DEMO BOARD TEST REPORT

108~150VAC/60HZ, PF>0.7, CW 140V/55mA and RGB 140V/12mA Five-Channel Linear Solution for Smart LED with KP18058

FEATURES

- PF > 0.7
- PST<1, SVM<1
- Fast Startup Time <0.3S Even at Minimum Dimming
- 0.1% Dimming Depth
- No Audible Noise
- Constant Input Power with Line Compensation Function
- PWM Dimming for RGB Channels
- Analog Dimming for CW Channels
- Thermal Protection
- Single layer PCB at a low cost

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. 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 108-150Vac input, 140V/55mA output of the CW channels and 140V/12mA output of the RGB channels within A60 LED Bulb.

APPLICATIONS

- LED Smart Lighting with Wireless Control

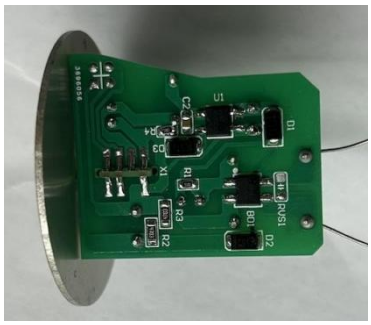
DEMO BOARD SEPCIFICATION

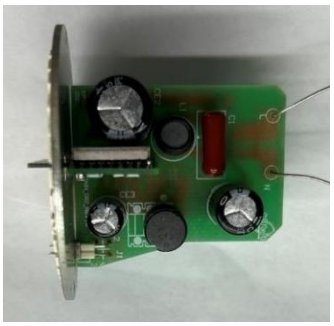
Description	Symbol	Min	Type	Max	Unit	Note
Input Voltage	Vin	108		150	Vac	60Hz
Output	Vout/Iout	CW: 140V/55mA; RGB:140V/12mA				
System Efficiency	η	80			%	120Vac/60Hz
Power Factor	PF	0.7				120Vac/60Hz
Startup Time	Tst			300	ms	120Vac/60Hz
Standby Power				200	mW	120Vac/60Hz
Conducted EMI Margin		6			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 KP18058+KP35026_D02_REV1.0

Part A

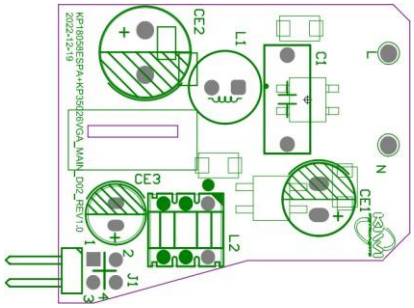




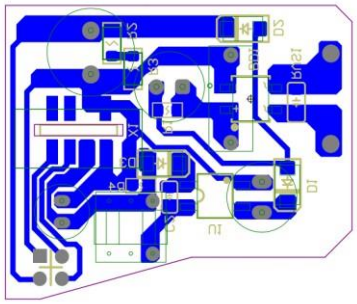
Part B

Printed Circuit Board Layout

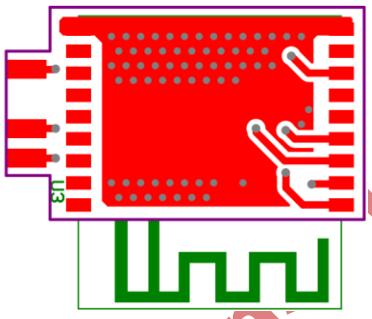
Part A (MAIN) Top Layer



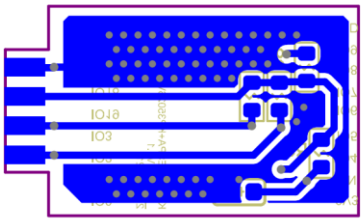
Part A (MAIN) Bottom Layer



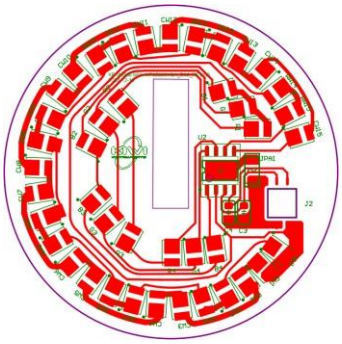
Part A (WIFI) Top Layer



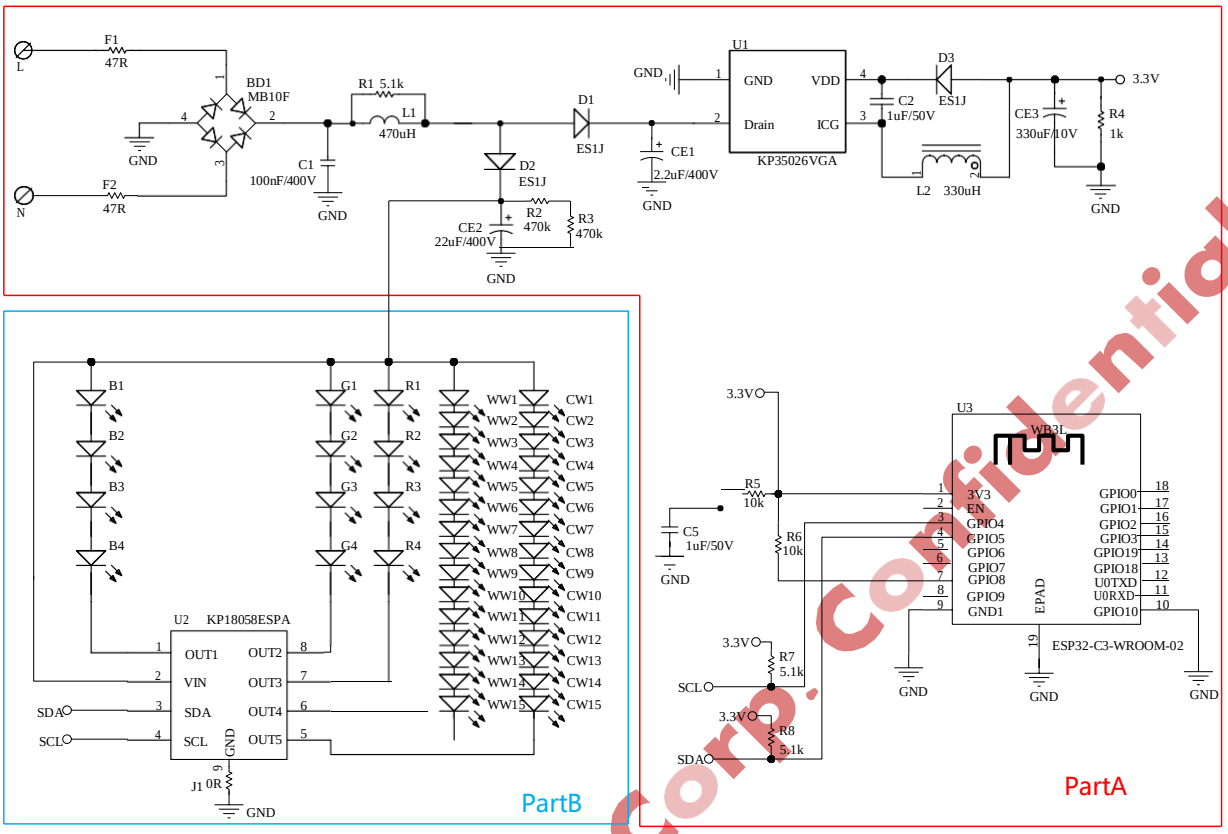
Part A (WIFI) Bottom Layer



Part B (LED) Top Layer



Schematic



Bill of Material

Part A (MAIN)

No.	Designator	Value	Description	Package	Manufacturer	Part Number
1	BD1	1000V/1A	BRD 1A 1000V 1.1V	MBF	World	MB10F
2	C1	100nF/400V	CBB 400Vdc 12*5*9 P10	TH	STE	B22G104JN1B01 20090050EOZ
3	C2	1μF/50V	Ceramic Cap 50V ±10% X7R	0805	WE	885012207103
4	CE1	2.2μF/400V	Electrolytic Cap 400V 8*12 P3.5	TH	AISHI	EWH2GM2R2F12OT
5	CE2	22μF/400V	Electrolytic Cap 400V 10*16 P5.0	TH	AISHI	EGM2GM150G16OT3
6	CE3	330μF/10V	Electrolytic Cap 10V 6.3*11 P2.5	TH	AISHI	EWH1AM331E11OT
7	D1, D2, D3	600V/1A	DIO FRD 1A 600V 35nS 1.7V	SMA	MDD	ES1J
8	F1, F2	47R	Fuse Resistor ±5% 1W	TH	SY	RFB01J47R0A520SC
9	L1	470μH	Inductor Isat 0.31A Rdc 1.68Ω 6*8	TH	FH	VLU0608-471KB
10	L2	330μH	Inductor Isat 0.88A Rdc 0.70Ω 8*9.5	TH	WE	7447720331
11	R1	5.1k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K5101FT
12	R2, R3	470k	Chip Resistor ±1% 1/4W	1206	FH	RS-06K4703FT
13	R4	1k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K3900FT
14	U1	-	Low Cost Fast Dynamic Response Non-isolated PWM Power Switch	SOP-4	KIWI	KP35026VGA

Part A (WIFI)

No.	Designator	Value	Description	Package	Manufacturer	Part Number
15	C5	1μF/50V	Ceramic Cap 50V ±10% X7R	0805	WE	885012207103
16	R5, R6	10k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K1002FT
17	R7, R8	5.1k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K5101FT
18	U3	-	ESP32-C3-WROOM-02	WB3L	ESPRESSIF	/

Part B (LED)

No.	Designator	Value	Description	Package	Manufacturer	Part Number
19	J1	0R	Chip Resistor ±1% 1/4W	1206	FH	RS-06000FT
20	U2	-	Five-Channel High-Voltage Linear LED Dimming Driver	ESOP-8	KIWI	KP18058ESPA
21	B1~B4	Blue LED	LED Voltage 36V	2835	Any	B1~B4
22	G1~G4	Green LED	LED Voltage 36V	2835	Any	G1~G4
23	R1~R4	Red LED	LED Voltage 36V	2835	Any	R1~R4
24	WW1~WW14	Warm LED	LED Voltage 9V	2835	Any	WW1~WW14
25	WW15	Warm LED	LED Voltage 18V	2835	Any	WW15
26	CW1~CW14	Cool LED	LED Voltage 9V	2835	Any	CW1~CW14
27	CW15	Cool LED	LED Voltage 18V	2835	Any	CW15

Test Result

1. Steady characteristics

1.1 System Efficiency

Standard: PF>0.7, η>80% @ 120Vac input & full load

Result: Pass

Vin(Vac)	Fline(Hz)	Pin(W)	Vo(V)	Io(mA)	PF	Eff(%)
108	60	4.75	130.3	31.13	0.692	85.39
120		9.02	134.8	54.4	0736	81.30
132		11.56	136.2	63.6	0.739	74.93
140		11.5	135.2	59.3	0.725	69.72
150		10.8	133.8	51.6	0.703	63.93

1.2 Standby Power

Standard: the standby power should be no more than 200mW at input 120Vac and remote dim off.

Result: Pass

Vin(Vac)	Fin(Hz)	Pstb (mW)
108	60	168.46
120	60	182.35
132	60	197.3

1.3 PST and SVM

Standard: PST<1, SVM<1.6 @ 120Vac input & full load.

Result: Pass

PST	SVM
0.3	0.777

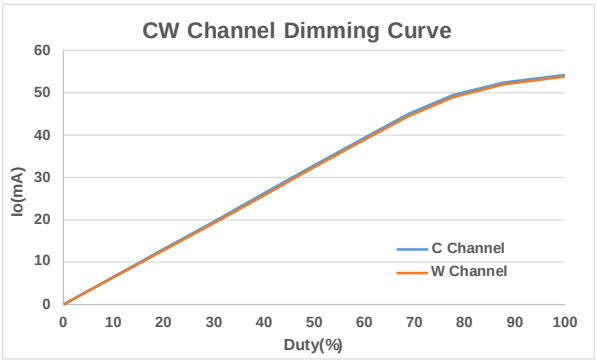
1.4 Dimming Curve

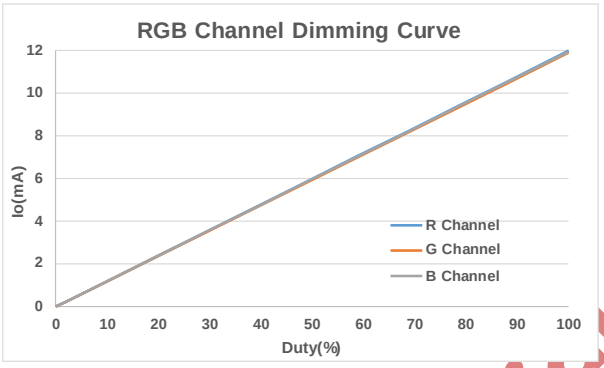
Standard:

1. the degree of dimming linearity should be as small as possible.

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:

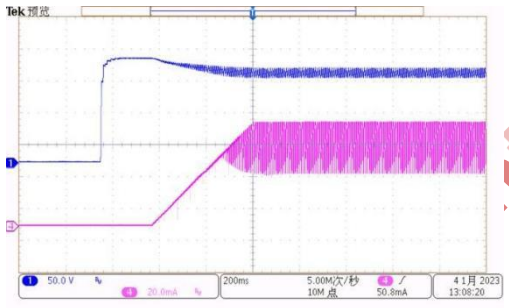
1. the startup time should no more than 300ms;

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

Result: Pass

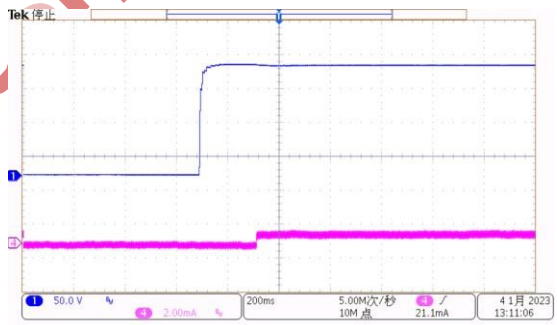
Waveforms (CW Mode):

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



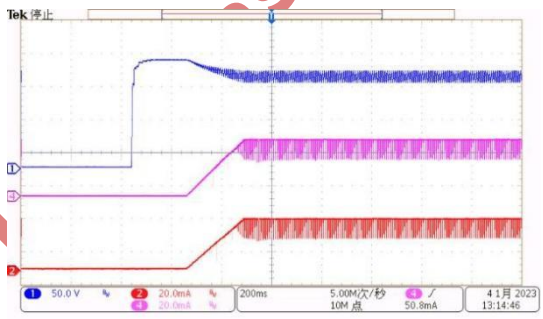
(CH1-Vbus, CH4-Io_C)
Comments: Startup time = 218ms

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



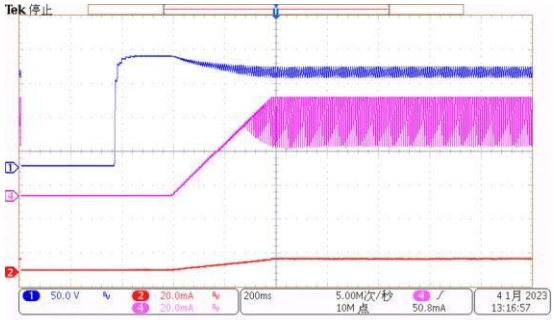
(CH1-Vbus, CH4-Io_C)
Comments: Startup time = 218ms

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



(CH1-Vbus, CH2-Io_W, CH4-Io_C)
Comments: CW Channel Start at the same time

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

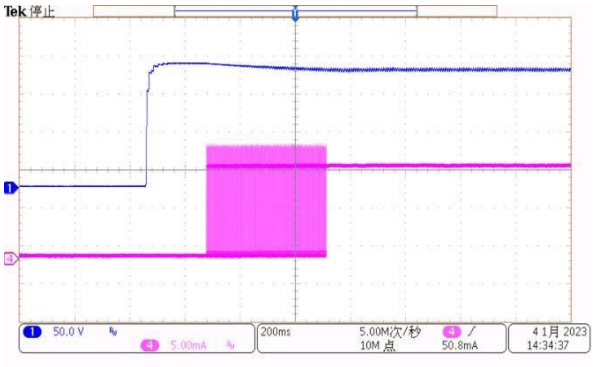


(CH1-Vbus, CH2-Io_W, CH4-Io_C)
Comments: CW Channel Start at the same time

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.

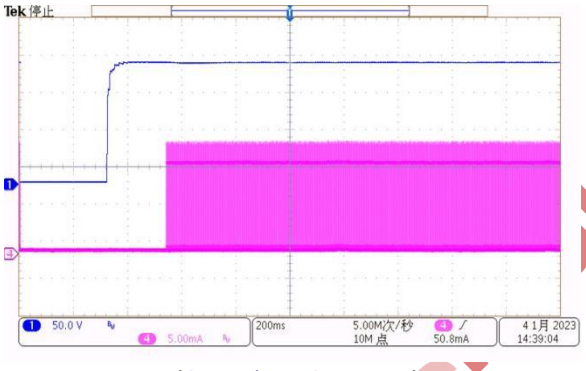
Waveforms (RGB Mode):

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



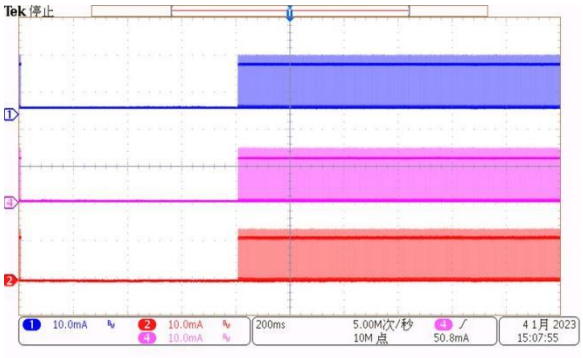
(CH1-Vbus, CH4-Io_R)
Comments: Startup Time=218ms

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



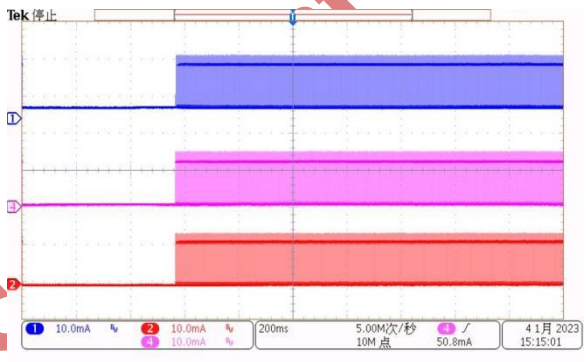
(CH1-Vbus, CH4-Io_R)
Comments: Startup Time=218ms

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



(CH1-Io_B , CH2-Io_G, CH4-Io_R)
Comments: RGB Channel Start at the same time

Test Condition: 120Vac/60Hz Input,
Duty: (R: 80%, G: 50%, B: 20%)



(CH1-Io_B , CH2-Io_G, CH4-Io_R)
Comments: RGB Channel Start at the same time

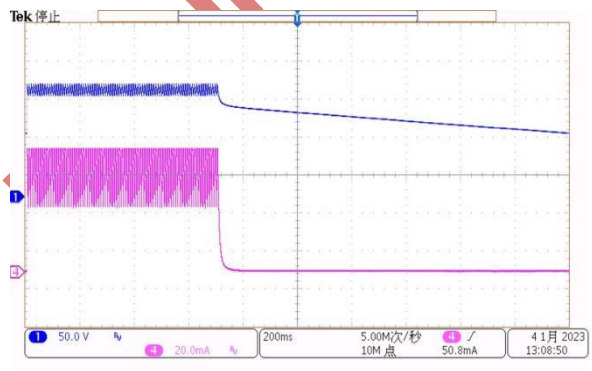
2.2 Power Off

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

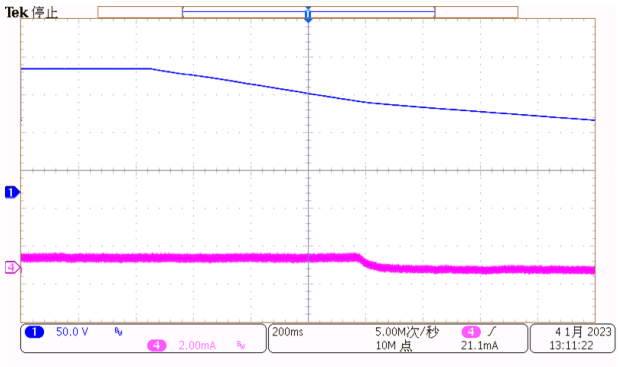
Waveforms (CW Mode):

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



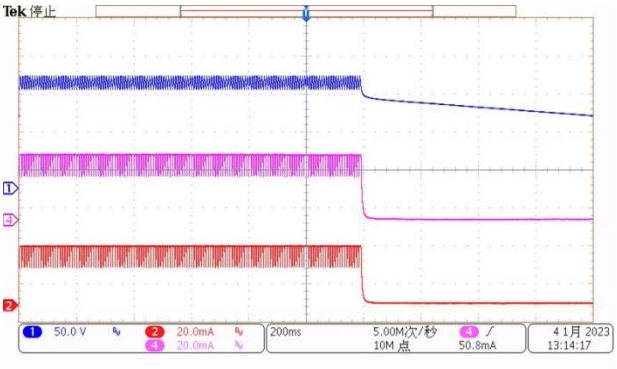
(CH1-Vbus, CH4-Io_C)
Comments: Power Off OK

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



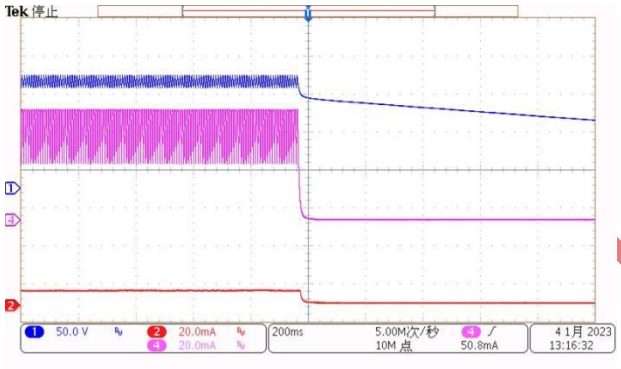
(CH1-Vbus, CH4-Io_C)
Comments: Power Off OK

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



(CH1-Vbus, CH2-Io_W, CH4-Io_C)
Comments: CW Channel Stop at the same time

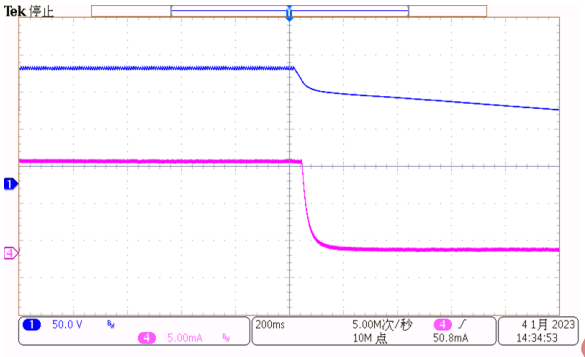
Test Condition: 120Vac/60Hz Input,
Duty: (C: 90%, W: 10%)



(CH1-Vbus, CH2-Io_W, CH4-Io_C)
Comments: CW Channel Stop at the same time

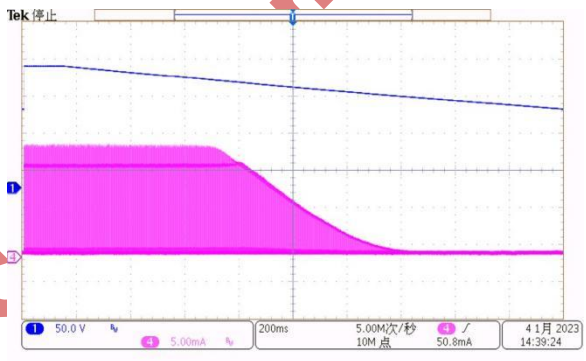
Waveforms (RGB Mode):

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



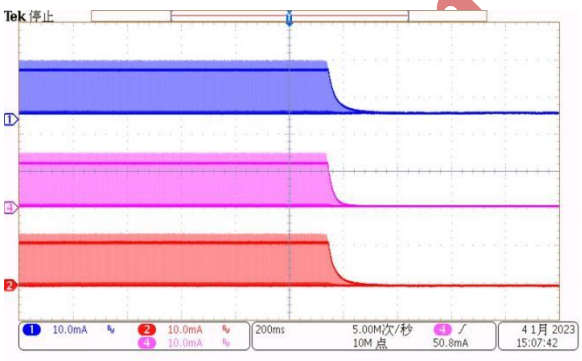
(CH1-Vbus, CH4-Io_R)
Comments: Power Off OK

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



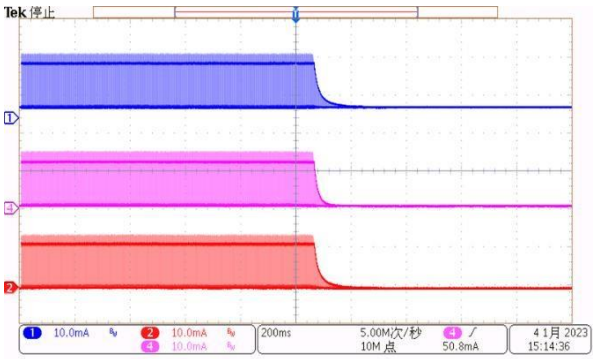
(CH1-Vbus, CH4-Io_R)
Comments: Power Off OK

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



(CH1-Io_B , CH2-Io_G, CH4-Io_R)
Comments: RGB Channel Stop at the same time

Test Condition: 120Vac/60Hz Input,
Duty: (R: 80%, G: 50%, B: 20%)



(CH1-Io_B , CH2-Io_G, CH4-Io_R)
Comments: RGB Channel Stop at the same time

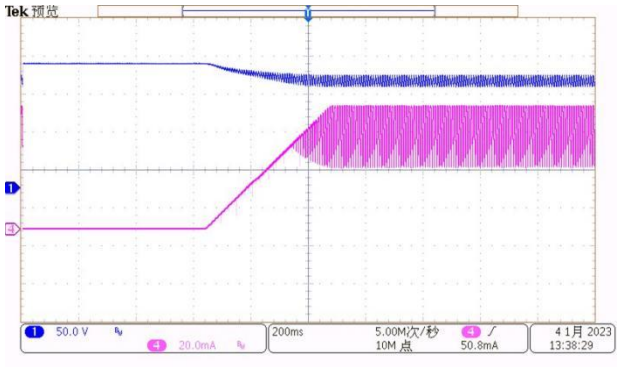
2.3 Dimming On

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

Result: Pass

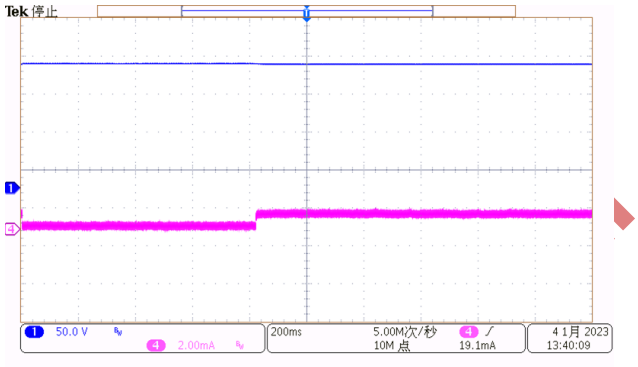
Waveforms (CW Mode):

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



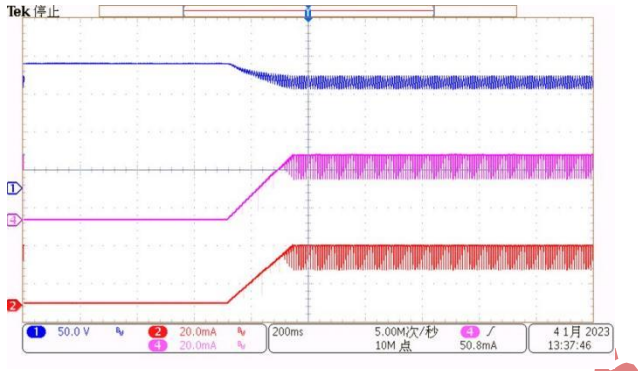
(CH1-Vbus, CH4-Io_C)
Comments: DIM ON OK

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



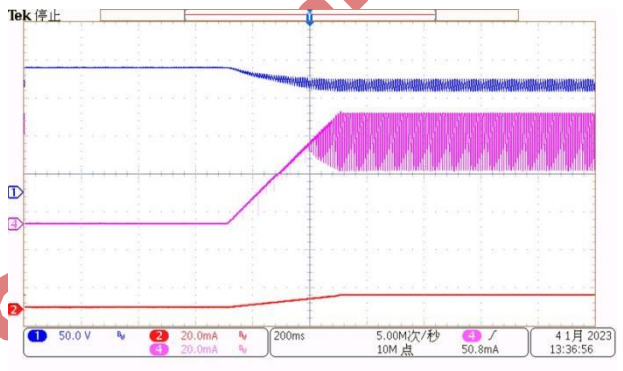
(CH1-Vbus, CH4-Io_C)
Comments: DIM ON OK

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



(CH1-Vbus, CH2-Io_W, CH4-Io_C)
Comments: CW Channel DIM ON at the same time

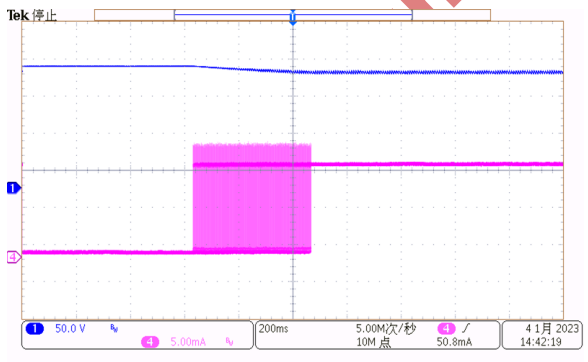
Test Condition: 120Vac/60Hz Input,
Duty: (C: 90%, W: 10%)



(CH1-Vbus, CH2-Io_W, CH4-Io_C)
Comments: CW Channel DIM ON at the same time

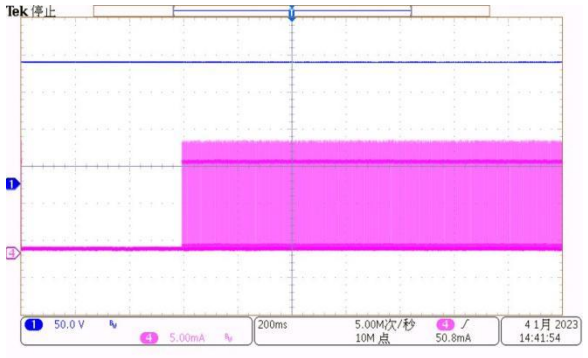
Waveforms (RGB Mode):

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



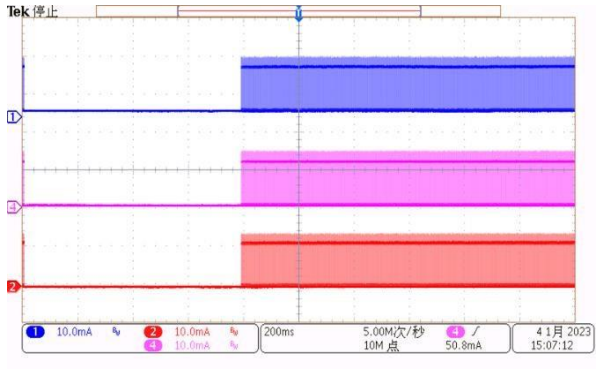
(CH1-Vbus, CH4-Io_R)
Comments: DIM ON OK

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



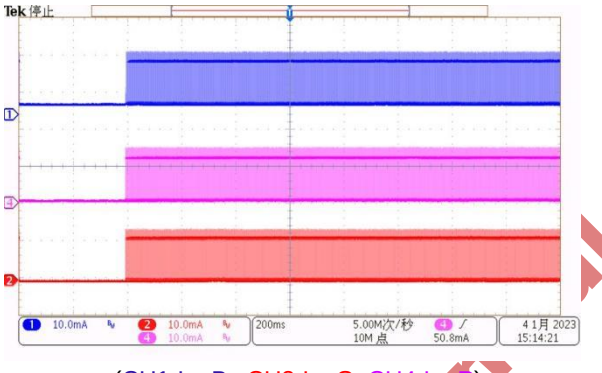
(CH1-Vbus, CH4-Io_R)
Comments: DIM ON OK

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



(CH1-Io_B , CH2-Io_G, CH4-Io_R)
Comments: RGB Channel DIM ON at the same time

Test Condition: 120Vac/60Hz Input,
Duty: (R: 80%, G: 50%, B: 20%)



(CH1-Io_B , CH2-Io_G, CH4-Io_R)
Comments: RGB Channel DIM ON at the same time

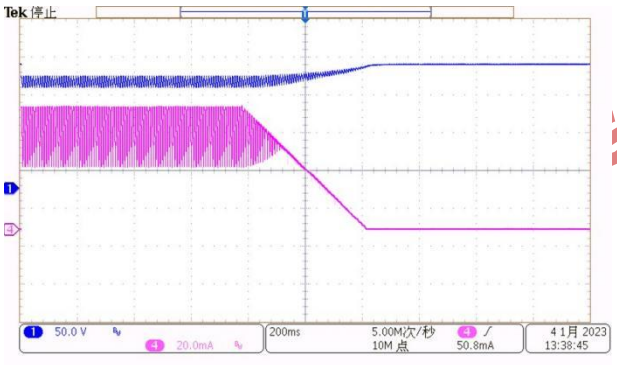
2.4 Dimming Off

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

Result: Pass

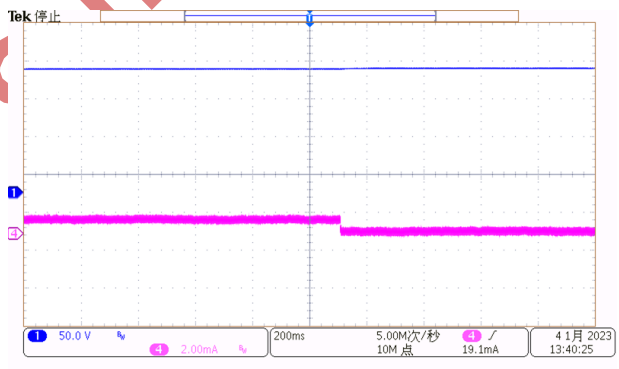
Waveforms (CW Mode):

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



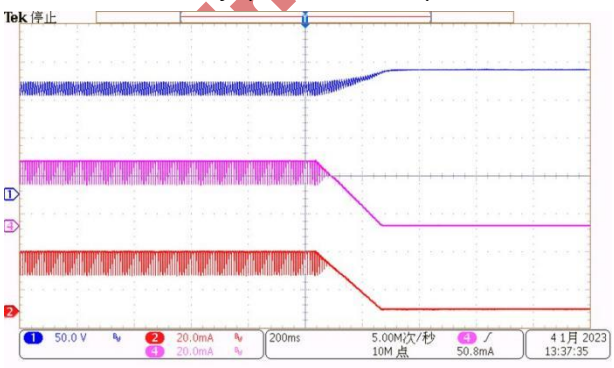
(CH1-Vbus, CH4-Io_C)
Comments: DIM OFF OK

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



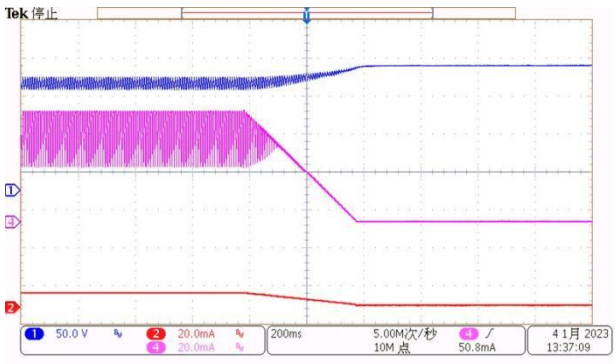
(CH1-Vbus, CH4-Io_C)
Comments: DIM OFF OK

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



(CH1-Vbus, CH2-Io_W, CH4-Io_C)
Comments: CW Channel DIM OFF at the same time

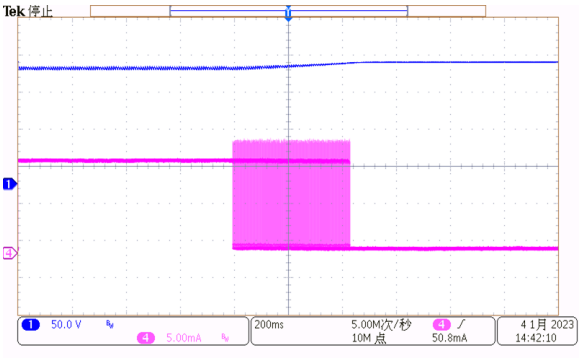
Test Condition: 120Vac/60Hz Input,
Duty: (C: 90%, W: 10%)



(CH1-Vbus, CH2-Io_W, CH4-Io_C)
Comments: CW Channel DIM OFF at the same time

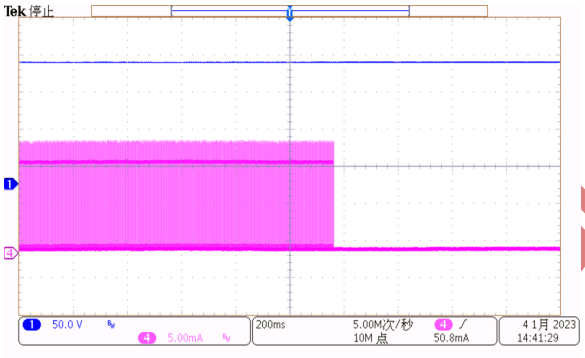
Waveforms (RGB Mode):

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



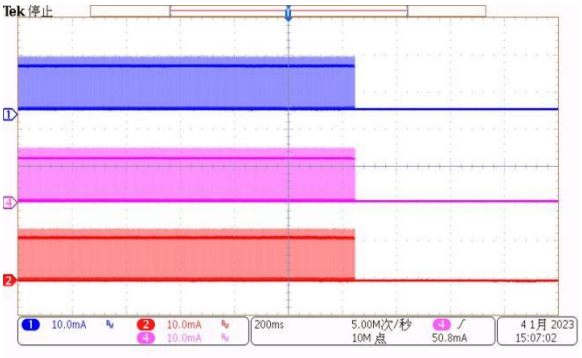
(CH1-Vbus, CH4-Io_R)
Comments: DIM OFF OK

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



(CH1-Vbus, CH4-Io_R)
Comments: DIM OFF OK

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



(CH1-Io_B , CH2-Io_G, CH4-Io_R)
Comments: RGB Channel DIM OFF at the same time

Test Condition: 120Vac/60Hz Input,
Duty: (R: 80%, G: 50%, B: 20%)

(CH1-Io_B , CH2-Io_G, CH4-Io_R)
Comments: RGB Channel DIM OFF at the same time

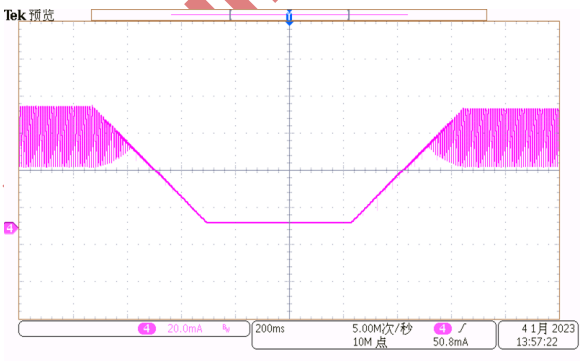
2.5 Dimming Dynamic

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

Result: Pass

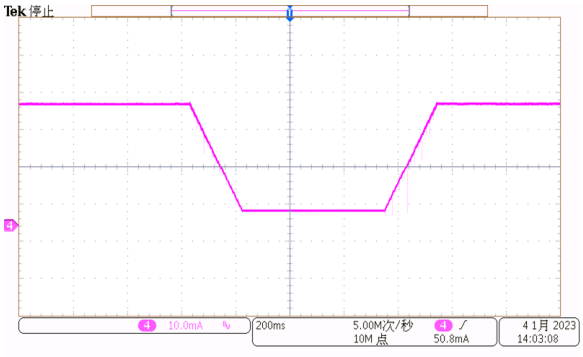
Waveforms (CW Mode):

Test Condition: 120Vac/60Hz Input,
Duty: (C: 100%)→ (C: 1%)→ (C: 100%)



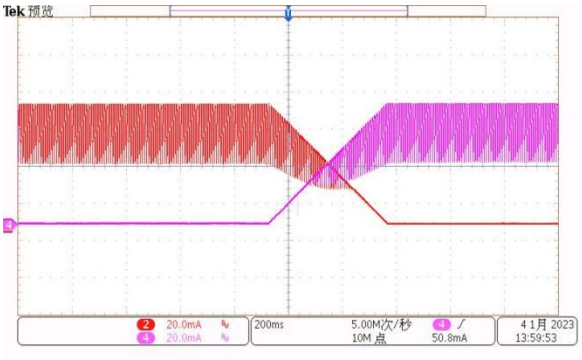
(CH4-Io_C)
Comments: Dimming OK

Test Condition: 120Vac/60Hz Input,
Duty: (C: 50%)→ (C: 10%)→ (C: 50%)



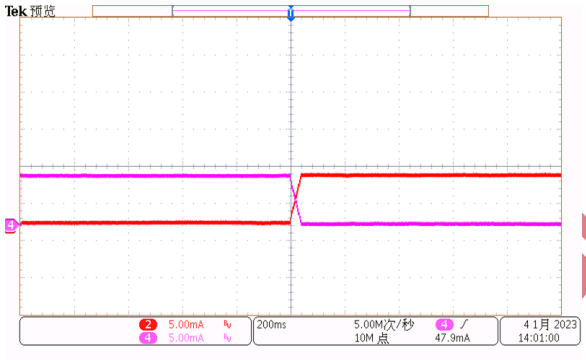
(CH4-Io_C)
Comments: Dimming OK

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



(CH2-Io_W, CH4-Io_C)
Comments: Dimming OK

Test Condition: 120Vac/60Hz Input,
Duty: (C: 10%, W: 0%)→ (C: 0%, W: 10%)



(CH2-Io_W, CH4-Io_C)
Comments: Dimming OK

3. Thermal Test

Standard: CW mode:ΔT<90℃(Limited 115℃); RGB mode:ΔT<70℃

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, Ta is the temperature inside the plastic box.

Component	**Test Condition:** CW Mode, Full Load		**Test Condition:** RGB Mode, Full Load	
	120Vac/60Hz		120Vac/60Hz	
	Ta=22 ℃		Ta=22.8℃	
	Tc(℃)	Trise(℃)	Tc(℃)	Trise(℃)
KP18058ESPA	94.6	72.6	85.8	63
KP35026VGA	76.2	54.2	66.9	44.1
Light Board	96.5	74.5	84.1	61.3

4. EMC/EMS Test

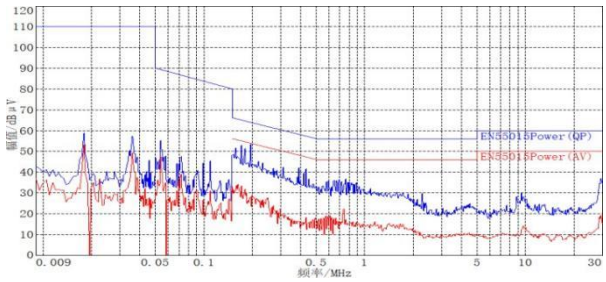
Standard:

Standard	EN55015
Content	CE/RE
Requirement	6 dB Margin

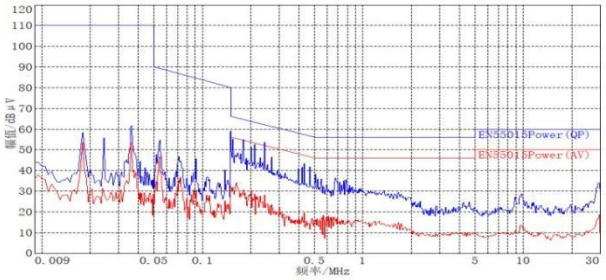
4.1 Conducted Emissions

Result: Pass

Test Condition: Vin=120VAC/60Hz, CW Mode, Full Load

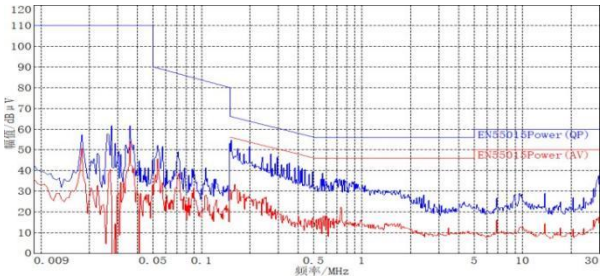


Conduction EMI---LINE

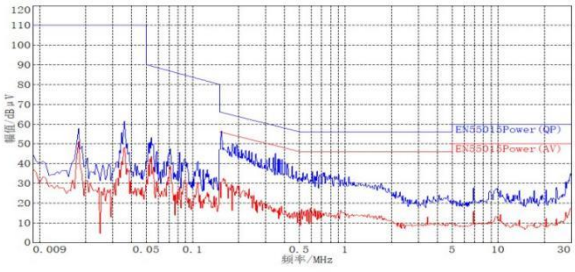


Conduction EMI---NEUTRAL

Test Condition: Vin=120VAC/60Hz, RGB Mode, Full Load



Conduction EMI---LINE

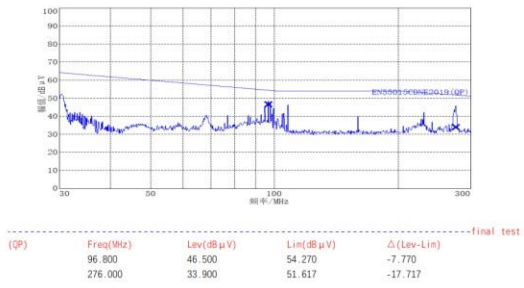


Conduction EMI---NEUTRAL

4.2 Radiated Emissions

Result: Pass

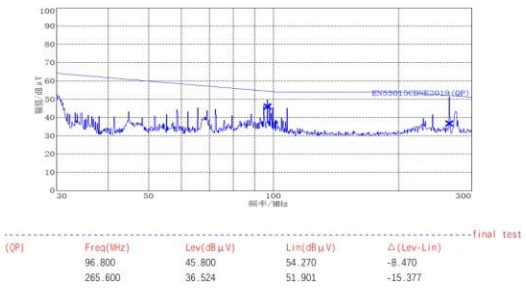
Test Condition: Vin=120VAC/60Hz, CW Mode, Full Load



(QP)	Freq(MHz)	Lev(dBμV)	Lim(dBμV)	Δ(Lev-Lim)
	96.800	46.500	54.270	-7.770
	276.000	33.900	51.617	-17.717

final test

Test Condition: Vin=120VAC/60Hz, RGB Mode, Full Load



(QP)	Freq(MHz)	Lev(dBμV)	Lim(dBμV)	Δ(Lev-Lim)
	96.800	45.800	54.270	-8.470
	265.600	36.524	51.901	-15.377

final test

5. Surge Test

Input voltage was set at 120VAC/60Hz. 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)
120Vac/60Hz	+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 108VAC and 150VAC.
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.

Revision History

DATE	REV	DESCRIPTION
2023/01/09	1.0	First Release

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