EVF52001-4263-RE-00A

100W, USB PD Sourcing Ports Supporting Firmware Update, Advanced PDP Management for Automotive Evaluation Board

DESCRIPTION

The EVF52001-4263-RE-00A is designed for 100W USB power delivery (PD) applications. It is designed to demonstrate the capabilities of MPS's automotive USB Type-C power delivery (PD) solution using the MPF52001 and MPQ4263.

The MPF52001 is a highly integrated USB PD controller for sourcing ports. It integrates a 32-bit ARM Cortex-M0 microcontroller (MCU), up to 36MHz operation frequency, USB Type-C port controller, and legacy charging protocol management. A firmware update feature is supported via the CC lines.

The MPQ4263 is a buck-boost converter with two low-side MOSFETs (LS-FETs). The device can deliver up to 100W of peak output power (P_{OUT}) at a certain input supply range with excellent efficiency.

It is recommended to read the datasheets for the MPF52001 and MPQ4263 prior to making any changes to the EVF52001-4263-RE-00A.

PERFORMANCE SUMMARY

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

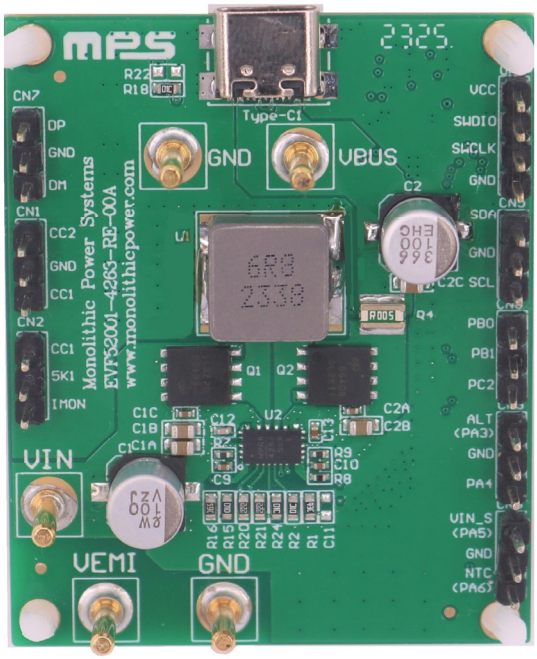
Parameters	Conditions	Value
Input voltage range (V_{IN})		3.6V to 36V
Typical efficiency	V_{IN} = 12V, V_{OUT} = 20V, I_{OUT} = 3A, f_{SW} = 280kHz	96.79%
Peak efficiency	V_{IN} = 12V, V_{OUT} = 15V, I_{OUT} = 1A, f_{SW} = 280kHz	97.80%
Default switching frequency (f_{SW})		280kHz

Default PDO List	V_{OUT}	I_{OUT}
1	5V	3A
2	9V	3A
3	15V	3A
4	20V	5A (1)
5	3.3V to 11V	3A
6	3.3V to 16V	3A
7	3.3V to 21V	5A (1)

Note:

1) For 100W of output power, a 5A cable is required.

EVALUATION BOARD



LxWxH (7.2cmx2.9cmx1.4cm) (2)

4 Layers (2oz/1oz/1oz/2oz)

Board Number	MPS IC Number		Firmware Version	PDFU Version
EVF52001-4263-RE-00A	MPQ4263GQVE-0002-AEC1	MPF52001GRE-0000-AEC2	fr0000	br1001

Note:

2) The board width does not include the gold finger, and the width of the gold finger is 0.4cm.

QUICK START GUIDE

1. Preset the power supply (V_{IN}) to 12V, and turn the power supply off.
2. Connect the power supply terminals to:
   a. Positive (+): VIN
   b. Negative (-): GND
3. Connect the power delivery (PD) protocol sniffer or mobile device to the USB Type-C port.
4. Turn the power supply on after making the connections.
5. The VBUS starts up automatically at the default voltage set by the PD protocol sniffer or mobile device. The PD protocol sniffer can select different power delivery object (PDO) outputs.
6. Maximum PD output power: 100W.
7. Over-temperature protection (OTP) function: When the NTC temperature exceeds 80°C, PD power is reduced. When the temperature exceeds 120°C, OTP shuts down the PD output. When the temperature falls below 120°C, the PD function is enabled. This function is disabled by default. If the user wants to enable OTP, add an NTC resistor (R22) on the evaluation board. The EVF52001-4263-RE-00A Bill of Materials section on page 5 shows the recommended part number.

Table 1: NTC Temperature and Max PDO Power

NTC Temperature	ADC Voltage on PA6	Max PDO Power
NTC < 80°C	2.447V to V_{CC}	100W
80°C < NTC < 100°C	<2.447V	60W
100°C < NTC < 120°C	<1.633V	30W
120°C < NTC	<1.041V	PDO is shut down

8. Battery voltage sense function: When the voltage between the VIN and GND pins is below 11.6V, PD power is reduced. When V_{IN} is below 6.6V, the PD engine shuts down. The hysteresis is 800mV.

Table 2: Battery Voltage and PD Power

Battery Voltage	PD Power (Only Single Port Is Connected)
11.6V < V_{IN}	100W
6.6V < V_{IN} < 11.6V	60W
V_{IN} < 6.6V	PDO is shut down

Figure 1 on page 4 shows the measurement equipment set-up.

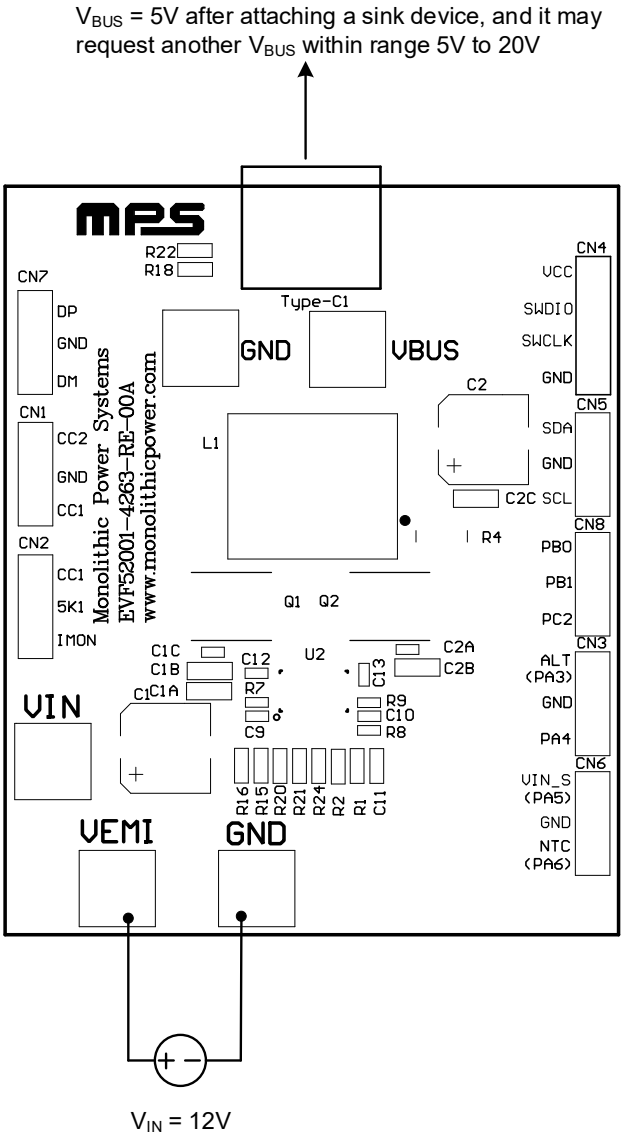


Figure 1: Evaluation Board Set-Up

EVALUATION BOARD SCHEMATIC

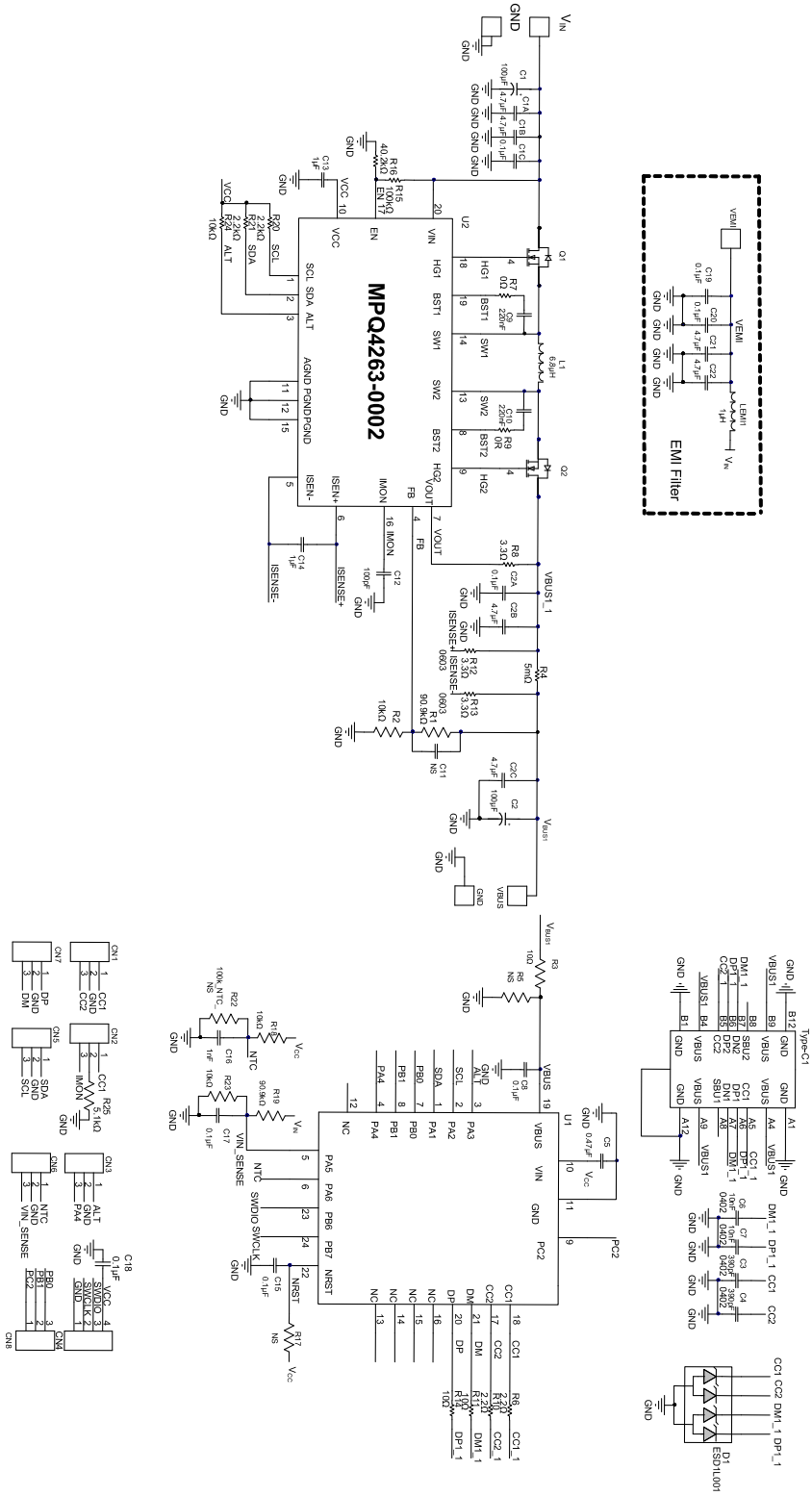


Figure 2: Evaluation Board Schematic (3)

Note:

3) The NTC function is disabled by default. Add an NTC resistor (R22) if the NTC function is needed. The EVF52001-4263-RE-00A Bill of Materials section on page 5 shows the recommended part number.

EVF52001-4263-RE-00A BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	C1	100µF	Electrolytic capacitor, 35V, 100µF	SMD	Chemi-con	EMZJ350ADA101MF80G
1	C2	100µF	Electrolytic capacitor, 25V, 100µF	SMD	Chemi-con	HHXC250ARA101MF80G
6	C2B, C2C, C21, C22, C1A, C1B,	4.7µF	Ceramic capacitor, 50V,X7S/X5R	0805	Murata	GRM21BR61H475ME51L
2	C1C, C2A	100nF	Ceramic capacitor, 50V, X7R	0402	Murata	GRM155R71H104ME14D
4	C8, C15, C17,C18	100nF	Ceramic capacitor, 50V, X7R	0603	Wurth	885012206095
2	C3, C4	390pF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM1885C1H391JA01D
1	C5	470nF	Ceramic capacitor, 25V, X5R/X7R	0603	Murata	GRM188R71E474KA12D
2	C6, C7	10nF	Ceramic capacitor, 50V, X7R	0402	Wurth	885012205067
2	C9, C10	220nF	Ceramic capacitor, 16V, X7R	0402	Murata	GRM155R71C224KA12D
3	C11,R5, R17	NS				
1	C12	100pF	Ceramic capacitor, 25V,C0G	0402	Murata	GRM1555C1E101JA01D
1	C13	1µF	Ceramic capacitor, 10V/16V, X6S	0402	Murata	GRM155C81C105KE11D
1	C14	1µF	Ceramic capacitor, 16V, X7R	0603	Wurth	885012206052
1	C16	1nF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM188R71H102KA01D
2	C19, C20	0.1µF	Ceramic capacitor, 50V, X7S	0805	Taiyo Yuden	MBASU21GSB7104KTNA01
7	CN1, CN2, CN3, CN5, CN6, CN7, CN8	3 pins	3 pins, 1 row, 2.54mm	DIP	Wurth	61300311121
1	D1	V_{RMW} = 5V	EDS diode	SOT23_6	onsemi	ESD1L001W1T2G
1	L1	6.8µH	Inductor	SMD	superworld	PIAQ1005S6R8MN
1	LEMI1	1µH	Inductor	SMD	superworld	PIFQ0503A1R0MN
2	Q1, Q2	40V, 22A	N-channel MOSFET	8-DFN-EP (5mmx 6mm)	Alpha & Omega Semiconductor	AONS66406
1	R1, R19	90.9kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0790K9L
4	R2, R23, R18, R24	10kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0710KL

EVF52001-4263-RE-00A BILL OF MATERIALS *(continued)*

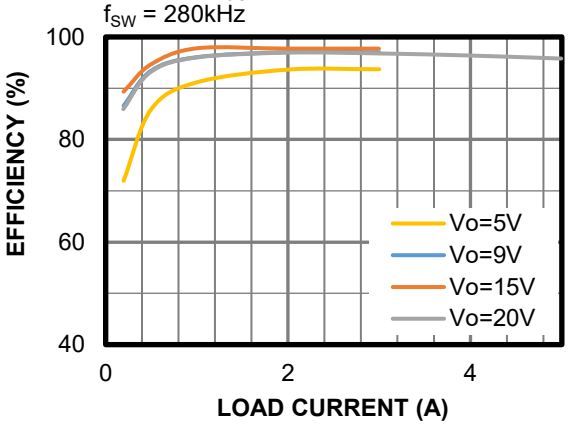
Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
3	R3, R11, R14	10Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0710RL
1	R4	5mΩ	1%, long side, 1W, current-sensing resistor	L1508	Film Tech	RL3720WT-R005-F
2	R6, R10	2.2Ω	Film resistor, 1%	0603	Yageo	RC0603FR-072R2L
2	R7, R9	0Ω	Film resistor, 1%	0402	Yageo	RC0402FR-070RL
1	R8	3.3Ω	Film resistor, 1%	0402	Yageo	RC0402FR-073R3L
2	R12, R13	3.3Ω	Film resistor, 1%	0603	Yageo	RC0603FR-073R3L
1	R15	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
1	R16	40.2kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0740K2L
2	R20, R21	2.2kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-072K2L
Optional	R22	100kΩ NTC	NTC resistor	0603	TDK	NTCG164KF104FTDS
1	R25	5.1kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-075K1L
1	Type-C1	20V	USB Type-C port	SMD	Findee	PC-071603863-R
5	VEMI, VIN, GND, VBUS, GND	Φ2.0	φ2.0 copper pin	DIP	Any	
1	CN4	4 pins	4 pins,1 row, straight	DIP	Wurth	61300411121
1	U1	MPQ4263-0002-AEC1	Hybrid buck-boost converter	QFN-20 (3mmx 5mm)	MPS	MPQ4263GQVE-0002-AEC1-Z
1	U2	MPF52001-0000-AEC2	Single USB PD controller	QFN-20 (4mmx 4mm)	MPS	MPF52001GRE-0000-AEC2-Z

EVB TEST RESULTS

Performance curves and waveforms are tested on the evaluation board. V_{IN} = 12V, V_{OUT} = 5V, L = 6.8µH, f_{SW} = 280kHz, forced PWM mode, T_A = 25°C, unless otherwise noted.

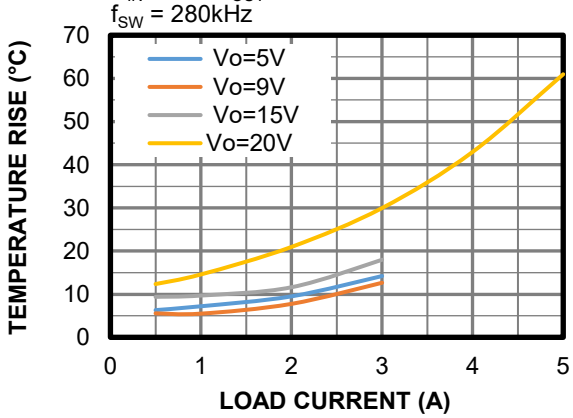
Efficiency vs. Load Current

V_{IN} = 12V, I_{OUT} = 0A to 3A, L = 6.8µH, f_{SW} = 280kHz



Temperature Rise vs. Load Current

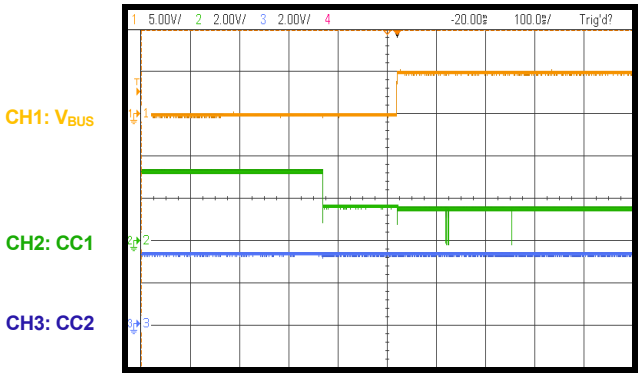
V_{IN} = 12V, I_{OUT} = 0A to 3A, L = 6.8µH, f_{SW} = 280kHz



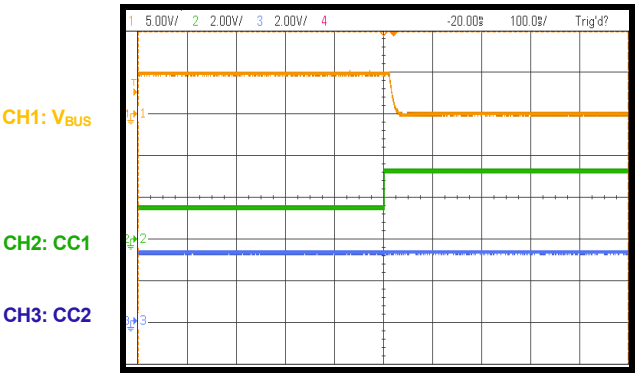
EVB TEST RESULTS

V_{IN_SYS} (DC/DC converter's V_{IN}) = 12V, MPF52001-AEC2 is supplied by the MPS DC/DC converter's V_{CC}, V_{BUS} = 3.3V to 21V, T_A = 25°C, unless otherwise noted.

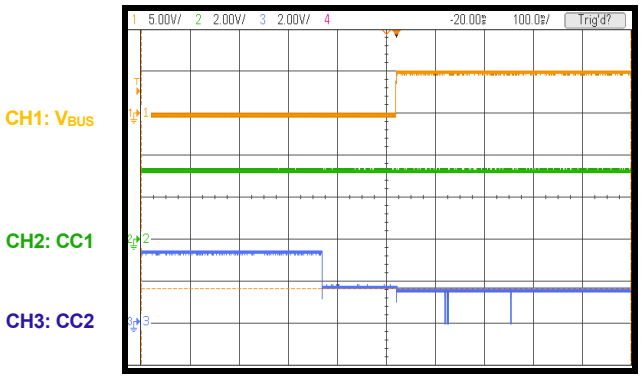
CC1 Attached Rd to Enable VBUS



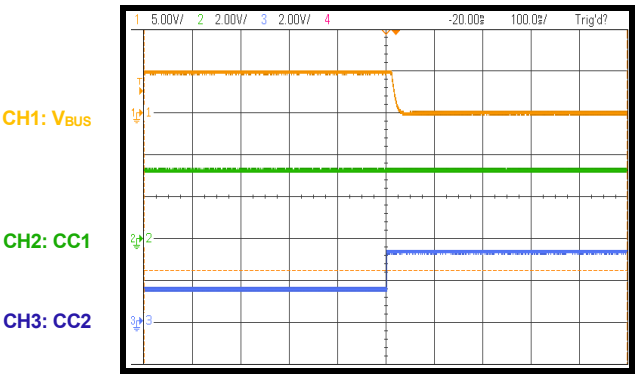
CC1 Detached Rd to Disable VBUS



CC2 Attached Rd to Enable VBUS

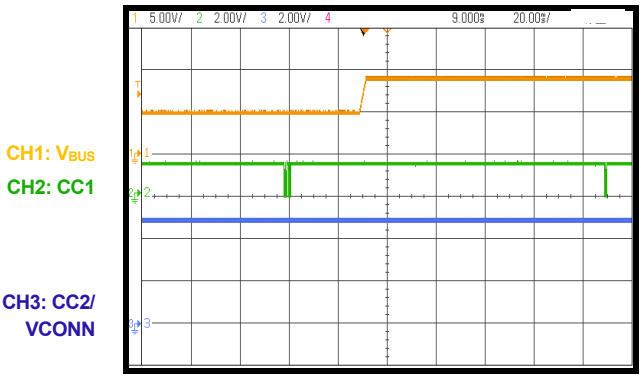


CC2 Detached Rd to Disable VBUS



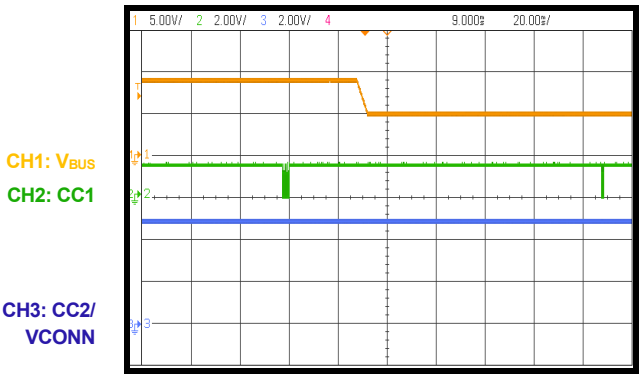
PDO Transition

5V PDO to 9V PDO



PDO Transition

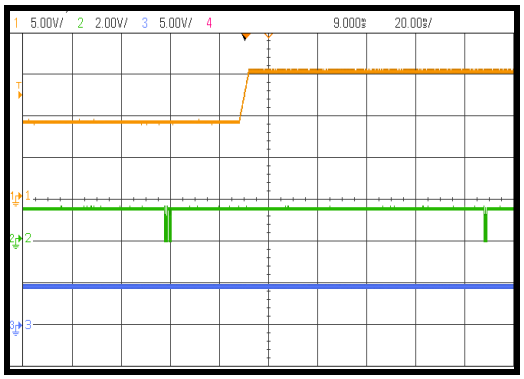
9V PDO to 5V PDO



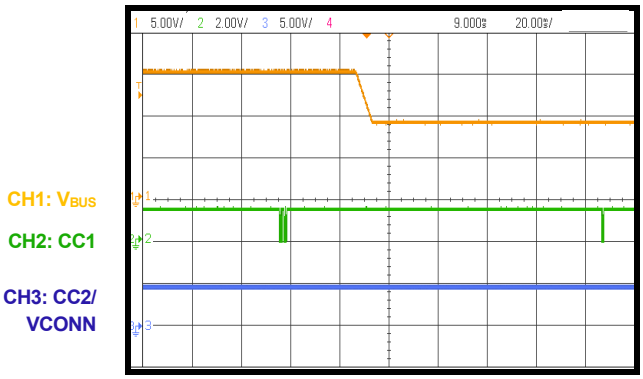
EVB TEST RESULTS *(continued)*

V_{IN_SYS} (DC/DC converter's V_{IN}) = 12V, MPF52001-AEC2 is supplied by the MPS DC/DC converter's V_{CC}, V_{BUS} = 3.3V to 21V, T_A = 25°C, unless otherwise noted.

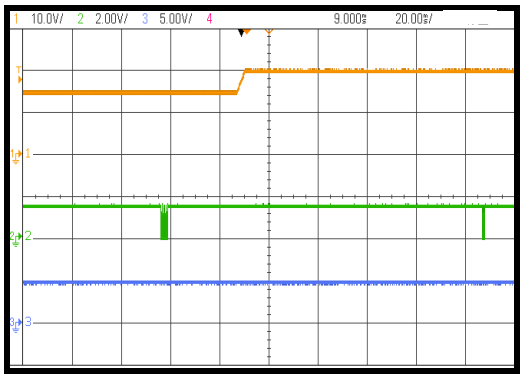
PDO Transition
9V PDO to 15V PDO



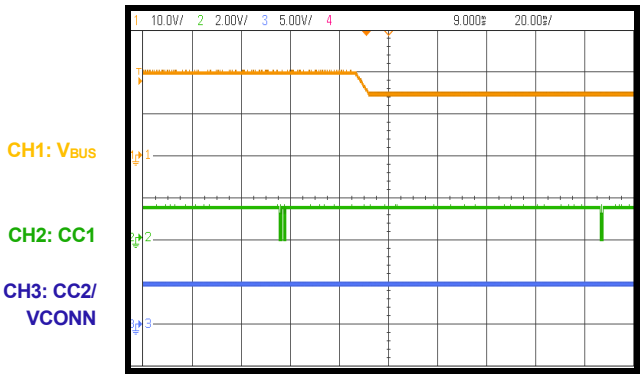
PDO Transition
15V PDO to 9V PDO



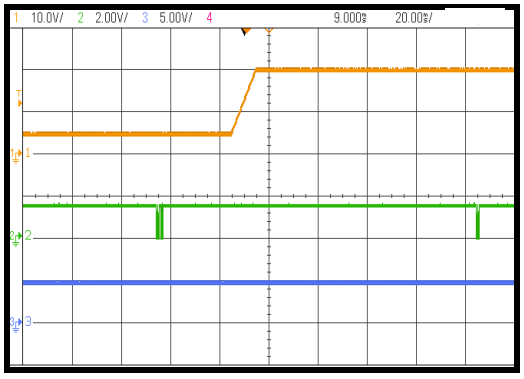
PDO Transition
15V PDO to 20V PDO



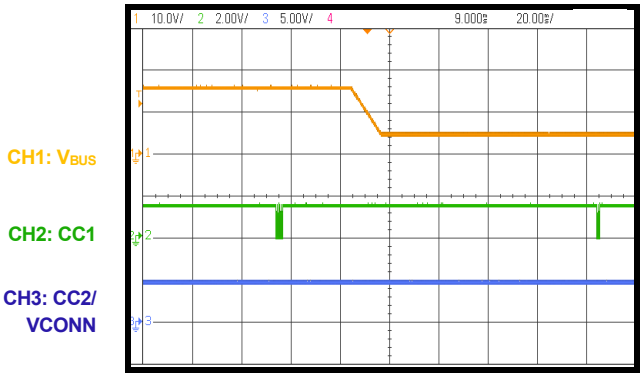
PDO Transition
20V PDO to 15V PDO



PDO Transition
5V PDO to 20V PDO



PDO Transition
20V PDO to 5V PDO



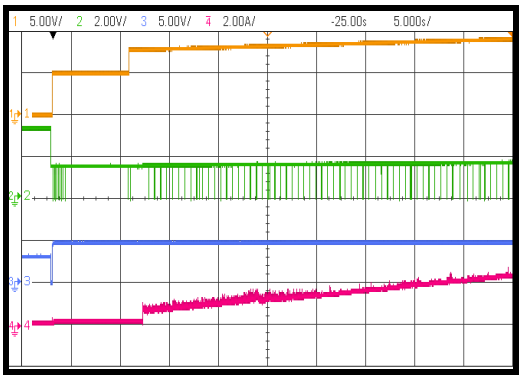
EVB TEST RESULTS *(continued)*

V_{IN_SYS} (DC/DC converter's V_{IN}) = 12V, MPF52001-AEC2 is supplied by the MPS DC/DC converter's V_{CC}, V_{BUS} = 3.3V to 21V, T_A = 25°C, unless otherwise noted.

Mobile Phone Charging Test

Phone requests 3.3V to 21V APDO

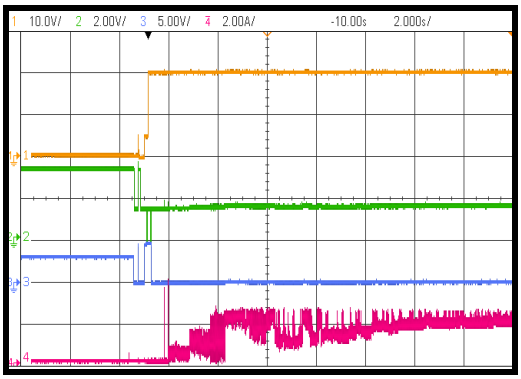
CH1: V_{BUS}
CH2: CC1
CH3: CC2/ VCONN
CH4: Charging Current



Laptop Charging Test

Laptop requests 20V PDO

CH1: V_{BUS}
CH2: CC1
CH3: CC2/ VCONN
CH4: Charging Current



PCB LAYOUT

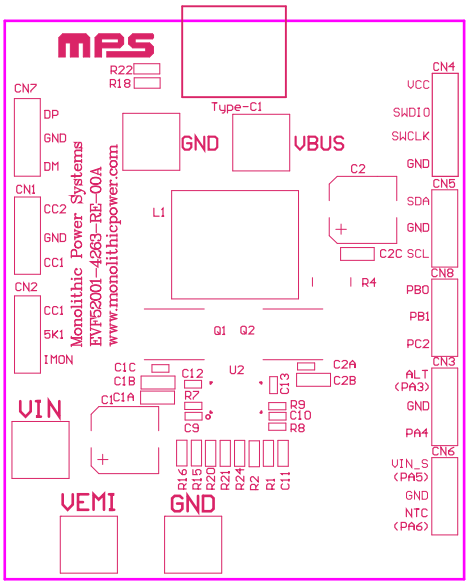


Figure 3: Top Silk

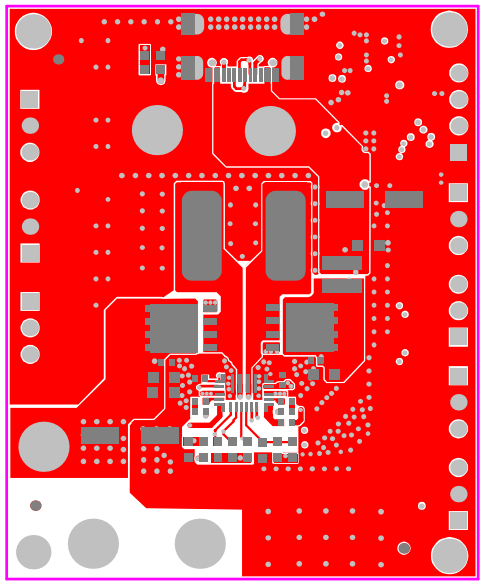


Figure 4: Top Layer

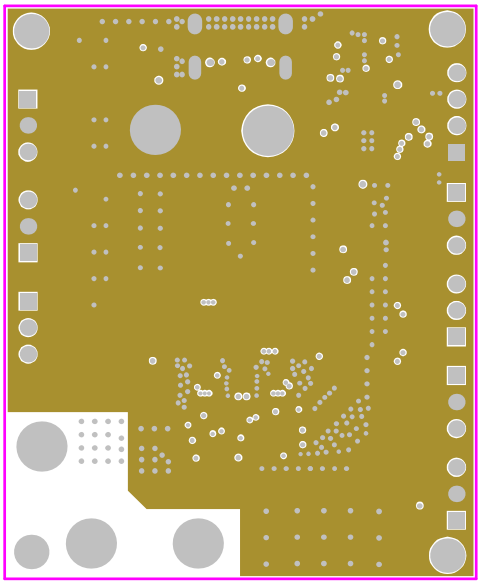


Figure 5: Mid-Layer 1

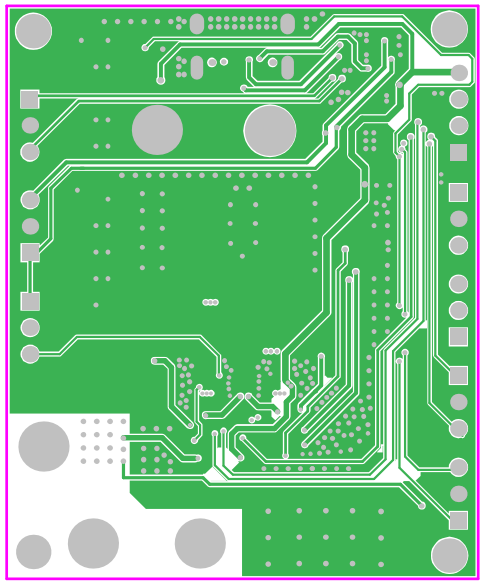


Figure 6: Mid-Layer 2

PCB LAYOUT *(continued)*

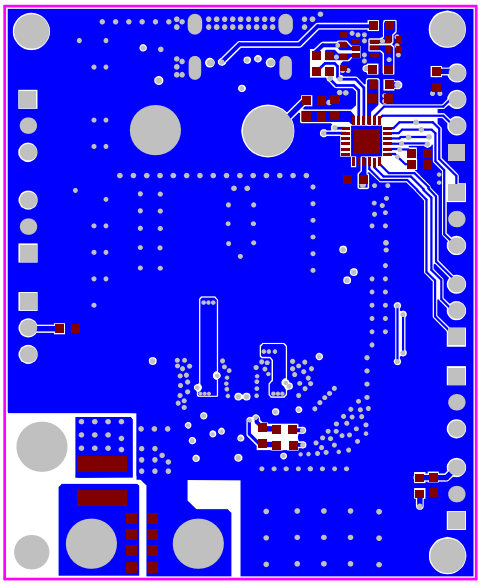


Figure 7: Bottom Layer

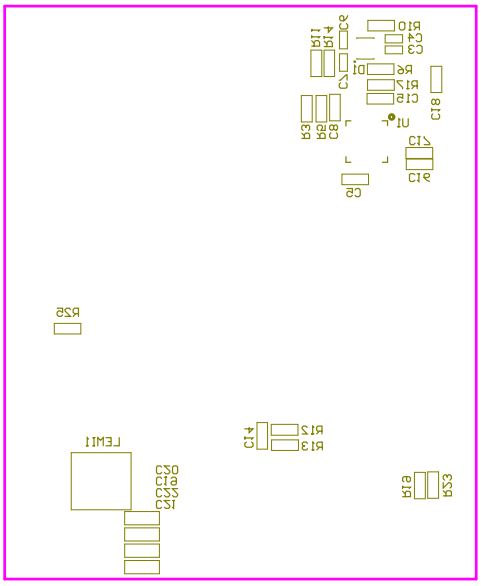


Figure 8: Bottom Silk

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	4/23/2025	Initial Release	-