DEMO BOARD TEST REPORT

0/1-10V/Resistor/PWM 3in1 PWM Signal Generator Driver with KP1402

FEATURES

- Wide Vin Operation Voltage 10V to 100V
- Multiple Dimming:
  - Voltage: 0/1V to 10V, 10-0/1V
  - PWM dimming: 0.4k to 2kHz
  - Resistor: 0 to 100kΩ
- Support PWM Positive and Negative Logic Dimming Function
- Flexible DIM Pin Sourcing Current
- Flexible Output Signal Frequency
- Independent and Adjustable DIM OFF Function

APPLICATIONS

- 0 to 10V Dimming Luminaires
- Dimmable LED Power Supply
- Dimming Control Devices

INTRODUCTION

This demo board of KP1402 can detect multiple dimming input signals, including 0/1-10V, 10-0/1V voltage, 0-100% PWM, and resistor, and then converter to a PWM signal, which provides dimming signal for LED driver.

This demo board of KP1402 is designed with several flexibly configure functions by external resistors. These functions include setting the output frequency, setting the sourcing current of the DIM pin, setting the voltage or duty cycle of the dimming signal during dimming off, and setting the positive and negative dimming logic.

KP1402 can be supplied by 10V to 100V operating voltage.

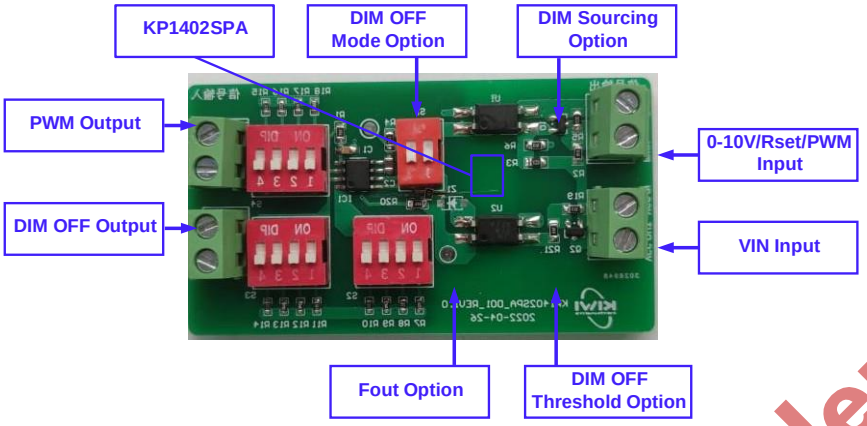
DEMO BOARD SEPCIFICATION

Description	Symbol	Min.	Typ.	Max.	Unit	Note
Vin Input						
Input Voltage	Vin	10		100	V_{DC}	
1/0-10V DIM Input						
DIM Voltage	V_{DIM}	0		10	V_{DC}	
PWM DIM Input						
High Level Voltage	V_{PWM_H}		10		V_{DC}	
PWM Frequency	F_{DIM}	0.4		2	kHz	
Adjustable Resistor DIM Input						
resistance	R_{DIM}	0		100	kΩ	
PWM Output						
PWM Output Duty	Duty	7		100	%	
PWM Output Frequency	F_{OUT}	0.2		4	kHz	
DIM OFF Output						
DIM Voltage at DIM OFF	V_{DIMOFF}	0		4.9	V	

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

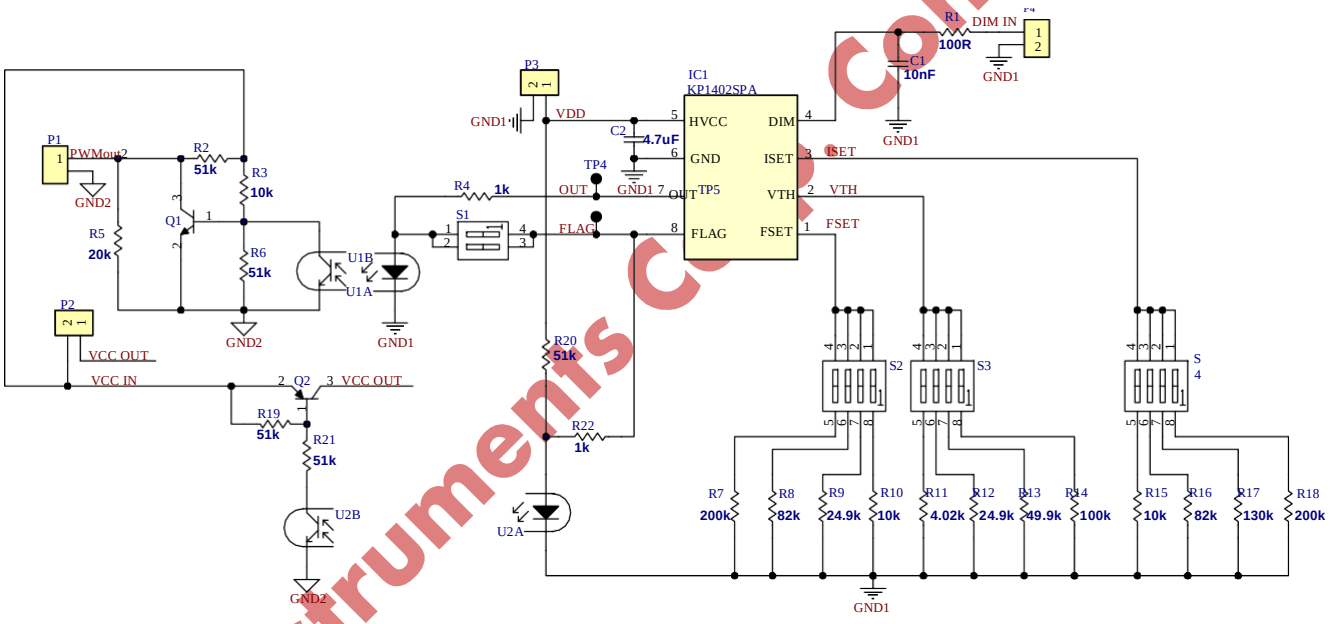
Kiwi Instruments Corp.
Tel: +86-18681585060 E-mail: wyq@cokinic.com
www.cokinsemi.com

Demo Board of KP1402SPA



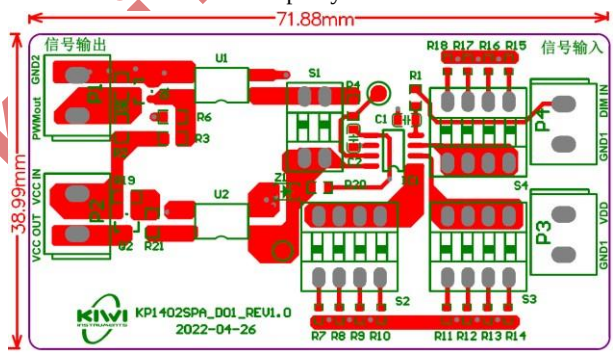
Board Size (in mm): L x W=72 x 39

Schematic

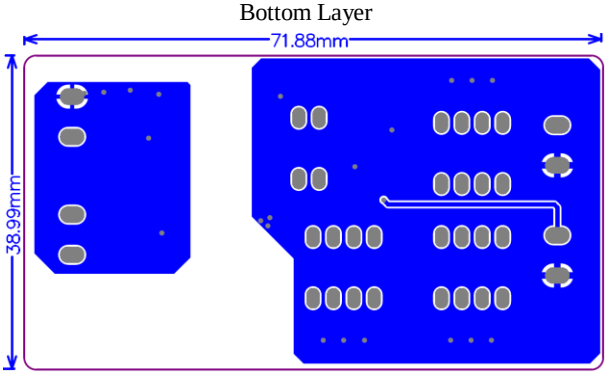


Printed Circuit Board Layout

Top Layer



Bottom Layer



Circuit Description

The demo board of KP1402 is a 3-in-1 dimming interface converter. The demo board can convert analog voltage (0-10V, 10-0V and resistor) or PWM signal into a PWM signal with a flexible frequency.

1. Dim OFF Function Option——DIP Switch S_1 and S_3

The demo board of KP1402 provides different DIM OFF modes through DIP switch S_1. When S_1 is in the ON state, it can realize DIM OFF by reducing the PWM output duty cycle to 0; when S_1 is in the OFF state, it can provide DIM OFF through the independent DIM OFF output.

The demo board of KP1402 can also adjust the DIM voltage when entering the DIM OFF state. The adjustment range of DIM OFF threshold is 0V-4.9V, and the function can be realized by DIP switch S_3 and resistor R_{11}, R_{12}, R_{13} and R_{14}.

2. PWM output Frequency Option——DIP Switch S2

The demo board of KP1402 can adjust the PWM output signal frequency to meet different application requirements. The output frequency adjustment range is 0.2kHz-4kHz, and the function is realized by DIP switch S_2 and resistors R_7, R_8, R_9 and R_{10}.

3. Dimming sourcing current Option——DIP Switch S4

KP1402 can adjust the dimming detection current in stages to be compatible with resistor dimmers of different specifications. The DIM detection current can be divided into three grades: 100uA, 150uA, and 200uA. And the function can be realized by DIP switch S_4 and resistors R_{15}, R_{16}, R_{17} and R_{18}.

In addition, the positive dimming logic and the negative dimming logic can also be set through the DIP switch S_4.

Bill of Material

No.	Designator	Value	Description	Package	Manufacturer	Part Number
1	C1	10nF/25V	Ceramic Cap, 25V X7R	0805	TDK	
2	C2	4.7uF/50V	Ceramic Cap, 50V X7R	0805	TDK	
3	R1	100R	Film Resistor, 1%	0805	Yageo	
4	R2	51k	Film Resistor, 1%	0805	Yageo	
5	R3	10k	Film Resistor, 1%	0805	Yageo	
6	R4	1k	Film Resistor, 1%	0805	Yageo	
7	R5	20K	Film Resistor, 1%	0805	Yageo	
8	R6	51k	Film Resistor, 1%	0805	Yageo	
9	R7	200k	Film Resistor, 1%	0603	Yageo	
10	R8	82K	Film Resistor, 1%	0603	Yageo	
11	R9	25k	Film Resistor, 1%	0603	Yageo	
12	R10	10k	Film Resistor, 1%	0603	Yageo	
13	R11	4k	Film Resistor, 1%	0603	Yageo	
14	R12	24.9k	Film Resistor, 1%	0603	Yageo	
15	R13	25k	Film Resistor, 1%	0603	Yageo	
16	R14	100k	Film Resistor, 1%	0603	Yageo	
17	R15	10k	Film Resistor, 1%	0603	Yageo	
18	R16	82k	Film Resistor, 1%	0603	Yageo	
19	R17	130k	Film Resistor, 1%	0603	Yageo	
20	R18	200k	Film Resistor, 1%	0603	Yageo	
21	R19	51k	Film Resistor, 1%	0805	Yageo	
22	R20	51k	Film Resistor, 1%	0805	Yageo	
23	R21	1k	Film Resistor, 1%	0805	Yageo	
24	Q1	60V200mA	NPN Switching transistor, 60V200mA	SOT23	LGE	MMBT3904
25	Q2	40V200mA	PNP Switching transistor, 40V200mA	SOT23	LGE	MMBT3906
26	U1	PC817	Optocoupler, EL,817,C245	SMD-4	MDD	
27	U2	PC817	Optocoupler, EL,817,C245	SMD-4	MDD	
28	S1	2P	DIP Switch, D=2.54mm, P=7.5mm, 2P	DIP	TEJIATE	
29	S2	4P	DIP Switch, D=2.54mm, P=7.5mm, 4P	DIP	TEJIATE	
30	S3	4P	DIP Switch, D=2.54mm, P=7.5mm, 4P	DIP	TEJIATE	
31	S4	4P	DIP Switch, D=2.54mm, P=7.5mm, 4P	DIP	TEJIATE	
32	P1	2P	Connector, D=5.08mm	DIP	MG	
33	P2	2P	Connector, D=5.08mm	DIP	MG	
34	P3	2P	Connector, D=5.08mm	DIP	MG	
35	P4	2P	Connector, D=5.08mm	DIP	MG	
36	IC1	KP1402SP	Dimming Signal Converter Compatible with 0~10V, Resistor, and PWM Dimming	SOP-8	Kiwi instruments	KP1402SP

Test Result

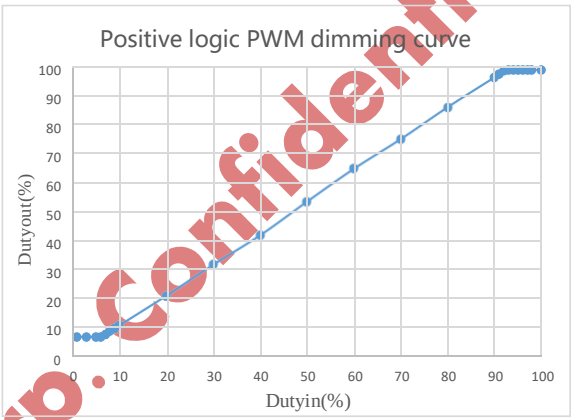
1 Dimming curve

1.1 Positive logic PWM dimming curve

Test Conditions: V_{IN} =15V; S_1: OFF, S_2: OFF, S_3-1:ON, S_4-2: ON; Dimming Input: 1kHz PWM dimming signal,V_{PWMH}=10V; Test the PWM output duty cycle VS PWM input duty.

Result: OK

Duty in(%)	Dutyout(%)	Duty in(%)	Dutyout(%)
100	100	40	43
95	100	30	32.89
94	100	20	22.19
93	100	10	11.97
92	99.6	9	10.87
91	98.51	8	9.87
90	97.45	7	8.76
80	87.16	6	7.94
70	76.16	5	7.94
60	65.93	3	7.94
50	54.61	0	7.94

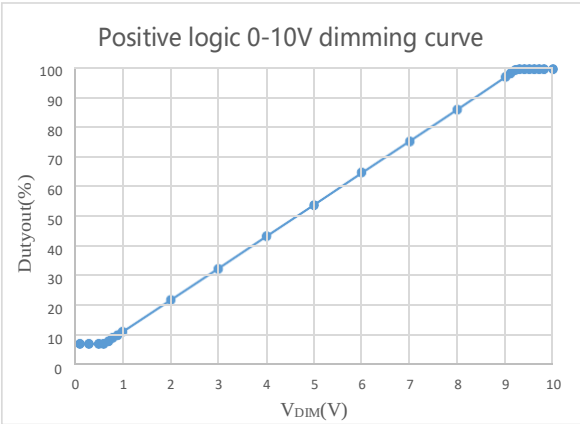


1.2 Positive logic 0-10V dimming curve

Test Conditions: V_{IN} =15V; S_1: OFF, S_2: OFF, S_3-1:ON, S_4-2: ON; Dimming Input: 0-10V dimming signal;Test the output duty cycle VS 0-10 input voltage.

Result: OK

V_{DIM}(V)	Dutyout(%)	V_{DIM}(V)	Dutyout(%)
10	100	4	43.8
9.5	100	3	33.09
9.4	100	2	22.48
9.3	100	1	11.88
9.2	99.6	0.9	10.87
9.1	98.4	0.8	9.76
9	97.24	0.7	8.66
8	86.4	0.6	7.93
7	75.75	0.5	7.93
6	65.13	0.3	7.93
5	54.41	0	7.93

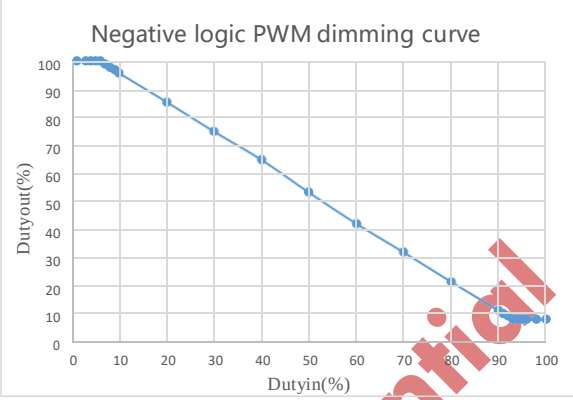


1.3 Negative logic PWM dimming curve

Test Conditions: V_{IN} =15V; S_1: OFF, S_2: OFF, S_3-1:ON, S_4-1: ON; Dimming Input: 1kHz PWM dimming signal,V_{PWMH}=10V; Test the PWM output duty cycle VS PWM input duty.

Result: OK

Dutyin(%)	Dutyout(%)	Dutyin(%)	Dutyout(%)
100	7.93	40	64.83
95	7.93	30	74.9
94	7.93	20	85.42
93	8.05	10	95.69
92	9.16	9	96.76
91	10.16	8	97.8
90	11.17	7	99
80	21.38	6	100
70	31.88	5	100
60	42.1	3	100
50	53.21	0	100

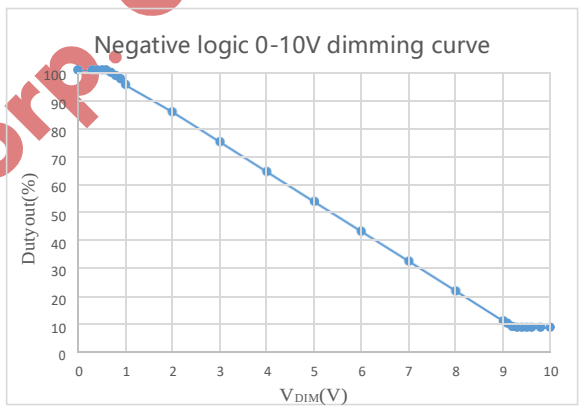


1.4 Negative logic 0-10V dimming curve

Test Conditions: V_{IN}=15V; S_1: OFF, S_2: OFF, S_3-1:ON, S_4-1: ON; DIM Input: 0-10V dimming signal; Testthe output duty cycle VS 0-10 input voltage.

Result: OK

V_{DIM}(V)	Dutyout(%)	V_{DIM}(V)	Dutyout(%)
10	7.99	4	63.63
9.5	7.99	3	74.34
9.4	7.99	2	84.97
9.3	7.99	1	94.73
9.2	8.3	0.9	96.76
9.1	9.36	0.8	97.91
9	10.37	0.7	99.06
8	21.08	0.6	100
7	31.74	0.5	100
6	42.34	0.3	100
5	52.96	0	100

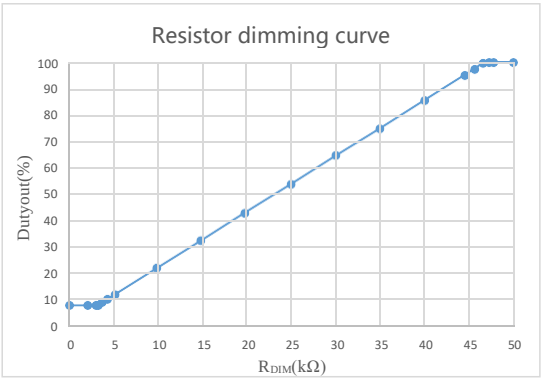


1.5 Resistor dimming curve

Test Conditions: V_{IN}=15V; S_1: OFF, S_2: OFF, S_3-1:ON, S_4-2: ON; Dimming Input: adjustable resistor, R_{max}=100kΩ; Test the output duty cycle VS resistor.

Result: OK

R_{DIM}(kΩ)	Dutyout(%)	R_{DIM}(kΩ)	Dutyout(%)
50	100	19.72	43
47.83	100	14.74	32.39
47.31	100	9.82	22.09
46.58	99.6	5.11	12.18
45.65	97.45	4.26	10.37
44.54	95.17	3.68	9.06
40.04	85.69	3.2	8.14
34.94	74.85	2.95	7.93
30.05	64.73	2	7.93
24.96	53.91	0	7.93



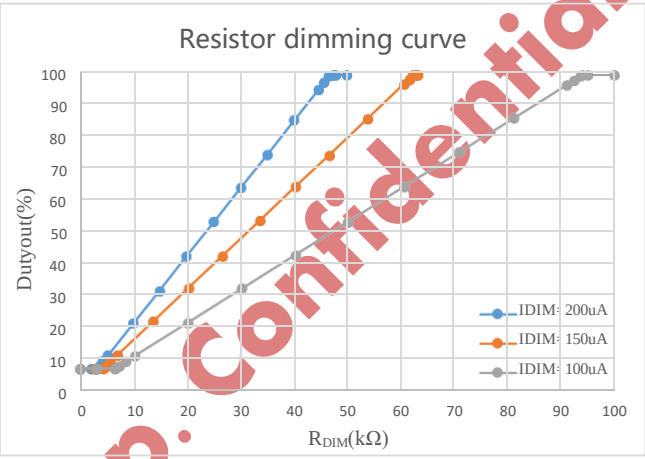
2 Input signal

2.1 Dimming input sourcing current

Test Conditions: V_{IN}=15V; S_1: OFF, S_2: OFF, S_3-1:ON; DIM Input: flexible resistor, R_{max}=100kΩ; Test theDIM pin sourcing current I_{DIM} and resistance dimming curve under different states of the DIP switch S_4.

Result: OK

State	I_{DIM}(μA)
S_4 OFF	-5.3
S_4-1 ON	-5.3
S_4-2 ON	199
S_4-3 ON	149.3
S_4-4 ON	99.5



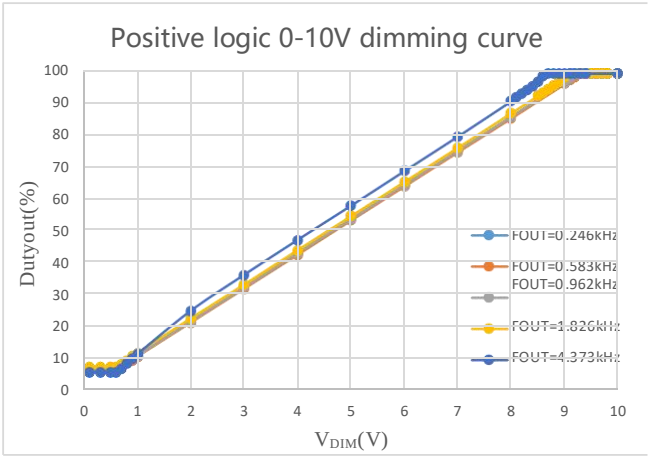
3 PWM Output signal

3.1 PWM Output frequency

Test Conditions: V_{IN}=15V; S_1: OFF, S_3-1:ON, S_4-2: ON; Dimming Input: 0-10V dimming signal; Test thefrequency F_{OUT} of the output PWM signal and dimming curve under different states of the DIP switch S_2.

Result: OK

State	F_{OUT}(kHz)
S_2 OFF	0.962
S_2-1 ON	0.246
S_2-2 ON	0.583
S_2-3 ON	1.826
S_2-4 ON	4.373



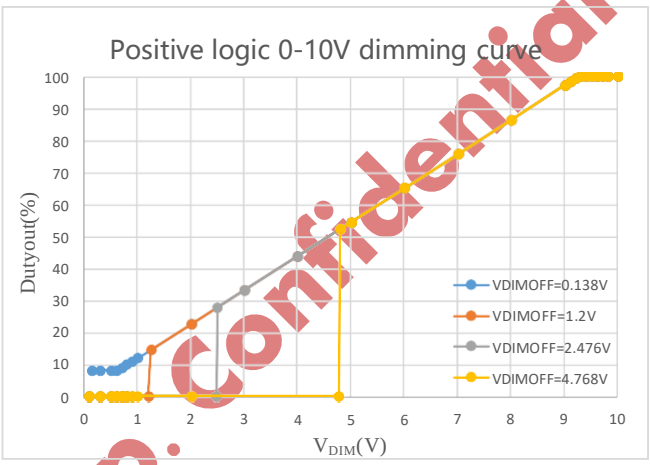
Remark：4.37Hz is over setting specification , it is only for reference.

3.2 DIM OFF threshold

Test Conditions: V_{IN}=15V; S_1: ON, S_2:OFF, S_4-2: ON； Dimming Input: 0-10V dimming signal; Test the DIM OFF threshold V_{DIMOFF} (DIM voltage when entering DIM OFF mode) of the output PWM signal and dimming curve under different states of the DIP switch S_3.

Result: OK

State	V_{DIMOFF}(V)	V_{DIMON}(V)
S_3 OFF	4.774	5.37
S_3-1 ON	0.138	0.29
S_3-2 ON	1.2	1.364
S_3-3 ON	2.476	2.79
S_3-4 ON	4.774	5.37



4 Input and output waveforms

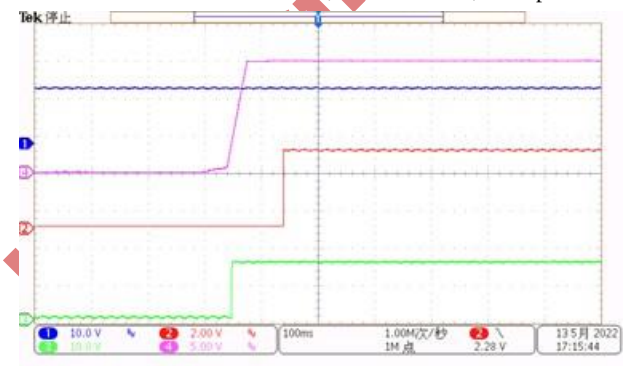
4.1 Startup

Test Conditions: V_{IN}=0V->15V; $V_{CC\ IN}$=15V; S_2:OFF, S_3-3: ON, S_4-2: ON； Dimming Input: 0-10V dimming signal;

Result: OK

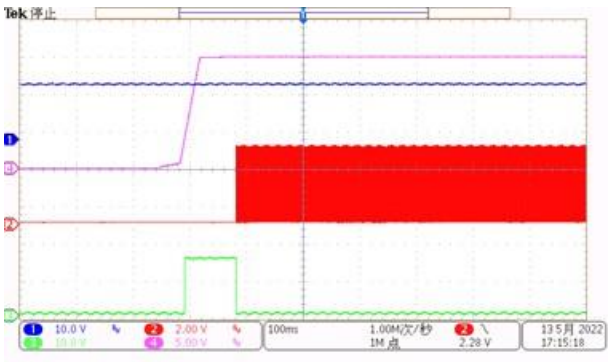
Waveforms：

Test Condition: S_1 OFF, V_{DIM}>$V_{DIM\ ON}$, startup



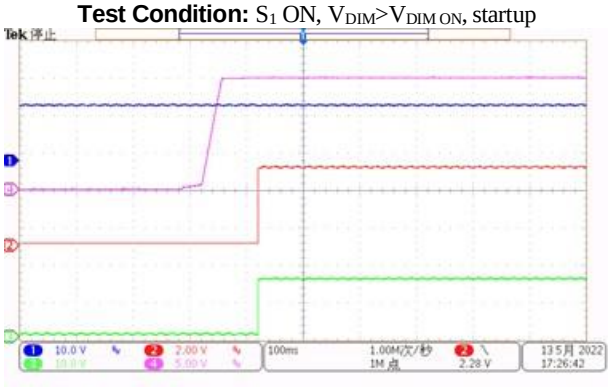
($CH1$- $V_{CC\ IN}$, CH2-PWM out, CH3-$V_{CC\ OUT}$, CH4: V_{IN})
Comments: Startup OK, Startup delay time is 80ms

Test Condition: S_1 OFF, V_{DIM}<$V_{DIM\ ON}$, startup



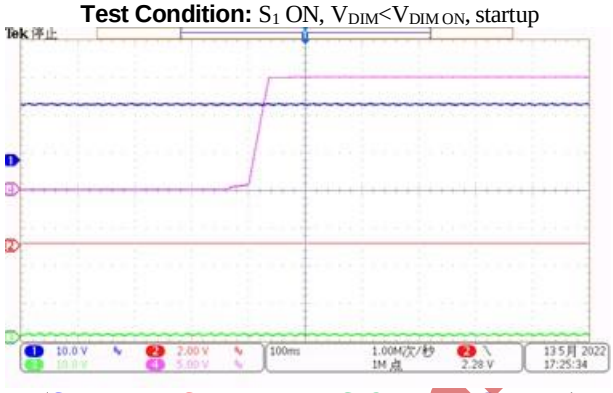
($CH1$- $V_{CC\ IN}$, CH2-PWM out, CH3-$V_{CC\ OUT}$, CH4: V_{IN})
Comments: Startup OK, Startup delay time is 80ms

Test Condition: S_1 ON, V_{DIM}>$V_{DIM\ ON}$, startup



(CH1- $V_{CC\ IN}$, CH2-PWM out, CH3-$V_{CC\ OUT}$, CH4: V_{IN})
Comments: OK

Test Condition: S_1 ON, V_{DIM}<$V_{DIM\ ON}$, startup



(CH1- $V_{CC\ IN}$, CH2-PWM out, CH3-$V_{CC\ OUT}$, CH4: V_{IN})
Comments: OK

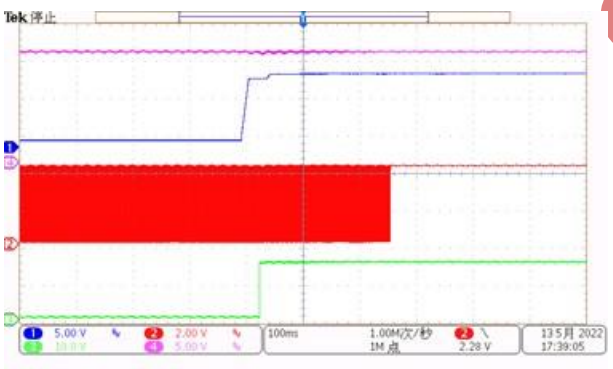
4.2 Dynamic dimming

Test Conditions: V_{IN}=15V; $V_{CC\ IN}$=15V; S_1: OFF, S_2:OFF, S_3-3: ON, S_4-2: ON; Dimming Input：0-10V dimming signal;

Result: OK

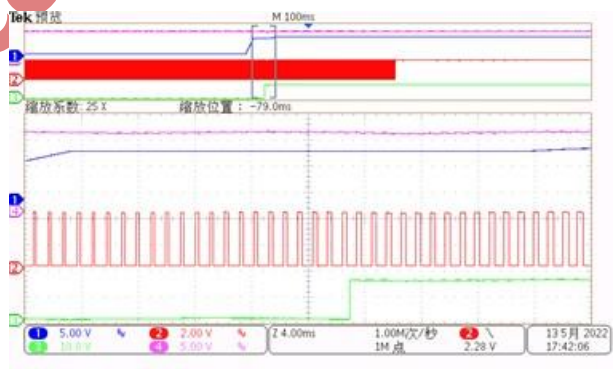
Waveforms：

Test Condition: V_{DIM}：1V->10V



(CH1- DIM, CH2-PWM out, CH3-$V_{CC\ OUT}$, CH4: V_{IN})
Comments: OK, PWM out changes smoothly

Test Condition: V_{DIM}：1V->10V



(CH1- DIM, CH2-PWM out, CH3-$V_{CC\ OUT}$, CH4: V_{IN})
Comments: OK, PWMout changes smoothly

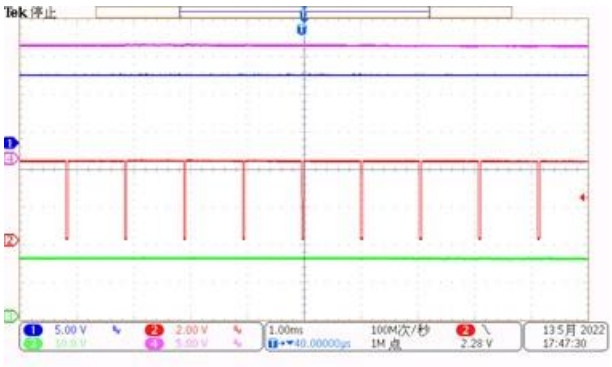
4.3 Steady state waveform

Test Conditions: V_{IN}=15V; $V_{CC\ IN}$=15V; S_1: OFF, S_2: OFF, S_3-3: ON, S_4-2: ON; Dimming Input: 0-10V dimming;

Result: OK

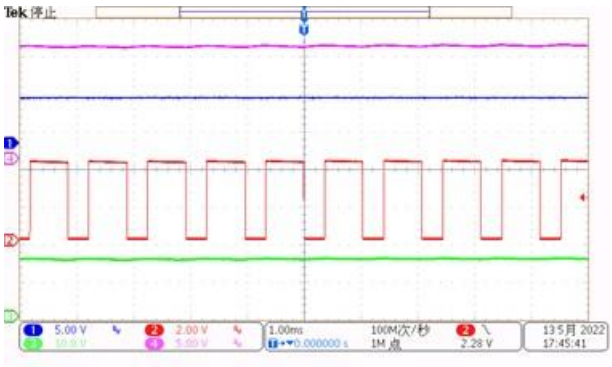
Waveforms：

Test Condition: V_{DIM} =9V



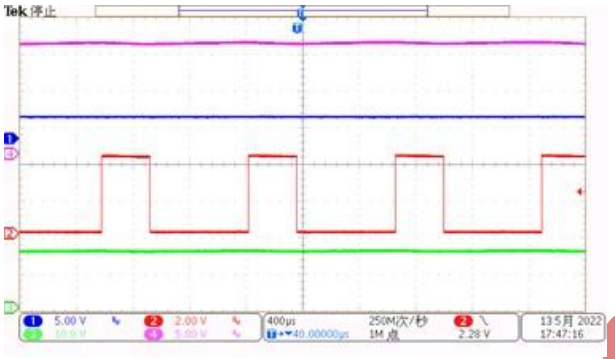
(CH1- V_{HV}, CH2-V_{FLAG}, CH3-V_{OUT})
Comments: Steady state works normally, PWMout=96.82%

Test Condition: V_{DIM} =6V



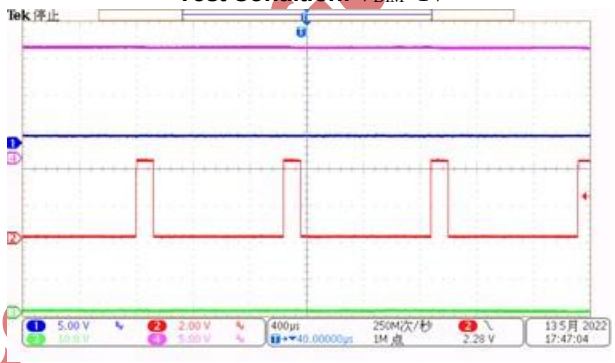
(CH1- V_{dim}, CH2-V_{FLAG}, CH3-V_{OUT})
Comments: Steady state works normally, PWMout=64.78%

Test Condition: V_{DIM} =3V



CH1- V_{dim}, CH2-V_{FLAG}, CH3-V_{OUT})
Comments: Steady state works normally, PWMout=32.94%

Test Condition: V_{DIM}=1V



CH1- V_{dim}, CH2-V_{FLAG}, CH3-V_{OUT})
Comments: Steady state works normally, PWMout=11.77%

Test Setup Guide

1. Set the DC Source between 10Vdc to 100Vdc.
2. Connect the DC Source terminal to the VIN INPUT “VDD” and “GND1” terminals on the Demo Board.

Turn on the DC Source to make system startup; and Turn off the DC Source to make system shutdown.

Revision History

DATE	REV	DESCRIPTION
2022/05/17	1.0	First Release

Disclaimer

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