EVQ4488-U-00B

Smart, Dual USB Charging Port Power Converter with Programmable Frequency for Automotive, AEC-Q100 Qualified

NOT RECOMMENDED FOR NEW DESIGNS

The Future of Analog IC Technology®

DESCRIPTION

The EVQ4488-U-00B Evaluation Board is designed to demonstrate the capabilities of MPS' MPQ4488.The MPQ4488 integrates a monolithic step-down switch-mode converter with two USB current-limit switches and charging port identification circuitry for each port. It achieves 6A output current over a wide input-supply range with excellent load and line regulation.

The output of the USB switch is current limited. Both USB ports support DCP schemes for Battery Charging specification (BC1.2), the Divider Mode, 1.2V/1.2V Mode and USB TYPE-C 5V@3A DFP Mode eliminating outside user interaction.

ELECTRICAL SPECIFICATION

Parameter	Symbol	Value	Units
Operating Input Voltage	V_{IN}	12	V
Switching Frequency	Fs	450	kHz
Output Voltage	V_{USB1}/V_{USB2}	5.17	V
Output Current	USB1_ I_{OUT}	3	A
	USB2_ I_{OUT}	3	A

FEATURES

- Wide 6V to 36V Operating Input-Voltage Range
- Selectable Output Voltage: 5.1V, 5.17V and 5.3V
- 90mV Line Drop Compensation
- Accurate USB1/USB2 Output-Current Limit
- 18mΩ/15mΩ Low $R_{DS(ON)}$ Internal Buck Power MOSFETs
- 18mΩ/18mΩ Low $R_{DS(ON)}$ Internal USB1/USB2 Power MOSFETs
- Load Shedding versus Temperature
- Hiccup Current Limit for both Buck and USB
- Supports DCP schemes for BC1.2, Divider Mode, and 1.2V/1.2V Mode
- Supports USB TYPE-C 5V@3A Mode

APPLICATIONS

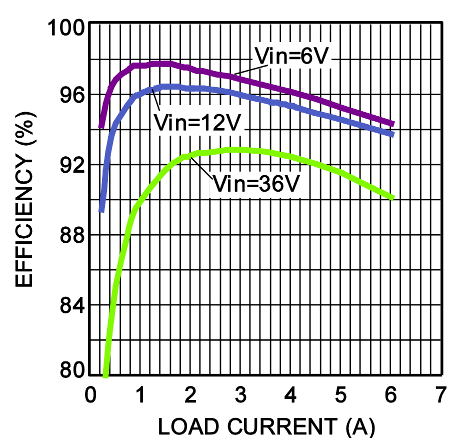
- USB Dedicated Charging Ports (DCP)
- USB Type-C Charging Port

EVQ4488-U-00B EVALUATION BOARD

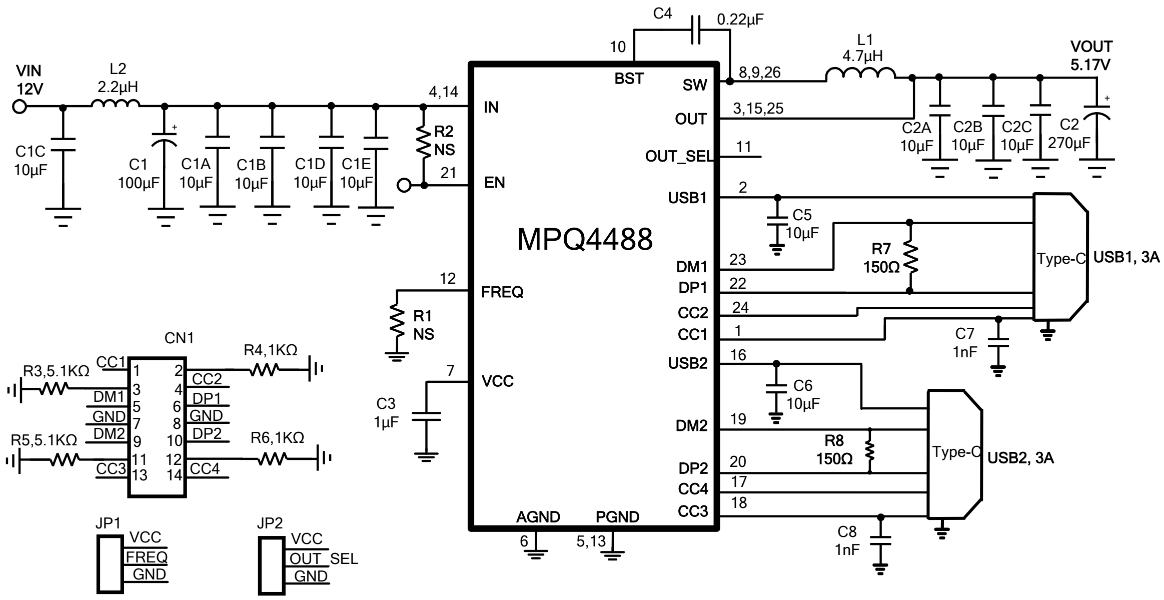
(L x W x H) 5cm x 5cm x 1.7cm
(Four Layer PCB/2oz per layer)

Board Number	MPS IC Number
EVQ4488-U-00B	MPQ4488

Efficiency vs. Load Current



EVALUATION BOARD SCHEMATIC



Note: R7 and R8 are on the bottom side of EVB board.

EVQ4488-U-00B BILL OF MATERIALS

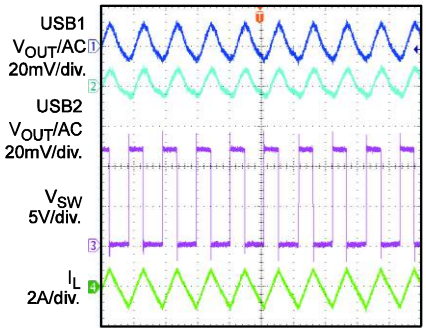
Qty	Ref	Value	Description	Package	Manufacturer	Part Number
5	C1A, C1B, C1C,C1D, C1E	10μF	Ceramic Capacitor, 35V, X6S	0805	Murata	GRM21BC8YA106KE11
1	C1	100uF	Aluminum Electrolytic Capacitor, 35V, 160mΩ ESR	SMT	Chemi-Con	EMZJ35ADA101MF80G
1	C2	270μF	Polymer Capacitor,6.3V	DIP	Chemi-Con	APSK6R3ELL271ME08S
2	C2A, C2B	10μF	Ceramic Capacitor, 10V, X7R	0805	Murata	GRM21BR71A106KE51L
1	C2C	10μF	Ceramic Capacitor, 6.3V, X7R	0603	Murata	GRM219R60J106KE19D
1	C3	1μF	Ceramic Capacitor, 16V, X7R	0603	Murata	GRM188R71C105KA12D
1	C4	0.22μF	Ceramic Capacitor, 10V, X5R	0402	Murata	GRM155R61A224KE19
2	C5, C6	10μF	Ceramic Capacitor, 6.3V, X7R	0603	Murata	GRM219R60J106KE19D
2	C7, C8	1nF	Ceramic Capacitor, 25V, X7R	0603	Murata	GRM188R71E102KA01D
0	R1,R2	NS				
2	R3,R5	5.1KΩ	Film Resistor, 1%	0603	Royal	RL0603FR-075K1L
2	R4,R6	1KΩ	Film Resistor, 1%	0603	Royal	RL0603FR-071KL
2	R7,R8	150Ω	Film Resistor, 1%	0603	Royal	RL0603FR-07150RL
1	L1	4.7μH	Inductor, DCR 7mΩ	SMT	Wurth	7443551470
1	L2	2.2μH	Inductor, DCR 29mΩ	SMT	Wurth	74438356022
2	USB1, USB2	USB	TYPE-C USB Port	DIP	Wurth	632723300011
1	U1	MPQ4488	Step Down Converter with Dual USB Charging Port	QFN26 (5mmx5mm)	MPS	MPQ4488GU
1	CN1	Header	2.54mm, 14pin, Dual pin header, default all pins open	DIP	Wurth	61301421121
2	JP1,JP2	Header	2.54mm, 3pin header, default all pins open	DIP	Wurth	61300311121

TYPICAL PERFORMANCE CHARACTERISTICS

V_{IN} = 12V, V_{OUT} = 5.17V, L =4.7µH, T_A = 25°C, unless otherwise noted.

Output Ripple

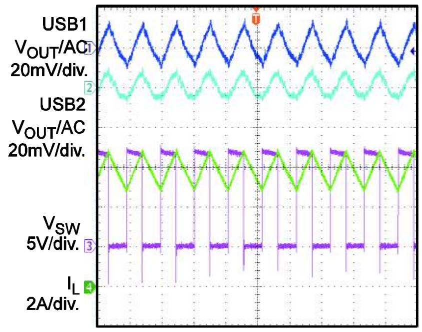
V_{IN}=12V, V_{OUT}=5.17V,
USB1_I_{OUT}=USB2_I_{OUT}=0A



2µs/div.

Output Ripple

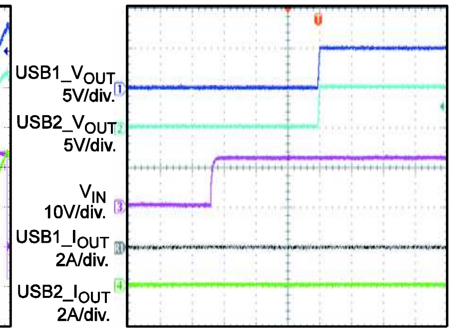
V_{IN}=12V, V_{OUT}=5.17V,
USB1_I_{OUT}=USB2_I_{OUT}=3A



2µs/div.

Power Start-up

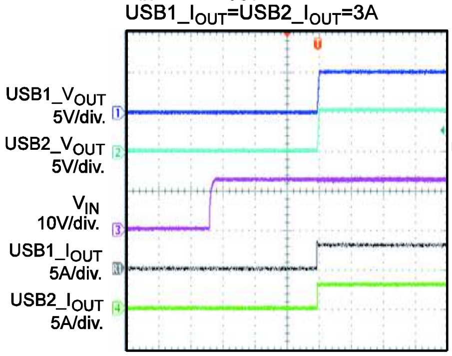
V_{IN}=12V, V_{OUT}=5.17V,
USB1_I_{OUT}=USB2_I_{OUT}=0A



40ms/div.

Power Start-up

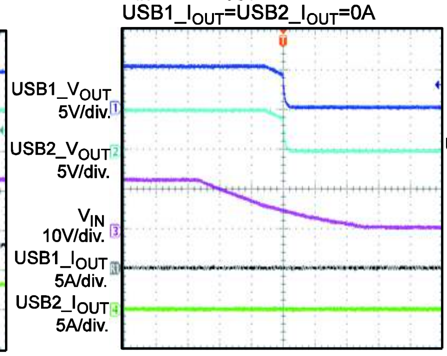
V_{IN}=12V, V_{OUT}=5.17V,
USB1_I_{OUT}=USB2_I_{OUT}=3A



40ms/div

Power Shutdown

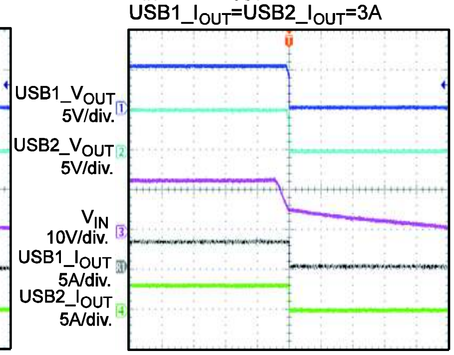
V_{IN}=12V, V_{OUT}=5.17V,
USB1_I_{OUT}=USB2_I_{OUT}=0A



20ms/div

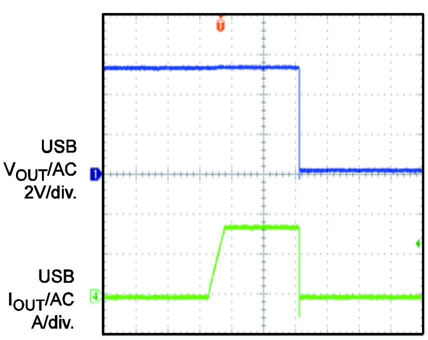
Power Shutdown

V_{IN}=12V, V_{OUT}=5.17V,
USB1_I_{OUT}=USB2_I_{OUT}=3A



10ms/div

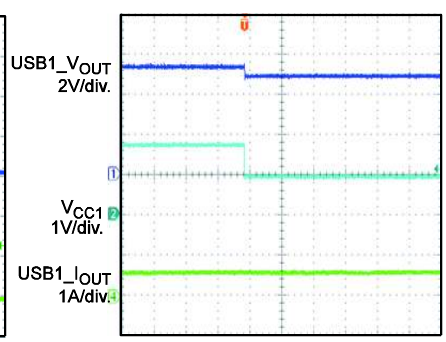
USB Over-Current Protection



2ms/div

Load Shedding Entry

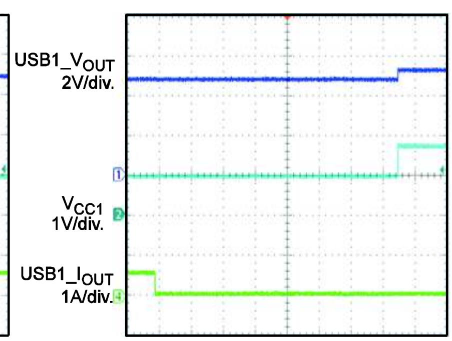
V_{IN}=12V, V_{OUT}=5.17V



10ms/div

Load Shedding Recovery

V_{IN}=12V, V_{OUT}=5.17V

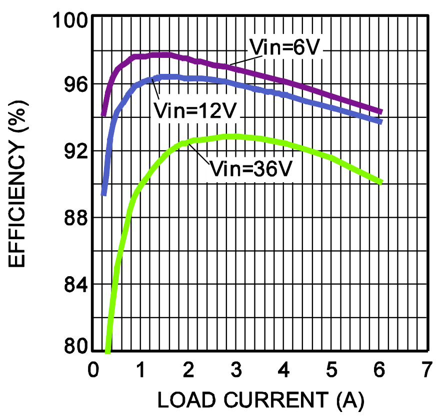


2s/div

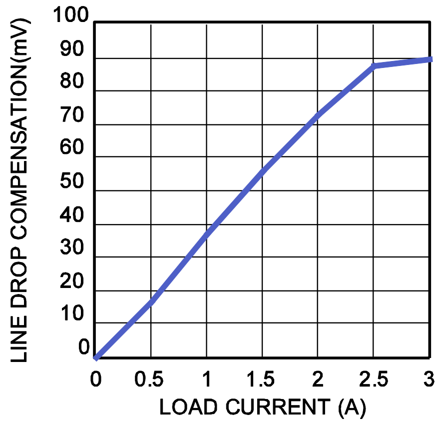
TYPICAL PERFORMANCE CHARACTERISTICS *(continued)*

V_{IN} = 12V, V_{OUT} = 5.17V, L =4.7µH, T_A = 25°C, unless otherwise noted.

Efficiency vs. Load Current

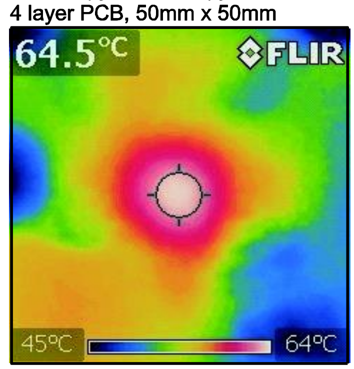


Line Drop Compensation vs. Load Current



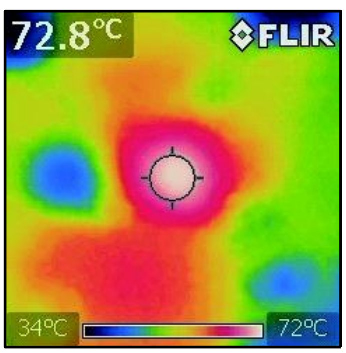
Thermal Image

V_{IN}=12V,
USB1_I_{OUT}=USB2_I_{OUT}=2.4A
4 layer PCB, 50mm x 50mm



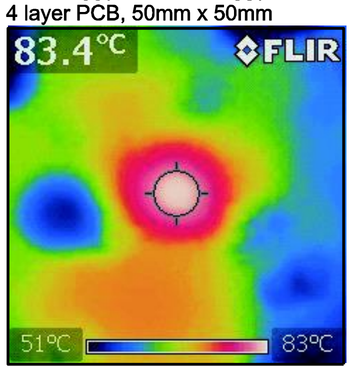
Thermal Image

Vin=12V,
USB1_IOUT=2.4A, USB2_IOUT=3A
4 layer PCB, 50mm×50mm



Thermal Image

V_{IN}=12V,
USB1_I_{OUT}=3A,USB2_I_{OUT}=3A
4 layer PCB, 50mm x 50mm



PRINTED CIRCUIT BOARD LAYOUT

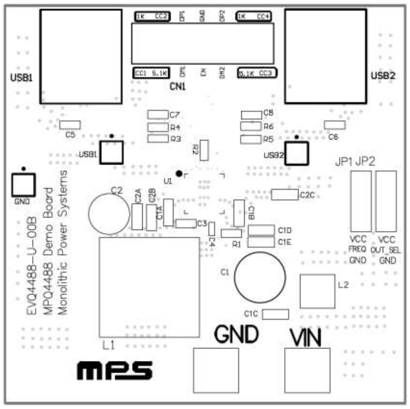


Figure 1—Top Silk Layer

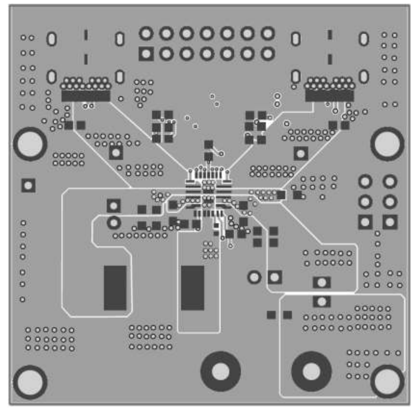


Figure 2—Top Layer

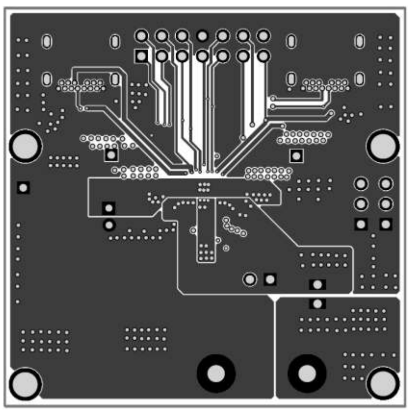


Figure 3—Middle1 Layer

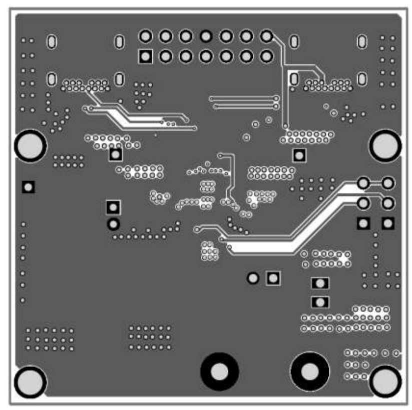


Figure 4—Middle2 Layer

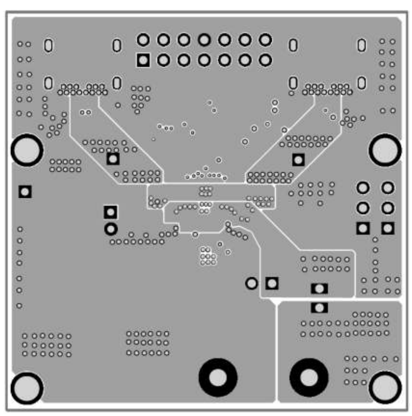


Figure 5—Bottom Layer

QUICK START GUIDE

1. Connect the positive and negative terminals of the load to the USB1, USB2 and GND pins, respectively.
2. Preset the power supply output between 6V and 36V, and then turn off the power supply.
3. Connect the positive and negative terminals of the power supply output to the VIN and GND pins, respectively.
4. Turn the power supply on, the board will automatically start up. But if no type-C device is attached, there is no Vbus output.
5. For USB Type-C 5V/3A DFP mode, if no type-C device is attached, short pin1 and pin 3 of CN1 with a jumper to enable USB1 output, short pin 11 and pin 13 of CN1 with a jumper to enable USB2 output; short pin 2 and pin 4 of CN1 with a jumper to enable VCONN1 output, short pin 12 and pin 14 of CN1 with a jumper to enable VCONN2 output.

   If type-C device is attached, all CN1 pins should be float.
6. For USB Type-A 5V/2.4A mode, change R3 =80.6kΩ and connect pin1 and pin 3 of CN1 with a jumper to enable USB1 output, change R5 =80.6kΩ and connect pin 11 and pin 13 of CN1 with a jumper to enable USB2 output. Keep R4, R6 float. Remove C7 and C8.