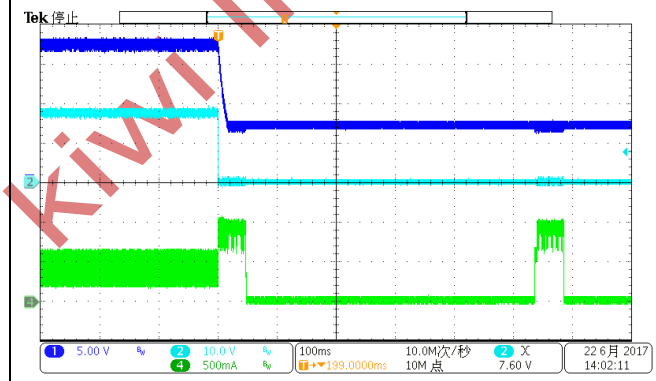


(CH2-Vo1_ac,CH4-Io)

Comments: Vo1_ripple_pp=1.25V

5) Over Load Protection Test

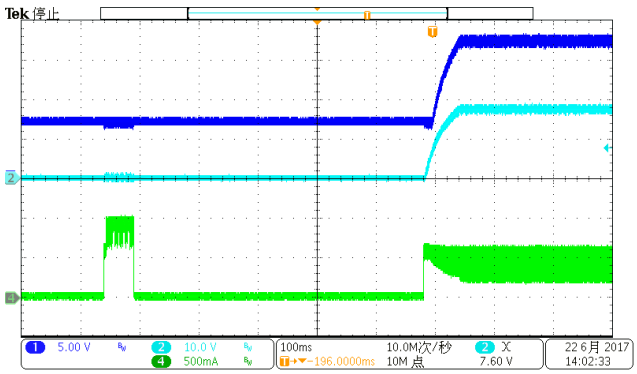
Test Condition: 115Vac/60Hz Input,Vo1 Output short



Short Load Protection Enter

(CH1-VDD, CH2-Vo1,CH4-IL)

Comments: OK



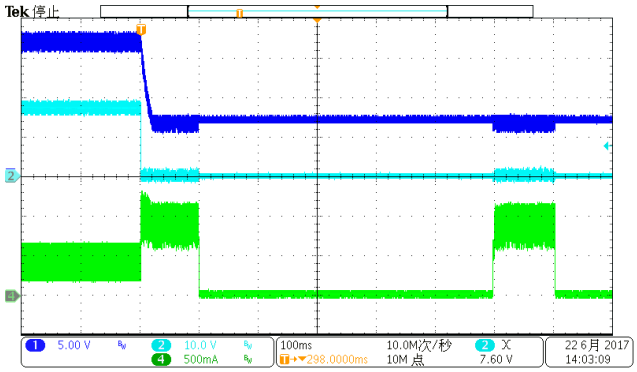
Short Load Protection Recovery

(CH1-VDD, CH2-Vo1,CH4-IL)

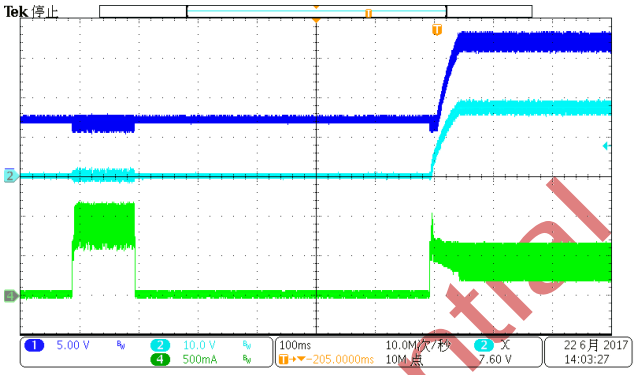
Comments:OK

Kiwi Instrument Confidential

Test Condition: 230Vac/50Hz Input,Vo1 Output short



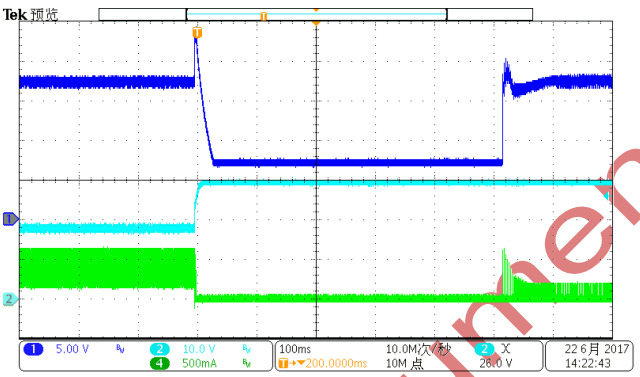
Short Load Protection Enter
(CH1-VDD, CH2-Vo1,CH4-IL)
Comments: OK



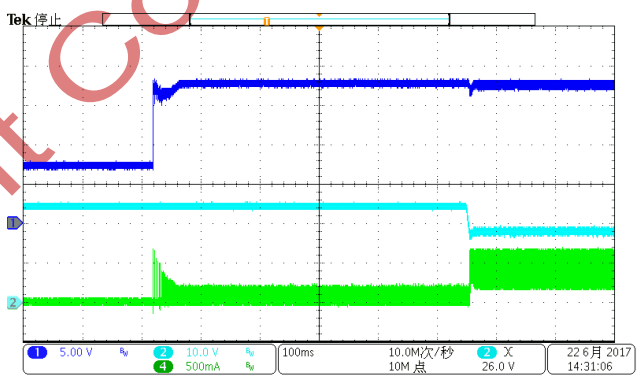
Short Load Protection Recovery
(CH1-VDD, CH2-Vo1,CH4-IL)
Comments:OK

6) Over Voltage Protection Test

Test Condition: 115Vac/60Hz Input, 25V DC source applied to board Vo1 output

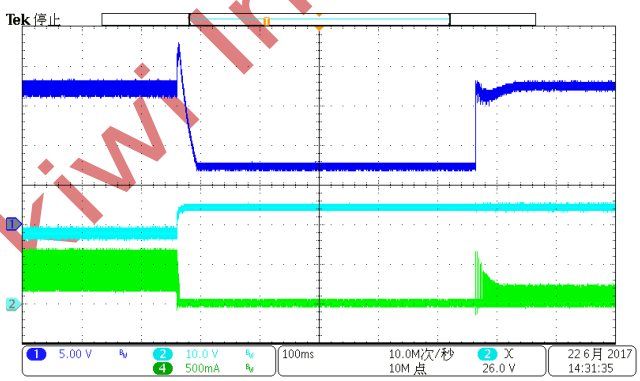


Over Voltage Protection Enter
(CH1-VDD, CH2-Vo1,CH4-IL)
Comments: OVP Enter is OK

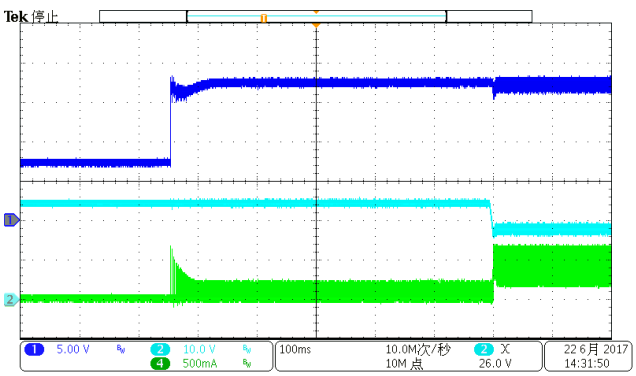


Over Voltage Protection Recovery
(CH1-VDD, CH2-Vo1,CH4-IL)
Comments: OVP Recovery is OK

Test Condition: 230Vac/50Hz Input,25V DC source applied to board Vo1 output



Over Voltage Protection Enter
(CH1-VDD, CH2-Vo1,CH4-IL)
Comments:OVP Enter is OK

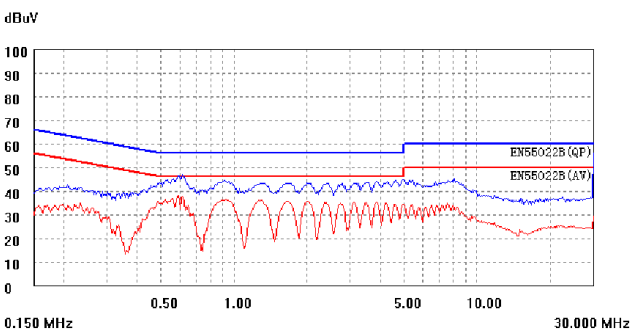


Over Voltage Protection Recovery
(CH1-VDD, CH2-Vo1,CH4-IL)
Comments:OVP Recovery is OK

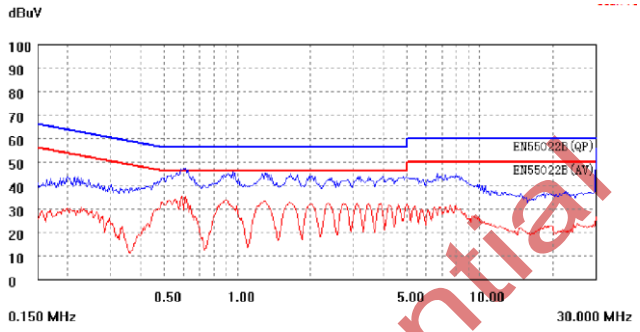
Kiwi Instrument Confidential

3. EMC Test Result

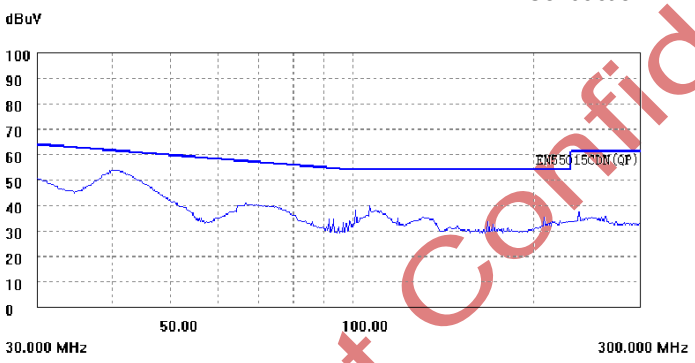
Test Condition: Vin=120VAC/60Hz, Vout1=18V/0.4A ,Vout2=5V/0.1A



Conduction EMI---LINE

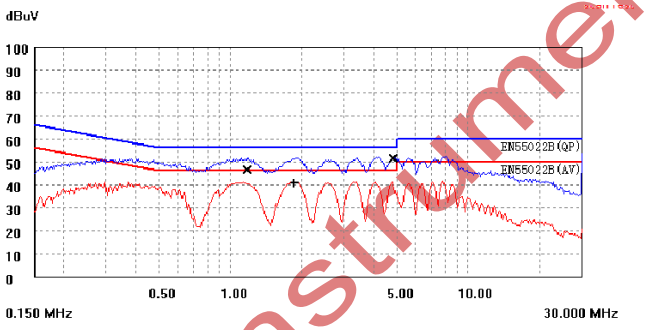


Conduction EMI---NEUTRAL

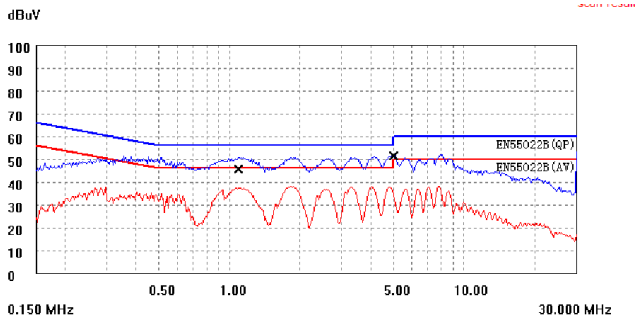


Radiation EMI---CDN

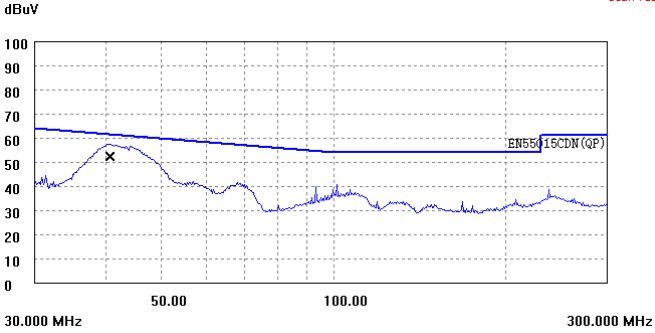
Test Condition: Vin=230VAC/50Hz, Vout1=18V/0.4A ,Vout2=5V/0.1A



Conduction EMI---LINE



Conduction EMI---NEUTRAL



Radiation EMI---CDN

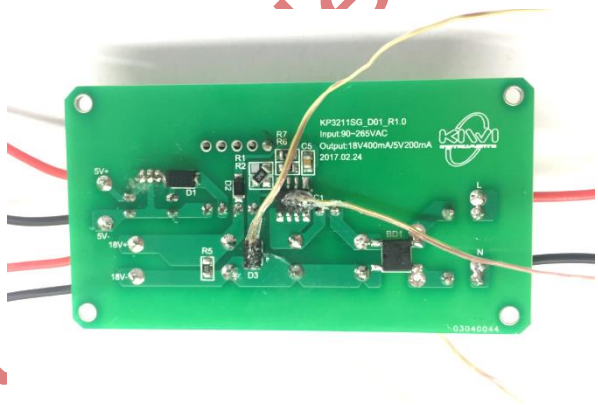
Kiwi Instrument Confidential

Kiwi Instrument Confidential

4. Thermal Test

90Vac/60Hz, 265Vac/50Hz; 18V/0.4A & 5V/0.1A output; Ta=30°c under natural convection, Burn-in 1Hour.

Component	90Vac		265Vac	
	Tc(°C)	Trise(°C)	Tc(°C)	Trise(°C)
IC1	99.2	69.2	105.4	75.4
C4	73.7	43.7	79.1	49.1
D3	77.8	47.8	81.4	51.4
T1	72.9	42.9	71	41



kiwi Instruments Confidential

5. Surge Test

Line to Line2kV 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 testedwith5 timesand 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

kiwi Instrument Confidential

Test Setup Guide

1. Connect the “18V+”, “18V-”,“5V+”, “5V-” 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.

kiwi Instrument Confidential

Revision History

DATE	REV	DESCRIPTION
2017/06/22	1.0	First Release

Kiwi Instrument Confidential

Contact Us:

US (Headquarter):

Add:2060 Walsh Ave, Suite 244, Santa Clara, CA, 95050
Tel:1-+86-18681585060
Fax: 1-408-905-6912
E-mail:marketing@kiwiinst.com

Hangzhou (R&D Center):

Add: Room 1201,Building C, No.581 HuoJuRoad,BinjiangDist.Hangzhou,P.R.C
Tel:(86) 571-8795-8612
Fax:(86) 571-8795-5363
E-mail: marketing@kiwiinst.com.cn

Shenzhen (Marketing/Field Support):

Add:B302-B303, University Creative Park, Xili Rd., Nanshan District, Shenzhen, P.R.C
Tel:(86)755-8204-2689
Fax:(86)755-8204-2192
E-mail:marketing@kiwiinst.com.cn

Disclaimer

Information that is provided by Kiwi Instruments Corporation is believed to be accurate and reliable. Kiwi instrument reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. No third party intellectual property infringement of the applications should be guaranteed by users when integrating Kiwi instrument products into any application. No legal responsibility for any said applications is assumed by Kiwi Instrument.