



## DEMO BOARD TEST REPORT

# 8W Smart Dimmable RGBCW LED Driver with KP28162+KP18026+KP15051+KP18032+KP521403

## FEATURES

- Patented Link-Dim™ Technology for High PF and Flicker-less
- Universal input voltage 90Vac~265Vac
- PF>0.7
- IEC-61000-3-2:2019 Harmonic Requirement
- Total Smart Dimming & Color Mix Solution with 5-channel RGBCW
- Wide Dimming Range for 0.1%-100%
- Fast Start up Time <0.5s @ 0.1%
- Low Standby Power<0.15W

## APPLICATIONS

- Smart LED Bulbs with Zigbee/Bluetooth Control

## INTRODUCTION

The demo board is designed to demonstrate the total smart dimmable RGBCW solution of multiple chips with LED driver and MCU/wireless module. The combination of KP28162 and KP18026 is performed color-mix and dimmable Cold and Warm White LEDs, and the combination of KP15051 and KP18032 is performed color-mix Red, Green, Blue LEDs. The output current of five channels RGBCW LEDs can independently be set by PWM signal for various scenes. Determined by the customer wireless module about the standby power, the demo board can be configured two kinds of circuit. The demo board is design for less than 0.15W standby power with Espressif wireless Module.

The demo board is typically designed for 8W application with 90VAC to 265VAC, High PF>0.7, THD meet IEC61000-3-2, and with output 60V/115mA of CW channels and output 15V/180mA of RGB channels within A60 LED Bulb.

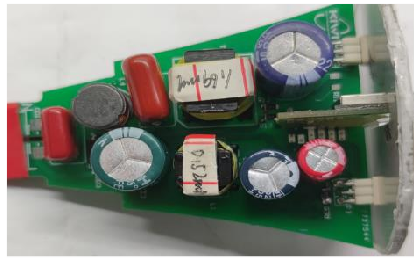
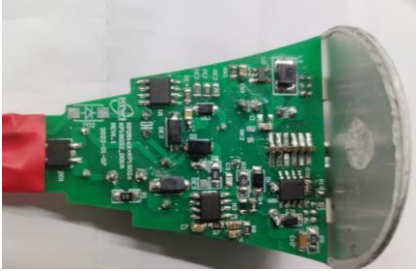
## DEMO BOARD SEPCIFICATION

Description	Symbol	Min.	Typ.	Max.	Unit	Note
Input Voltage	V <sub>in</sub>	90		265	Vac	
Output	V <sub>out</sub> /I <sub>out</sub>	CW:60V/115mA; RGB:15V/180mA				
System Efficiency	η	85			%	Within Wireless Module
Standby Loss	P <sub>STB</sub>			0.15	W	Within Wireless Module
Power Factor	PF	0.7				
Startup Time	T <sub>ST</sub>			0.5	S	
Conducted EMI Margin		6			dB	EN55015
Radiated EMI Margin		6			dB	EN55015
Surge Test		1			kV	Differential Mode

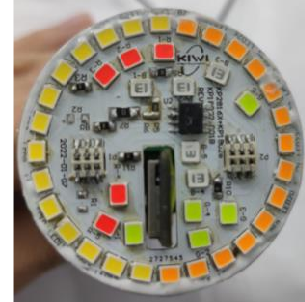
**Note:** The table above shows the minimum acceptable performance of the design. Actual performance is listed in the results section.

## Demo Board

PartA

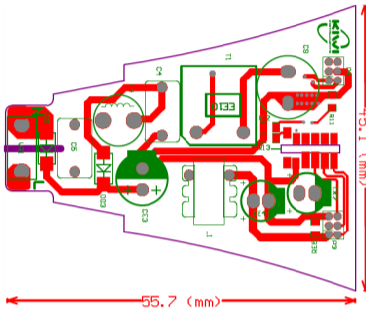


PartB

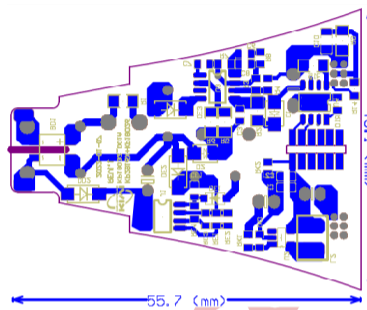


## Printed Circuit Board Layout

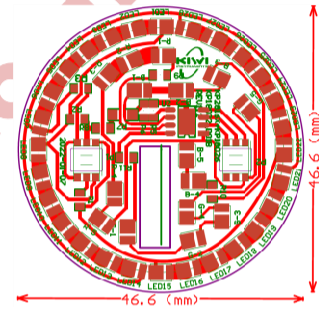
Top Layer (Part A)



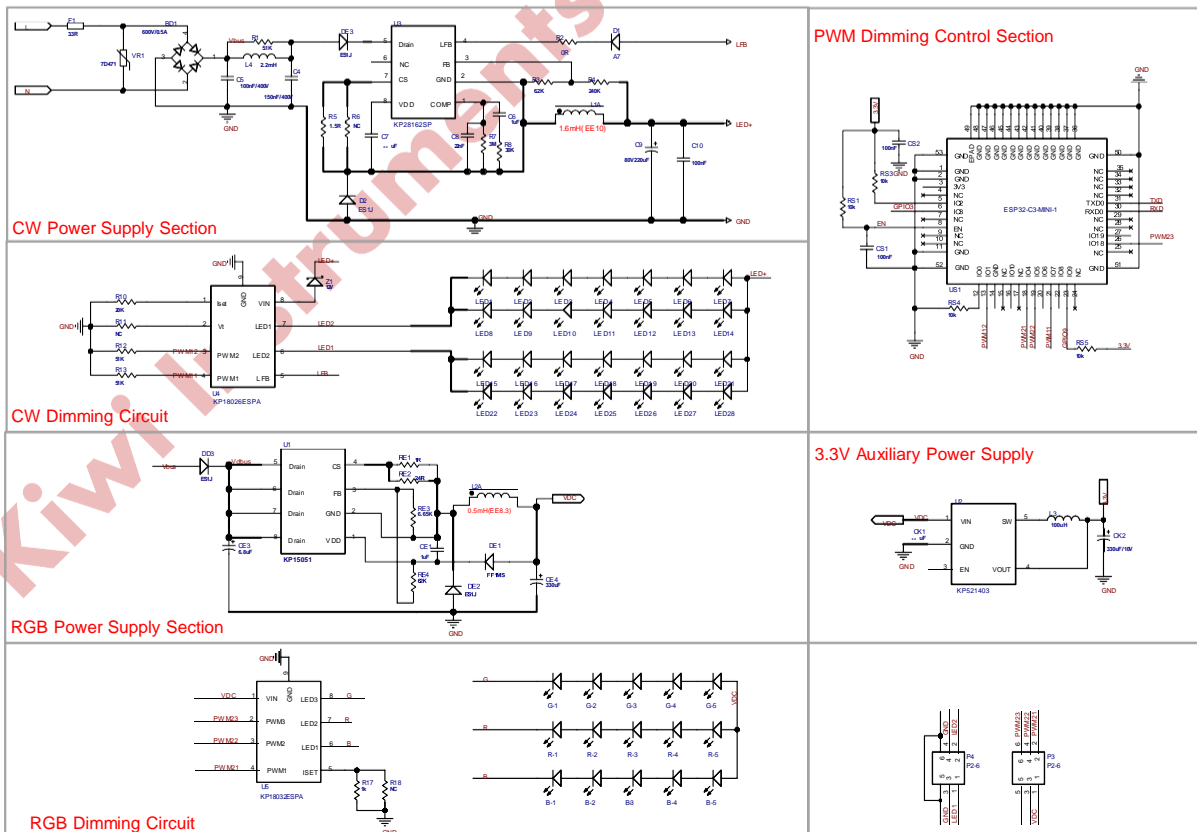
Bottom Layer (Part A)



Top Layer (Part B)



## Schematic





**8W Smart Dimmable RGBCW LED Driver  
with KP28162+KP18026+KP15051+KP18032+KP521403**

**Bill of Material**

No.	Designator	Value	Description	Package	Manufacturer	Part Number
1	BD1	1000V/1A	BRD 1A 1000V 1.1V	MBF	MDD	MB10F
2	F1	3.3R	Chip Resistor ±1% 1/4W	1206	FH	RS-06L3R30FT
3	VR1	7D471	VARISTOR 300VAC 35J 1200A	TH	WE	820573011
4	C4	100nF	CBB 400Vdc 12*5*9 P10	TH	STE	B22G104JN1B0120 09Q050EOZ
5	C5	150nF	CBB 400Vdc 12*5*8 P10	TH	STE	B22G154JN1B0120 080050EOZ
6	C6	1µF	Ceramic Cap 50V ±10% X7R	0805	WE	885012207103
7	C7	2.2µF	Ceramic Cap 50V ±10% X7R	0805	YAGEO	CC0805KKX7R9BB 225
8	C8	22nF	Ceramic Cap 50V ±10% X7R	0805	WE	885012207094
9	C9	220µF	Electrolytic Cap 80V 10*20 P5.0	TH	AISHI	ERF1BM221G20OT
10	C10	100nF	Ceramic Cap 100V ±10% X7R	0805	WE	885012207128
11	CE1	1µF	Ceramic Cap 50V ±10% X7R	0805	WE	885012207103
12	CE3	6.8µF	Electrolytic Cap 400V 10*12 P5.0	TH	AISHI	EGM2GM6R8G12O T
13	CE4	22µF	Electrolytic Cap 25V 5*11 P2.0	TH	AISHI	ERS1EM220D11OT
14	CK1	1µF	Ceramic Cap 50V ±10% X7R	0805	WE	885012207103
15	CK2	330µF	Electrolytic Cap 6.3V 6.3*11 P2.5	TH	AISHI	ERR0JM331E11OT
16	CS1	100nF	Ceramic Cap 50V ±10% X7R	0805	WE	85012207098
17	CS2	100nF	Ceramic Cap 50V ±10% X7R	0805	WE	85012207098
18	D1	1000V/1A	DIO FRD 1A 1000V 1V	SOD-123FL	DIYI	A7
19	D2	600V/1A	DIO FRD 1A 600V 35nS 1.7V	SMA	MDD	ES1J
20	D3	600V/1A	DIO FRD 1A 600V 35nS 1.7V	SMA	MDD	ES1J
21	DE2	600V/1A	DIO FRD 1A 600V 35nS 1.7V	SMA	MDD	ES1J
22	DE3	600V/1A	DIO FRD 1A 600V 35nS 1.7V	SMA	MDD	ES1J
23	DE1	1000V/1A	DIO FRD 1A 1000V 500nS 1.3V	SOD-123FL	DIYI	F1M
24	L1	1.6mH	Single Winding Inductor, Bobbin=EE10	TH		
25	L2	0.52mH	Single Winding Inductor, Bobbin=EE8.3	TH		
26	L3	68µH	Inductor Isat 0.61A Rdc 2.10Ω	1812	WE	744045680
27	L4	2.2mH	Inductor Isat 0.35A Rdc 4.73Ω 8*9.5	TH	WE	7447720222
28	R1	5.1K	Chip Resistor ±1% 1/8W	0805	FH	RS-05K5101FT
29	R2	0Ω	Chip Resistor ±1% 1/8W	0805	FH	RS-05L1R00FT
30	R3	6.2k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K6201FT
31	R4	240k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K2403FT
32	R5	1.5R	Chip Resistor ±1% 1/4W	1206	FH	RS-06L1R50FT
34	R7	30kΩ	Chip Resistor ±1% 1/8W	0805	FH	RS-05K3002FT
35	R8	5.1MΩ	Chip Resistor ±1% 1/8W	0805	FH	RS-05L5104FT
36	R10	20kΩ	Chip Resistor ±1% 1/8W	0805	FH	RS-05K2002FT

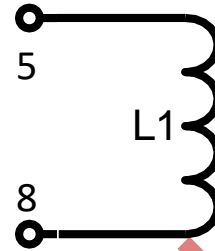
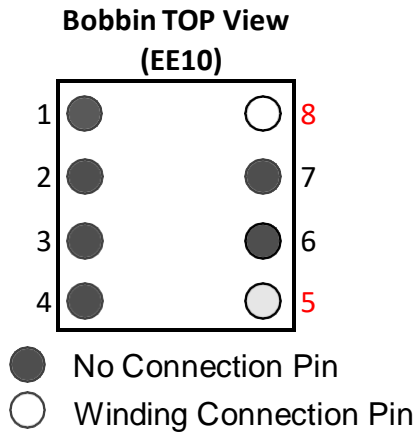


**8W Smart Dimmable RGBCW LED Driver  
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38	R12	51kΩ	Chip Resistor ±1% 1/8W	0805	FH	RS-05K5102FT
39	R13	51kΩ	Chip Resistor ±1% 1/8W	0805	FH	RS-05K5102FT
40	R17	1kΩ	Chip Resistor ±1% 1/8W	0805	FH	RS-05K1001FT
42	RE1	1Ω	Chip Resistor ±1% 1/8W	0805	FH	RS-05L1R00FT
43	RE2	2.4Ω	Chip Resistor ±1% 1/8W	0805	FH	RS-05L2R20FT
44	RE3	6.65kΩ	Chip Resistor ±1% 1/8W	0805	FH	RS-05K6201FT
45	RE4	62kΩ	Chip Resistor ±1% 1/8W	0805	FH	RS-05K6202FT
46	RS1	10kΩ	Chip Resistor ±1% 1/8W	0805	FH	RS-05K1002FT
47	RS3	10kΩ	Chip Resistor ±1% 1/8W	0805	FH	RS-05K1002FT
48	RS4	10kΩ	Chip Resistor ±1% 1/8W	0805	FH	RS-05K1002FT
49	RS5	10kΩ	Chip Resistor ±1% 1/8W	0805	FH	RS-05K1002FT
50	U1	KP28162SG	PF>0.7, Adaptive Constant Voltage high side BUCK controller	SOP8	Kiwi Instrument	KP28162SG
51	U2	KP18026ESP	High-Efficiency, Two-Channel Dimming and Color Mix Linear Constant Current LED driver	ESOP8	Kiwi Instrument	KP18026ESP
52	U3	KP15051SP	High Performance Low Cost Off-line PWM controller	SOP8	Kiwi Instrument	KP15051SP
53	U4	KP18032ESP	High-Efficiency, Three-Channel Dimming and Color Mix Linear Constant Current LED driver	ESOP8	Kiwi Instrument	KP18032ESP
54	U3	KP521403LG	40V,1A High Performance Synchronous Buck controller	SOP4	Kiwi Instrument	KP521403LG
55	US1	Dimming Module	Dimming module ESP32-C3-MINI-1		ESPRESSIF	
56	Z1	12V	Diode Zener 12V 2% 200mW	SOD-323	PANJIT	BZT52-B12S
57	LED1~LED14	Warm LED	Warm White LED-2835, 9V/1W	2835	Any	
58	LED15-LED28	Cool LED	Cool White LED-W-2835, 9V/1W	2835	Any	
59	R-1~R-5	Red LED	Red LED-W-2835, 3V/1W	2835	Any	
60	G-1~G-5	Green LED	Green LED-W-2835, 3V/1W	2835	Any	
61	B-1~B-5	Blue LED	Blue LED-W-2835, 3V/1W	2835	Any	
62	P3	Connector	Connector, FH1.5,P=1.5mm, 2*3P	TH	Shuolian	
63	P4	Connector	Connector, FH1.5,P=1.5mm, 2*3P	TH	Shuolian	

## Transformer Manufacture Guide---L1

### 1. Electrical Diagram



### 2. Winding Order

Number	Winding	Layer	Start	End	Wire Size	Turns
1	N1	Primary	5	8	0.2d*1P	195Ts
2	Tape					2Ts

### 3. Electrical Specification

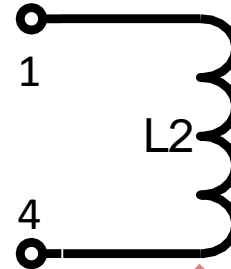
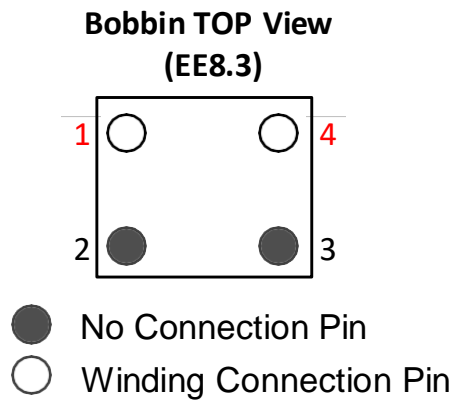
Items	Test Condition	Test Pin	Specification
Primary Inductance	Measured at 40kHz, 1.0 VRMS	Pins 5-8	1.65mH ± 5%
DC Resistance		Pins 5-8	2.6Ω

### 4. Transformer BOM

Items	Description
1	<b>Core:</b> EE10, AE=12.10
2	<b>Bobbin:</b> EF10, 4+4 Pin
3	<b>Wire:</b> Φ0.2mm, 2UEW, Class B
4	<b>Tape:</b> 7mm(W) × 0.06mm(TH)

## Transformer Manufacture Guide---L2

### 1. Electrical Diagram



### 2. Winding Order

Number	Winding	Layer	Start	End	Wire Size	Turns
1	N1	Primary	1	4	0.2d*1P	132Ts
2	Tape					2Ts

### 3. Electrical Specification

Items	Test Condition	Test Pin	Specification
Primary Inductance	Measured at 40kHz, 1.0 VRMS	Pins 1-4	0.5mH ± 5%
DC Resistance	-	Pins 1-4	1.6Ω

### 4. Transformer BOM

Items	Description
1	<b>Core:</b> EE8.3, AE=7.0
2	<b>Bobbin:</b> EF8.3, 2+2 Pin
3	<b>Wire:</b> Φ0.2mm, 2UEW, Class B
4	<b>Tape:</b> 6mm(W) × 0.06mm(TH)

## Test Result

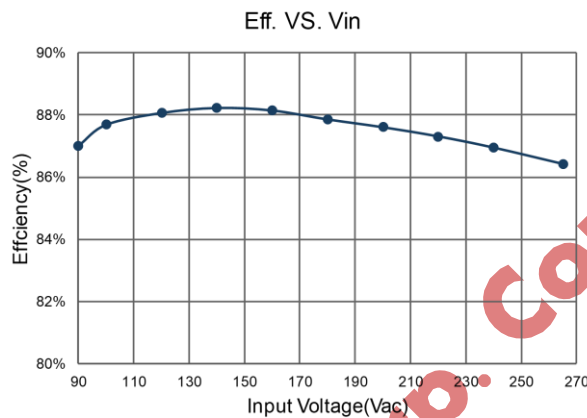
### 1. Steady Characteristics

#### 1.1 System Efficiency

**Test Conditions:** Input: 90-265Vac; Output: 60V/115mA(C&W), 15V/180mA(R&G&B), (C, W, R, G, B) = (100%, 0%, 0%, 0%, 0%)

**Standard:** Eff > 86%

**Result:** Pass



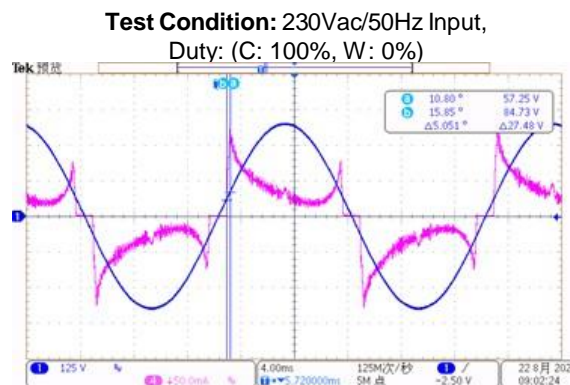
#### 1.2 Total Harmonic current

**Test Conditions:** Input: 230Vac; Output: 60V/115mA(C&W), 15V/180mA(R&G&B), (C, W, R, G, B) = (100%, 0%, 0%, 0%, 0%)

**Standard:** requirements of IEC-61000-3-2:2019 ( the start phase of input current must be less than 60° and the peak phase of input current must be less than 65°, and the subharmonic should be meet 3<sup>rd</sup> subharmonic < 86%, 5<sup>th</sup> subharmonic <61%).

**Result:** Pass

Sub-harmonic	Value	Limit
3 <sup>rd</sup>	55.7	86%
5 <sup>th</sup>	33.4	61%



(CH1-Vin, CH4-Iin)

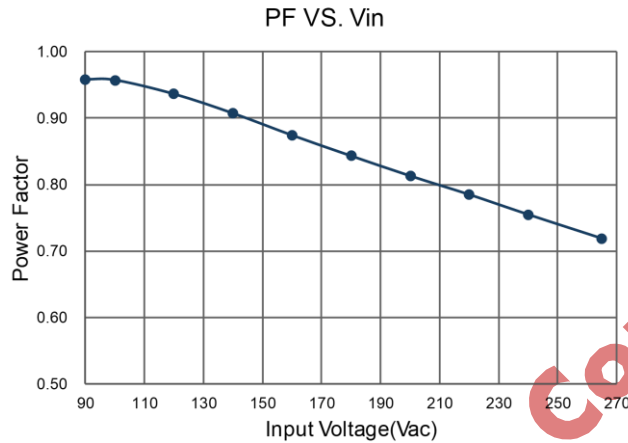
**Comments:** Start Phase:10.8° (Limit 60°),  
Peak Phase:15.85° (Limit 65°)

### 1.3 Power Factor

**Test Conditions:** Input: 90-265Vac; Output: 60V/115mA (C&W), 15V/180mA(R&G&B) (C, W, R, G, B) = (100%, 0%, 0%, 0%, 0%)

**Standard:** PF > 0.7

**Result:** Pass

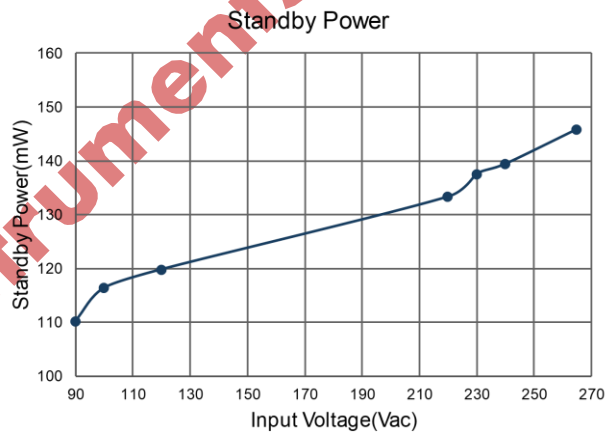


### 1.4 Standby Power

**Test Conditions:** Input: 90-265Vac; Output: Dim OFF, (C, W, R, G, B) = (0%, 0%, 0%, 0%, 0%)

**Standard:** P<sub>STB</sub> < 150mW

**Result:** Pass



### 1.5 Line Regulation

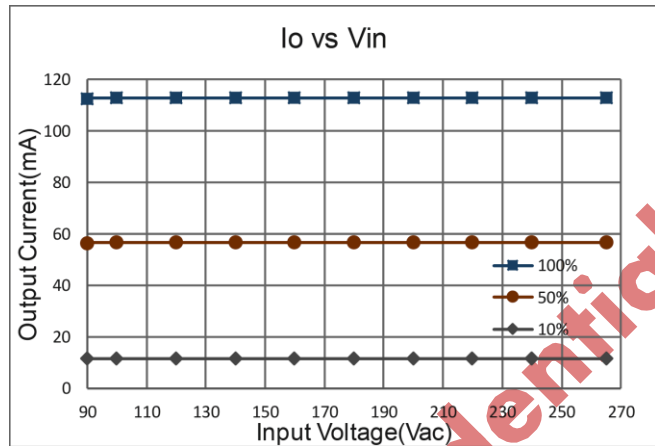
**Test Conditions:** Input: 90~265Vac; Output: 60V/115mA(C&W), 15V/180mA(R&G&B), (C, W, R, G, B) = (100%, 0%, 0%, 0%, 0%)

**Standard:** Line Reg < 1%

**Result:** Pass



Vin(V)	Io(mA)		
	100%	50%	10%
90	112.8	56.6	11.53
100	112.9	56.7	11.54
120	112.9	56.7	11.54
140	112.9	56.7	11.54
160	112.9	56.7	11.54
180	112.9	56.7	11.54
200	112.9	56.7	11.54
220	112.9	56.7	11.54
240	112.9	56.7	11.55
265	112.9	56.7	11.55
Line Reg	0.1%	0.2%	0.2%

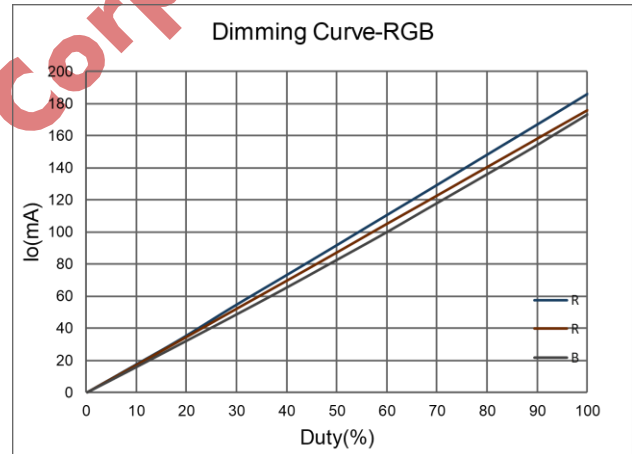
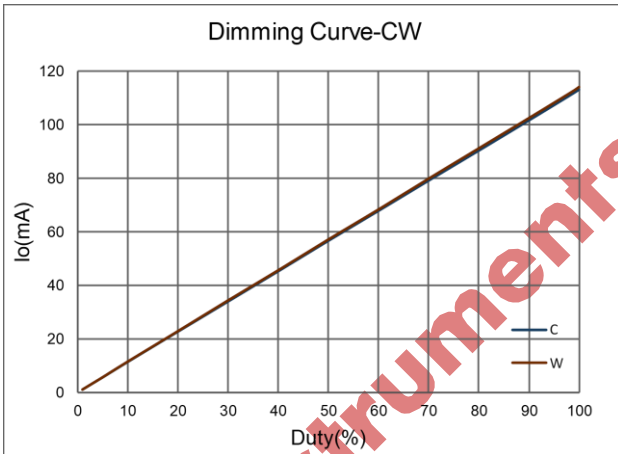


**1.6 Dimming Curve**

**Test Conditions:** Input: 220Vac; Output: 60V/115mA(C&W), 15V/180mA(R&G&B)

**Standard:** High linearity of dimming curve

**Result:** Pass



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## 2. Dynamic Characteristics

### 2.1 Power On

**Test Conditions:** Input: 120/220Vac; Output: 60V/115mA(C&W), 15V/180mA(R&G&B)

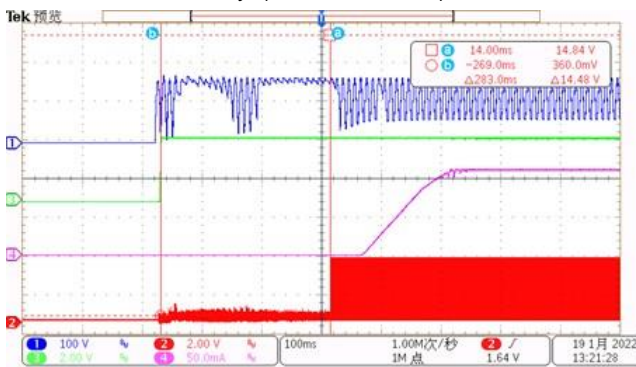
**Standard:** No flicker and no overshoot, turn on delay time < 0.5s @CW Mode

**Result:** Pass

Vin(Vac)	F(Hz)	Io_c(mA)	Turn on delay time
120	60	115	0.49
120	60	57	0.423
120	60	1.2	0.392
220	50	115	0.470
220	50	57	0.409
220	50	1.2	0.376

### Waveforms (CW Mode):

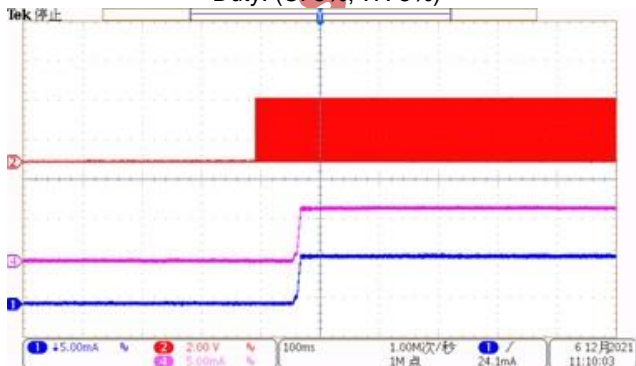
**Test Condition:** 120Vac/60Hz Input,  
Duty: (C: 100%, W: 0%)



(CH1-Vbus, CH2-PWMC, CH3-3.3V, CH4-Io\_C)

**Comments:** Tst=490ms, No flicker and no overshoot

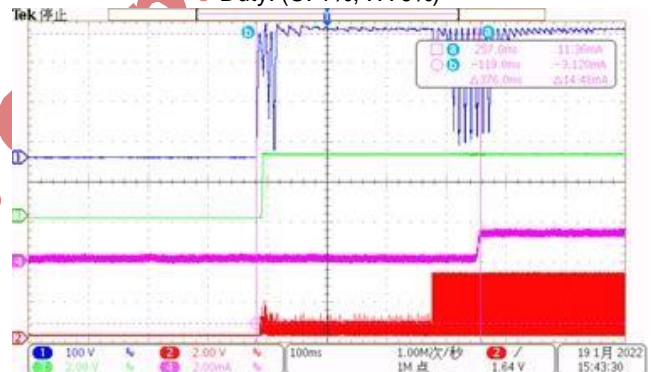
**Test Condition:** 220Vac/50Hz Input,  
Duty: (C: 5%, W: 5%)



(CH1-Io\_W, CH2-PWMC, CH4-Io\_C)

**Comments:** OK, No flicker and no overshoot

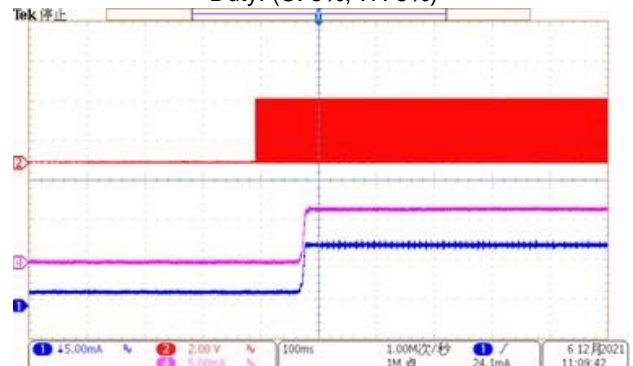
**Test Condition:** 220Vac/50Hz Input,  
Duty: (C: 1%, W: 0%)



(CH1-Vbus, CH2-PWMC, CH3-3.3V, CH4-Io\_C)

**Comments:** Tst=376ms, No flicker and no overshoot

**Test Condition:** 120Vac/60Hz Input,  
Duty: (C: 5%, W: 5%)

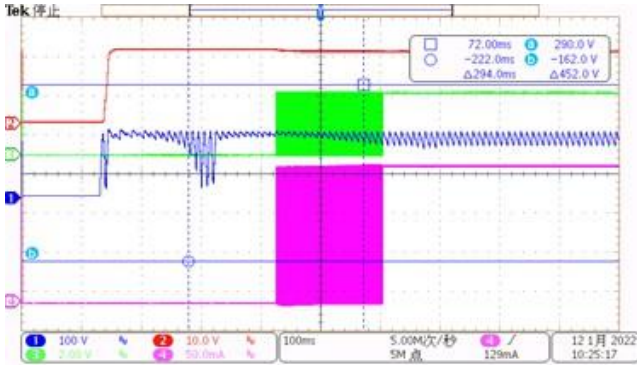


(CH1-Io\_W, CH2-PWMC, CH4-Io\_C)

**Comments:** OK, No flicker and no overshoot

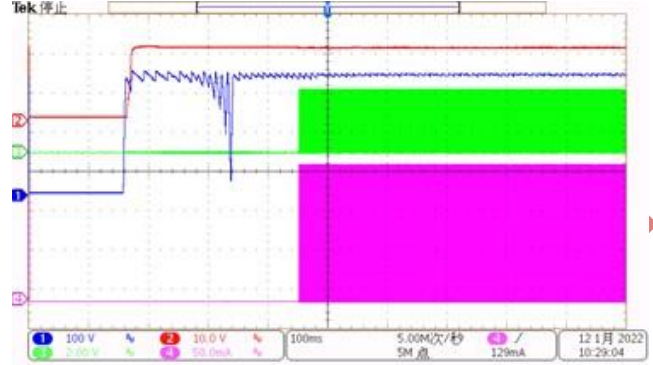
### Waveforms (RGB Mode):

**Test Condition:** 120Vac/60Hz Input,  
Duty: (R: 100%, G: 0%, B: 0%)



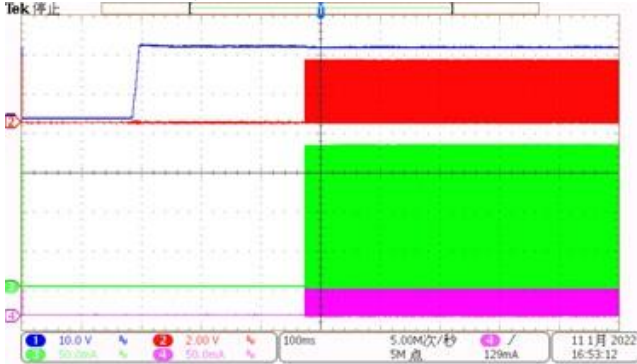
(CH1-Vbus, CH2-Vdc, CH3-PWMR, CH4-Io\_R)  
**Comments:** OK, No flicker and no overshoot

**Test Condition:** 220Vac/50Hz Input,  
Duty: (R: 1%, G: 0%, B: 0%)



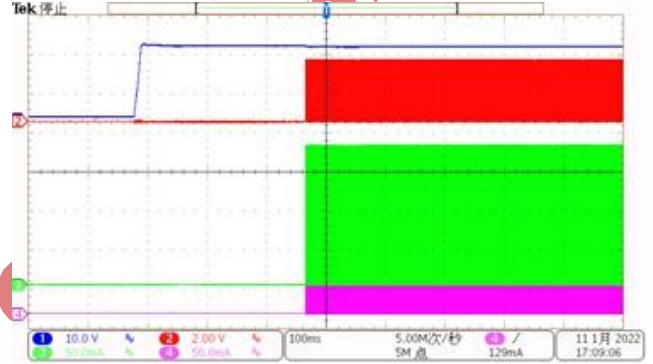
(CH1-Vbus, CH2-Vdc, CH3-PWMR, CH4-Io\_R)  
**Comments:** OK, No flicker and no overshoot

**Test Condition:** 230Vac/50Hz Input,  
Duty: (R: 33%, G: 33%, B: 33%)



(CH1-Vbus, CH2-PWMR, CH3-Io\_G, CH4-Io\_B)  
**Comments:** OK, No flicker and no overshoot

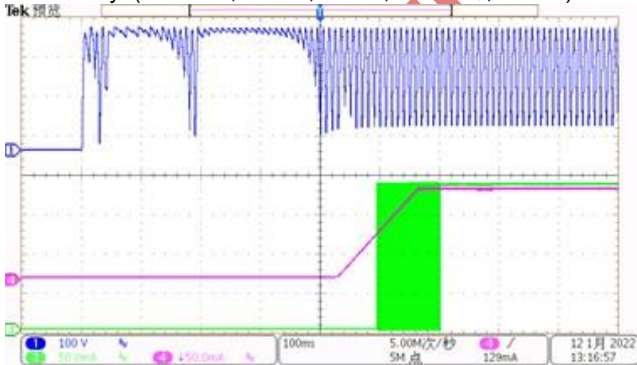
**Test Condition:** 230Vac/50Hz Input,  
Duty: (R: 1%, G: 10%, B: 1%)



(CH1-Vbus, CH2-PWMR, CH3-Io\_G, CH4-Io\_B)  
**Comments:** OK, No flicker and no overshoot

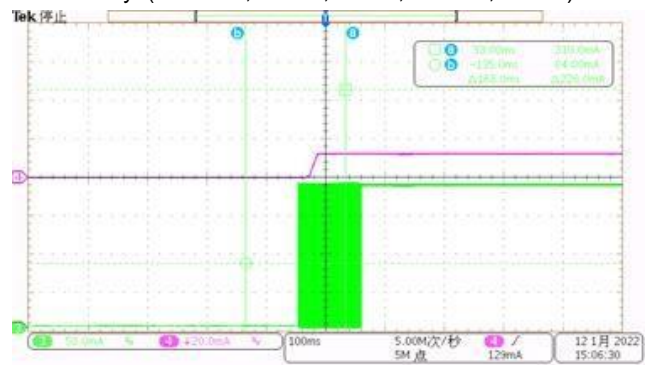
**Waveforms (CWRGB Mode):**

**Test Condition:** 230Vac/50Hz Input,  
Duty: (R: 100%, G: 0%, B: 0%, C: 100%, W: 0%)

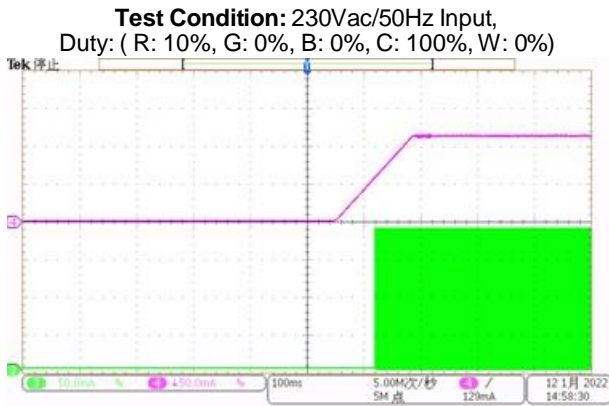


(CH1-Vbus, CH3-Io\_R, CH4-Io\_C)  
**Comments:** OK, No flicker and no overshoot

**Test Condition:** 230Vac/50Hz Input,  
Duty: (R: 100%, G: 0%, B: 0%, C: 10%, W: 0%)

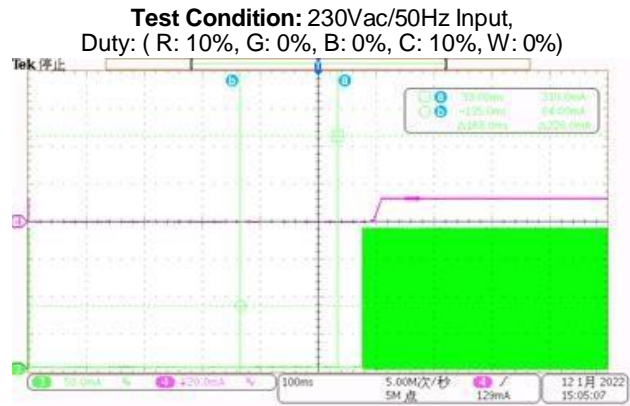


(CH1-Vbus, CH3-Io\_R, CH4-Io\_C)  
**Comments:** OK, No flicker and no overshoot



(CH3-lo\_R, CH4-lo\_C)

**Comments:** OK, No flicker and no overshoot



(CH3-lo\_R, CH4-lo\_C)

**Comments:** OK, No flicker and no overshoot

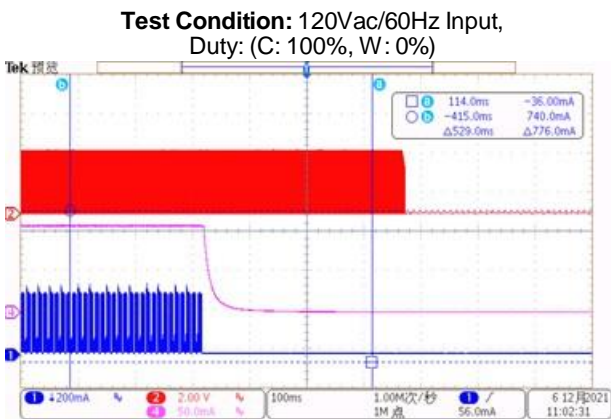
**2.2 Power Off**

**Test Conditions:** Input: 120/220Vac; Output: 60V/115mA(C&W), 15V/180mA(R&G&B)

**Standard:** No flicker and no overshoot

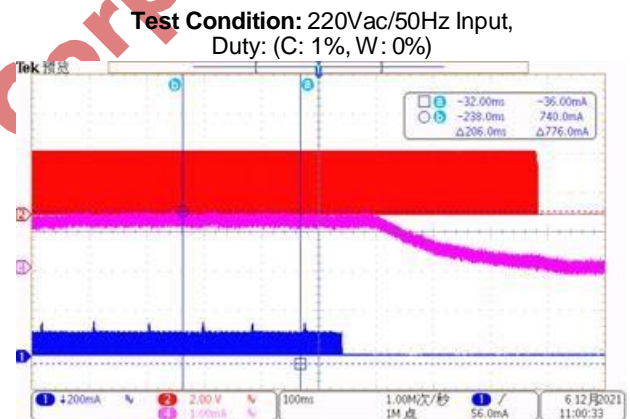
**Result:** Pass

**Waveforms (CW Mode):**



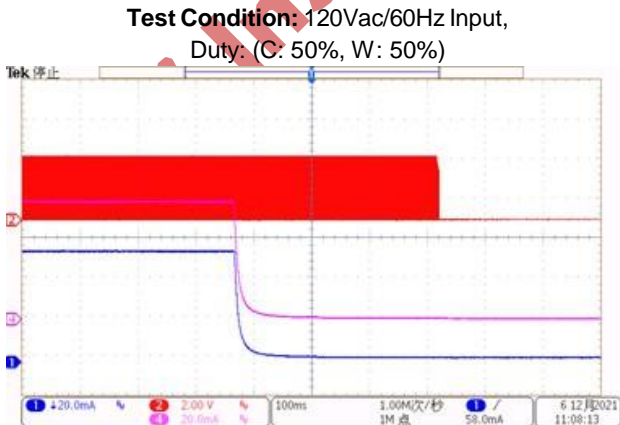
(CH1-IL, CH2: PWMC, CH4-lo\_C)

**Comments:** OK, No flicker and no overshoot



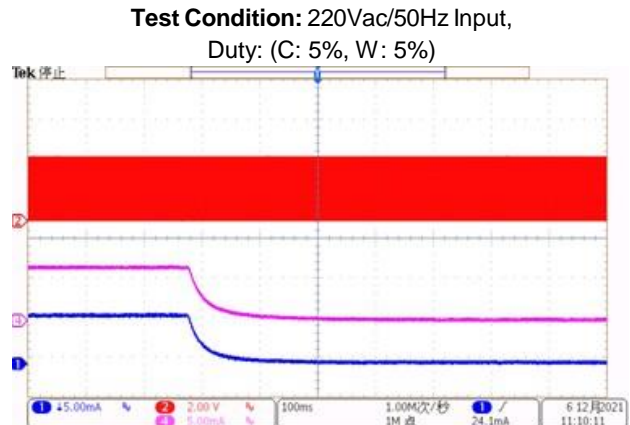
(CH1-IL, CH2: PWMC, CH4-lo\_C)

**Comments:** OK, No flicker and no overshoot



(CH1-lo\_W, CH2: PWMC, CH4-lo\_C)

**Comments:** OK, No flicker and no overshoot

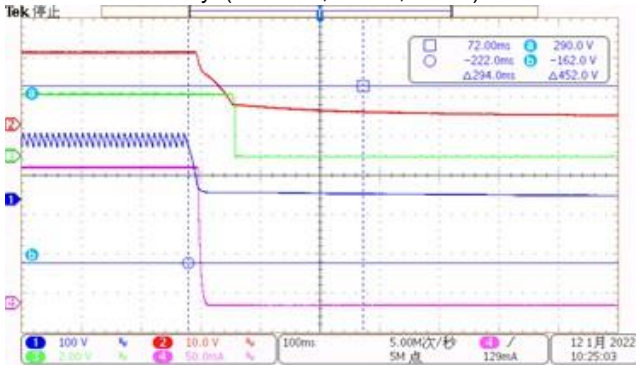


(CH1-lo\_W, CH2: PWMC, CH4-lo\_C)

**Comments:** OK, No flicker and no overshoot

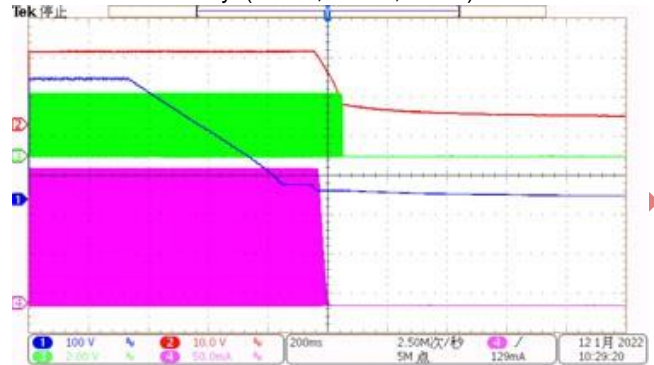
**Waveforms (RGB Mode):**

**Test Condition:** 120Vac/60Hz Input,  
Duty: (R: 100%, G: 0%, B: 0%)



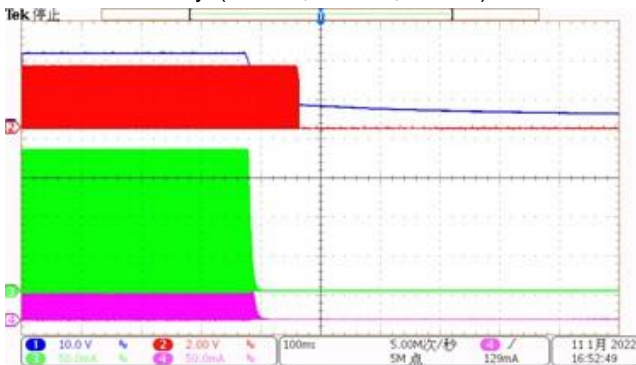
(CH1-Vbus, CH2-Vdc, CH3-PWMR, CH4-Io\_R)  
**Comments:** OK, No flicker and no overshoot

**Test Condition:** 220Vac/50Hz Input,  
Duty: (R: 1%, G: 0%, B: 0%)



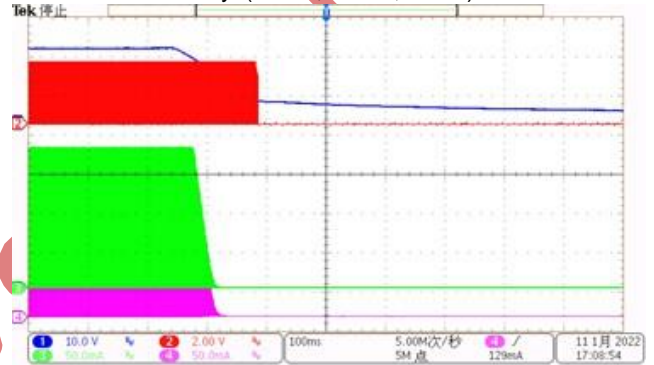
(CH1-Vbus, CH2-Vdc, CH3-PWMR, CH4-Io\_R)  
**Comments:** OK, No flicker and no overshoot

**Test Condition:** 120Vac/60Hz Input,  
Duty: (R: 33%, G: 33%, B: 33%)



(CH1-Vdc, CH2-PWMR, CH3-Io\_G, CH4-Io\_B)  
**Comments:** OK, No flicker and no overshoot

**Test Condition:** 220Vac/50Hz Input,  
Duty: (R: 1%, G: 1%, B: 1%)



(CH1-Vdc, CH2-PWMR, CH3-Io\_G, CH4-Io\_B)  
**Comments:** OK, No flicker and no overshoot

**2.3 Dimming on**

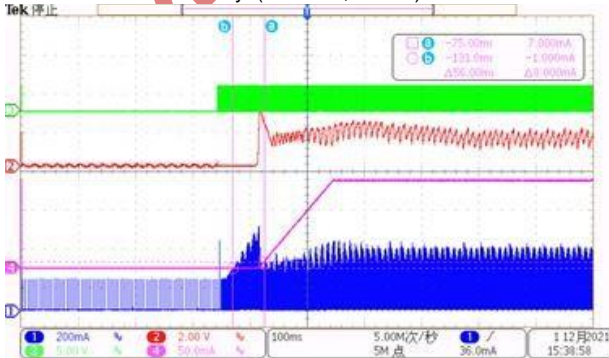
**Test Conditions:** Input: 120/220Vac; Output: 60V/115mA(C&W), 15V/180mA(R&G&B)

**Standard:** Smoothly and No flicker

**Result:** Pass

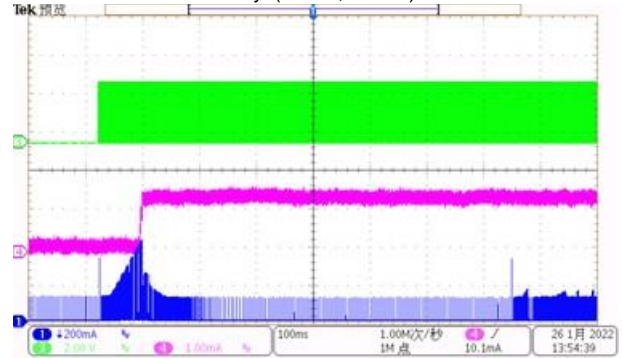
**Waveforms (CW Mode):**

**Test Condition:** 220Vac/50Hz Input,  
Duty: (C: 100%, W: 0%)



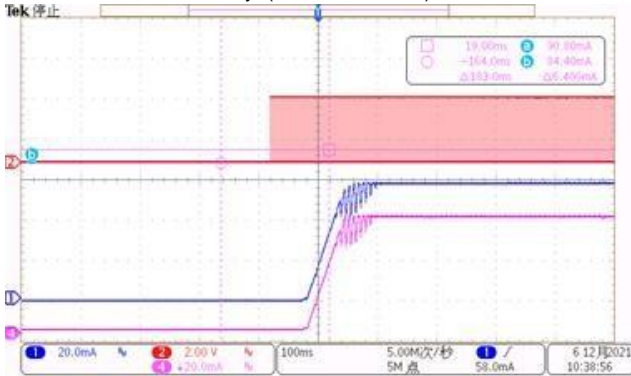
(CH1-IL, CH2-LED-C, CH3: PWM, CH4-Io\_C)  
**Comments:** OK, No flicker and no overshoot

**Test Condition:** 120Vac/60Hz Input,  
Duty: (C: 1%, W: 0%)



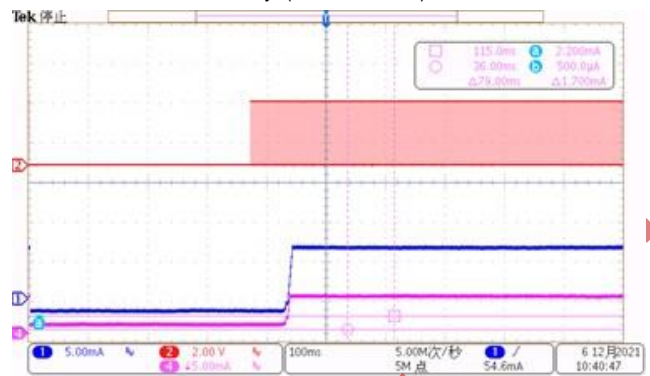
(CH1-IL, CH2-LED-C, CH3: PWM, CH4-Io\_C)  
**Comments:** OK, No flicker and no overshoot

**Test Condition:** 120Vac/60Hz Input,  
Duty: (C: 50%, W: 50%)



(CH1-Io\_W, CH2-PWMC, CH4-Io\_C)  
**Comments:** OK, No flicker and no overshoot

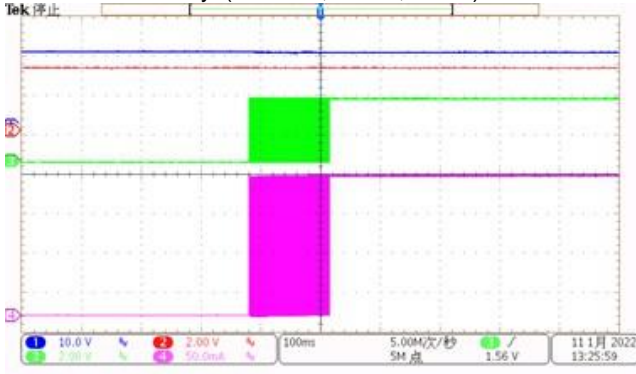
**Test Condition:** 220Vac/50Hz Input,  
Duty: (C: 7%, W: 3%)



(CH1-Io\_W, CH2-PWMC, CH4-Io\_C)  
**Comments:** OK, No flicker and no overshoot

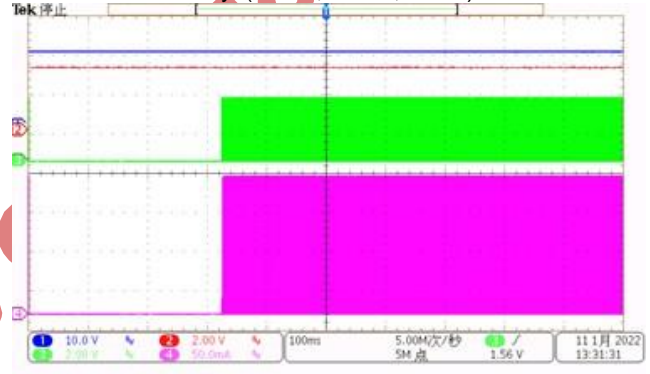
**Waveforms (RGB Mode):**

**Test Condition:** 220Vac/50Hz Input,  
Duty: (R: 100%, G: 0%, B: 0%)



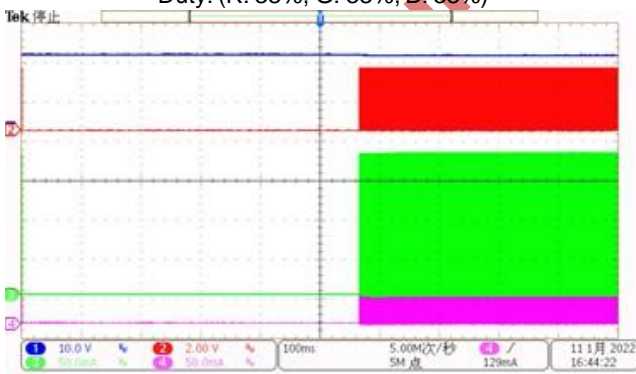
(CH1-Vdc, CH2-3.3V, CH3: PWM, CH4-Io\_R)  
**Comments:** OK, No flicker and no overshoot

**Test Condition:** 120Vac/60Hz Input,  
Duty: (R: 1%, G: 0%, B: 0%)



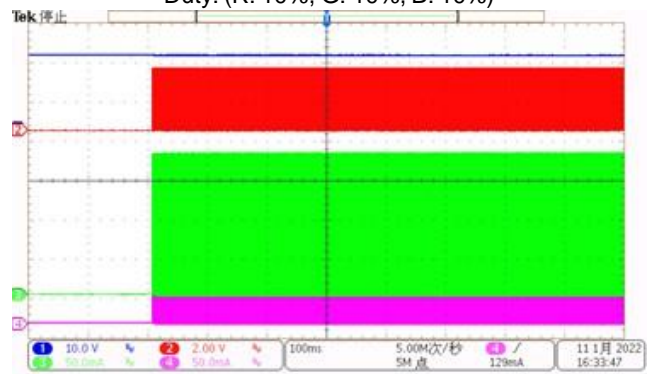
(CH1-Vdc, CH2-3.3V, CH3: PWM, CH4-Io\_R)  
**Comments:** OK, No flicker and no overshoot

**Test Condition:** 220Vac/50Hz Input,  
Duty: (R: 33%, G: 33%, B: 33%)



(CH1-Vdc, CH2-PWMR, CH3-Io\_G, CH4-Io\_B)  
**Comments:** OK, No flicker and no overshoot

**Test Condition:** 120Vac/60Hz Input,  
Duty: (R: 10%, G: 10%, B: 10%)



(CH1-Vdc, CH2-PWMR, CH3-Io\_G, CH4-Io\_B)  
**Comments:** OK, No flicker and no overshoot

**2.4 Dimming off**

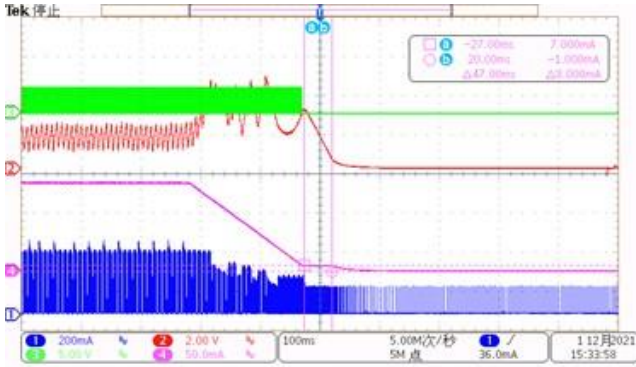
**Test Conditions:** Input: 120/220Vac; Output: 60V/115mA(C&W), 15V/180mA(R&G&B)

**Standard:** Smoothly and No flicker

**Result:** Pass

**Waveforms (CW Mode):**

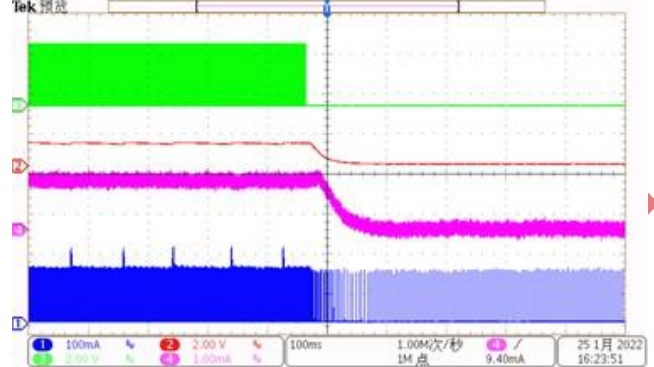
**Test Condition: 220Vac/50Hz Input,  
Duty: (C: 100%, W: 0%)**



(CH1-IL, CH2-LED\_C, CH3:PWM, CH4-Io\_C)

**Comments: OK**

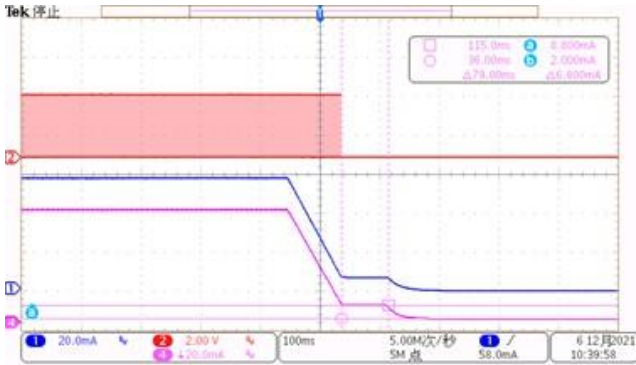
**Test Condition: 120Vac/60Hz Input,  
Duty: (C: 1%, W: 0%)**



(CH1-IL, CH2-LED\_C, CH3:PWM, CH4-Io\_C)

**Comments: OK**

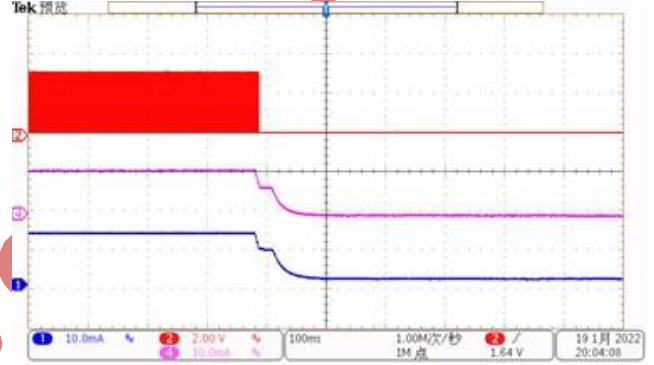
**Test Condition: 220Vac/50Hz Input,  
Duty: (C: 50%, W: 50%)**



(CH1-Io\_W, CH2-PWM\_C,, CH4-Io\_C)

**Comments: OK, no flicker**

**Test Condition: 120Vac/60Hz Input,  
Duty: (C: 90%, W: 10%)**

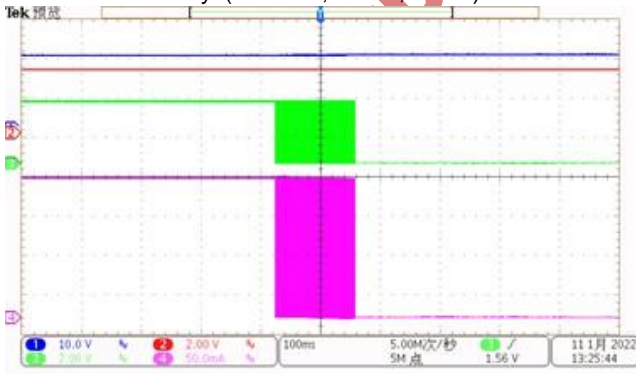


(CH1-Io\_W, CH2-PWM\_C,, CH4-Io\_C)

**Comments: OK, no flicker**

**Waveforms (RGB Mode):**

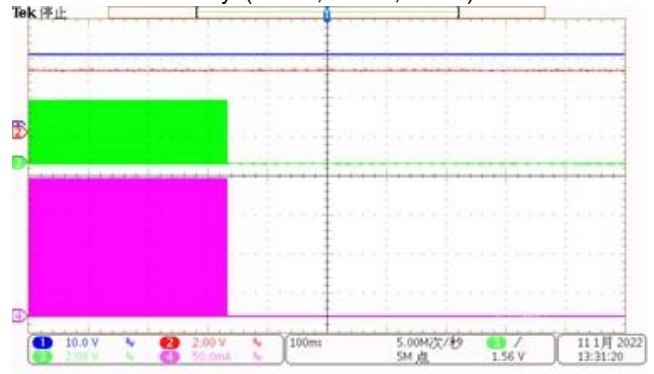
**Test Condition: 220Vac/50Hz Input,  
Duty: (R: 100%, G: 0%, B: 0%)**



(CH1-Vdc, CH2-3.3V, CH3: PWMR, CH4-Io\_R)

**Comments: OK**

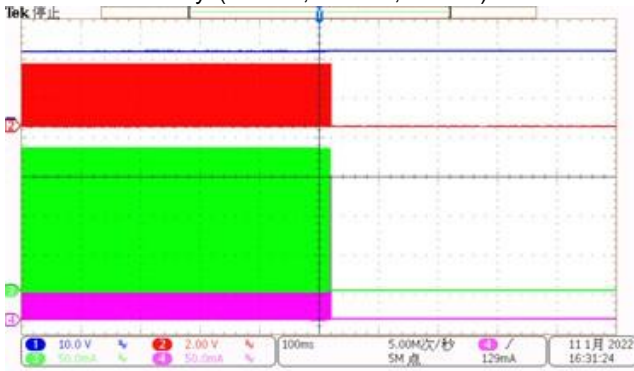
**Test Condition: 120Vac/60Hz Input,  
Duty: (R: 1%, G: 0%, B: 0%)**



(CH1-Vdc, CH2-3.3V, CH3: PWMR, CH4-Io\_R)

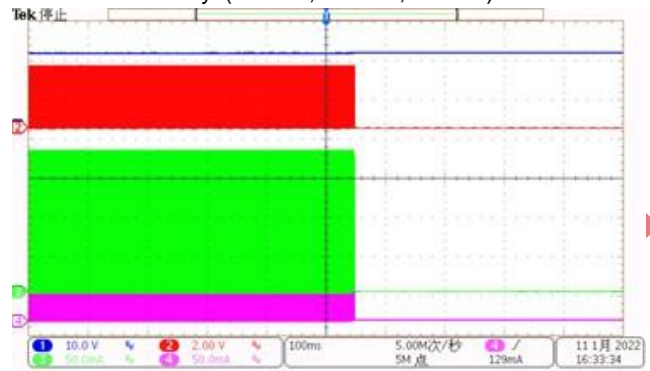
**Comments: OK**

**Test Condition:** 220Vac/50Hz Input,  
Duty: (R: 33%, G: 33%, B: 33%)



(CH1-Vdc, CH2-PWMR, CH3-Io\_G, CH4-Io\_B)  
**Comments:** OK

**Test Condition:** 120Vac/60Hz Input,  
Duty: (R: 10%, G: 10%, B: 10%)



(CH1-Vdc, CH2-PWMR, CH3-Io\_G, CH4-Io\_B)  
**Comments:** OK

**2.5 Dynamic Dimming**

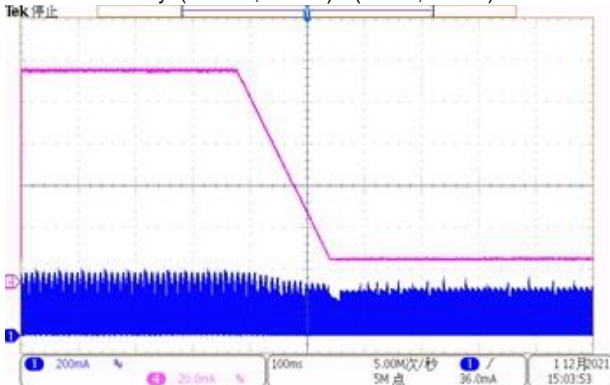
**Test Conditions:** Input: 220Vac; Output: 60V/115mA(C&W), 15V/180mA(R&G&B)

**Standard:** Smoothly and No flicker

**Result:** Pass

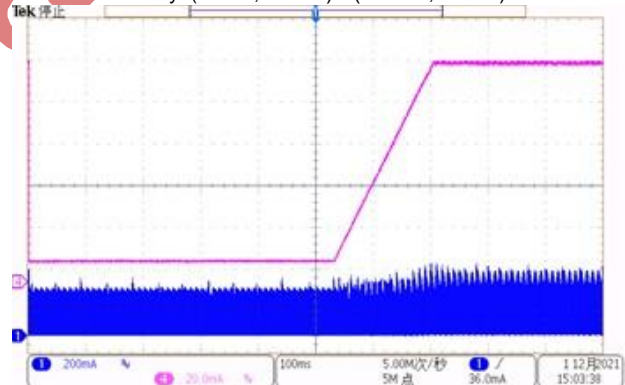
**Waveforms (CW Mode):**

**Test Condition:** 220Vac/60Hz Input,  
Duty: (C: 95%, W: 0%)→(C: 5%, W: 0%)



(CH1-IL, CH4-Io\_C)  
**Comments:** OK

**Test Condition:** 220Vac/50Hz Input,  
Duty: (C: 5%, W: 0%)→(C: 95%, W: 0%)



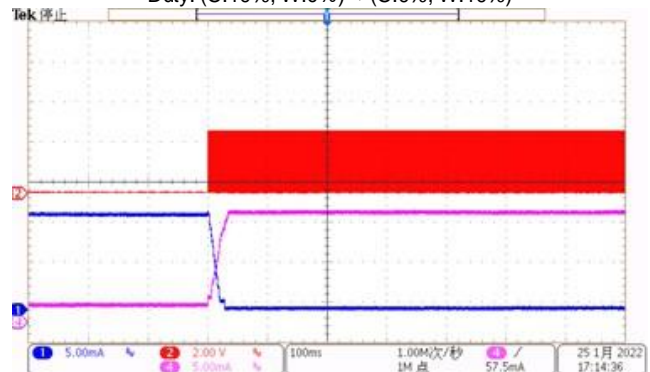
(CH1-IL, CH4-Io)  
**Comments:** OK

**Test Condition:** 220Vac/50Hz Input,  
Duty: (C:100%, W:0%)→(C:0%, W:100%)



(CH1-Io\_W, CH2-PWMC, CH4-Io\_C)  
**Comments:** OK

**Test Condition:** 220Vac/50Hz Input,  
Duty: (C:10%, W:0%)→(C:0%, W:10%)

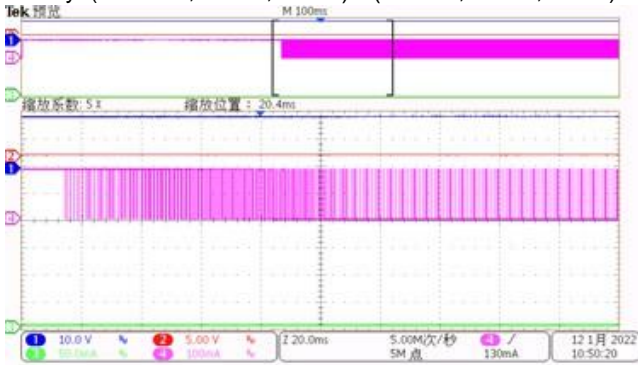


(CH1-Io\_W, CH2-PWMC, CH4-Io\_C)  
**Comments:** OK



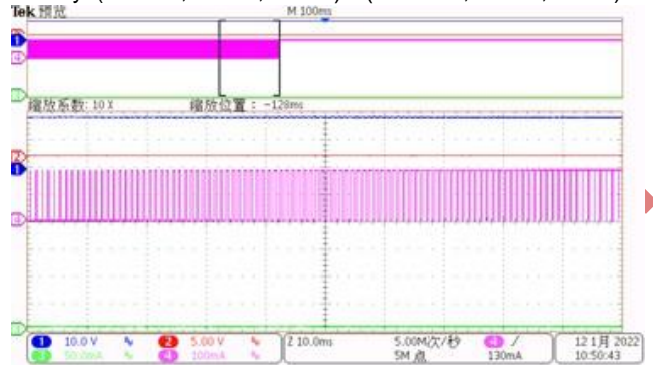
**Waveforms (RGB Mode):**

**Test Condition:** 230Vac/50Hz Input,  
Duty: (R: 100%, G: 0%, B: 0%)→(R: 10%, G: 0%, B: 0%)



(CH1-Vdc, CH2: 3.3V, CH3: Io\_G, CH4-Io\_R)  
Comments: OK

**Test Condition:** 230Vac/50Hz Input,  
Duty: (R: 10%, G: 0%, B: 0%)→(R: 100%, G: 0%, B: 0%)



((CH1-Vdc, CH2: 3.3V, CH3: Io\_G, CH4-Io\_R)  
Comments: OK

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### 3. Thermal Test

**Test Condition:** Burn in for 1 hour within A60 lamp cavity @ confined container (60cm\*40cm\*40cm plastic box) and steady environment with no airflow, Ta is the temperature inside the plastic box.

**Standard:** The maximum temperature is less than 110°C

**Result:** Pass

<b>Test Condition: CW Mode, Input Power 8W</b>				
Component	120Vac		220Vac	
	Ta=23.6°C		Ta=23.3°C	
	T(°C)	Trise(°C)	T(°C)	Trise(°C)
KP28162SP	89.6	66	95.3	72
KP18026ESP	89.8	66.2	89.6	66.3
KP15051SP	67.6	44	68.3	45
KP18032ESP	77.2	53.6	77.1	53.8
KP521403LG	72.8	49.2	73	49.7
LED board	82.9	59.3	82.5	59.2
<b>Test Condition: RGB Mode, Input Power 6W</b>				
Component	120Vac		220Vac	
	Ta=25.5°C		Ta=27.2°C	
	T(°C)	Trise(°C)	T(°C)	Trise(°C)
KP28162SP	76.8	51.3	78.8	51.6
KP18026ESP	79.5	54	80.7	53.5
KP15051SP	101.2	75.7	106.5	79.3
KP18032ESP	94.3	68.8	94.6	67.4
KP521403LG	85.2	59.7	87.6	91.2
LED board	91.5	66	91.2	64

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**4. EMC/EMS Test Result**

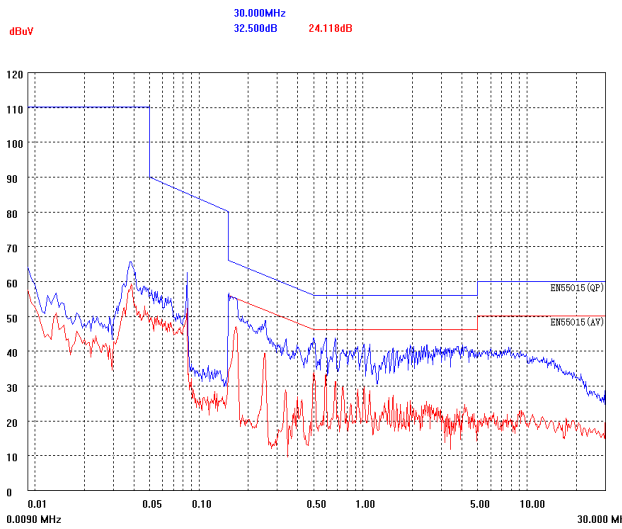
**4.1 Conducted Emissions**

**Test Conditions:** Input :110VAC/220VAC; Output: 8W@CW Mode, 6W@RGB Mode

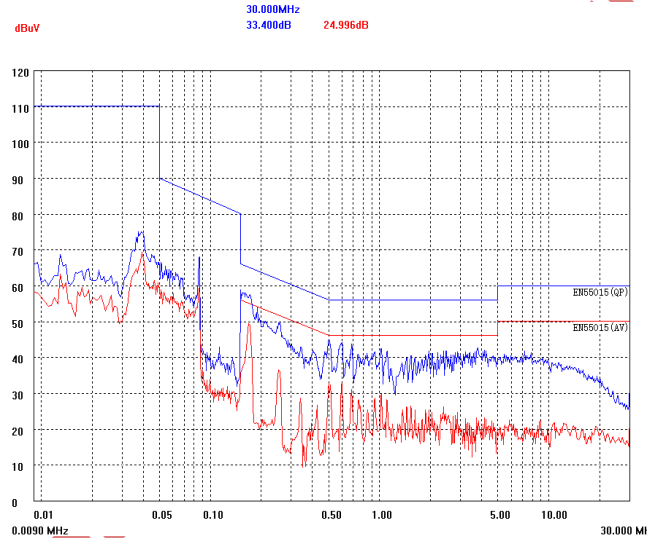
**Standard:** EN55015

**Result:** Pass

**Test Condition: Vin=220VAC/50Hz, CW Mode, Input Power 8W**

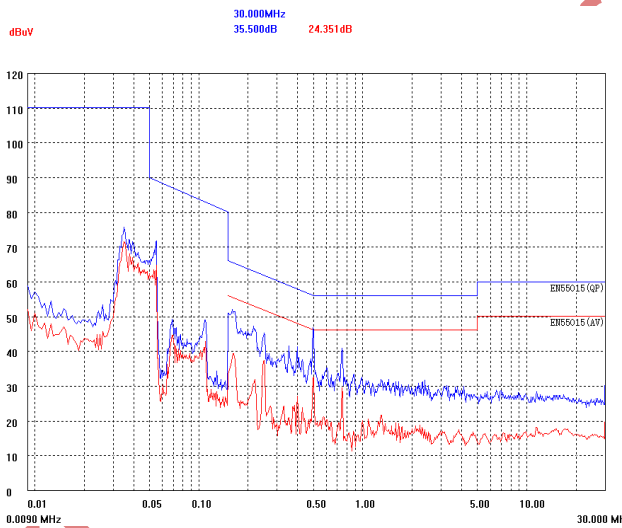


Conduction EMI--LINE

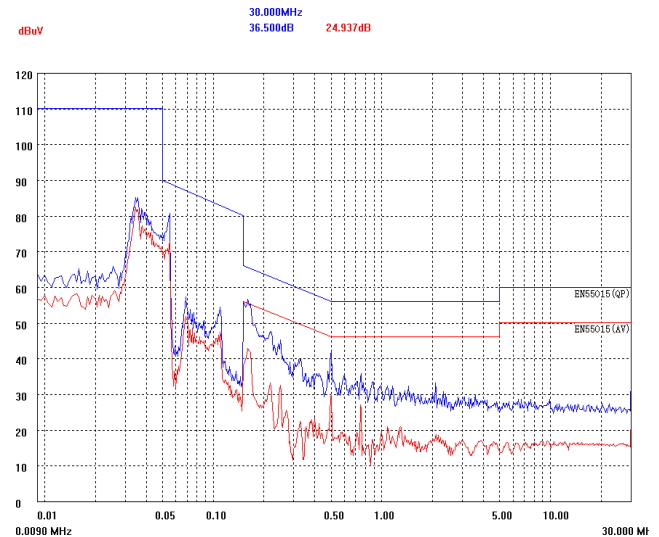


Conduction EMI--NEUTRAL

**Test Condition: Vin=110VAC/50Hz, CW Mode, Input Power 8W**



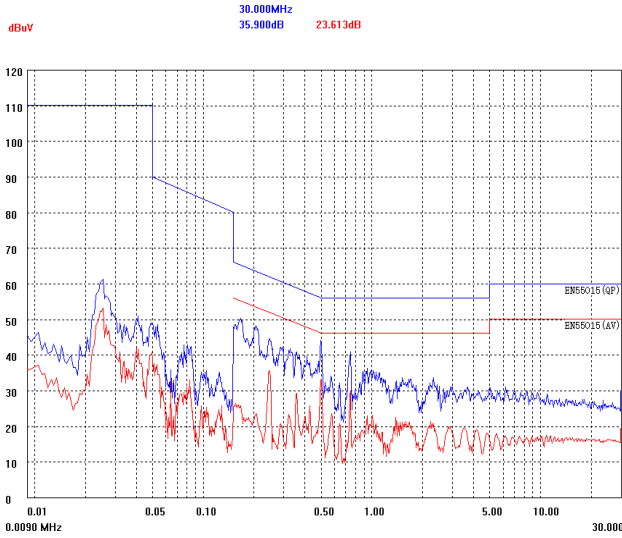
Conduction EMI--LINE



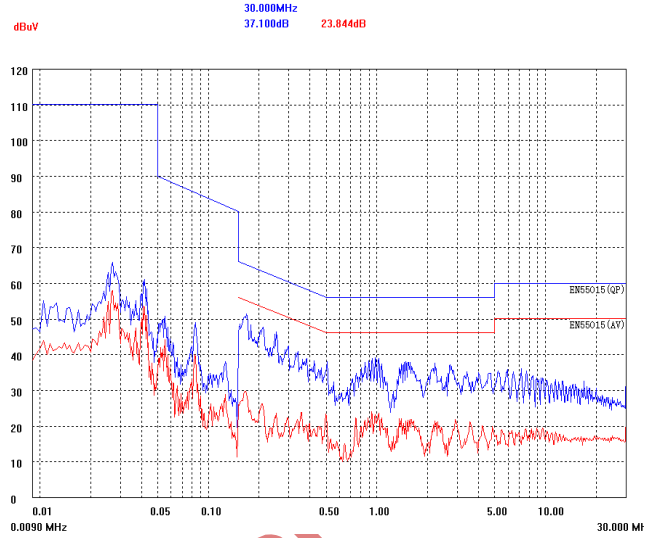
Conduction EMI--NEUTRAL



**Test Condition: Vin=220VAC/50Hz, RGB Mode, Input Power 6W**

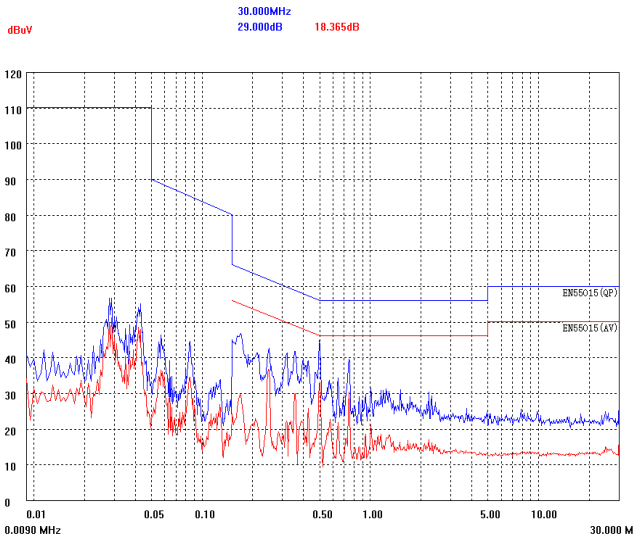


Conduction EMI--LINE

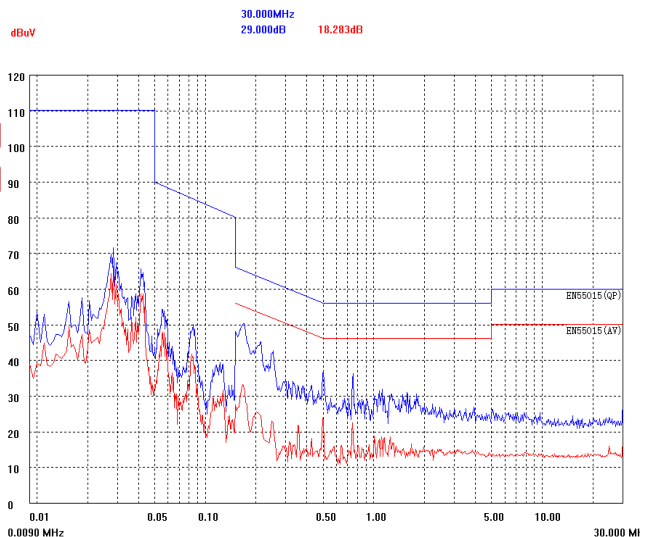


Conduction EMI--NEUTRAL

**Test Condition: Vin=110VAC/50Hz, RGB Mode, Input Power 6W**



Conduction EMI--LINE



Conduction EMI--NEUTRAL

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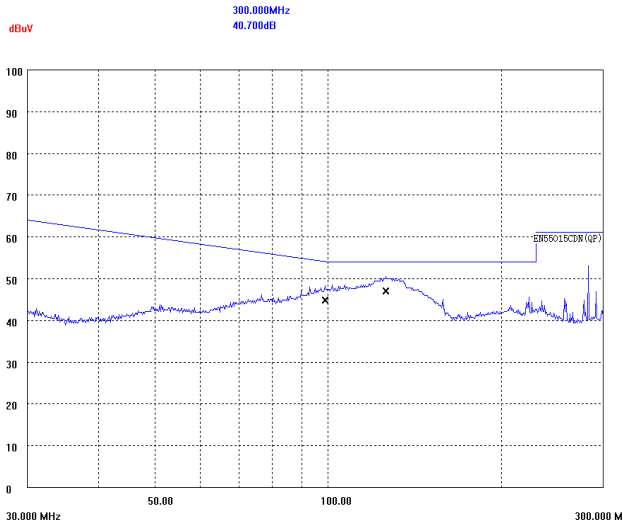
## 4.2 Radiated Emissions

**Test Conditions:** Input :110VAC/220VAC; Output: 8W @CW Mode, 6W @RGB Mode

**Standard:** EN55015

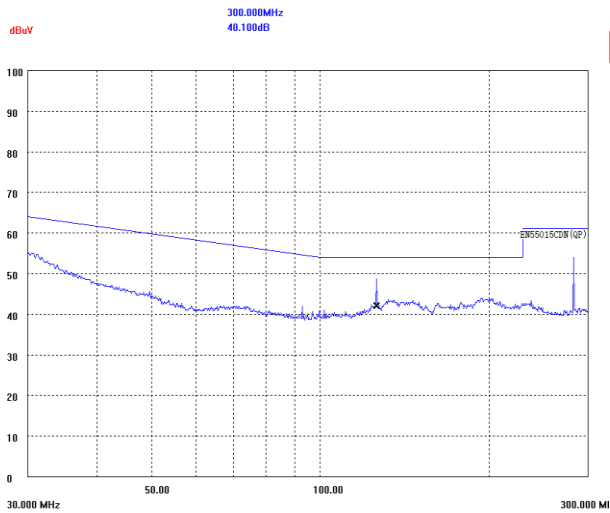
**Result:** Pass

**Test Condition: Vin=220AC/50Hz, CW Mode, Input Power 8W**



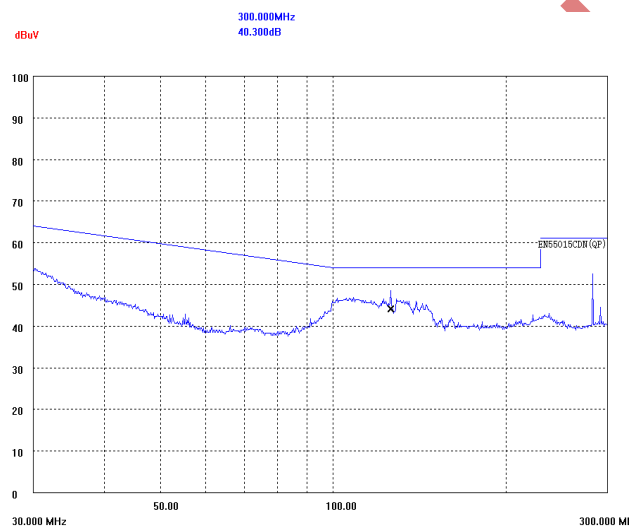
序号	频率 (MHz)	电平值 (QP)	LIM (QP)	Δ (QP-LIM)	序号	频率 (MHz)	电平值 (AY)	LIM (A)
0	96.720	44.726	54.183	-9.457				
1	126.020	47.920	54.100	-6.180				

**Test Condition: Vin=220VAC/50Hz, RGB Mode, Input Power 6W**



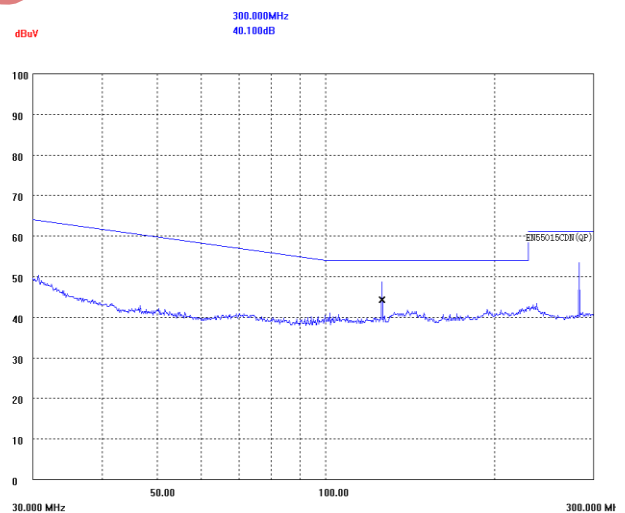
序号	频率 (MHz)	电平值 (QP)	LIM (QP)	Δ (QP-LIM)	序号	频率 (MHz)	电平值 (AY)	LIM (A)
0	126.990	42.020	54.000	-11.980				

**Test Condition: Vin=110AC/50Hz, CW Mode, Input Power 8W**



序号	频率 (MHz)	电平值 (QP)	LIM (QP)	Δ (QP-LIM)	序号	频率 (MHz)	电平值 (AY)	LIM (A)
0	126.000	44.020	54.000	-9.980				

**Test Condition: Vin=110AC/50Hz, RGB Mode, Input Power 6W**



序号	频率 (MHz)	电平值 (QP)	LIM (QP)	Δ (QP-LIM)	序号	频率 (MHz)	电平值 (AY)	LIM (A)
0	126.000	44.220	54.000	-9.780				

## 5 Surge Test

Line to Line 1kV surge testing was completed according to IEC61000-4-5. Input voltage was set at 220VAC/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 25 seconds before next one.

Input Voltage (VAC)	Surge Level (V)	Injection Location	Injection Phase (°)	Test Result (Pass/Fail)
220Vac/50Hz	+1000	L to N	0	Pass
	+1000	L to N	90	Pass
	+1000	L to N	180	Pass
	+1000	L to N	270	Pass
	-1000	L to N	0	Pass
	-1000	L to N	90	Pass
	-1000	L to N	180	Pass
	-1000	L to N	270	Pass

### Test Setup Guide

1. Set the AC Power Source between 90VAC and 265VAC.
2. Connect the AC Power Source terminal to the "L" and "N" terminals on the Demo Board.
3. The dimming program for Espressif modules is in the file "Dimming code-28162+18026+15051+18032+521403\_D01\_REV1.0"

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
2022/08/19	1.0	First Release

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