



## DEMO BOARD TEST REPORT

# 220~265VAC/50HZ, PF>0.7, CW 260V/27.5mA and RGB 260V/6mA Five-Channel Linear Solution for Smart LED with KP18058

## FEATURES

- Meet the Latest Harmonic Current Requirements of IEC-61000-3-2:2019
- PF > 0.7
- Fast Startup Time <0.3S Even at Minimum Dimming
- 0.1% Dimming Depth
- No Flicker
- No Audible Noise
- Constant Input Power with Line Compensation Function
- PWM Dimming for RGB Channels
- Analog Dimming for CW Channels
- Thermal Protection
- Compact Package ESSOP-10L

## APPLICATIONS

- LED Smart Lighting with Wireless Control

## GENERAL DESCRIPTION

The Demo Board is designed to demonstrate the high performance of KP18058. KP18058 is a high-precision five-channel LED linear constant current dimming controller which meets the latest Harmonic Current Requirements of IEC-61000-3-2:2019 and PF>0.7. It can independently set the output current of five channels by I2C (Inter-Integrated-Circuit Bus) to support various scenes. KP18058 integrates line compensation function, which can easily meet the requirements of constant input power without additional components. And it integrates OTP functions which will automatically reduce the output current to ensure the safety and reliability of the system. And it meets the EN55015B conducted and radiated EMI requirement.

The Demo Board is typically designed for 9W application with 220-265Vac input, 260V/27.5mA output of the CW channels and 260V/6mA output of the RGB channels within A60 LED Bulb.

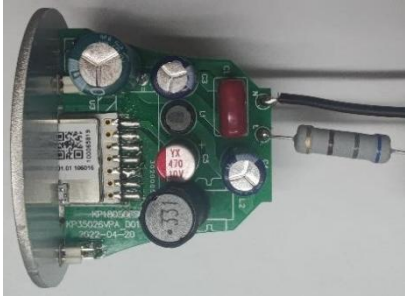
## DEMO BOARD SEPCIFICATION

Description	Symbol	Min	Type	Max	Unit	Note	
Input Voltage	Vin	220		265	Vac	50Hz	
Output	Vout/Iout	CW:260V/27.5mA; RGB:260V/6mA					
System Efficiency	$\eta$	80			%	230Vac/50Hz	
Power Factor	PF	0.7				230Vac/50Hz	
Total Harmonic Distortion	THD	IEC-61000-3-2:2019					
Startup Time	Tst			300	ms	230Vac/50Hz	
Standby Power				200	mW	230Vac/50Hz	
Conducted EMI Margin		6			dB		
Radiated EMI Margin		6			dB		
Surge Test		1			kV		

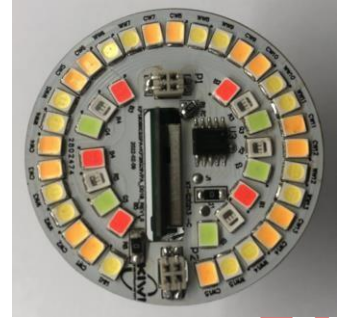
**Note:** The table above shows the minimum acceptable performance of the design. Actual performance is listed in the results section.

**Demo Board of KP18058ESPA+KP35026VGA-D01-REV1.0**

**Part A**

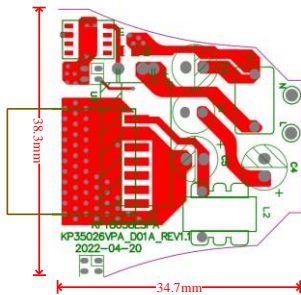


**Part B**

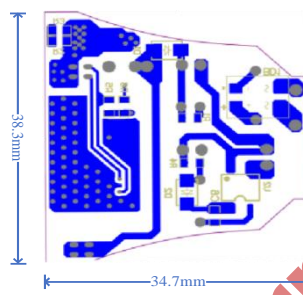


**Printed Circuit Board Layout**

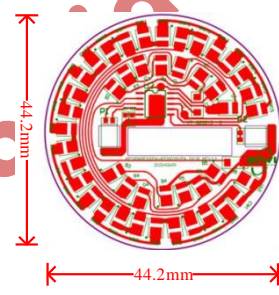
**Top Layer(Part A)**



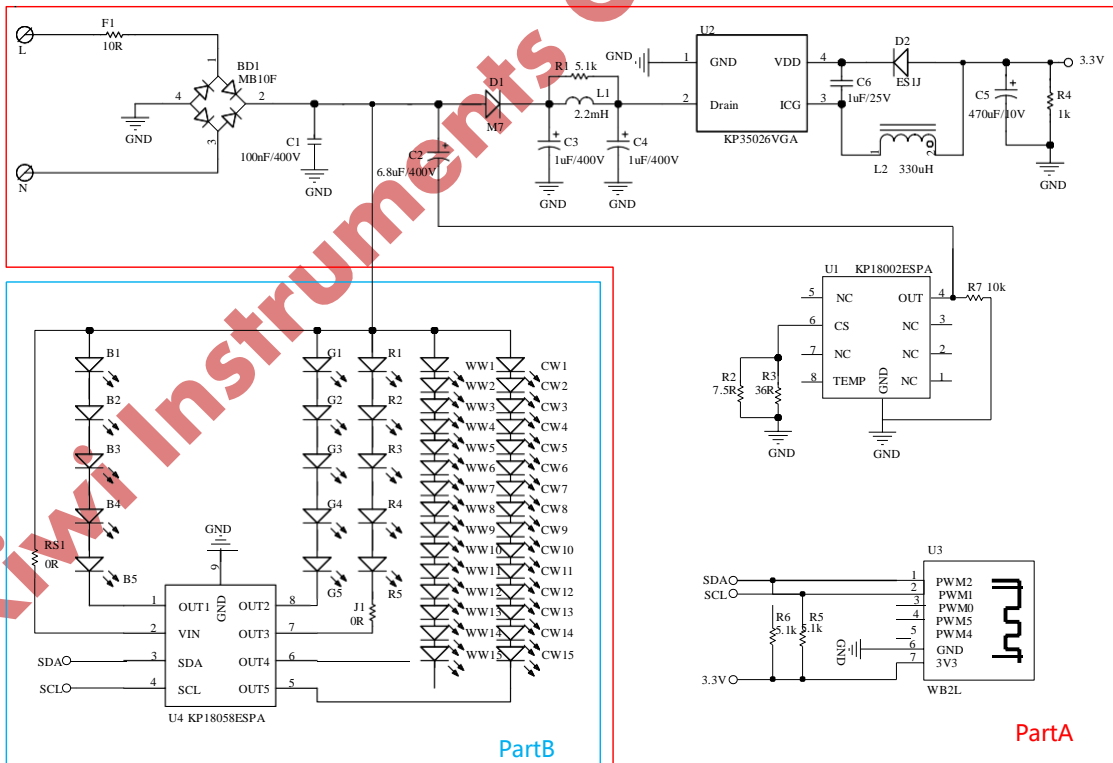
**Bottom Layer(Part A)**



**Top Layer(Part B)**



**Schematic**





**Demo Board Test Report**  
**220~265VAC/50HZ, PF>0.7, CW 260V/27.5mA and RGB 260V/6mA**  
**Five-Channel Linear Solution for Smart LED with KP18058**

**Bill of Material**

No.	Designator	Value	Description	Package	Manufacturer	Part Number
1	C1	100nF/400V	CBB21,400Vdc(200Vac), P=7.5mm, T=4.5mm	TH	Fala	
2	C2	6.8μF/400V	Electrolytic Cap, 400V,10*12	TH	AISHI	
3	C3	1μF/400V	Electrolytic Cap, 400V,6.3*12	TH	AISHI	
4	C4	1μF/400V	Electrolytic Cap, 400V,6.3*12	TH	AISHI	
5	C5	470μF/10V	Electrolytic Cap, 10V,6.3*12	TH	WE	
6	C6	1μF/25V	Ceramic Cap, 25V X7R	0805	WE	
7	D1	1000V/1A	Fast Recovery Rectifiers, TRR=150ns(VF=1.1V@IF=1A)	SMA	YEA SHIN	M7
8	D2	600V/1A	1.0 AMP Surface Mount Super Fast Recovery Rectifiers, TRR=35ns(VF=1.7V@IF=1A)	SMA	Taiwan Semiconductor	ES1J
9	R1	5.1K	Film Resistor, 1%	0805	Fenghua	
10	R2	7.5R	Film Resistor, 1%	0805	Fenghua	
11	R3	36R	Film Resistor, 1%	0805	Fenghua	
12	R4	1K	Film Resistor, 1%	0805	Fenghua	
13	R5	5.1K	Film Resistor, 1%	0805	Fenghua	
14	R6	5.1K	Film Resistor, 1%	0805	Fenghua	
15	R7	10k	Film Resistor, 1%	0805	Fenghua	
16	RS1	0R	Film Resistor, 1%	1206	Fenghua	
17	J1	0R	Film Resistor, 1%	1206	Fenghua	
18	BD1	1000V/0.8A	SINGLE PHASE SILICON BRIDGE(VF=1V@IF=0.4A)	SOP4	SHIKUES	MB10F
19	F1	10R	Fuse Resistor,1W	TH	Yanxin	
20	L1	2.2mH	WE-TI Inductor, Isat=0.18A, Rdc=15Ω,5*7.5	TH	WE	
21	L2	330μH	WE-TI Inductor, Isat=0.85A, Rdc=0.47Ω,8*12	TH	WE	
22	U1	KP18002ESPA	Single Channel Constant-input Power Linear Constant Current LED Driver	ESOP-8	Kiwi Instrument	KP18002ESPA
23	U2	KP35026VGA	Low Cost Fast Dynamic Response Non-isolated PWM Power Switch	SOP-4	Kiwi Instrument	KP35026VGA
24	U3	WiFi Module		WB2L	tuya	
25	U4	KP18058ESPA	PF>0.7, Five-Channel High- Voltage Linear LED Dimming Driver	ESOP-8	Kiwi Instrument	KP18058ESPA
26	B1~B5	Blue LED	LED Voltage 54V	2835	Any	
27	G1~G5	Green LED	LED Voltage 54V	2835	Any	
28	R1~R5	Red LED	LED Voltage 54V	2835	Any	
29	WW1~WW15	Warm LED	LED Voltage 18V	2835	Any	
30	CW1~CW15	Cool LED	LED Voltage 18V	2835	Any	

## Test Result

### 1. Steady characteristics

#### 1.1 System Efficiency

**Standard:** PF>0.7,  $\eta$ >80%. @ 230Vac input & full load

**Result:** Pass

Vin (Vac)	Fline (Hz)	Pin (W)	Vo (V)	Io(mA)	PF	Eff (%)
220	50	9.1	266.1	28.84	0.7624	84.33
230		9.25	266.7	28.48	0.8026	82.11
240		9.85	267.8	29.27	0.8274	79.58
250		10.32	266.1	29.71	0.8296	76.61
265		10.3	266.1	28.14	0.8170	72.69

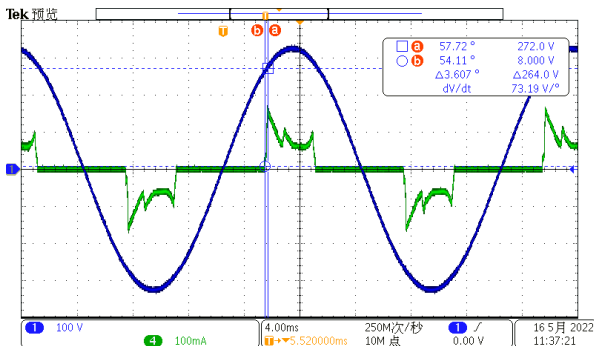
**Note:** The test data includes the wireless module.

#### 1.2 Total Harmonic current

**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

**Test Condition:** 230Vac/50Hz Input, 260V/27.5mA Output



(CH1-Vin, CH4-Iin)

**Comments:** Start Phase:54.11°(Limit 60°),  
Peak Phase:57.72°(Limit 65°)

Sub-harmonic	Value	Limit
3 <sup>rd</sup>	61.5%	86%
5 <sup>th</sup>	16.81%	61%

#### 1.3 Standby Power

**Standard:** the standby power should be no more than 200mW at input 230Vac and remote dim off.

**Result:** Pass

Vin (Vac)	Fin (Hz)	Pstb (mW)
220	50	143.59
230	50	138.04
240	50	162.6

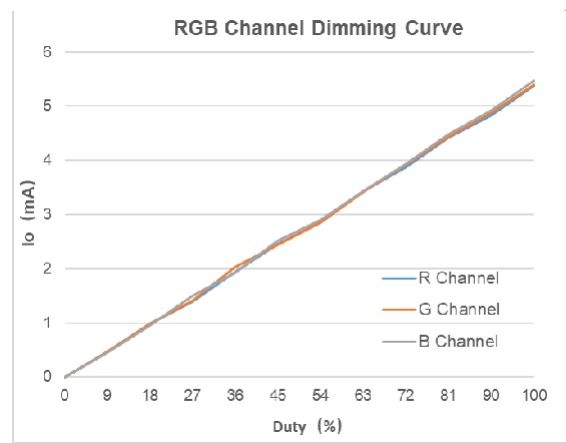
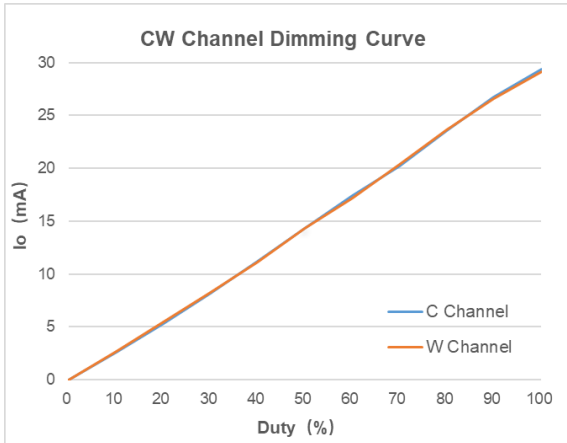
**Note:** The test data include external wireless module.

### 1.4 Dimming Curve

**Standard:**

1. the degree of dimming linearity <math>\lt; \pm 5\%</math>;
2. C and W channel dimming curves should keep as consistent as possible; R, G and B channel dimming curves should keep as consistent as possible.

**Result: Pass**



## 2. Dynamic characteristics

### 2.1 Power On

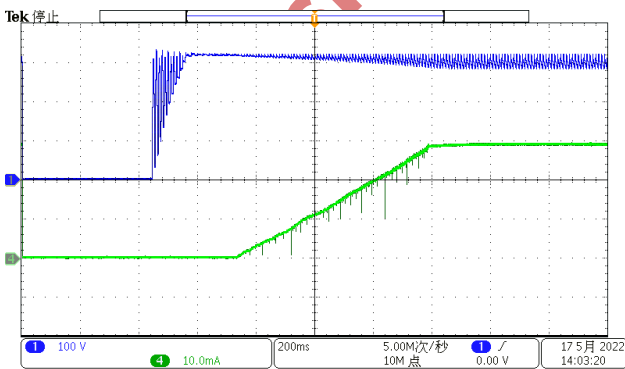
**Standard:**

1. the startup time should no more than 300ms;
2. the rising process of output current should be smooth with different duty under CW mode and RGB mode.

**Result: Pass**

**Waveforms (CW Mode):**

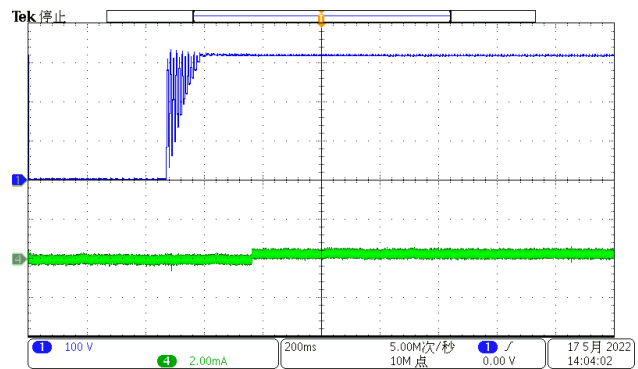
**Test Condition: 230Vac/50Hz Input,  
Duty: (C: 100%, W: 0%)**



(CH1-Vbus, CH4-Io\_C)

**Comments: Startup time = 294ms**

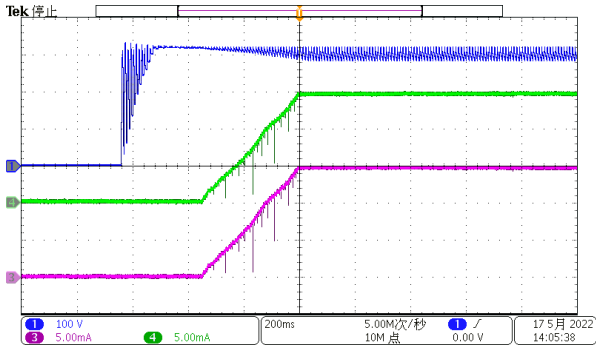
**Test Condition: 230Vac/50Hz Input,  
Duty: (C: 1%, W: 0%)**



(CH1-Vbus, CH4-Io\_C)

**Comments: Startup time = 294ms**

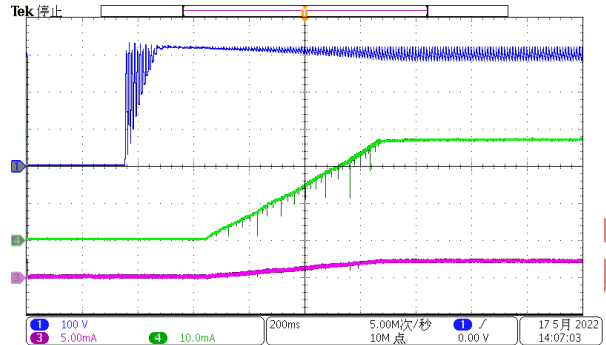
**Test Condition: 230Vac/50Hz Input,**  
**Duty: (C: 50%, W: 50%)**



(CH1-Vbus, CH3-Io\_W, CH4-Io\_C)

**Comments: CW Channel Start at the same time**

**Test Condition: 230Vac/50Hz Input,**  
**Duty: (C: 90%, W: 10%)**



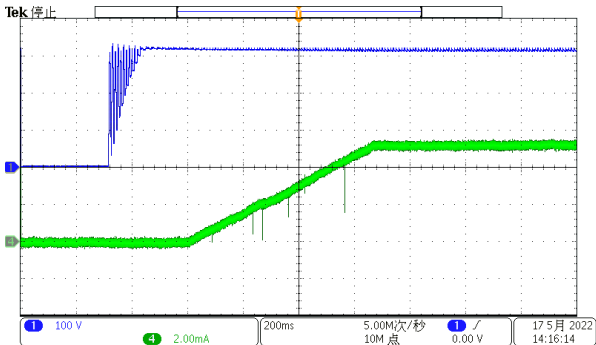
(CH1-Vbus, CH3-Io\_W, CH4-Io\_C)

**Comments: CW Channel Start at the same time**

**Note:** There exist some burrs in the current waveforms due to the changing duty cycle and the burrs do not affect the smoothness of the dimming process. Similar situations also appear in part of results below and no more detailed description.

**Waveforms (RGB Mode):**

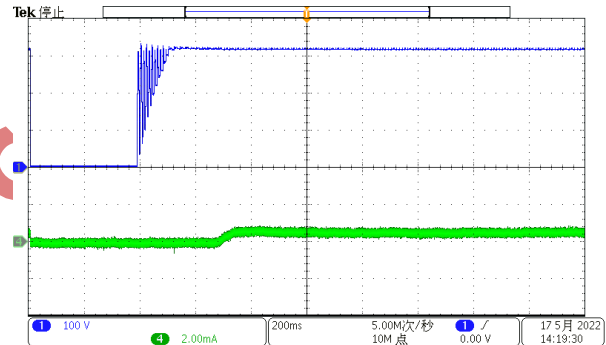
**Test Condition: 230Vac/50Hz Input,**  
**Duty: (R: 100%, G: 0%, B: 0%)**



(CH1-Vbus, CH4-Io\_R)

**Comments: Startup Time=294ms**

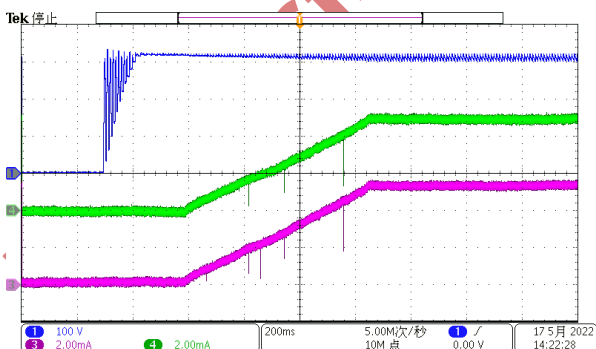
**Test Condition: 230Vac/50Hz Input,**  
**Duty: (R: 1%, G: 0%, B: 0%)**



(CH1-Vbus, CH4-Io\_R)

**Comments: Startup Time=294ms**

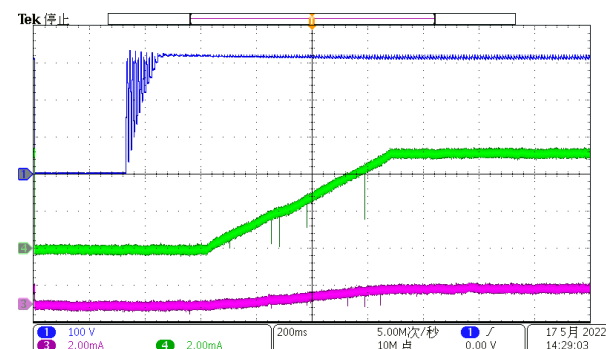
**Test Condition: 230Vac/50Hz Input,**  
**Duty: (R: 33%, G: 33%, B: 33%)**



(CH1-Vbus, CH3-Io\_G, CH4-Io\_R)

**Comments: RGB Channel Start at the same time**

**Test Condition: 230Vac/50Hz Input,**  
**Duty: (R: 80%, G: 0%, B: 20%)**



(CH1-Vbus, CH3-Io\_G, CH4-Io\_R)

**Comments: RGB Channel Start at the same time**

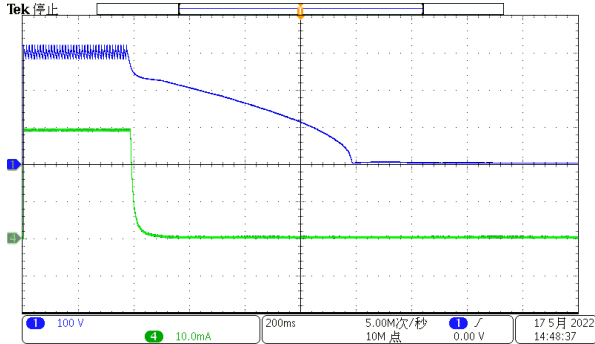
## 2.2 Power Off

**Standard:** the falling process of output current should be smooth and have no noticeable upwarp with different duty under CW mode and RGB mode.

**Result:** Pass

### Waveforms (CW Mode):

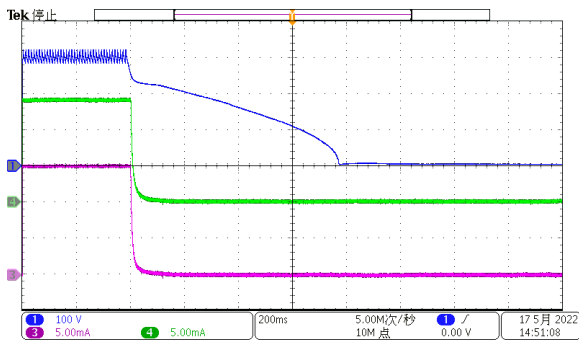
**Test Condition:** 230Vac/50Hz Input,  
Duty: (C: 100%, W: 0%)



(CH1-Vbus, CH4-Io\_C)

**Comments:** Power Off OK

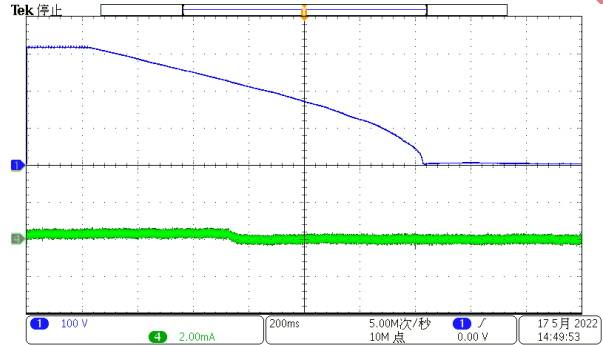
**Test Condition:** 230Vac/50Hz Input,  
Duty: (C: 50%, W: 50%)



(CH1-Vbus, CH3-Io\_W, CH4-Io\_C)

**Comments:** CW Channel Stop at the same time

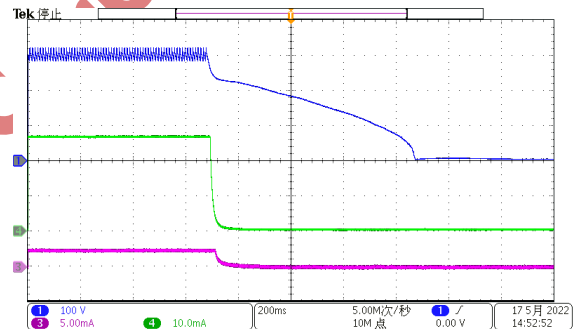
**Test Condition:** 230Vac/50Hz Input,  
Duty: (C: 1%, W: 0%)



(CH1-Vbus, CH4-Io\_C)

**Comments:** Power Off OK

**Test Condition:** 230Vac/50Hz Input,  
Duty: (C: 90%, W: 10%)

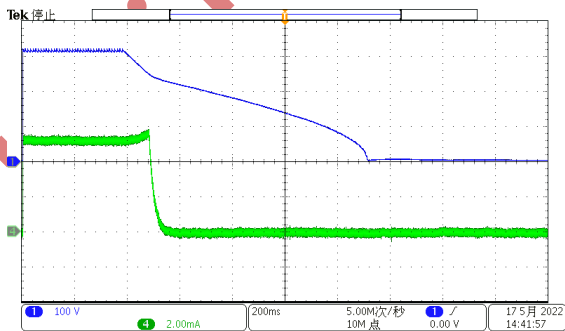


(CH1-Vbus, CH3-Io\_W, CH4-Io\_C)

**Comments:** CW Channel Stop at the same time

### Waveforms (RGB Mode):

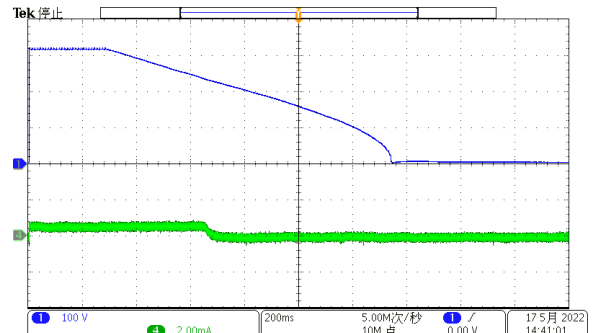
**Test Condition:** 230Vac/50Hz Input,  
Duty: (R: 100%, G: 0%, B: 0%)



(CH1-Vbus, CH4-Io\_R)

**Comments:** Power Off OK

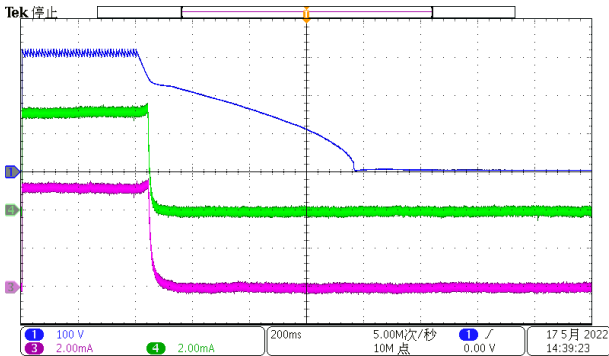
**Test Condition:** 230Vac/50Hz Input,  
Duty: (R: 1%, G: 0%, B: 0%)



(CH1-Vbus, CH4-Io\_R)

**Comments:** Power Off OK

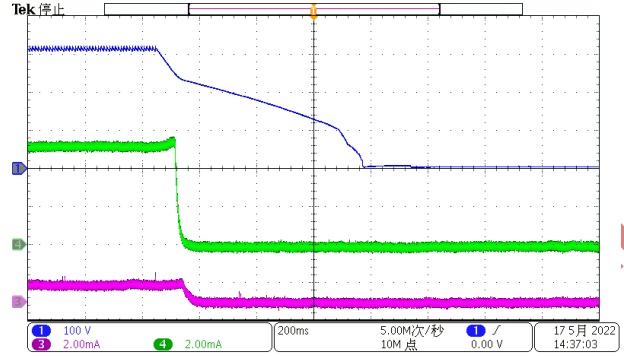
**Test Condition: 230Vac/50Hz Input,**  
**Duty: (R: 33%, G: 33%, B: 33%)**



(CH1-Vbus, CH3-Io\_G, CH4-Io\_R)

**Comments: RGB Channel Stop at the same time**

**Test Condition: 230Vac/50Hz Input,**  
**Duty: (R: 80%, G: 0%, B: 20%)**



(CH1-Vbus, CH3-Io\_G, CH4-Io\_R)

**Comments: RGB Channel Stop at the same time**

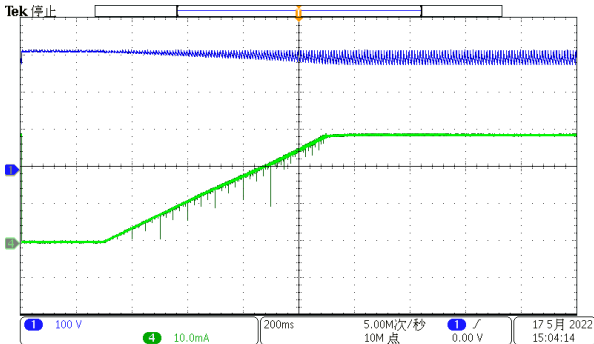
### 2.3 Dimming On

**Standard:** the rising process of output current should be smooth with different duty under CW mode and RGB mode.

**Result:** Pass

#### Waveforms (CW Mode):

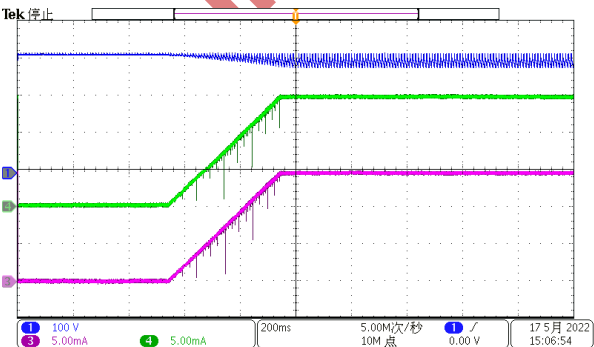
**Test Condition: 230Vac/50Hz Input,**  
**Duty: (C: 100%, W: 0%)**



(CH1-Vbus, CH4-Io\_C)

**Comments: DIM ON OK**

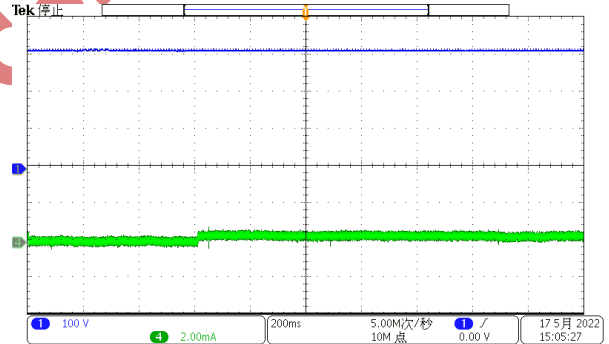
**Test Condition: 230Vac/50Hz Input,**  
**Duty: (C: 50%, W: 50%)**



(CH1-Vbus, CH3-Io\_W, CH4-Io\_C)

**Comments: CW Channel DIM ON at the same time**

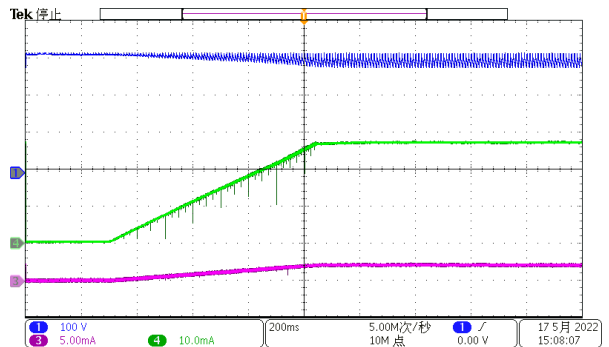
**Test Condition: 230Vac/50Hz Input,**  
**Duty: (C: 1%, W: 0%)**



(CH1-Vbus, CH4-Io\_C)

**Comments: DIM ON OK**

**Test Condition: 230Vac/50Hz Input,**  
**Duty: (C: 90%, W: 10%)**



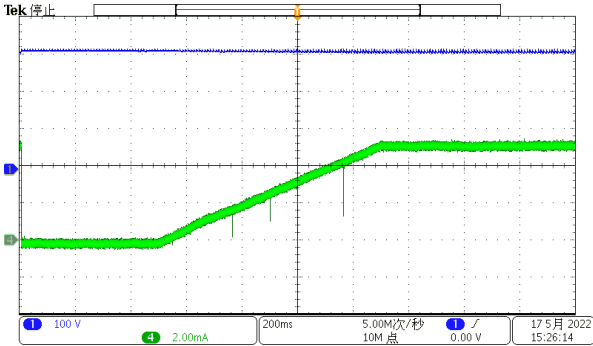
(CH1-Vbus, CH3-Io\_W, CH4-Io\_C)

**Comments: CW Channel DIM ON at the same time**



**Waveforms (RGB Mode):**

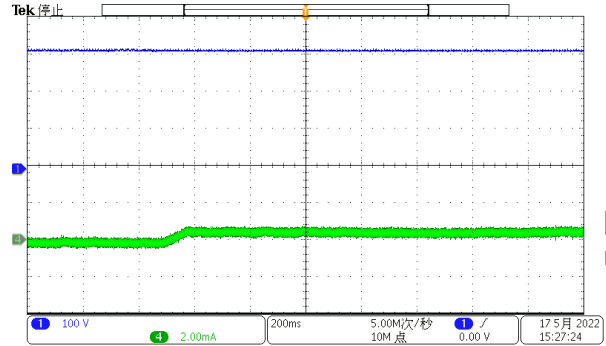
**Test Condition: 230Vac/50Hz Input,**  
**Duty: (R: 100%, G: 0%, B: 0%)**



(CH1-Vbus, CH4-Io\_R)

**Comments: DIM ON OK**

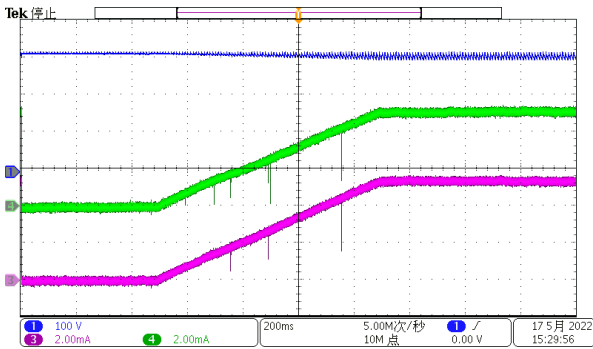
**Test Condition: 230Vac/50Hz Input,**  
**Duty: (R: 1%, G: 0%, B: 0%)**



(CH1-Vbus, CH4-Io\_R)

**Comments: DIM ON OK**

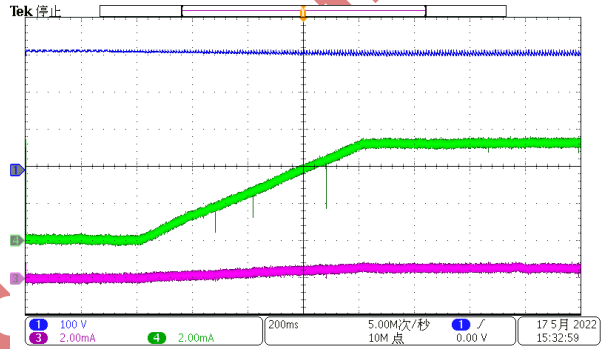
**Test Condition: 230Vac/50Hz Input,**  
**Duty: (R: 33%, G: 33%, B: 33%)**



(CH1-Vbus, CH3-Io\_G, CH4-Io\_R)

**Comments: RGB Channel DIM ON at the same time**

**Test Condition: 230Vac/50Hz Input,**  
**Duty: (R: 80%, G: 0%, B: 20%)**



(CH1-Vbus, CH3-Io\_G, CH4-Io\_R)

**Comments: RGB Channel DIM ON at the same time**

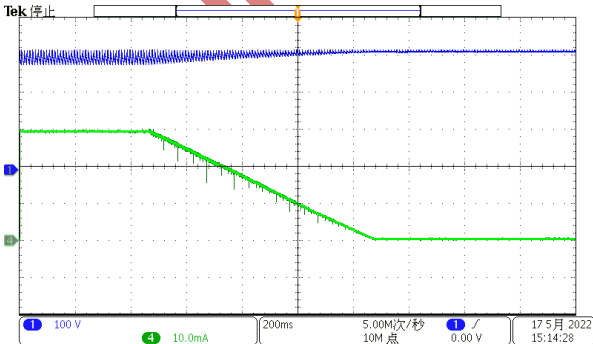
**2.4 Dimming Off**

**Standard:** the falling process of output current should be smooth with different duty under CW mode and RGB mode.

**Result:** Pass

**Waveforms (CW Mode):**

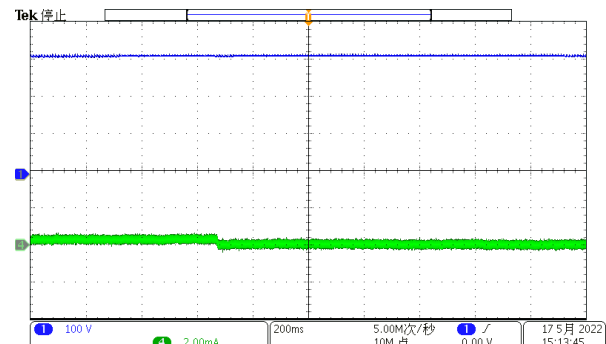
**Test Condition: 230Vac/50Hz Input,**  
**Duty: (C: 100%, W: 0%)**



(CH1-Vbus, CH4-Io\_C)

**Comments: DIM OFF OK**

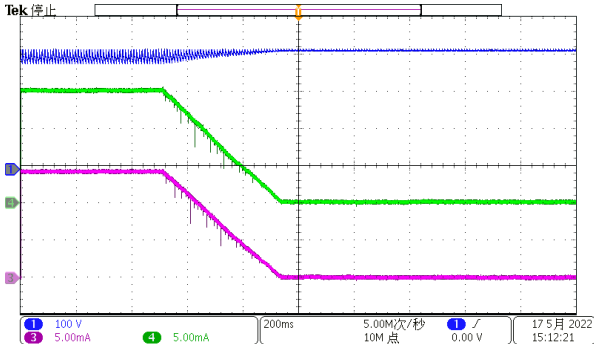
**Test Condition: 230Vac/50Hz Input,**  
**Duty: (C: 1%, W: 0%)**



(CH1-Vbus, CH4-Io\_C)

**Comments: DIM OFF OK**

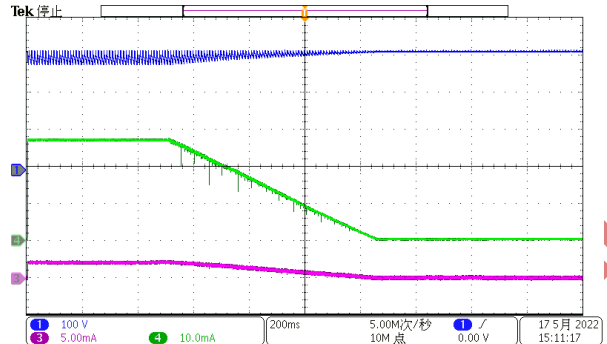
**Test Condition: 230Vac/50Hz Input,**  
**Duty: (C: 50%, W: 50%)**



(CH1-Vbus, CH3-Io\_W, CH4-Io\_C)

**Comments: CW Channel DIM OFF at the same time**

**Test Condition: 230Vac/50Hz Input,**  
**Duty: (C: 90%, W: 10%)**

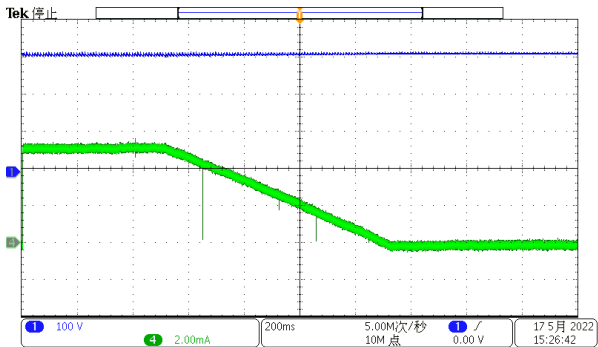


(CH1-Vbus, CH3-Io\_W, CH4-Io\_C)

**Comments: CW Channel DIM OFF at the same time**

**Waveforms (RGB Mode):**

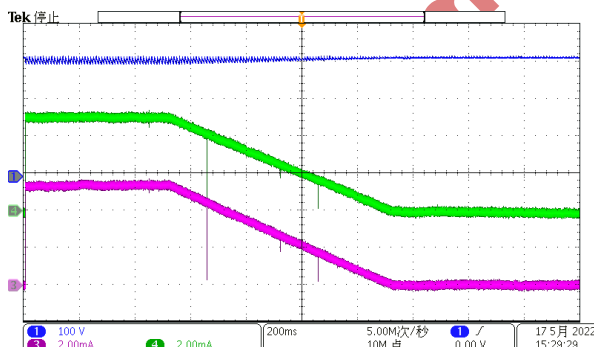
**Test Condition: 230Vac/50Hz Input,**  
**Duty: (R: 100%, G: 0%, B: 0%)**



(CH1-Vbus, CH4-Io\_R)

**Comments: DIM OFF OK**

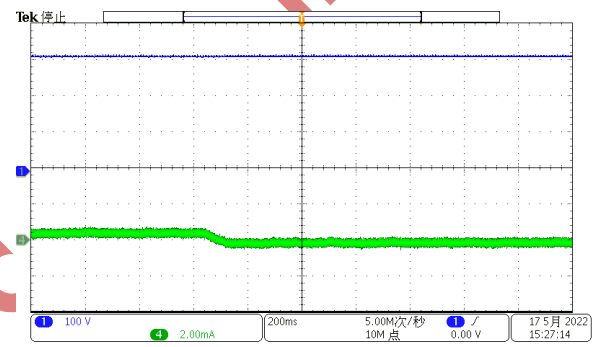
**Test Condition: 230Vac/50Hz Input,**  
**Duty: (R: 33%, G: 33%, B: 33%)**



(CH1-Vbus, CH3-Io\_G, CH4-Io\_R)

**Comments: RGB Channel DIM OFF at the same time**

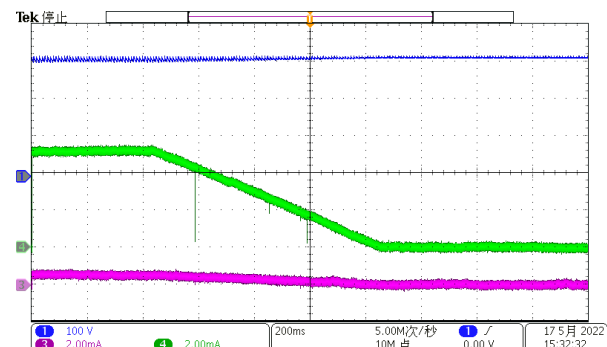
**Test Condition: 230Vac/50Hz Input,**  
**Duty: (R: 1%, G: 0%, B: 0%)**



(CH1-Vbus, CH4-Io\_R)

**Comments: DIM OFF OK**

**Test Condition: 230Vac/50Hz Input,**  
**Duty: (R: 80%, G: 0%, B: 20%)**



(CH1-Vbus, CH3-Io\_G, CH4-Io\_R)

**Comments: RGB Channel DIM OFF at the same time**

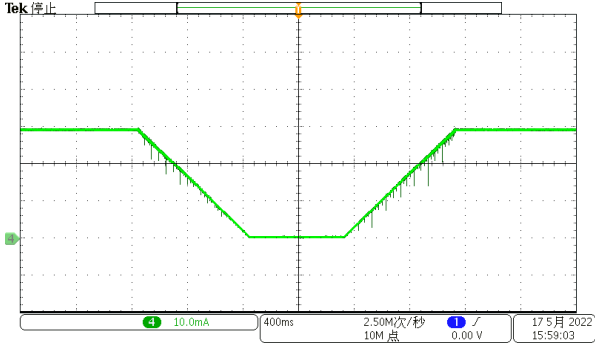
**2.5 Dimming Dynamic**

**Standard:** the color transitions of LEDs should be smooth, and the brightness of LEDs has no noticeable change when the duty changes.

**Result:** Pass

**Waveforms (CW Mode):**

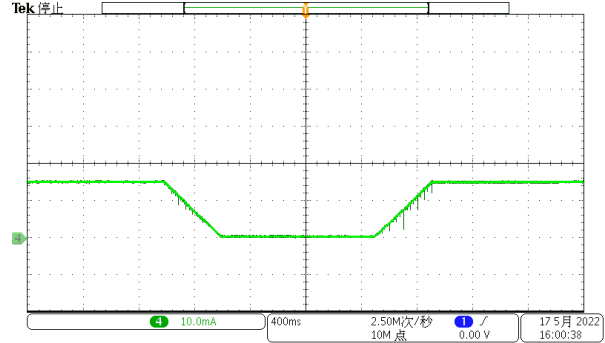
**Test Condition:** 230Vac/50Hz Input,  
 Duty: (C: 100%)→ (C: 1%)→ (C: 100%)



(CH4-Io\_C)

**Comments:** Dimming OK

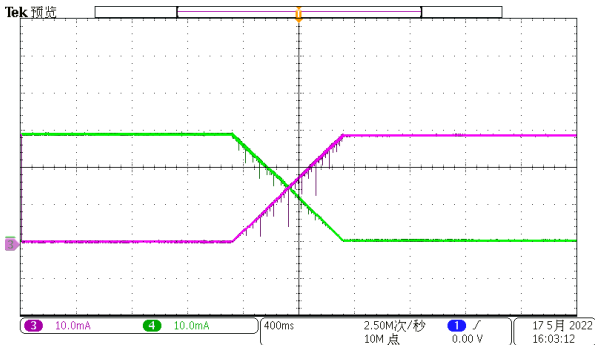
**Test Condition:** 230Vac/50Hz Input,  
 Duty: (C: 50%)→ (C: 10%)→ (C: 50%)



(CH4-Io\_C)

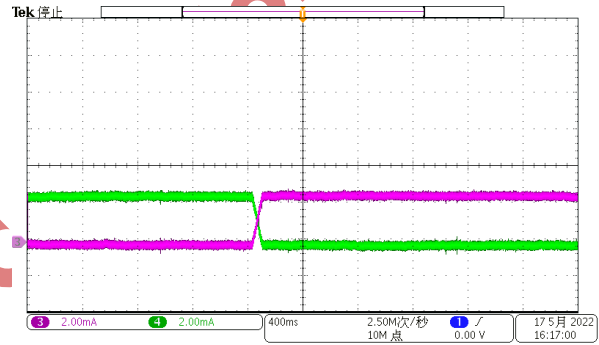
**Comments:** Dimming OK

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



(CH3-Io\_W, CH4-Io\_C)  
**Comments:** Dimming OK

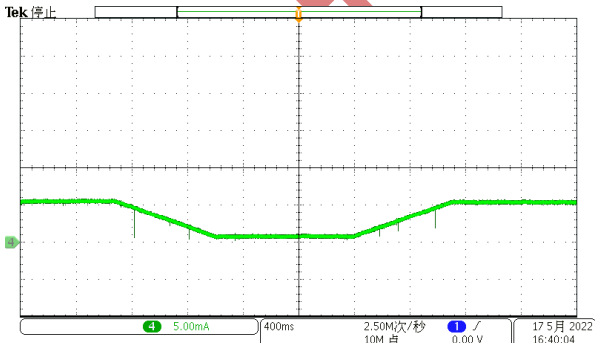
**Test Condition:** 230Vac/50Hz Input,  
 Duty: (C: 10%, W: 0%)→ (C: 0%, W: 10%)



(CH1-SDA, CH3-Io\_W, CH4-Io\_C)  
**Comments:** Dimming OK

**Waveforms (RGB Mode):**

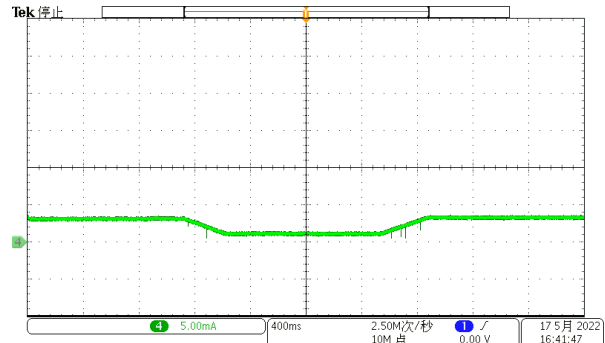
**Test Condition:** 230Vac/50Hz Input,  
 Duty: (R: 100%)→ (R: 1%)→ (R: 100%)



(CH4-Io\_R)

**Comments:** Dimming OK

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



(CH4-Io\_R)


**Comments:** Dimming OK

### 3. Thermal Test

**Standard:** CW mode:  $\Delta T < 90^{\circ}\text{C}$  (Limited  $115^{\circ}\text{C}$ ); RGB mode:  $\Delta T < 70^{\circ}\text{C}$

**Result:** Pass

**Test Condition:** Burn in for 1 hour in the A60 lamp cavity @ confined container (30cm\*30cm\*30cm plastic box) and steady environment with no airflow,  $T_a$  is the temperature inside the plastic box.

Test Condition: CW Mode, Input Power 9W				
Component	230Vac		240Vac	
	$T_a = 26.8^{\circ}\text{C}$		$T_a = 27.2^{\circ}\text{C}$	
	$T_c(^{\circ}\text{C})$	$T_{rise}(^{\circ}\text{C})$	$T_c(^{\circ}\text{C})$	$T_{rise}(^{\circ}\text{C})$
KP18058ESPA	104.2	77.4	102.4	75.2
KP35026VGA	104.6	77.8	102.9	75.7
KP18002ESPA	112.2	85.4	113.6	86.4
Light Board	113.1	86.3	110.1	82.9
Test Condition: RGB Mode, Input Power 6W				
Component	230Vac			
	$T_a = 26.5^{\circ}\text{C}$			
	$T_c(^{\circ}\text{C})$	$T_{rise}(^{\circ}\text{C})$		
KP18058ESPA	79.6	53.1		
KP35026VGA	85.8	59.3		
KP18002ESPA	82.1	55.6		
Light Board	82.2	55.7		
				

#### 4. EMC/EMS Test

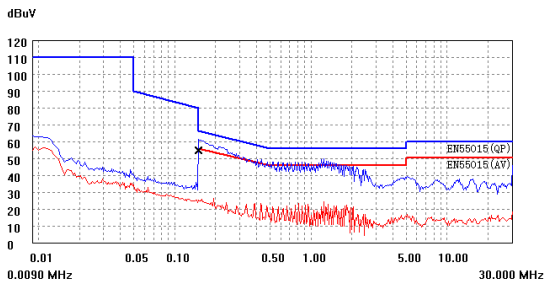
Standard:

Standard	EN55015
Content	CE/RE
Requirement	6 dB Margin

#### 4.1 Conducted Emissions

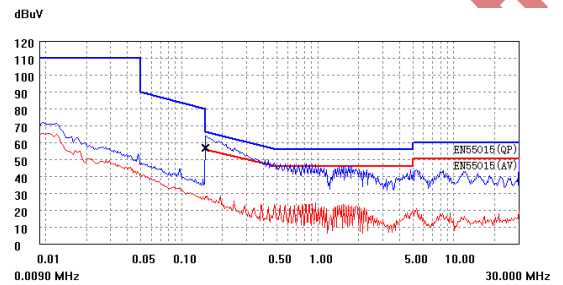
Result: Pass

Test Condition: Vin=230VAC/50Hz, CW Mode, Input Power 9W



(QP)	freq(MHz)	lev(dBuV)	Lim(dBuV)	Δ(lev-Lim)
	0.150	54.6	66.0	-11.4

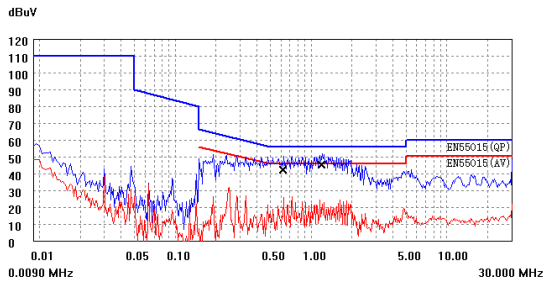
Conduction EMI--LINE



(QP)	freq(MHz)	lev(dBuV)	Lim(dBuV)	Δ(lev-Lim)
	0.150	57.0	66.0	-9.0

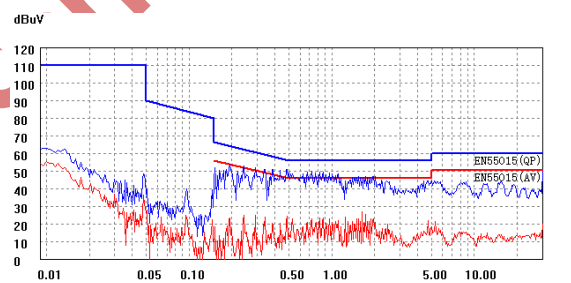
Conduction EMI--NEUTRAL

Test Condition: Vin=230VAC/50Hz, RGB Mode, Input Power 6W



(QP)	freq(MHz)	lev(dBuV)	Lim(dBuV)	Δ(lev-Lim)
	0.625	42.4	56.0	-13.6
	1.200	45.1	56.0	-10.9

Conduction EMI--LINE



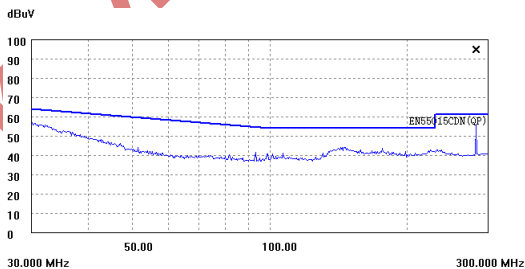
(QP)	freq(MHz)	lev(dBuV)	Lim(dBuV)	Δ(lev-Lim)
	0.625	42.4	56.0	-13.6
	1.200	45.1	56.0	-10.9

Conduction EMI--NEUTRAL

#### 4.2 Radiated Emissions

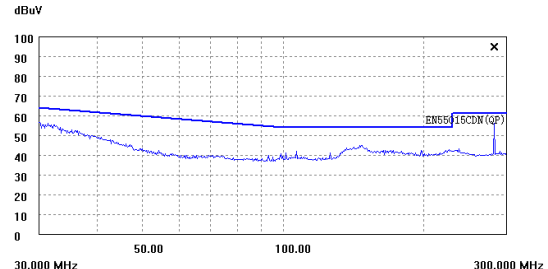
Result: Pass

Test Condition: Vin=230VAC/50Hz, CW Mode, Input Power 9W



(QP)	freq(MHz)	lev(dBuV)	Lim(dBuV)	Δ(lev-Lim)
	282.980	94.9	61.0	33.9

Test Condition: Vin=230VAC/50Hz, RGB Mode, Input Power 6W



(QP)	freq(MHz)	lev(dBuV)	Lim(dBuV)	Δ(lev-Lim)
	282.980	94.9	61.0	33.9



**Demo Board Test Report**  
**220~265VAC/50HZ, PF>0.7, CW 260V/27.5mA and RGB 260V/6mA**  
**Five-Channel Linear Solution for Smart LED with KP18058**

## 5. Surge Test

Line to Line 1kV 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 30 seconds before next one.

**Result:** Pass

Input Voltage (VAC)	Surge Level (V)	Injection Location	Injection Phase(°)	Test Result (Pass/Fail)
230Vac/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 220VAC and 265VAC.
2. Connect the AC Power Source terminal to the “L” and “N” terminals on the Demo Board
3. Turn on the AC Power Source to make system startup; and Turn off the AC Power Source to make system shutdown.



**Demo Board Test Report**  
**220~265VAC/50HZ, PF>0.7, CW 260V/27.5mA and RGB 260V/6mA**  
**Five-Channel Linear Solution for Smart LED with KP18058**

### Revision History

DATE	REV	DESCRIPTION
2022/06/23	1.0	First Release

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