EVQ7228-QJ-00A

16-Channel, Current Sink LED Driver with Adaptive Feedback Control (AFC) Evaluation Board, AEC-Q100

DESCRIPTION

The EVQ7228-QJ-00A is an evaluation board designed to demonstrate the capabilities of the MPQ7228, a 16-channel, current sink LED driver. Each channel is rated for up to 200mA of current, and 16 ICs can be cascaded together to create a 256-channel solution.

The MPQ7228 is optimized for animated or dynamic lighting applications. It employs a 12-bit pulse-width modulation (PWM) dimming and 6-bit analog dimming register per channel, allowing for the individual control of each channel. The MPQ7228 provides multi-frame universal asynchronous receiver-transmitter (UART) communication capability with a host microcontroller (MCU).

The MPQ7228 provides adaptive feedback control (AFC) to maximize system efficiency. The output voltage (V_{OUT}) of the pre-regulator (e.g. buck voltage regulator) is adjusted in real time so that the voltage across the channels remains constant at the 300mV minimum headroom voltage.

The MPQ7228 provides a failsafe (/FS) indicator to support functional safety in the system design. Full protection features include LED open protection, LED short protection, ISET pin open protection, ISET pin short protection, and over-temperature protection (OTP). If a fault occurs, the /FS pin pulls low and the matching fault register is set.

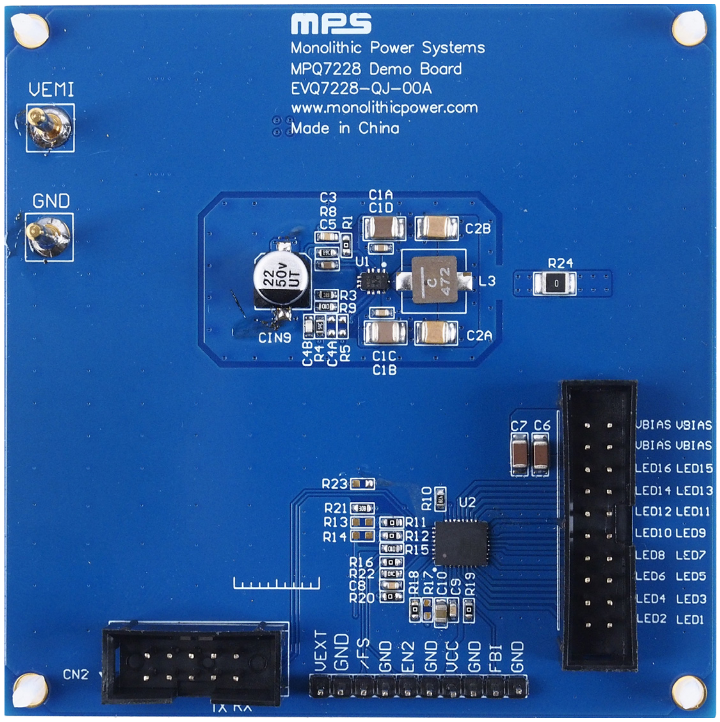
The MPQ7228 is available in a QFN-32 (5mmx6mm) package with wettable flanks. The MPQ7228 is available in AEC-Q100 Grade 1.

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C, unless otherwise noted.

Parameters	Conditions	Value
MPQ4323C input voltage (V_{IN}) range		7V to 36V
MPQ7228 LED load board	Two LEDs (V_{LED} = 4.8V to 7V) in series, total 16 channels	200mA/channel
MPQ7228 maximum LED current (I_{LED})	V_{BIAS} = 2.5V to 18V	200mA/channel

EVQ7228-QJ-00A EVALUATION BOARD



LxWxH (8.3cmx8.3cmx0.6cm)

Board Number	MPS IC Number
EVQ7228-QJ-00A	MPQ7228GQJE-AEC1

QUICK START GUIDE

The EVQ7228-QJ-00A evaluation board is easy to set up and use to evaluate the MPQ7228's performance. For proper measurement equipment set-up, refer to Figure 14 on page 11 and follow the steps below:

1. The LED voltage (V_{LED}) depends on the load configuration, described below.
    a. The default load configuration is two LEDs in series, where V_{LED} is between 4.8V and 7V.
    b. If the load exceeds two LEDs in series (where V_{LED} exceeds 7V) the VBIAS pin voltage (V_{BIAS}) is clamped to 6.8V, and the channel triggers LED open protection. The LED does not turn on.
    c. If the load is below two LEDs in series (where V_{LED} is below 4.8V), the channel triggers LED short protection. The LED flashes and then turns off.
2. Connect an LED load anode to the LED output pad (CN1, 17 to 20), then connect each LED load cathode to the corresponding LED input pad (CN1, 1 to 16) on the evaluation board (see Figure 1 and Figure 14 on page 11).

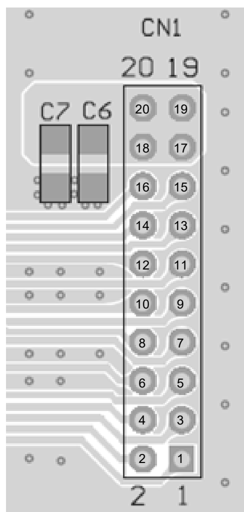


Figure 1: LED Load Connection Configuration

3. Ensure each string has two LEDs in series, and each LED can hold 200mA of current. If V_{LED} is not within the 4.8V to 7V range, follow steps 18 to step 21 starting on page 7 to set up the pre-VBIAS voltage (V_{BIAS_PRE}).
4. Preset a power supply (V_{EMI}) between 7V and 36V, then turn it off.
5. If longer cables (>0.5m total) are used between the source and the evaluation board, place a damping capacitor at the input terminals, especially when V_{IN} exceeds 24V.
6. Connect the VEMI terminals to:
    a. Positive (+): VEMI
    b. Negative (-): GND
7. After making the connections, turn on V_{EMI}. The MPQ7228 should start up. The user can use the VBPro and EVKT-USBSPIUART-00 communication interface to control the MPQ7228. The MPQ7228's 0x03 register is configured to 0x0000, which means the LED is off by default.

8. Connect CN2 on the evaluation board the communication interface, then connect the interface to the computer. This allows the device to be configured via Virtual Bench Pro 4.0, which is the configurable graphic user interface (GUI) (see Figure 2). (1) If this is a user's first time using the communication interface, contact an MPS FAE to obtain the driver file.

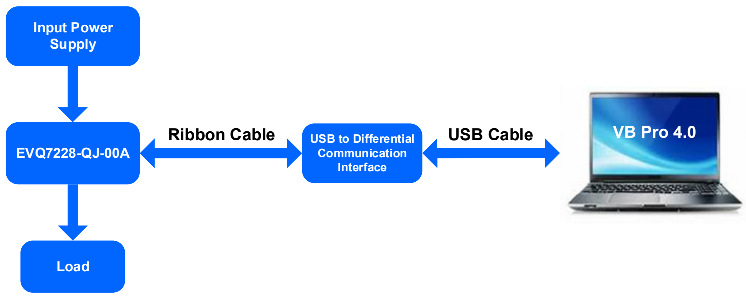


Figure 2: Connection to the UART Interface

9. In Virtual Bench Pro 4.0, enter the license code and secret key under Help. If the license code and secret key are not available, click "Request a license."

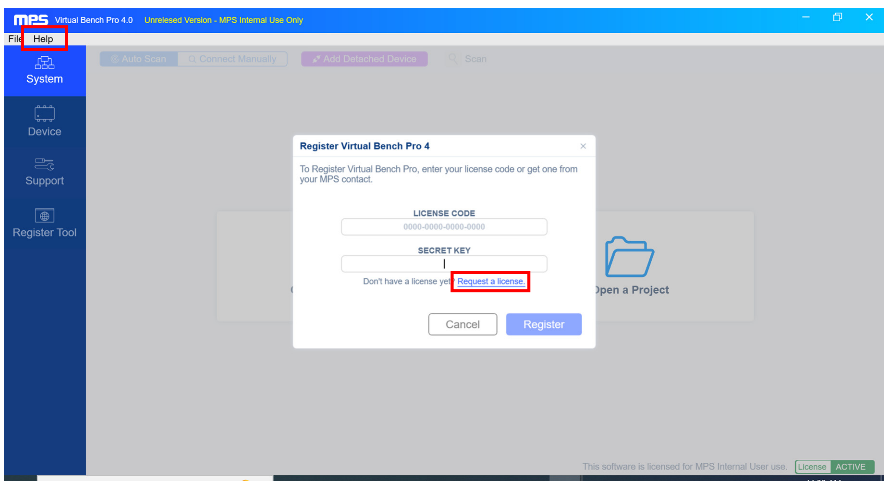


Figure 3: Enter the License Code and Secret Key

10. Select "Create New Project" and "Add Manually" (see Figure 4).

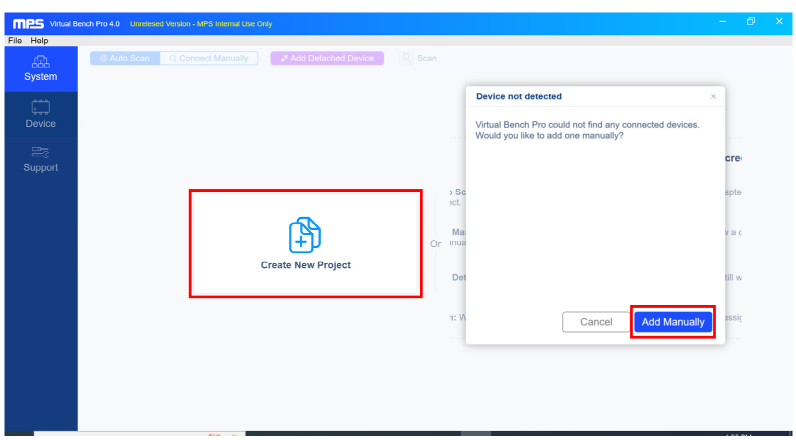


Figure 4: Create New Project in Virtual Bench

Note:

1) Contact an MPS FAE for more information on downloading Virtual Bench Pro 4.0.

11. To find the MPQ7228, select 0x08 under Supported Address Values and then click the “OK” button (see Figure 5). Double-click on the MPQ7228 window.

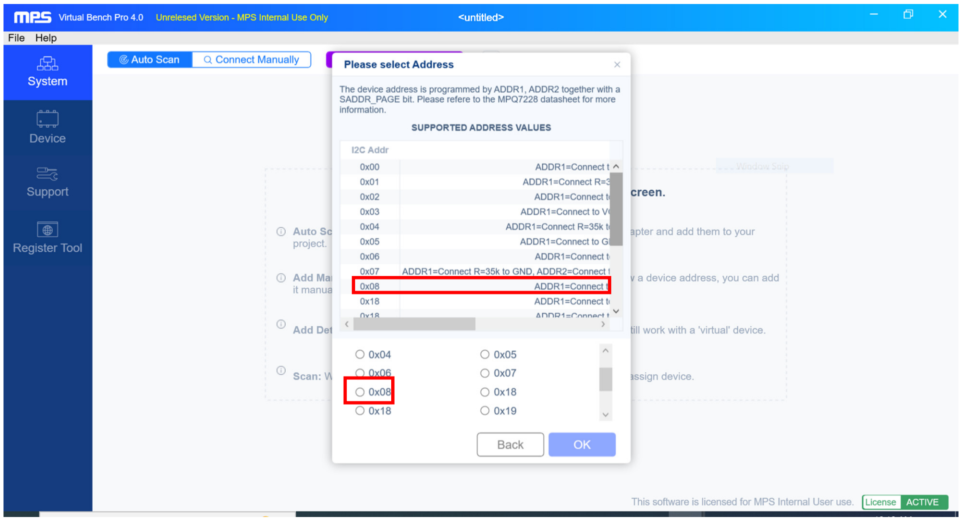


Figure 5: Select the Address in Virtual Bench

12. Connect the USB cable to the computer. When the circle next to the MPQ7228 becomes green, it means the communication interface is connected to the computer. When the remaining write cycles in the NVM becomes 0, this means that the VBPro is connected to the MPQ7228. The user can click the “Volatile Memory” button to read and write to the register (see Figure 6).

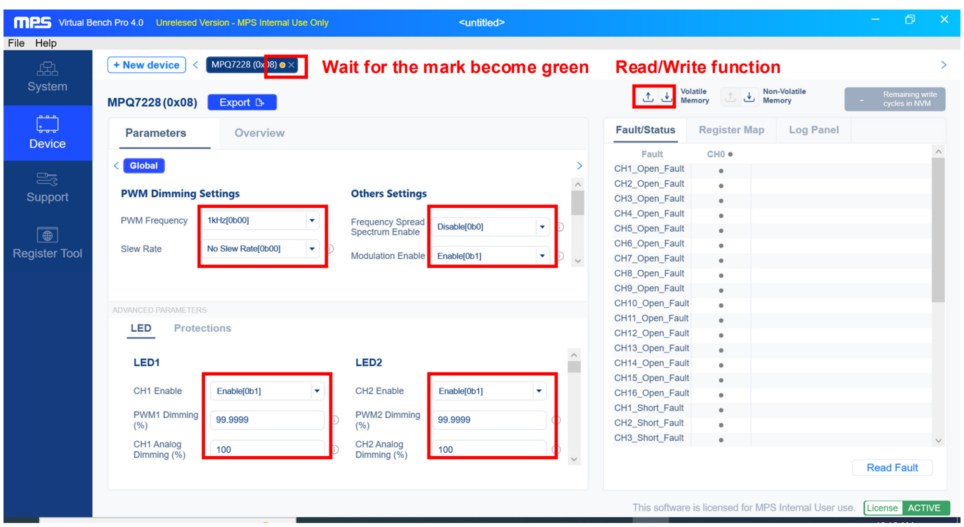


Figure 6: Read and Write in Virtual Bench

Contact an MPS FAE for more details regarding Virtual Bench Pro.

13. Table 1 on page 6 shows the MPQ7228’s register map.

Table 1: Register Map

Register Name	R/W	Address	Default Value
DEV_REV	R	0x00	0x0021
DEV_CFG_1	R/W	0x01	0x1200
DEV_CFG_2	R/W	0x02	0x2083
CH_EN	R/W	0x03	0x0000
DIAG_STAT_1	R1C	0x04	0x0000
DIAG_STAT_2	R1C	0x05	0x0000
DIAG_STAT_3	R1C	0x06	0x0000
CH1_PWM	R/W	0x07	0x0FFF
CH2_PWM	R/W	0x08	0x0FFF
CH3_PWM	R/W	0x09	0x0FFF
CH4_PWM	R/W	0x0A	0x0FFF
CH5_PWM	R/W	0x0B	0x0FFF
CH6_PWM	R/W	0x0C	0x0FFF
CH7_PWM	R/W	0x0D	0x0FFF
CH8_PWM	R/W	0x0E	0x0FFF
CH9_PWM	R/W	0x0F	0x0FFF
CH10_PWM	R/W	0x10	0x0FFF
CH11_PWM	R/W	0x11	0x0FFF
CH12_PWM	R/W	0x12	0x0FFF
CH13_PWM	R/W	0x13	0x0FFF
CH14_PWM	R/W	0x14	0x0FFF
CH15_PWM	R/W	0x15	0x0FFF
CH16_PWM	R/W	0x16	0x0FFF
CH1_ANA_DIM	R/W	0x17	0x0020
CH2_ANA_DIM	R/W	0x18	0x0020
CH3_ANA_DIM	R/W	0x19	0x0020
CH4_ANA_DIM	R/W	0x1A	0x0020
CH5_ANA_DIM	R/W	0x1B	0x0020
CH6_ANA_DIM	R/W	0x1C	0x0020
CH7_ANA_DIM	R/W	0x1D	0x0020
CH8_ANA_DIM	R/W	0x1E	0x0020
CH9_ANA_DIM	R/W	0x1F	0x0020
CH10_ANA_DIM	R/W	0x20	0x0020
CH11_ANA_DIM	R/W	0x21	0x0020
CH12_ANA_DIM	R/W	0x22	0x0020
CH13_ANA_DIM	R/W	0x23	0x0020
CH14_ANA_DIM	R/W	0x24	0x0020
CH15_ANA_DIM	R/W	0x25	0x0020
CH16_ANA_DIM	R/W	0x26	0x0020
PRE_VBIAS	R	0x27	0x6464
DROP_BAND	R	0x28	0x25B9
SUFFIX_CODE	R	0x32	0x00FF

Table 1: Register Map *(continued)*

Register Name	R/W	Address	Default Value
SADDR_PAGE	R	0x33	0x0000

Refer to the MPQ7228's datasheet for more details regarding register configuration.

14. To use the enable (EN) function, apply a digital input to the EN2 pin. Set R16 to 100kΩ and remove R2. Then drive EN2 above 2.2V to turn the regulator on; drive EN2 below 0.8V to turn it off.
15. I_{LED} is set by the external resistor, R10 (see Figure 8 on page 8). I_{LED} can be calculated with Equation (1):

$$I_{LED}\ (mA) = \frac{600}{R10\ (k\Omega)} \quad (1)$$

Table 2 shows the recommended resistances to set I_{LED}.

Table 2: Resistor Selection

I_{LED} (mA)	R10 (kΩ)
200	3.01
100	6.04
50	12.1

16. If the MPQ7228 is in slave mode, set R17 to 0Ω and remove R18. If the adaptive feedback control (AFC) function is disabled, or the AFC function is enabled and the part is the master, continue with the default settings for R17 and R18.
17. R11, R12, R13, and R14 set the MPQ7228's address via the SADDR_PAGE bit. The default configuration is 0x08. Refer to the MPQ7228's datasheet for more details.
18. R3 and R4 form a feedback (FB) divider network that uses the AFC function to adjust V_{BIAS_PRE} (see Figure 7).

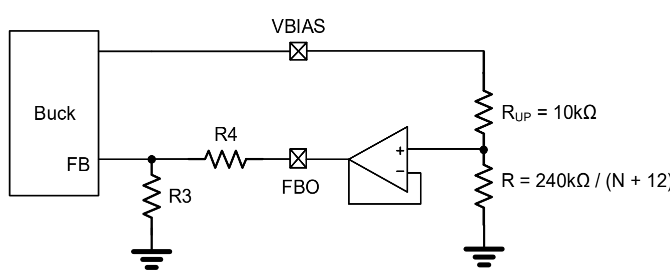


Figure 7: FB Divider Network Set-Up

19. To configure the FB resistor, the FBO pin voltage (V_{FBO}) and V_{BIAS} are required. V_{FBO} can be calculated with Equation (2):

$$V_{FBO} = V_{FB} \times (1 + \frac{R1}{R2}) \quad (2)$$

Where the FB voltage (V_{FB}) is the reference voltage of the DC/DC converter (e.g. 0.8V for the MPQ4323C), and V_{FBO} can be adjusted between 0.6V and 2.2V. If V_{FBO} is set to 1.2V and R3 is 80.6kΩ, then R4 is 40.2kΩ.

20. If the initial N = 100 (0x64), V_{BIAS_PRE} is 6.8V. To adjust V_{BIAS_PRE}, change R1 and R2, and ensure V_{FBO} is between 0.6V and 2.2V. V_{BIAS_PRE} can be calculated with Equation (3) on page 8:

$$V_{BIAS\_PRE} = \frac{10 + \frac{240}{N+12}}{\frac{240}{N+12}} \times V_{FBO} \tag{3}$$

21. If changing R3 and R4 does not sufficiently adjust V_{BIAS_PRE} to the required value, then change N to adjust V_{BIAS_PRE} using the one-time programmable (OTP) memory. The MPQ7228 can change the register default values one time via the OTP memory. Follow the steps below to set V_{BIAS_PRE}.
    a. The recommended V_{BIAS_PRE} is V_{LED} + 0.5V.
    b. If V_{BIAS} is below 3.5V, use an external source to power V_{CC}, which ranges between 3.2V and 3.5V.
22. The MPQ7228's OTP memory configuration is integrated into Virtual Bench.
    a. Disconnect the DC/DC converter using the MPQ7228's VBIAS pin (remove the inductor), set V_{BIAS} to 10V, and pull the MPQ7228's EN pin high if it is not pulled up to VBIAS.
    b. Ensure that the GUI can read and write to the MPQ7228's register correctly.
    c. The register values — including the pulse-width modulation (PWM) dimming setting, protections, and LED current setting — can be adjusted via the GUI (see Figure 8). After writing to the register, double-check the register map to determine whether the register value matches the required value.

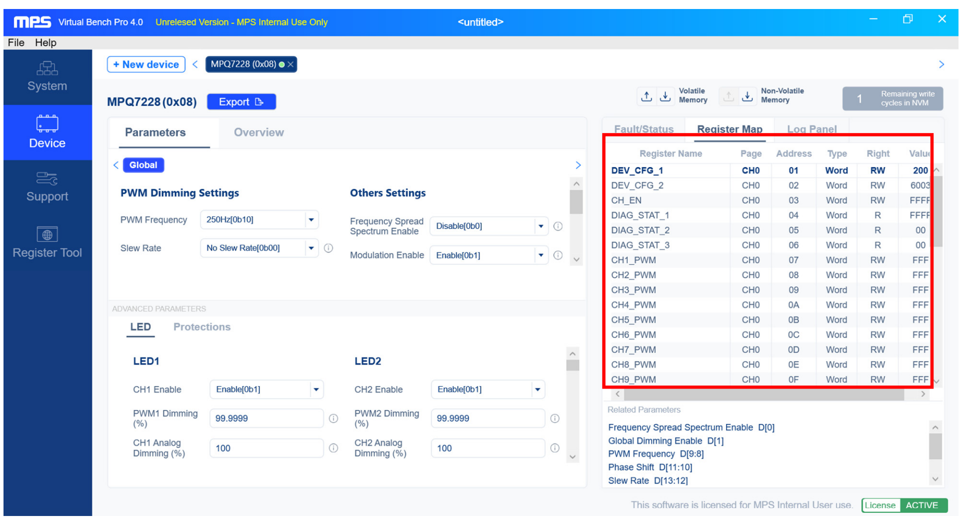


Figure 8: Register Map in Virtual Bench

    d. After changing the register value, click the "Non-Volatile Memory" button to start the OTP memory, then reset the MPQ7228 to validate the OTP memory. If the remaining OTP memory time under "Remaining write cycles in NVM" is 0, then this means that the device has used all available OTP write cycles (see Figure 9 on page 9).

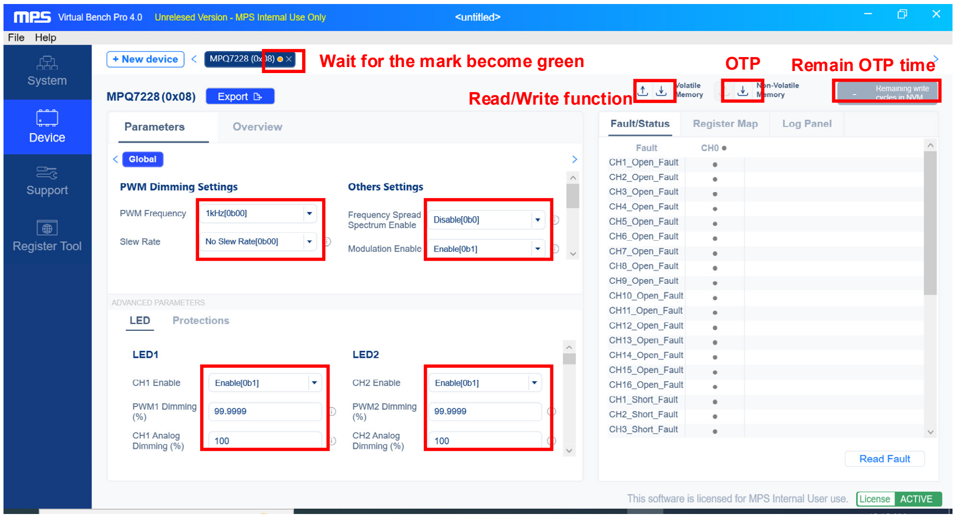


Figure 9: OTP Memory in Virtual Bench

e. It can also configure the OTP memory through “Import ATE file” under File (see Figure 10). (2) It provides an easy way to change the register value through the configuration file.

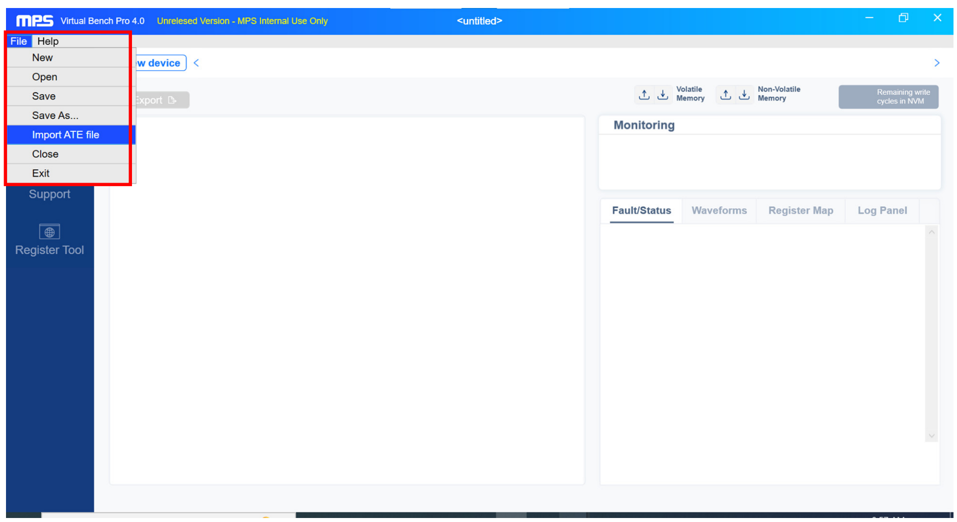


Figure 10: Import ATE File in Virtual Bench

f. After the file is loaded into the VBPro, the Register Map values of the ATE file are listed on the right side of the screen (see Figure 11 on page 10).

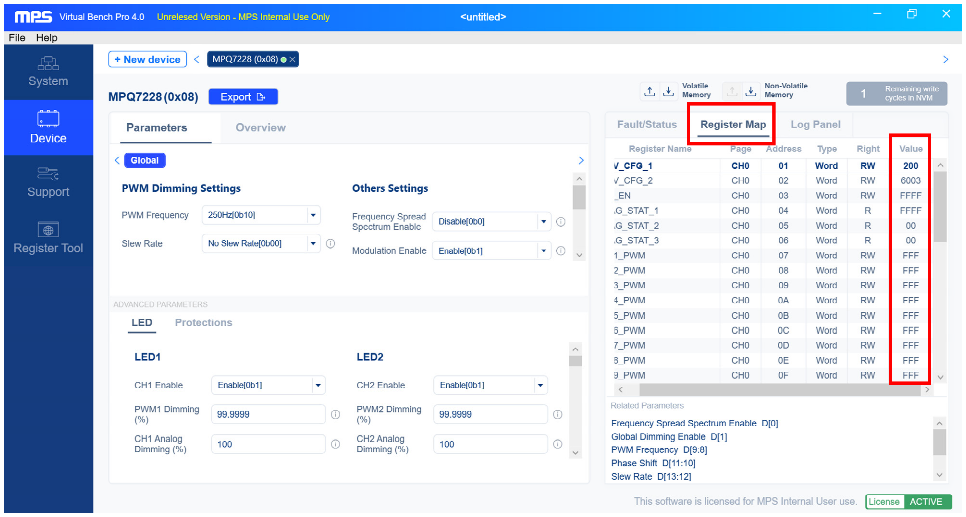


Figure 11: ATE File Register Map in Virtual Bench

Note:

2) Contact an MPS FAE to download the configuration file.

g. The evaluation board's default address is 0x08. To select the correct address, right-click on "MPQ7228 (0x00)" and change the address (see Figure 12).

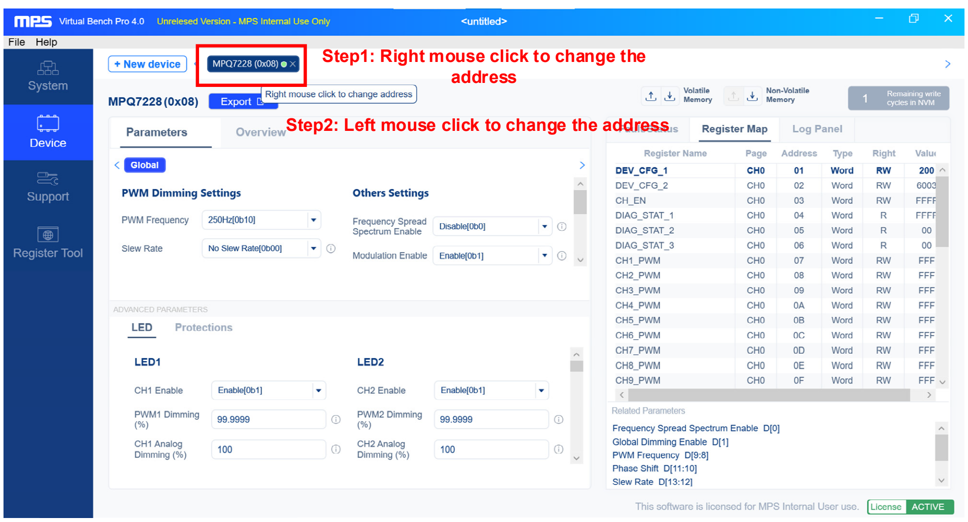
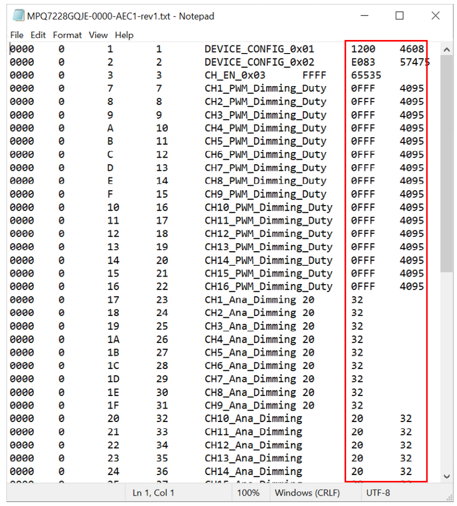


Figure 12: Change Address in Virtual Bench

h. After setting the correct device address, connect the USB communication interface. Once the button turns to green, click the "Non-Volatile Memory" button.

i. In the configuration file, the 1200 column is the register's hex value, and the 4608 column is the decimal value (see Figure 13 on page 11). To change the configuration file, these two columns must be consistent.



MPQ7228GQJE-0000-AEC1-rev1.txt - Notepad

File Edit Format View Help

```
0000	0	1	1	DEVICE_CONFIG_0x01	1200	4608
0000	0	2	2	DEVICE_CONFIG_0x02	E083	57475
0000	0	3	3	CH_EN_0x03	FFFF	65535
0000	0	7	7	CH1_PWM_Dimming_Duty	0FFF	4095
0000	0	8	8	CH2_PWM_Dimming_Duty	0FFF	4095
0000	0	9	9	CH3_PWM_Dimming_Duty	0FFF	4095
0000	0	A	10	CH4_PWM_Dimming_Duty	0FFF	4095
0000	0	B	11	CH5_PWM_Dimming_Duty	0FFF	4095
0000	0	C	12	CH6_PWM_Dimming_Duty	0FFF	4095
0000	0	D	13	CH7_PWM_Dimming_Duty	0FFF	4095
0000	0	E	14	CH8_PWM_Dimming_Duty	0FFF	4095
0000	0	F	15	CH9_PWM_Dimming_Duty	0FFF	4095
0000	0	10	16	CH10_PWM_Dimming_Duty	0FFF	4095
0000	0	11	17	CH11_PWM_Dimming_Duty	0FFF	4095
0000	0	12	18	CH12_PWM_Dimming_Duty	0FFF	4095
0000	0	13	19	CH13_PWM_Dimming_Duty	0FFF	4095
0000	0	14	20	CH14_PWM_Dimming_Duty	0FFF	4095
0000	0	15	21	CH15_PWM_Dimming_Duty	0FFF	4095
0000	0	16	22	CH16_PWM_Dimming_Duty	0FFF	4095
0000	0	17	23	CH1_Ana_Dimming	20	32
0000	0	18	24	CH2_Ana_Dimming	20	32
0000	0	19	25	CH3_Ana_Dimming	20	32
0000	0	1A	26	CH4_Ana_Dimming	20	32
0000	0	1B	27	CH5_Ana_Dimming	20	32
0000	0	1C	28	CH6_Ana_Dimming	20	32
0000	0	1D	29	CH7_Ana_Dimming	20	32
0000	0	1E	30	CH8_Ana_Dimming	20	32
0000	0	1F	31	CH9_Ana_Dimming	20	32
0000	0	20	32	CH10_Ana_Dimming	20	32
0000	0	21	33	CH11_Ana_Dimming	20	32
0000	0	22	34	CH12_Ana_Dimming	20	32
0000	0	23	35	CH13_Ana_Dimming	20	32
0000	0	24	36	CH14_Ana_Dimming	20	32
```

Ln 1, Col 1 | 100% | Windows (CRLF) | UTF-8

Figure 13: Register Configuration in ATE File

23. Figure 14 shows the measurement equipment set-up.

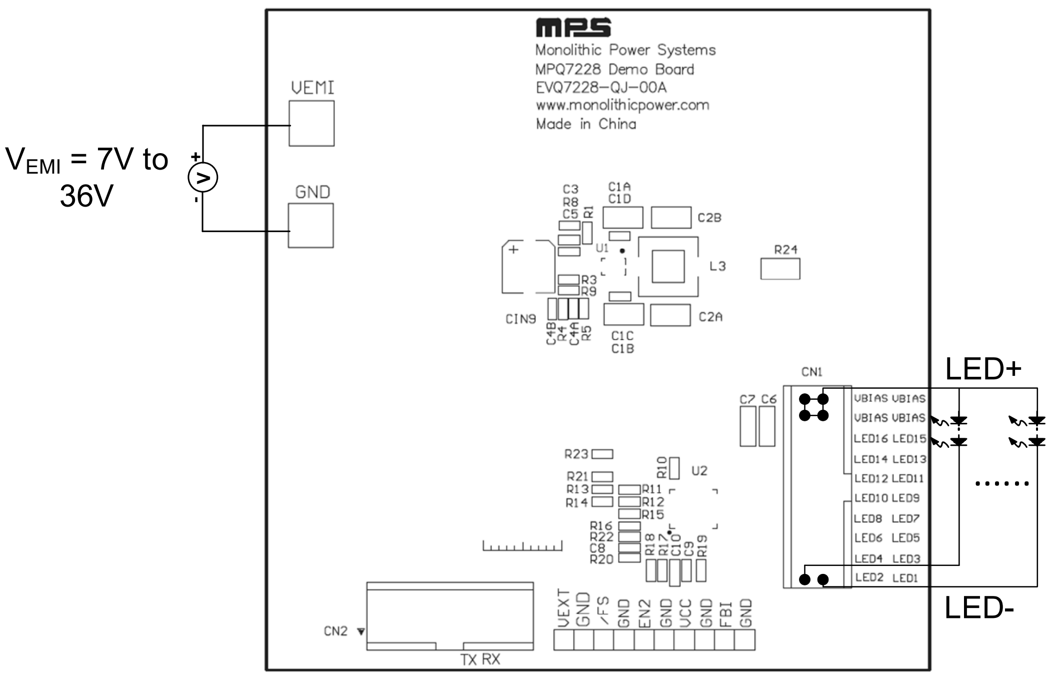


Figure 14: Measurement Equipment Set-Up

EVALUATION BOARD SCHEMATIC

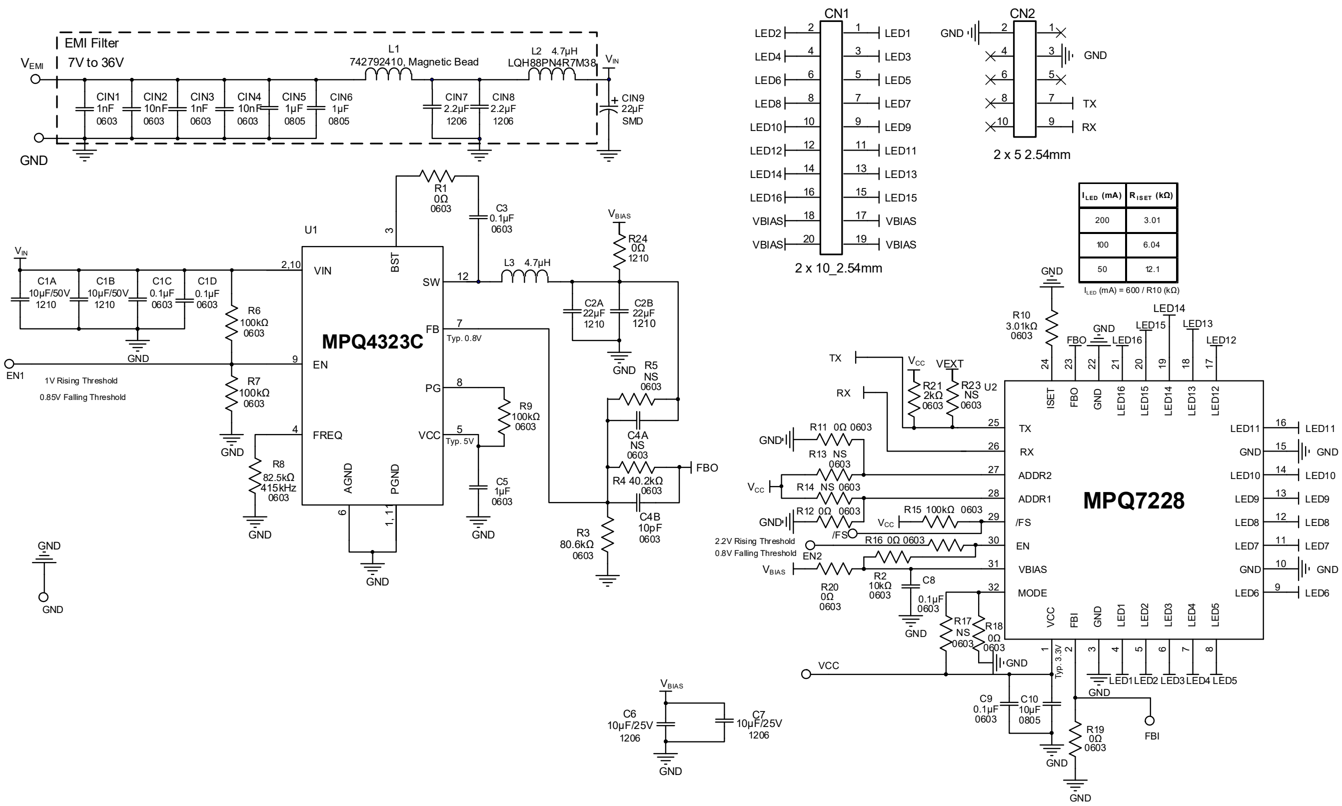


Figure 15: Evaluation Board Schematic

EVQ7228-QJ-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
2	CIN1, CIN3	1nF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM1885C1H102JA01D
2	CIN2, CIN4	10nF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM188R71H103KA01D
2	CIN5, CIN6	1µF	Ceramic capacitor, 50V, X7R	0805	Murata	GRM21BR71H105KA12L
2	CIN7, CIN8	2.2µF	Ceramic capacitor, 50V, X5R	1206	Murata	GRM31CR71H225KA88L
1	CIN9	22µF	Electrolytic capacitor, 50V	SMD	Panasonic	UT1H220M0605VG
2	C1A, C1B	10µF	Ceramic capacitor, 50V, X7R	1210	Murata	GRM32ER71H106KA12L
5	C1C, C1D, C3, C8, C9	0.1µF	Ceramic capacitor, 50V, X7R	0603	Murata	GCJ188R71H104KA12D
2	C2A, C2B	22µF	Ceramic Capacitor, 16V, X5R	1210	Murata	GRM32ER61C226KE20L
1	C4A	NS	Ceramic capacitor, 50V, NPO	0603	Wurth	885012006051
1	C4B	10pF	Ceramic capacitor, 50V, NPO	0603	Wurth	885012006051
1	C5	1µF	Ceramic capacitor, 10V, X7R	0603	Wurth	885012206026
2	C6, C7	10µF	Ceramic capacitor, 25V, X7R	1206	Murata	GRM31CR71E106KA12
1	C10	10µF	Ceramic capacitor, 10V, X7R	0805	Murata	GRM21BR71A106KE51L
1	L1	6A	Magnetic bead, 6A	1806	Murata	BLM41PG600SN1L
1	L2	1µH	Inductor	SMD	Coilcraft	XGL4020-102MEB
1	L3	4.7µF	Inductor	SMD	Coilcraft	XGL5030-472MEB
7	R1, R11, R12, R16, R18, R19, R20	0Ω	Film resistor, 5%	0603	Yageo	RC0603JR-070RL
1	R22	10kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0710KL
1	R3	80.6kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0780K6L
1	R4	40.2kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0740K2L
5	R5, R13, R14, R17, R23	NS	Film resistor, 1%	0603	Yageo	RC0603JR-070RL
4	R6, R7, R9, R15	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
1	R8	82.5kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0782K5L
1	R10	3.01kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-073K01L
1	R21	2kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-072KL
1	R24	0Ω	Film resistor, 5%	1210	Yageo	RC1210JR-070RL

EVQ7228-QJ-00A BILL OF MATERIALS *(continued)*

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
2	VEMI, GND	2mm	2mm golden pin	DIP	Custom (3)	
10	/FS, EN2, VCC, FBI, VEXT, GND	2.54mm	2.54mm test pin	DIP	Custom (3)	
1	CN1	2.54mm	2.54mm test pin	DIP	Custom (3)	
1	CN2	2.54mm	10-pin connector	DIP	Custom (3)	
1	U1	MPQ4323C	Step-down converter	QFN-12 (2mmx 3mm)	MPS	MPQ4323CGD-AEC1
1	U2	MPQ7228	16-channel current sink LED driver	QFN-32 (5mmx 6mm)	MPS	MPQ7228GQJE-AEC1

Note:

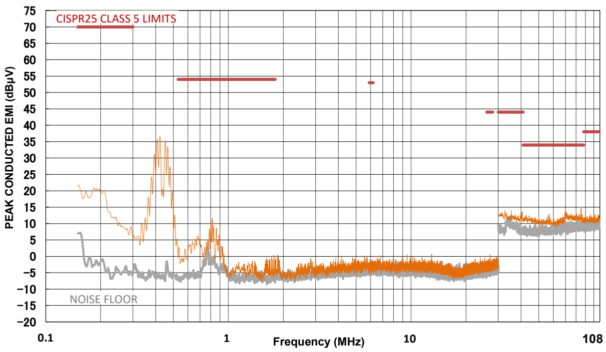
3) Contact an MPS FAE for more information regarding custom pins.

EVB TEST RESULTS

Two LEDs in series (V_{LED} = 6V), I_{LED}/channel = 200mA, T_A = 25°C, unless otherwise noted. [4]

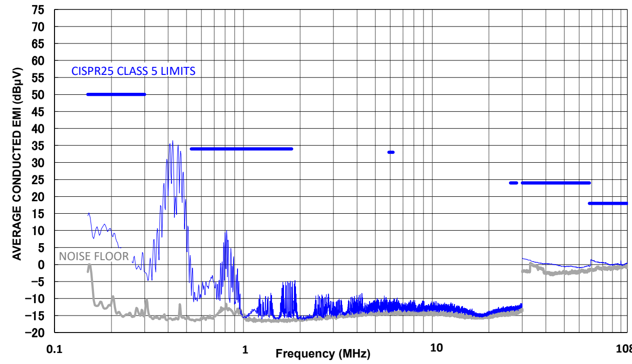
CISPR25 Class 5 Peak Conducted Emissions

150kHz to 108MHz



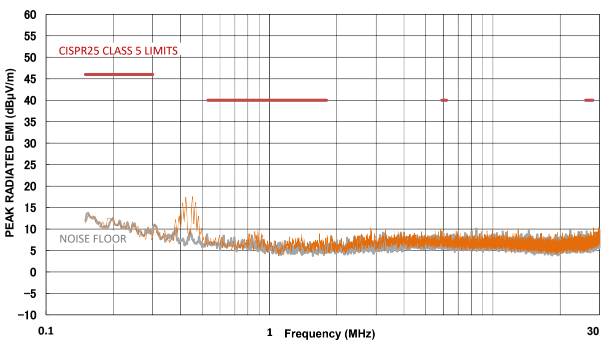
CISPR25 Class 5 Average Conducted Emissions

150kHz to 108MHz



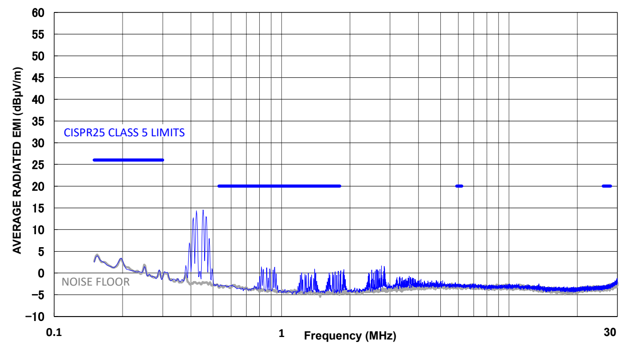
CISPR25 Class 5 Peak Radiated Emissions

150kHz to 30MHz



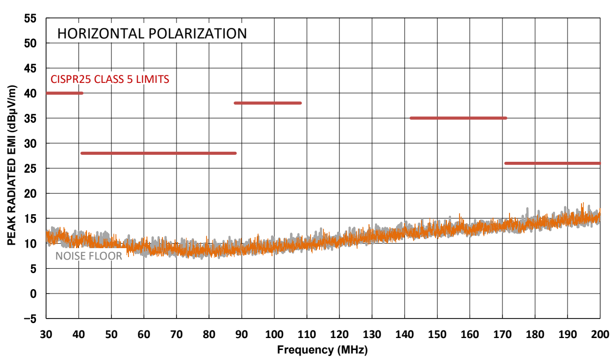
CISPR25 Class 5 Average Radiated Emissions

150kHz to 30MHz



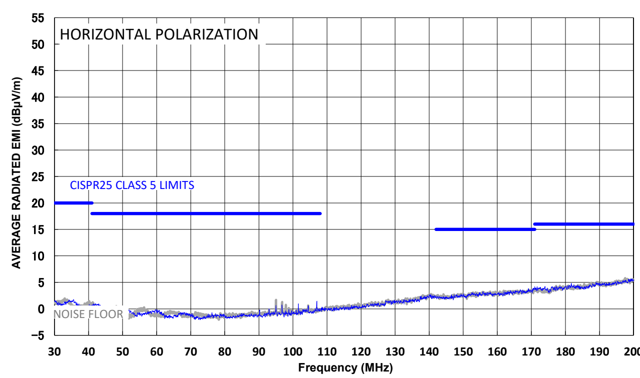
CISPR25 Class 5 Peak Radiated Emissions

Horizontal, 30MHz to 200MHz



CISPR25 Class 5 Average Radiated Emissions

Horizontal, 30MHz to 200MHz

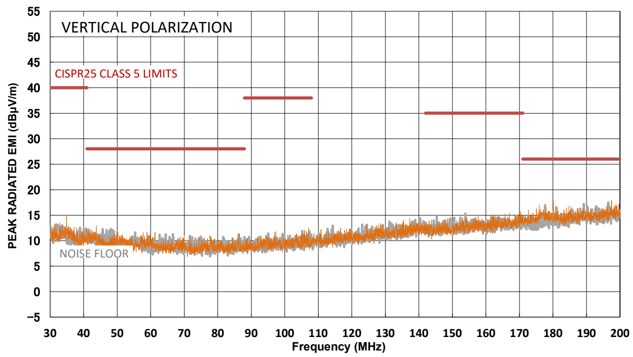


EVB TEST RESULTS *(continued)*

Two LEDs in series (V_{LED} = 6V), I_{LED}/channel = 200mA, T_A = 25°C, unless otherwise noted. (4)

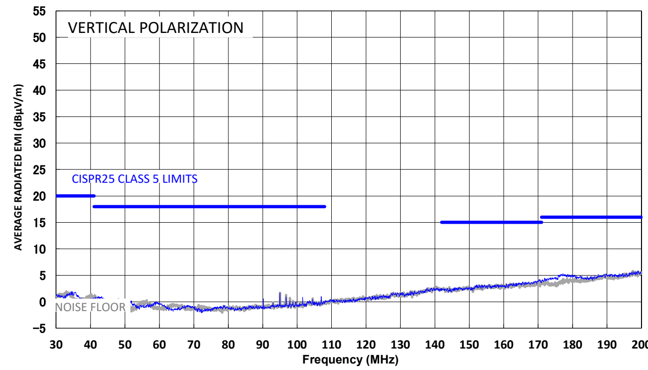
CISPR25 Class 5 Peak Radiated Emissions

Vertical, 30MHz to 200MHz



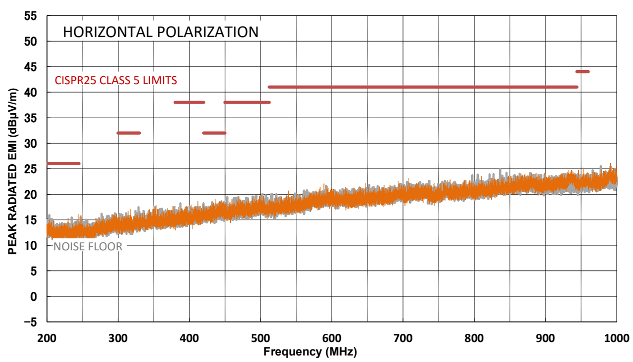
CISPR25 Class 5 Average Radiated Emissions

Vertical, 30MHz to 200MHz



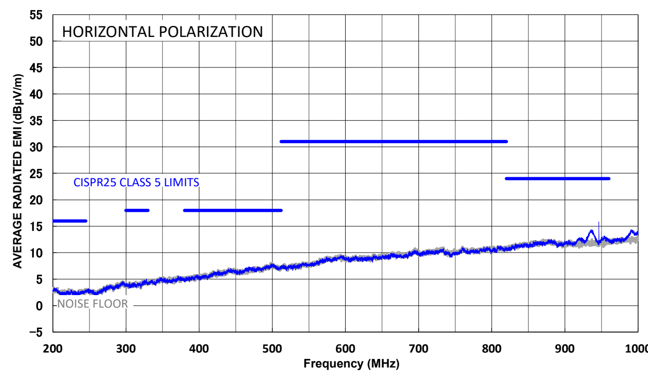
CISPR25 Class 5 Peak Radiated Emissions

Horizontal, 200MHz to 1GHz



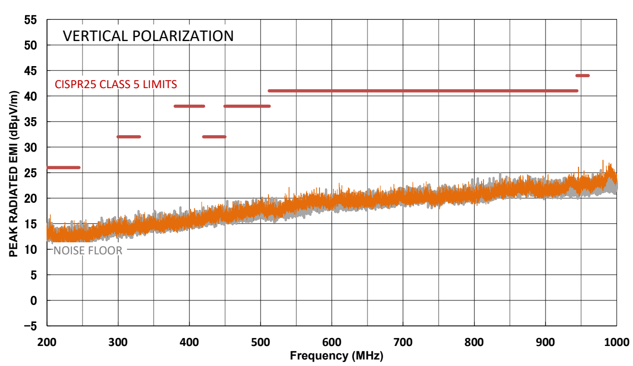
CISPR25 Class 5 Average Radiated Emissions

Horizontal, 200MHz to 1GHz



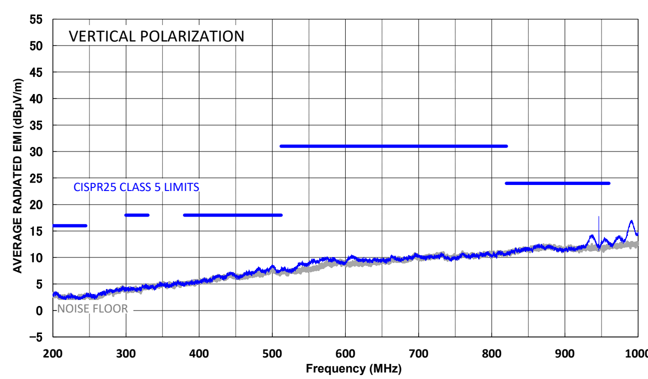
CISPR25 Class 5 Peak Radiated Emissions

Vertical, 200MHz to 1GHz



CISPR25 Class 5 Average Radiated Emissions

Vertical, 200MHz to 1GHz

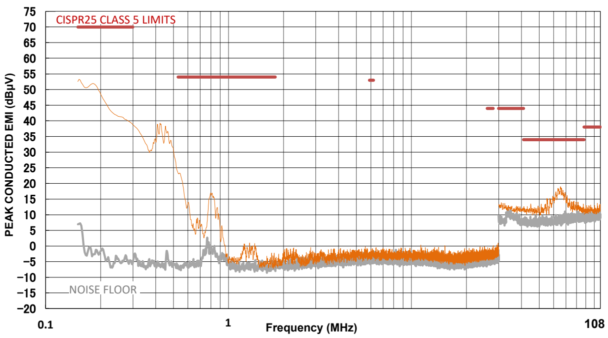


EVB TEST RESULTS *(continued)*

Two LEDs in series (V_{LED} = 6V), I_{LED}/channel = 200mA, T_A = 25°C, unless otherwise noted. [4]

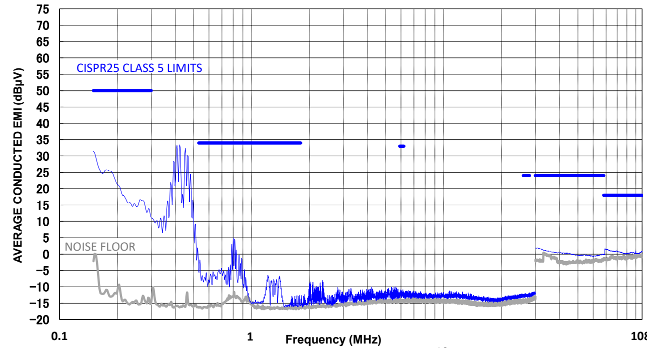
CISPR25 Class 5 Peak Conducted Emissions

150kHz to 108MHz



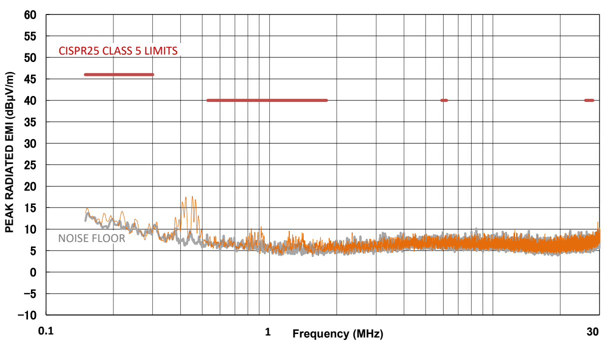
CISPR25 Class 5 Average Conducted Emissions

150kHz to 108MHz



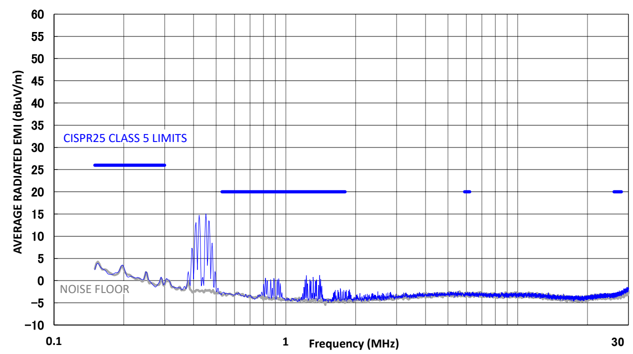
CISPR25 Class 5 Peak Radiated Emissions

150kHz to 30MHz



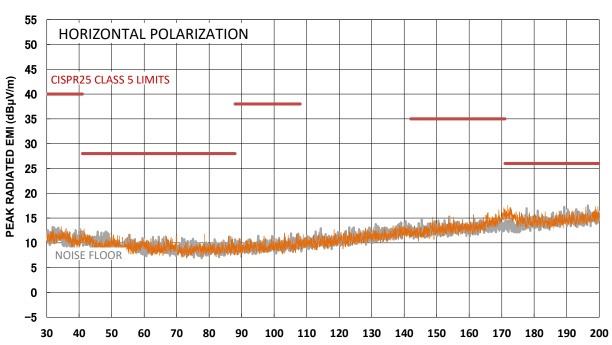
CISPR25 Class 5 Average Radiated Emissions

150kHz to 30MHz



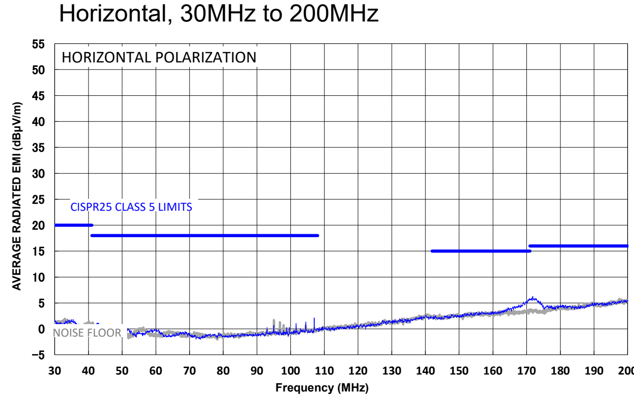
CISPR25 Class 5 Peak Radiated Emissions

Horizontal, 30MHz to 200MHz



CISPR25 Class 5 Average Radiated Emissions

Horizontal, 30MHz to 200MHz

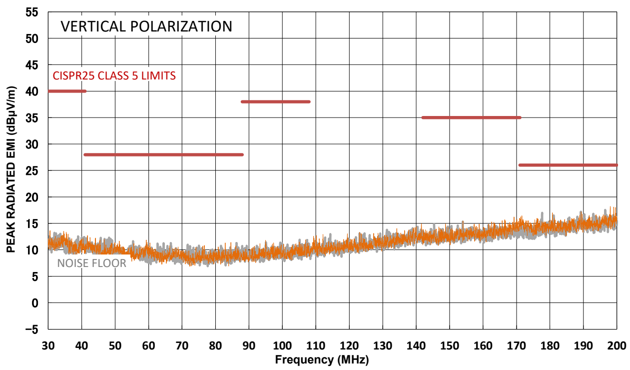


EVB TEST RESULTS *(continued)*

Two LEDs in series (V_{LED} = 6V), I_{LED}/channel = 200mA, T_A = 25°C, unless otherwise noted. [4]

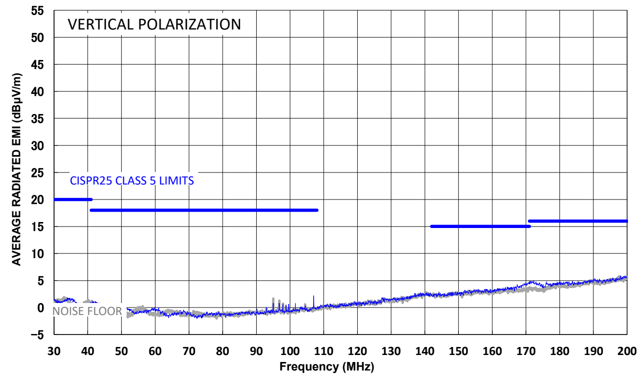
CISPR25 Class 5 Peak Radiated Emissions

Vertical, 30MHz to 200MHz



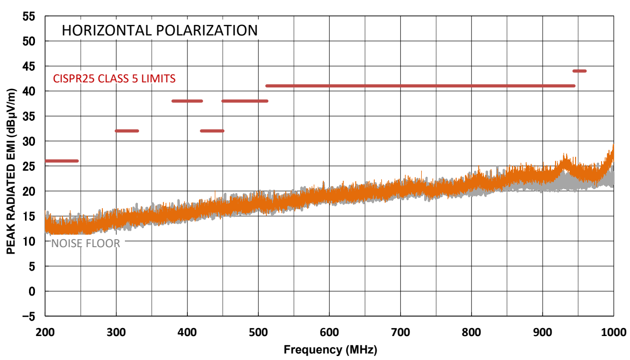
CISPR25 Class 5 Average Radiated Emissions

Vertical, 30MHz to 200MHz



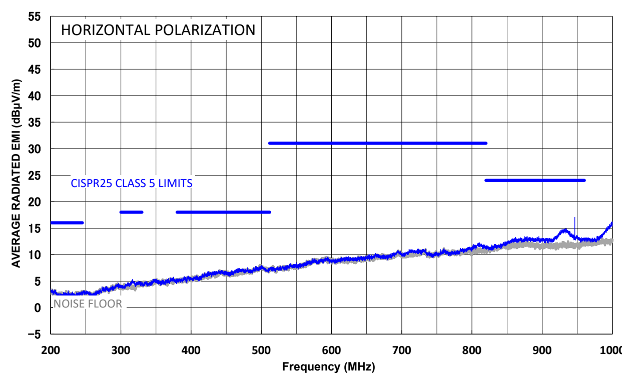
CISPR25 Class 5 Peak Radiated Emissions

Horizontal, 200MHz to 1GHz



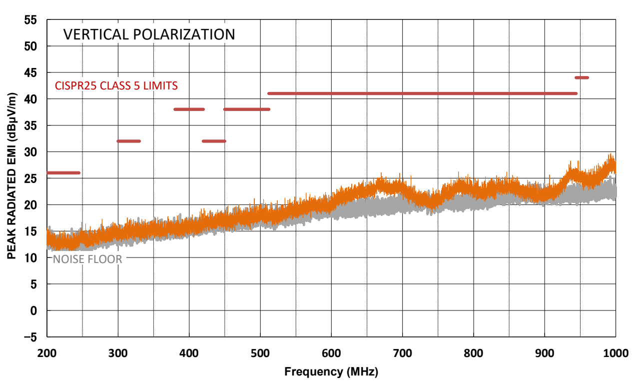
CISPR25 Class 5 Average Radiated Emissions

Horizontal, 200MHz to 1GHz



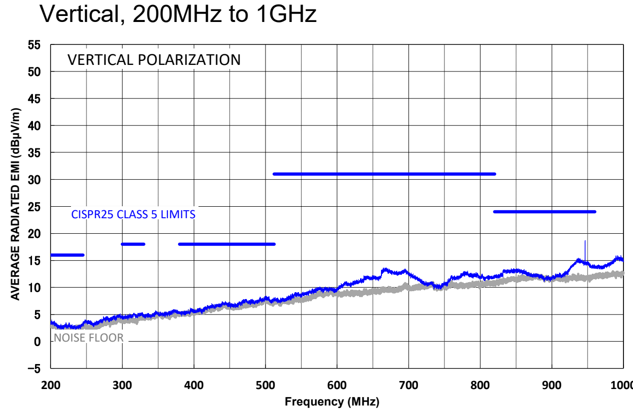
CISPR25 Class 5 Peak Radiated Emissions

Vertical, 200MHz to 1GHz



CISPR25 Class 5 Average Radiated Emissions

Vertical, 200MHz to 1GHz



Note:

4) The EMC test results are based on the schematic with EMI filters (see Figure 15 on page 12), where f_{PWM} = 250Hz, duty cycle = 50%, phase shift = 1µs, and slew rate = 5µs.

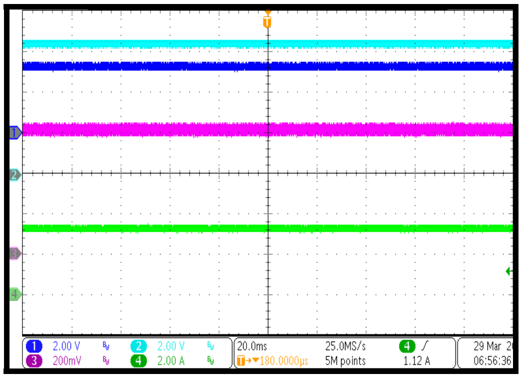
EVB TEST RESULTS *(continued)*

Two LEDs in series (V_{LED} = 6V), I_{LED}/channel = 200mA, T_A = 25°C, unless otherwise noted.

Steady State

Two LEDs in series (V_{LED} = 6V),
I_{LED} = 0.2A/channel

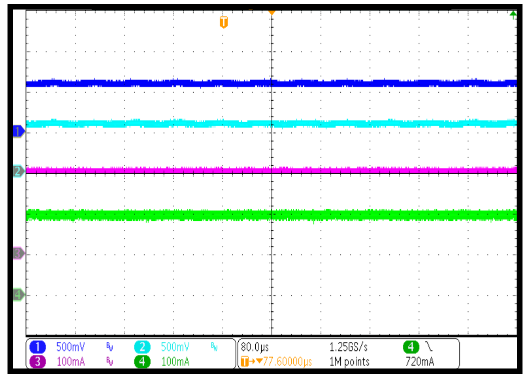
CH1: /FS
2V/div.
CH2: V_{BIAS}
2V/div.
CH3: V_{LED1}
200mV/div.
CH4: I_{LED}
2A/div.



Steady State

Two LEDs in series (V_{LED} = 6V),
I_{LED} = 0.2A/channel

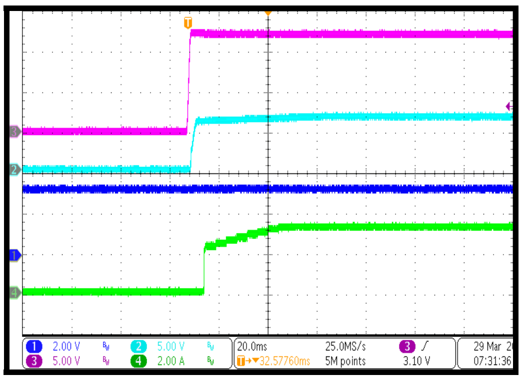
CH1: V_{LED1}
500mV/div.
CH2: V_{LED2}
500mV/div.
CH3: I_{LED1}
100mA/div.
CH4: I_{LED2}
100mA/div.



Pre-Buck Start-Up

Turn off the MPQ7228's EN and VCC pins, and turn on the pre-buck regulator's VIN pin

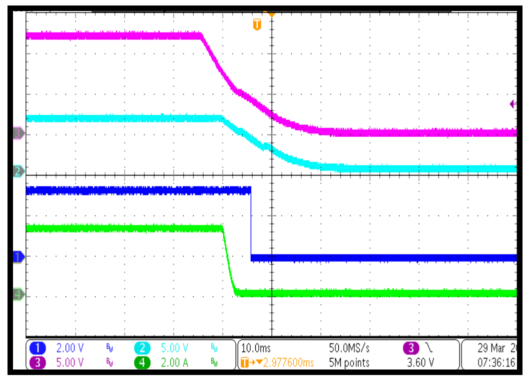
CH3: VIN
5V/div.
CH2: V_{BIAS}
5V/div.
CH1: /FS
2V/div.
CH4: I_{LED}
2A/div.



Pre-Buck Shutdown

Turn off the MPQ7228's EN and VCC pins, and turn off the pre-buck regulator's VIN pin

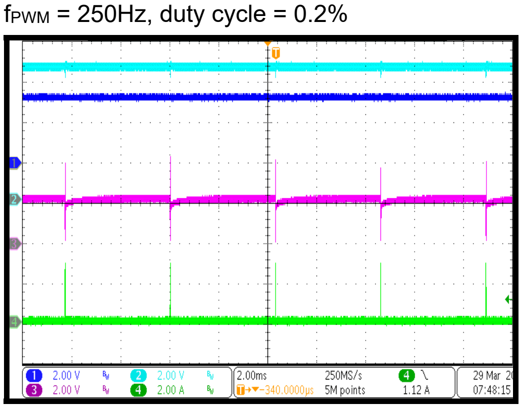
CH3: VIN
5V/div.
CH2: V_{BIAS}
5V/div.
CH1: /FS
2V/div.
CH4: I_{LED}
2A/div.



PWM Dimming

f_{PWM} = 250Hz, duty cycle = 0.2%

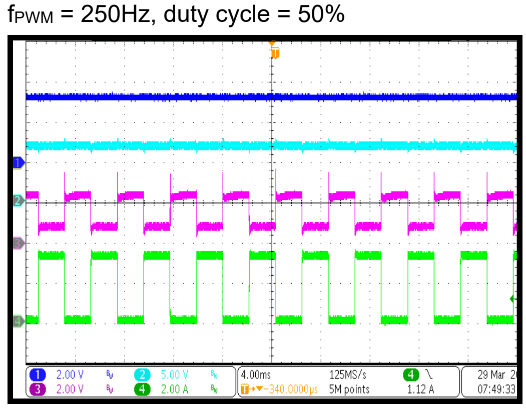
CH1: /FS
2V/div.
CH2: V_{BIAS}
2V/div.
CH3: V_{LED1}
2V/div.
CH4: I_{LED}
2A/div.



PWM Dimming

f_{PWM} = 250Hz, duty cycle = 50%

CH1: /FS
2V/div.
CH2: V_{BIAS}
5V/div.
CH3: V_{LED1}
2V/div.
CH4: I_{LED}
2A/div.



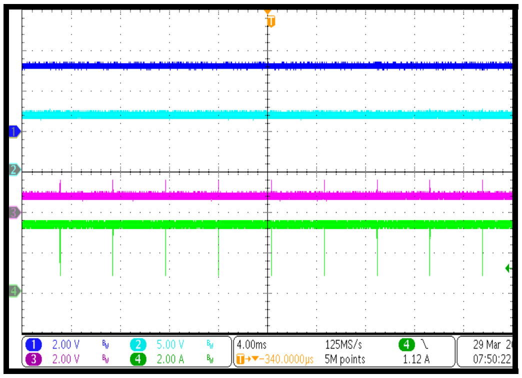
EVB TEST RESULTS *(continued)*

Two LEDs in series (V_{LED} = 6V), I_{LED}/channel = 200mA, T_A = 25°C, unless otherwise noted.

PWM Dimming

f_{PWM} = 250Hz, duty cycle = 99.9%

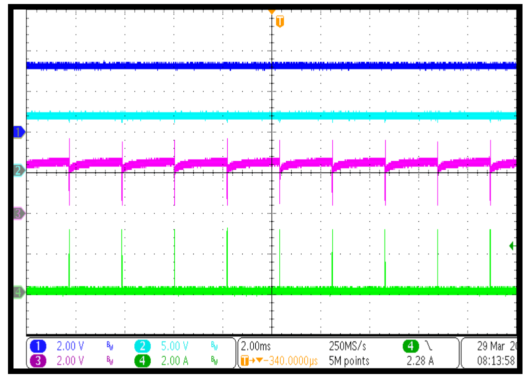
CH1: /FS 2V/div.
CH2: V_{BIAS} 5V/div.
CH3: V_{LED1} 2V/div.
CH4: I_{LED} 2A/div.



PWM Dimming

f_{PWM} = 500Hz, duty cycle = 0.3%

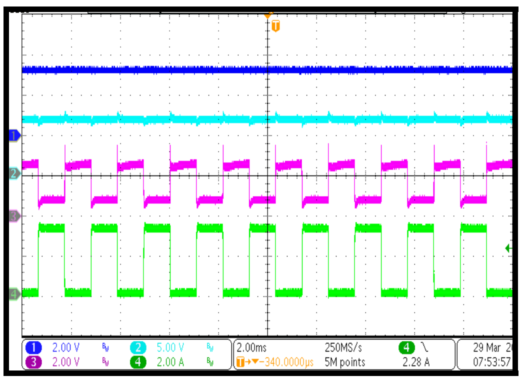
CH1: /FS 2V/div.
CH2: V_{BIAS} 5V/div.
CH3: V_{LED1} 2V/div.
CH4: I_{LED} 2A/div.



PWM Dimming

f_{PWM} = 500Hz, duty cycle = 50%

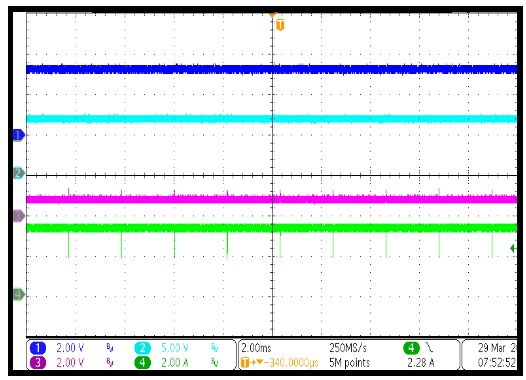
CH1: /FS 2V/div.
CH2: V_{BIAS} 5V/div.
CH3: V_{LED1} 2V/div.
CH4: I_{LED} 2A/div.



PWM Dimming

f_{PWM} = 500Hz, duty cycle = 99.9%

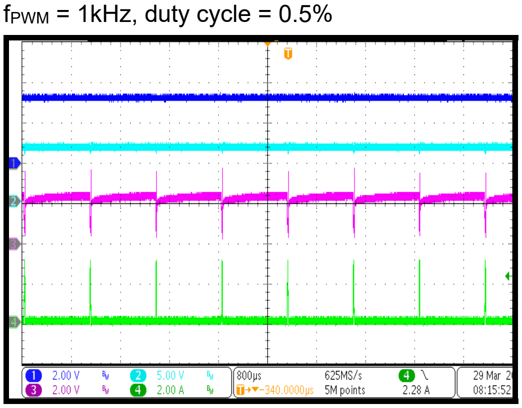
CH1: /FS 2V/div.
CH2: V_{BIAS} 5V/div.
CH3: V_{LED1} 2V/div.
CH4: I_{LED} 2A/div.



PWM Dimming

f_{PWM} = 1kHz, duty cycle = 0.5%

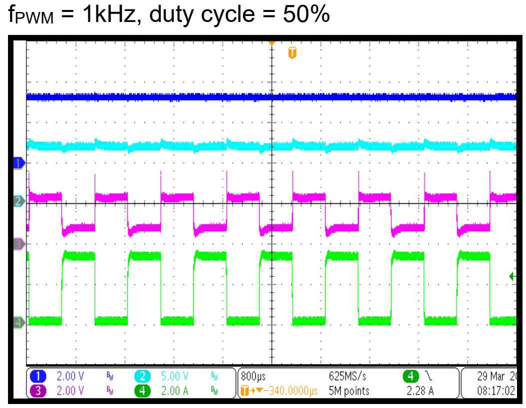
CH1: /FS 2V/div.
CH2: V_{BIAS} 5V/div.
CH3: V_{LED1} 2V/div.
CH4: I_{LED} 2A/div.



PWM Dimming

f_{PWM} = 1kHz, duty cycle = 50%

CH1: /FS 2V/div.
CH2: V_{BIAS} 5V/div.
CH3: V_{LED1} 2V/div.
CH4: I_{LED} 2A/div.



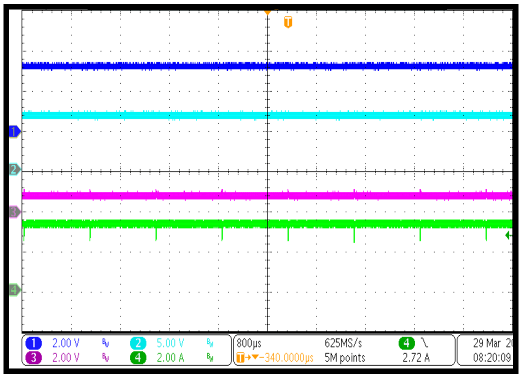
EVB TEST RESULTS *(continued)*

Two LEDs in series (V_{LED} = 6V), I_{LED}/channel = 200mA, T_A = 25°C, unless otherwise noted.

PWM Dimming

f_{PWM} = 1kHz, duty cycle = 99.9%

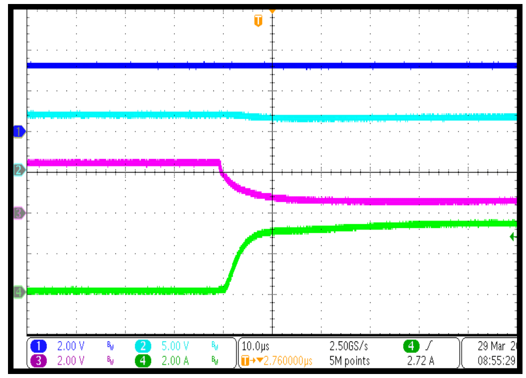
CH1: /FS 2V/div.
CH2: V_{BIAS} 5V/div.
CH3: V_{LED1} 2V/div.
CH4: I_{LED} 2A/div.



PWM Dimming Slew Rate

f_{PWM} = 1kHz, slew rate = 5µs

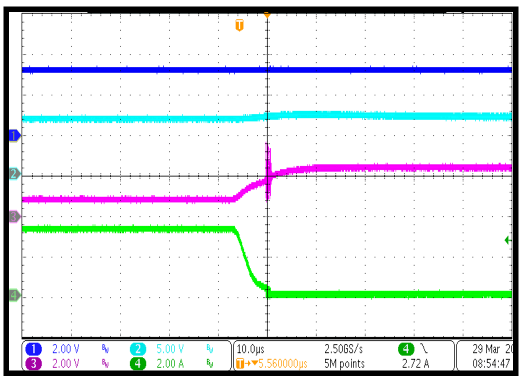
CH1: /FS 2V/div.
CH2: V_{BIAS} 5V/div.
CH3: V_{LED1} 2V/div.
CH4: I_{LED} 2A/div.



PWM Dimming Slew Rate

f_{PWM} = 1kHz, slew rate = 5µs

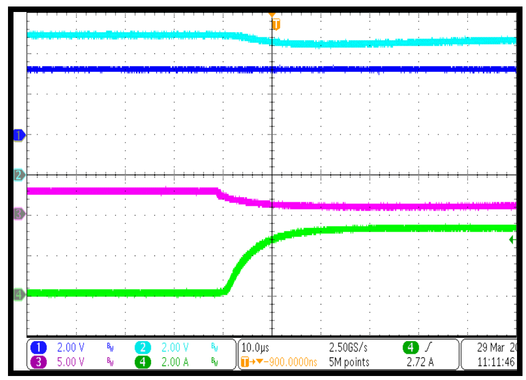
CH1: /FS 2V/div.
CH2: V_{BIAS} 5V/div.
CH3: V_{LED1} 2V/div.
CH4: I_{LED} 2A/div.



PWM Dimming Slew Rate

f_{PWM} = 1kHz, slew rate = 10µs

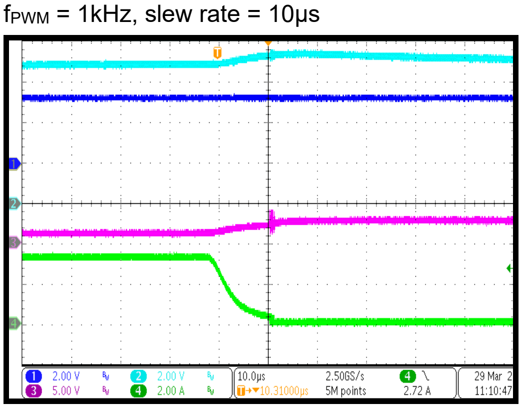
CH1: /FS 2V/div.
CH2: V_{BIAS} 2V/div.
CH3: V_{LED1} 5V/div.
CH4: I_{LED} 2A/div.



PWM Dimming Slew Rate

f_{PWM} = 1kHz, slew rate = 10µs

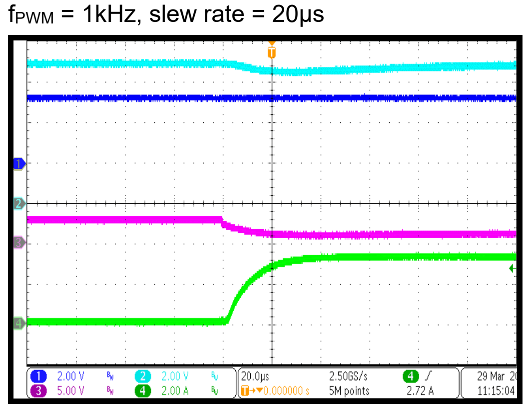
CH1: /FS 2V/div.
CH2: V_{BIAS} 2V/div.
CH3: V_{LED1} 5V/div.
CH4: I_{LED} 2A/div.



PWM Dimming Slew Rate

f_{PWM} = 1kHz, slew rate = 20µs

CH1: /FS 2V/div.
CH2: V_{BIAS} 2V/div.
CH3: V_{LED1} 5V/div.
CH4: I_{LED} 2A/div.



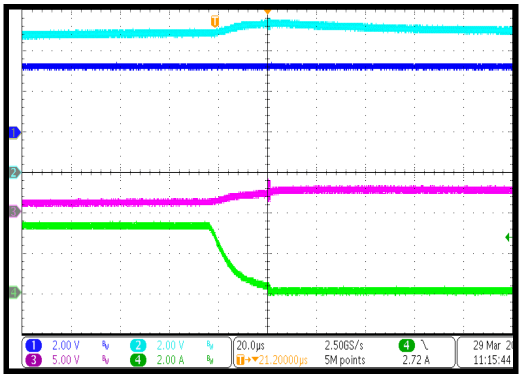
EVB TEST RESULTS *(continued)*

Two LEDs in series (V_{LED} = 6V), I_{LED}/channel = 200mA, T_A = 25°C, unless otherwise noted.

PWM Dimming Slew Rate

f_{PWM} = 1kHz, slew rate = 20μs

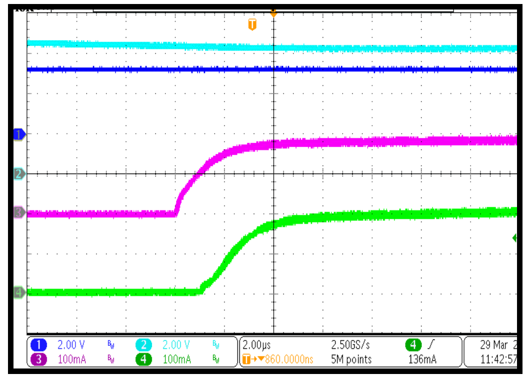
CH1: /FS 2V/div.
CH2: V_{BIAS} 2V/div
CH3: V_{LED1} 5V/div.
CH4: I_{LED} 2A/div.



PWM Dimming Phase Shift

No slew rate, phase shift = 1μs

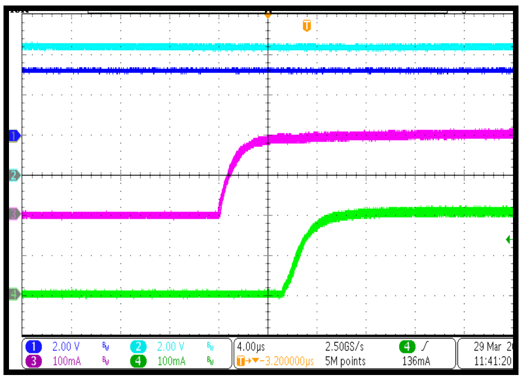
CH1: /FS 2V/div.
CH2: V_{BIAS} 2V/div.
CH3: I_{LED1} 100mA/div.
CH4: I_{LED2} 100mA/div.



PWM Dimming Phase Shift

No slew rate, phase shift = 5μs

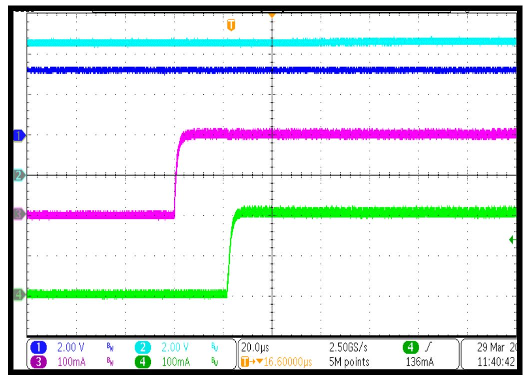
CH1: /FS 2V/div.
CH2: V_{BIAS} 2V/div.
CH3: I_{LED1} 100mA/div.
CH4: I_{LED2} 100mA/div.



PWM Dimming Phase Shift

No slew rate, phase shift = 20μs

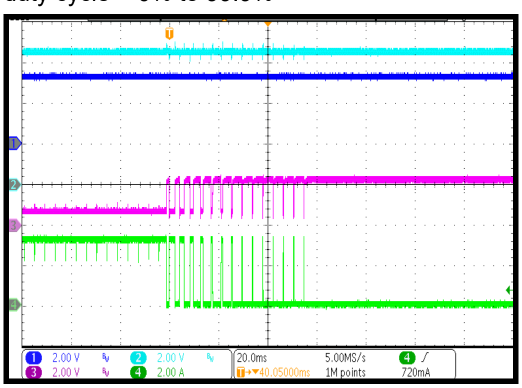
CH1: /FS 2V/div.
CH2: V_{BIAS} 2V/div.
CH3: I_{LED1} 100mA/div.
CH4: I_{LED2} 100mA/div.



PWM Auto-Dimming

f_{PWM} = 250Hz, normal speed, duty cycle = 0% to 99.9%

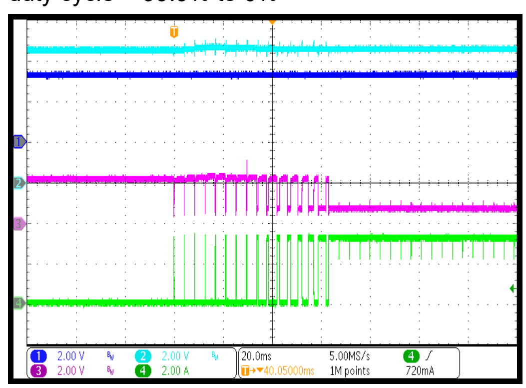
CH1: /FS 2V/div.
CH2: V_{BIAS} 2V/div.
CH3: V_{LED1} 2V/div.
CH4: I_{LED} 2A/div.



PWM Auto-Dimming

f_{PWM} = 250Hz, normal speed, duty cycle = 99.9% to 0%

CH1: /FS 2V/div.
CH2: V_{BIAS} 2V/div.
CH3: V_{LED1} 2V/div.
CH4: I_{LED} 2A/div.

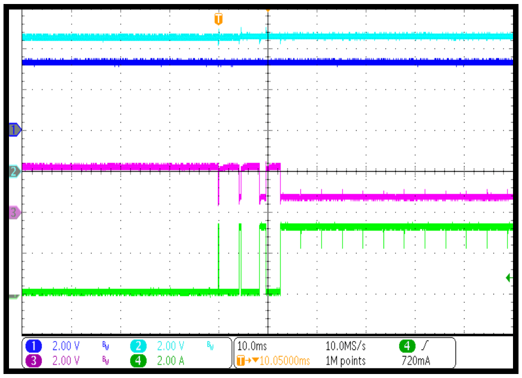


EVB TEST RESULTS *(continued)*

Two LEDs in series (V_{LED} = 6V), I_{LED}/channel = 200mA, T_A = 25°C, unless otherwise noted.

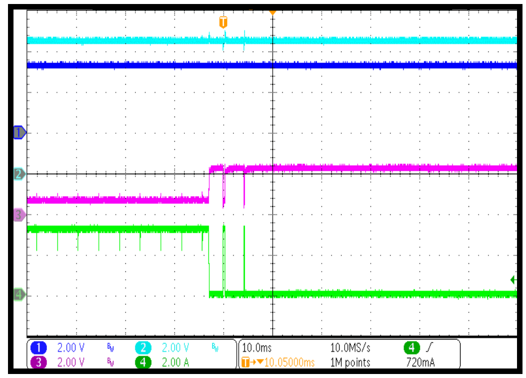
PWM Auto-Dimming
f_{PWM} = 250Hz, 4x speed,
duty cycle = 0% to 99.9%

CH1: /FS
2V/div.
CH2: V_{BIAS}
2V/div.
CH3: V_{LED1}
2V/div.
CH4: I_{LED}
2A/div.



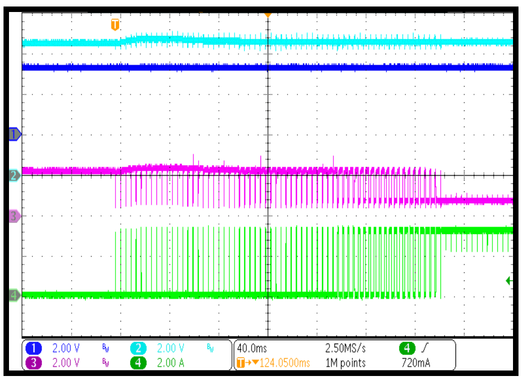
PWM Auto-Dimming
f_{PWM} = 250Hz, 4x speed,
duty cycle = 99.9% to 0%

CH1: /FS
2V/div.
CH2: V_{BIAS}
2V/div.
CH3: V_{LED1}
2V/div.
CH4: I_{LED}
2A/div.



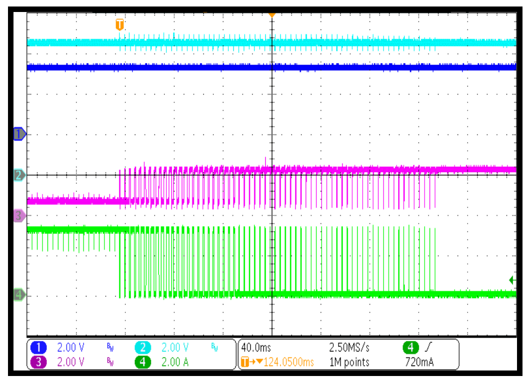
PWM Auto-Dimming
f_{PWM} = 250Hz, 1/4x normal speed,
duty cycle = 0% to 99.9%

CH1: /FS
2V/div.
CH2: V_{BIAS}
2V/div.
CH3: V_{LED1}
2V/div.
CH4: I_{LED}
2A/div.



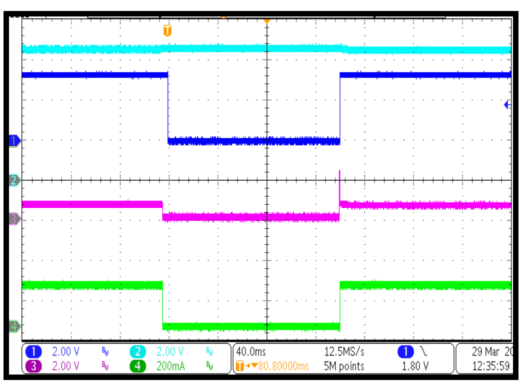
PWM Auto-Dimming
f_{PWM} = 250Hz, 1/4x normal speed,
duty cycle = 99.9% to 0%

CH1: /FS
2V/div.
CH2: V_{BIAS}
2V/div.
CH3: V_{LED1}
2V/div.
CH4: I_{LED}
2A/div.



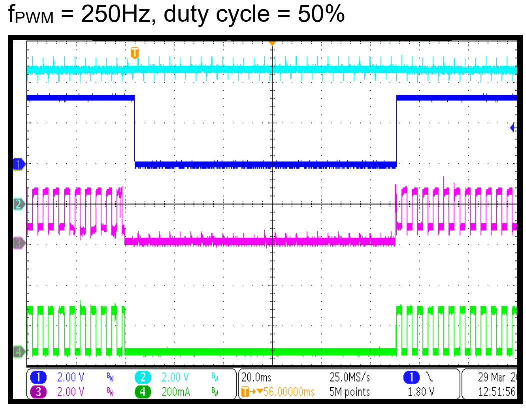
LED Open Entry/Recovery with /FS, No Latch

CH1: /FS
2V/div.
CH2: V_{BIAS}
2V/div.
CH3: V_{LED1}
2V/div.
CH4: I_{LED1}
200mA/div.



LED Open Entry/Recovery with /FS, No Latch
f_{PWM} = 250Hz, duty cycle = 50%

CH1: /FS
2V/div.
CH2: V_{BIAS}
2V/div.
CH3: V_{LED1}
2V/div.
CH4: I_{LED1}
200mA/div.

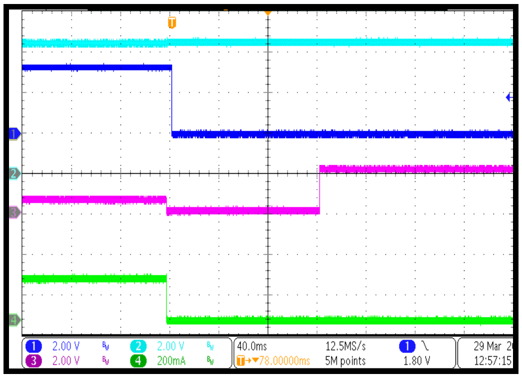


EVB TEST RESULTS *(continued)*

Two LEDs in series (V_{LED} = 6V), I_{LED}/channel = 200mA, T_A = 25°C, unless otherwise noted.

LED Open Entry/Recovery with /FS, Latch

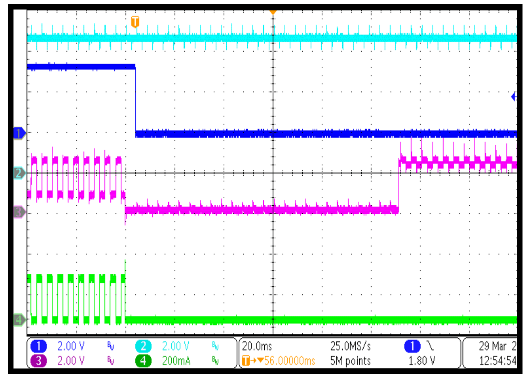
CH1: /FS 2V/div.
CH2: V_{BIAS} 2V/div.
CH3: V_{LED1} 2V/div.
CH4: I_{LED1} 200mA/div.



LED Open Entry/Recovery with /FS, Latch

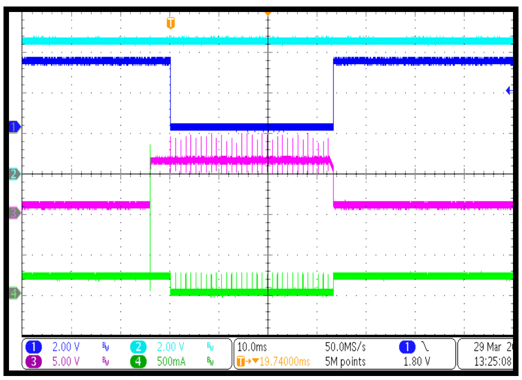
f_{PWM} = 250Hz, duty cycle = 50%

CH1: /FS 2V/div.
CH2: V_{BIAS} 2V/div.
CH3: V_{LED1} 2V/div.
CH4: I_{LED1} 200mA/div.



LED Short Entry/Recovery with /FS, No Latch

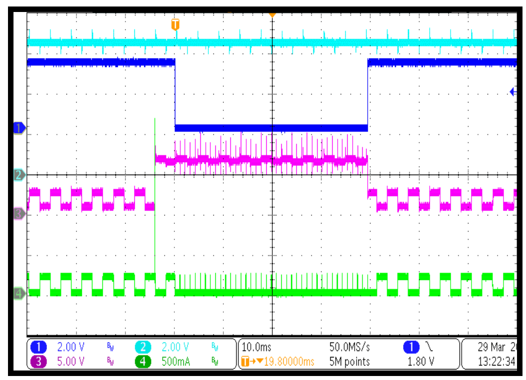
CH1: /FS 2V/div.
CH2: V_{BIAS} 2V/div.
CH3: V_{LED1} 5V/div.
CH4: I_{LED1} 500mA/div.



LED Short Entry/Recovery with /FS, No Latch

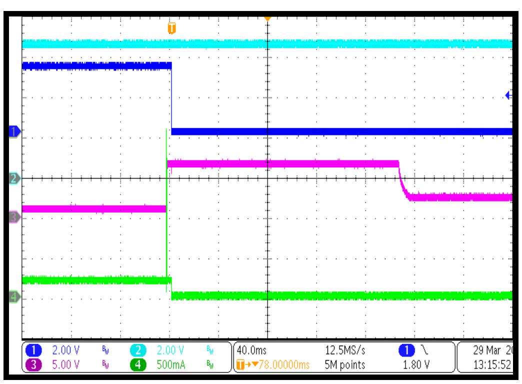
f_{PWM} = 250Hz, duty cycle = 50%

CH1: /FS 2V/div.
CH2: V_{BIAS} 2V/div.
CH3: V_{LED1} 5V/div.
CH4: I_{LED1} 500mA/div.



LED Short Entry/Recovery with /FS, Latch

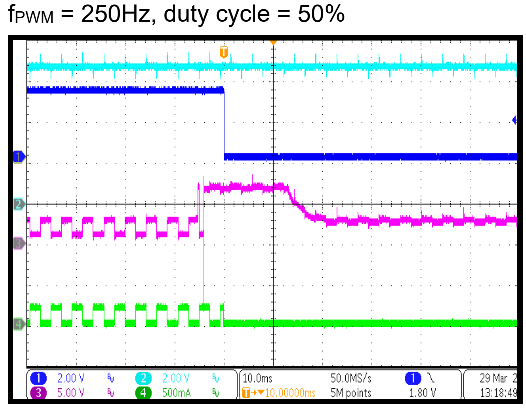
CH1: /FS 2V/div.
CH2: V_{BIAS} 2V/div.
CH3: V_{LED1} 5V/div.
CH4: I_{LED1} 500mA/div.



LED Short Entry/Recovery with /FS, Latch

f_{PWM} = 250Hz, duty cycle = 50%

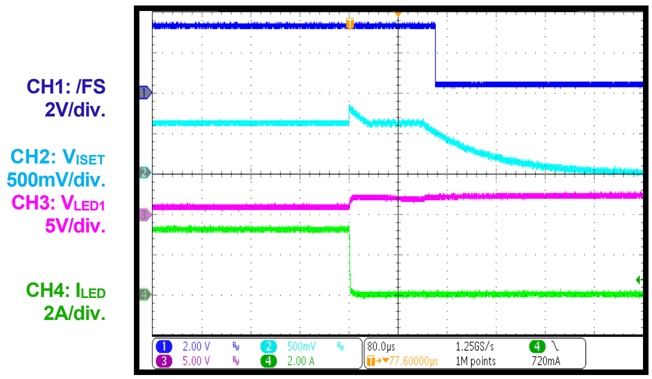
CH1: /FS 2V/div.
CH2: V_{BIAS} 2V/div.
CH3: V_{LED1} 5V/div.
CH4: I_{LED1} 500mA/div.



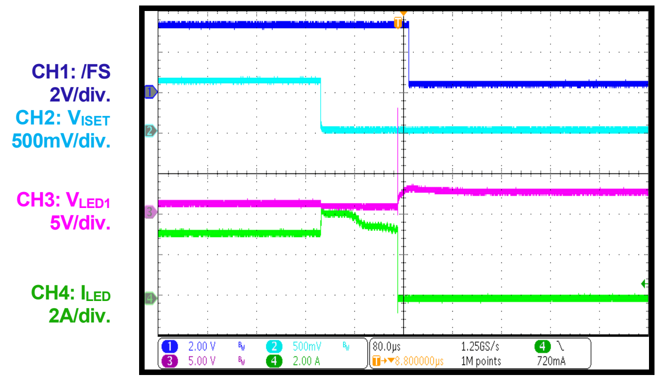
EVB TEST RESULTS *(continued)*

Two LEDs in series (V_{LED} = 6V), I_{LED}/channel = 200mA, T_A = 25°C, unless otherwise noted.

ISET Open Protection



ISET Short Protection



PCB LAYOUT [5]

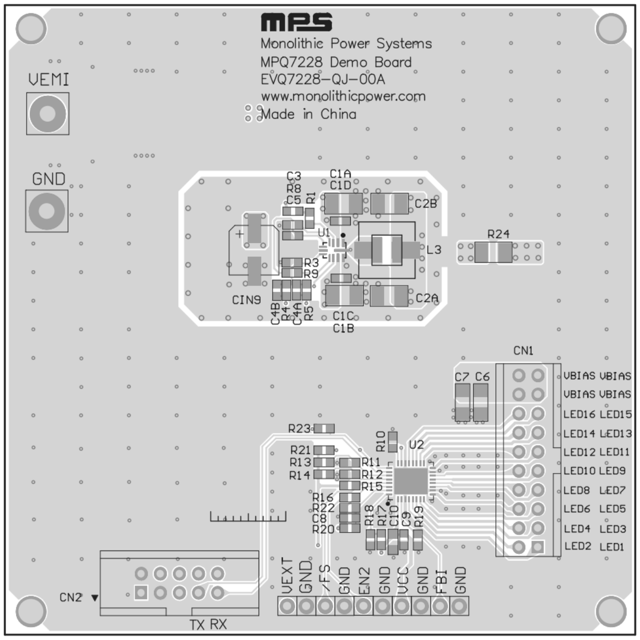


Figure 16: Top Silk and Top Layer

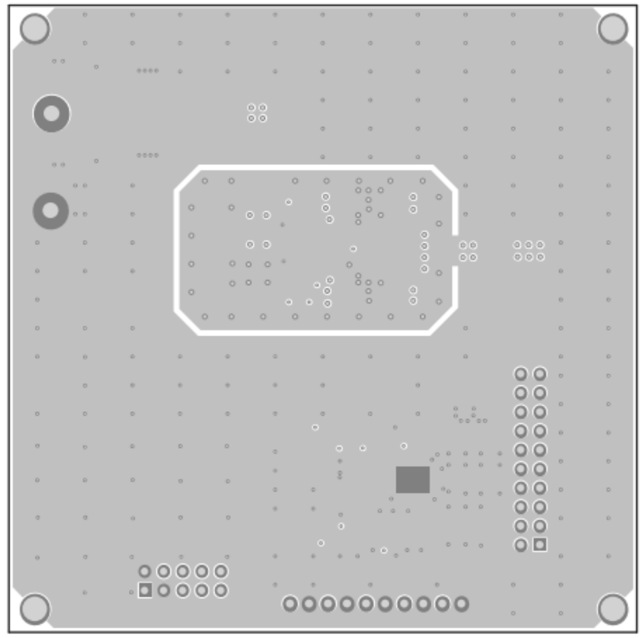


Figure 17: Mid-Layer 1

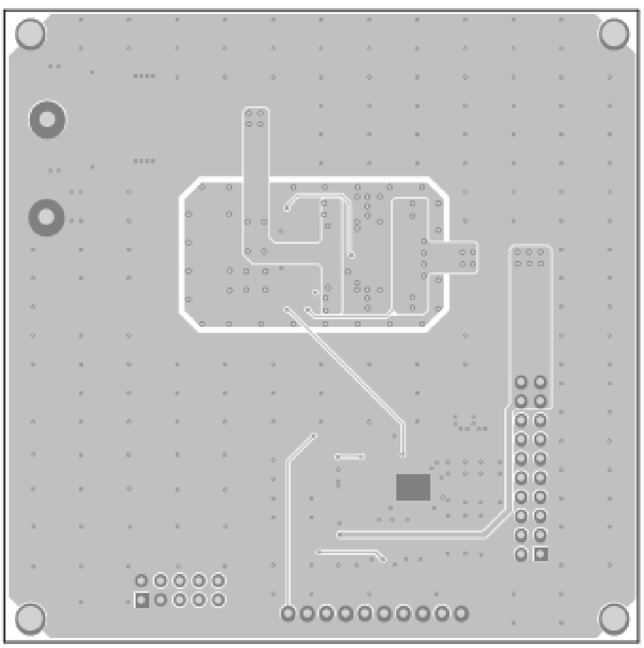


Figure 18: Mid-Layer 2

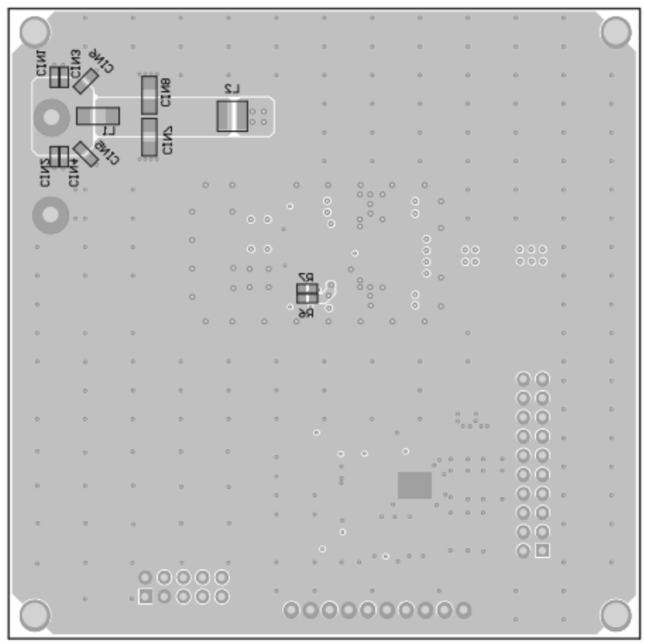


Figure 19: Bottom Layer and Bottom Silk

Note:

5) EVQ7228-QJ-00A, a 4-layer, 2oz PCB (83.8mmx83.8mm).

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	10/12/2023	Initial Release	-