

### DESCRIPTION

The MP2223 is a dual channel synchronous rectified step-down switch mode converter with built in internal power MOSFETs. It offers a very compact solution to achieve 3A/2A continuous output current over a wide input supply range.

Two channels operate with 180° out-of-phase to minimize the input capacitor and alleviate EMI. Current mode operation provides fast transient response and eases loop stabilization. Full protection features include hiccup mode OCP and thermal shut down.

Other features include power save mode at light load, and separate enable for power sequence control.

The MP2223 requires a minimum number of readily available standard external components and is available in a space saving 8-pin TSOT23-8 package.

### ELECTRICAL SPECIFICATION (1)

Parameter	Symbol	Value	Units
Input Voltage	$V_{IN}$	4.5 to 18	V
Output Voltage(1)	$V_{OUT(1)}$	1.8	V
Output Voltage(2)	$V_{OUT(2)}$	1.2	V
Output Current(CH1)	$I_{OUT(1)}$	3	A
Output Current(CH2)	$I_{OUT(2)}$	2	A

#### Notes:

1) For different Input/output voltage specs and different output capacitor/inductor may need change the application circuit parameters.

### FEATURES

- Wide 4.5V to 18V Operating Input Range
- 70mΩ/50mΩ for CH1, 100mΩ/60mΩ for CH2, Low  $R_{ds(on)}$  Internal Power MOSFETs
- Up to 3A (CH1) and 2A (CH2) Maximum Continuous Output Current
- 180° out-of-phase Operation
- Power Save Mode for Light Load
- 540kHz Fixed Switching Frequency
- OCP Protection and Hiccup
- OVP Protection
- Thermal Shutdown
- Both Channel Output Adjustable from 0.8V
- Available in a TSOT23-8 Package

### APPLICATIONS

- Laptop Computer
- Tablet PC
- Networking Systems
- Server
- Distributed Power Systems

All MPS parts are lead-free, halogen free, and adhere to the RoHS directive. For MPS green status, please visit MPS website under Quality Assurance.

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### EV2223-J-00A EVALUATION BOARD

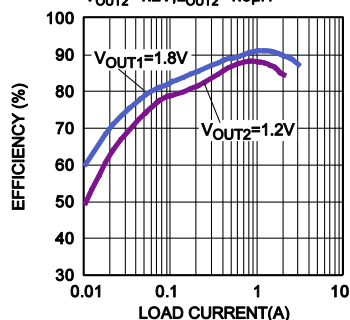


(L x W) 64mm x 48mm

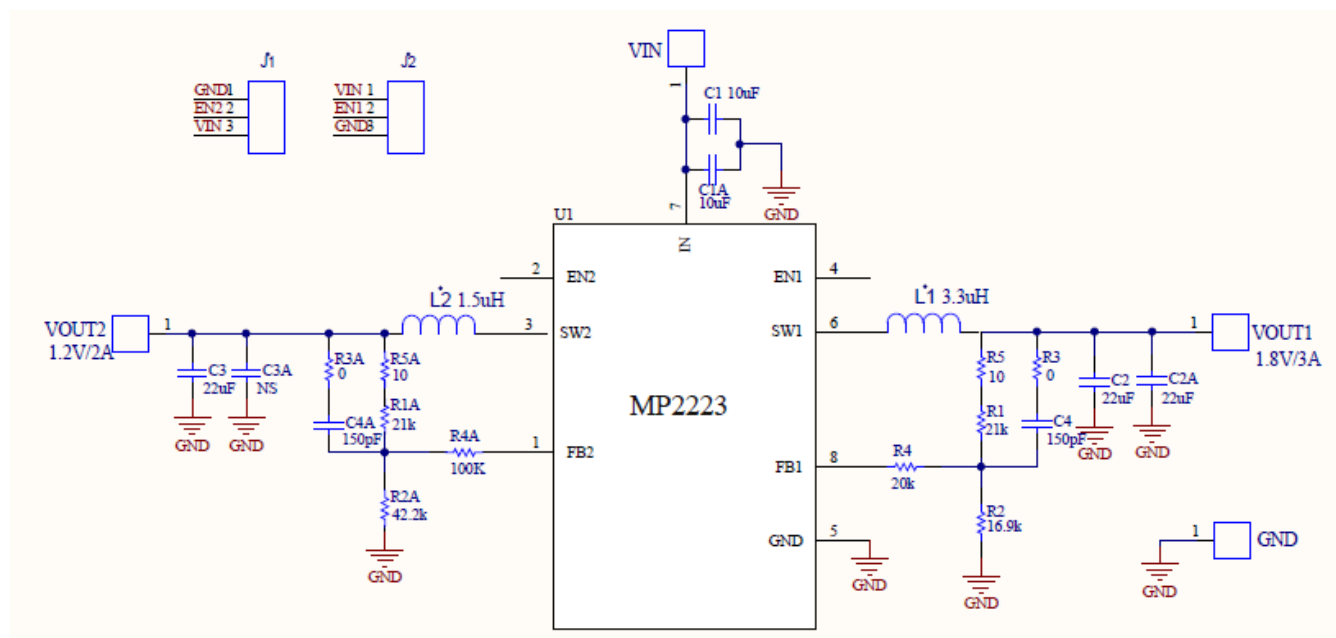
Board Number	MPS IC Number
EV2223-J-00A	MP2223GJ

#### Efficiency Vs. Load Current

$V_{IN}=12V$ ,  $V_{OUT1}=1.8V$ ,  $L_{OUT1}=3.3\mu H$ ,  
 $V_{OUT2}=1.2V$ ,  $L_{OUT2}=1.5\mu H$



# EVALUATION BOARD SCHEMATIC



**EV2223-J-00A BILL OF MATERIALS**

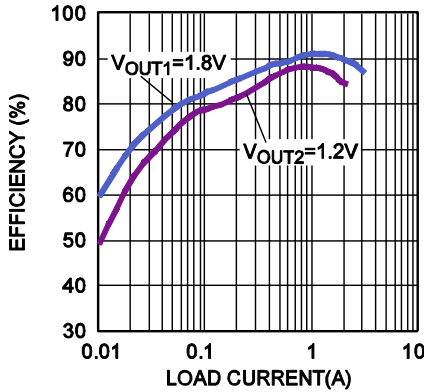
Qty	Des	Value	Description	Package	Manufacture	Manufacture_PN
2	C1, C1A	10 $\mu$ F	Ceramic Capacitor; 25V;X5R;	1206	muRata	GRM31CR61E106KA12L
3	C2, C2A, C3	22 $\mu$ F	Ceramic Capacitor; 16V;X5R;	1206	muRata	GRM31CR61C226ME15L
0	C3A	NS				
2	C4, C4A	150pF	Ceramic Cap , 50V,C0G	0603	muRata	GRM1885C1H51JA01D
2	R1, R1A	21k	Film Res,1%	0603	Yageo	RC0603FR-0721KL
1	R2	16.9k	Film Res,1%	0603	Yageo	RC0603FR-0716K9L
1	R2A	42.2k	Film Res,1%	0603	Yageo	RC0603FR-0742K2L
2	R3, R3A	0	Film Res,1%	0603	Yageo	RC0603FR-070RL
1	R4	20k	Film Res,1%	0603	Yageo	RC0603FR-0720KL
1	R4A	100k	Film Res,1%	0603	Yageo	RC0603FR-07100KL
2	R5, R5A	10R	Film Res,1%	0603	Yageo	RC0603FR-0710RL
1	L1	3.3 $\mu$ H	Inductor, RDC=17.2m $\Omega$ Isat=11A	7040	WE	744311330
1	L2	1.5 $\mu$ H	Inductor, RDC=6.6m $\Omega$ Isat=14A	7040	WE	744311150
1	U1	MP2223	Synchronous Step- Down Converter	TSOT23-8	MPS	MP2223GJ

# TYPICAL PERFORMANCE CHARACTERISTICS

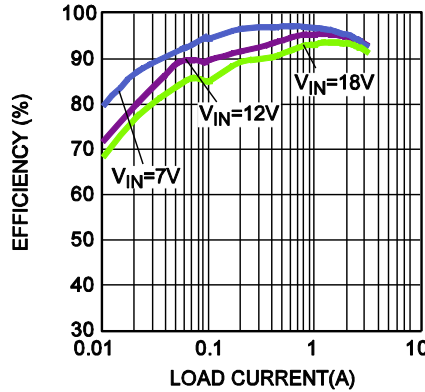
$V_{IN} = 12V$ ,  $V_{OUT1} = 1.8V$ ,  $V_{OUT2} = 1.2V$ ,  $L_{OUT1} = 3.3\mu H$ ,  $L_{OUT2} = 1.5\mu H$ ,  $T_A = 25^\circ C$ , unless otherwise noted.

**Efficiency Vs. Load Current**

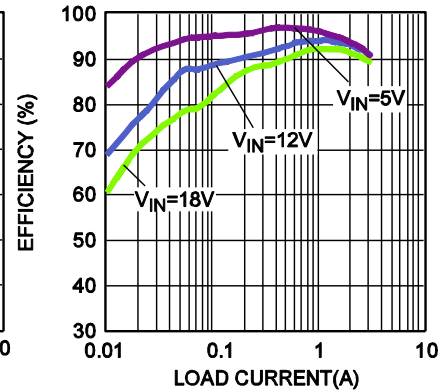
$V_{IN}=12V$ ,  $V_{OUT1}=1.8V$ ,  $L_{OUT1}=3.3\mu H$ ,  
 $V_{OUT2}=1.2V$ ,  $L_{OUT2}=1.5\mu H$


**Efficiency Vs. Load Current**

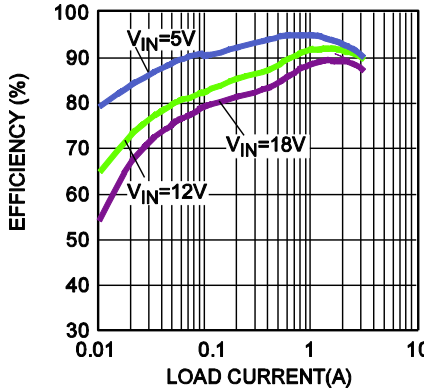
CH1,  $V_{OUT1}=5V$ ,  $L_{OUT1}=6.5\mu H$ ,  
DCR=21.5mohm


**Efficiency Vs. Load Current**

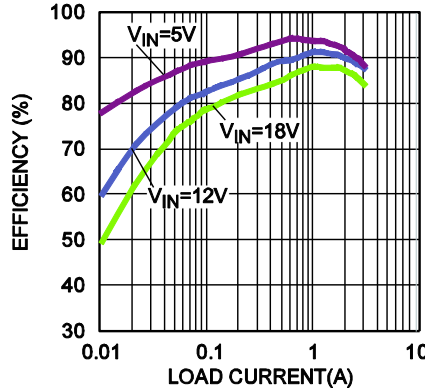
CH1,  $V_{OUT1}=3.3V$ ,  $L_{OUT1}=6.5\mu H$ ,  
DCR=21.5mohm


**Efficiency Vs. Load Current**

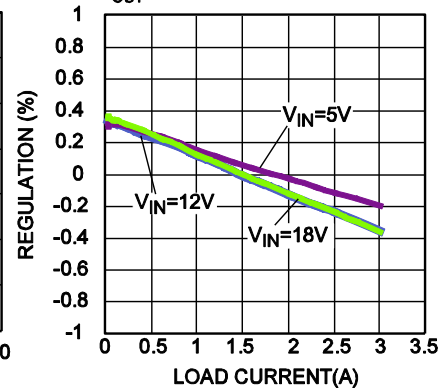
CH1,  $V_{OUT1}=2.5V$ ,  $L_{OUT1}=3.3\mu H$ ,  
DCR=9mohm


**Efficiency Vs. Load Current**

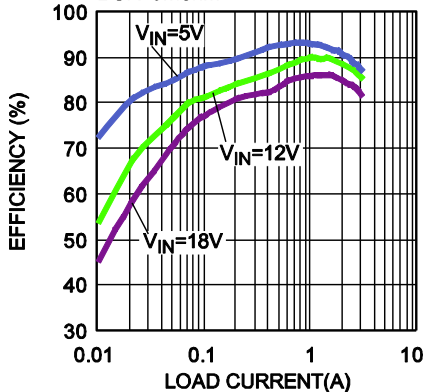
CH1,  $V_{OUT1}=1.8V$ ,  $L_{OUT1}=3.3\mu H$ ,  
DCR=9mohm


**Load Regulation**

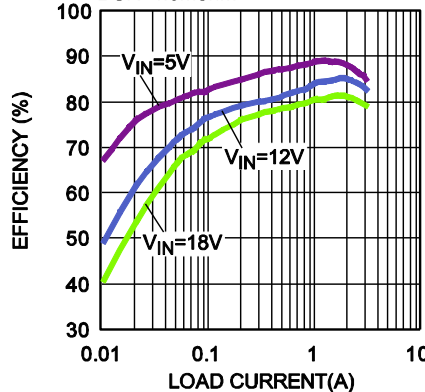
CH1,  $V_{IN}=5V$  to  $18V$ ,  $V_{OUT}=1.8V$ ,  
 $I_{OUT}=0A$  to  $3A$


**Efficiency Vs. Load Current**

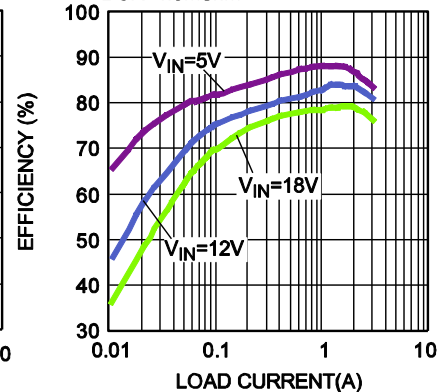
CH1,  $V_{OUT1}=1.5V$ ,  $L_{OUT1}=3.3\mu H$ ,  
DCR=9mohm


**Efficiency Vs. Load Current**

CH1,  $V_{OUT1}=1.2V$ ,  $L_{OUT1}=1.0\mu H$ ,  
DCR=4.6mohm


**Efficiency Vs. Load Current**

CH1,  $V_{OUT1}=1.0V$ ,  $L_{OUT1}=1.0\mu H$ ,  
DCR=4.6mohm

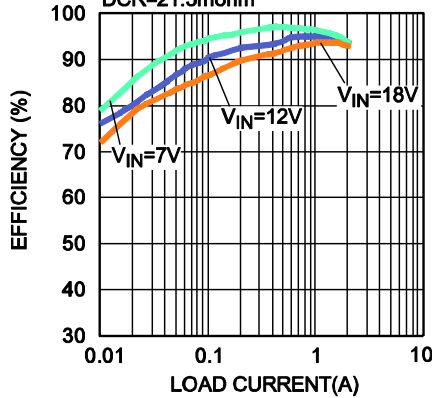


## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$V_{IN} = 12V$ ,  $V_{OUT1} = 1.8V$ ,  $V_{OUT2} = 1.2V$ ,  $L_{OUT1} = 3.3\mu H$ ,  $L_{OUT2} = 1.5\mu H$ ,  $T_A = 25^\circ C$ , unless otherwise noted.

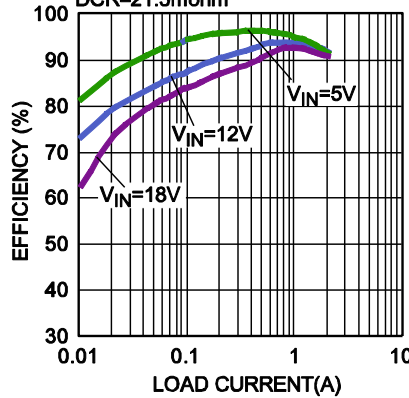
**Efficiency Vs. Load Current**

CH2,  $V_{OUT2}=5V$ ,  $L_{OUT2}=6.5\mu H$ ,  
DCR=21.5mohm



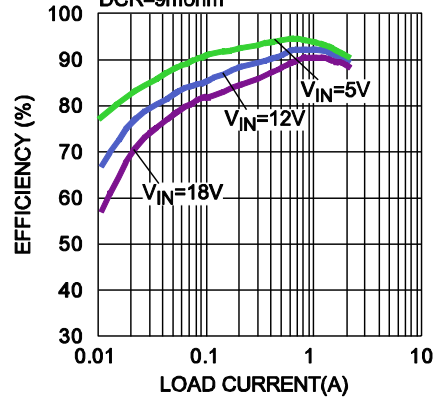
**Efficiency Vs. Load Current**

CH2,  $V_{OUT2}=3.3V$ ,  $L_{OUT2}=6.5\mu H$ ,  
DCR=21.5mohm



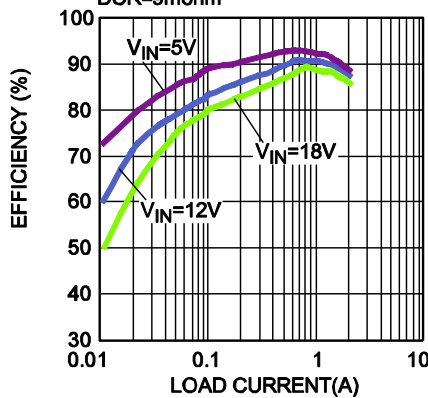
**Efficiency Vs. Load Current**

CH2,  $V_{OUT2}=2.5V$ ,  $L_{OUT2}=3.3\mu H$ ,  
DCR=9mohm



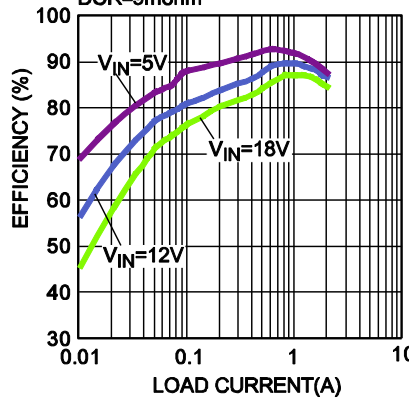
**Efficiency Vs. Load Current**

CH2,  $V_{OUT2}=1.8V$ ,  $L_{OUT2}=3.3\mu H$ ,  
DCR=9mohm



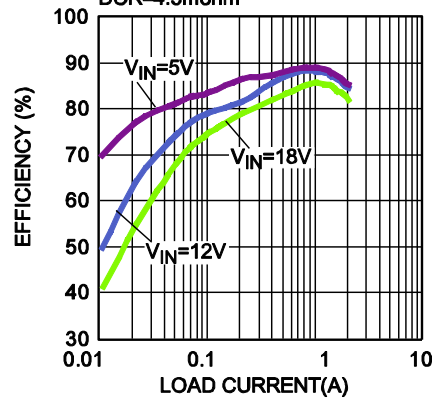
**Efficiency Vs. Load Current**

CH2,  $V_{OUT2}=1.5V$ ,  $L_{OUT2}=3.3\mu H$ ,  
DCR=9mohm



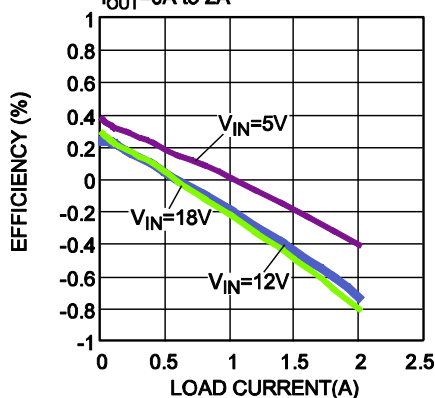
**Efficiency Vs. Load Current**

CH2,  $V_{OUT2}=1.2V$ ,  $L_{OUT2}=1.5\mu H$ ,  
DCR=4.3mohm



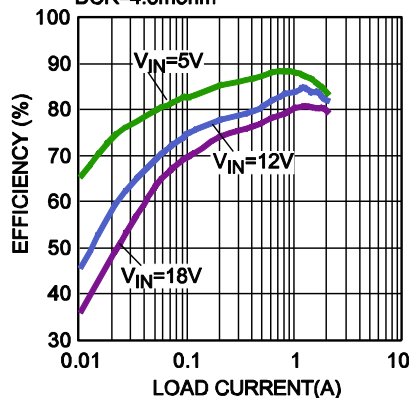
**Load Regulation**

CH2,  $V_{IN}=5V$  to  $18V$ ,  $V_{OUT}=1.2V$ ,  
 $I_{OUT}=0A$  to  $2A$



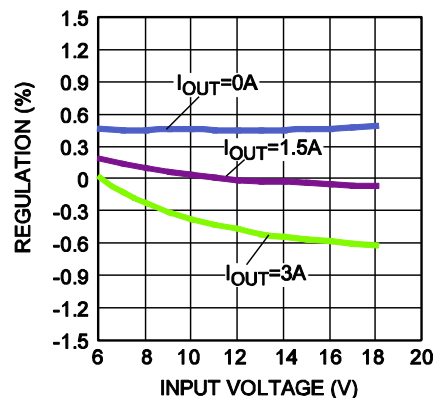
**Efficiency Vs. Load Current**

CH2,  $V_{OUT2}=1.0V$ ,  $L_{OUT2}=1.5\mu H$ ,  
DCR=4.3mohm



**Line Regulation**

CH1,  $V_{OUT1}=3.3V$ ,  $V_{IN}=6V$  to  $18V$

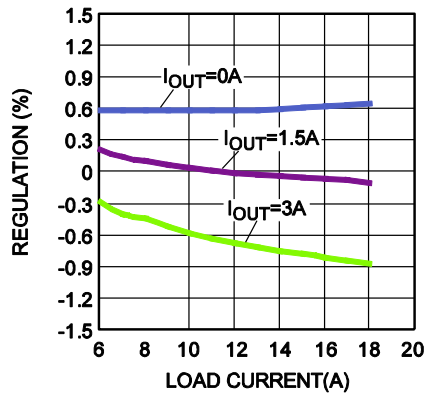


## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

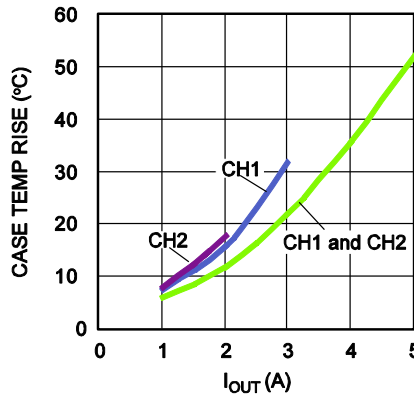
$V_{IN} = 12V$ ,  $V_{OUT1} = 1.8V$ ,  $V_{OUT2} = 1.2V$ ,  $L_{OUT1} = 3.3\mu H$ ,  $L_{OUT2} = 1.5\mu H$ ,  $T_A = 25^\circ C$ , unless otherwise noted.

### Line Regulation

CH2,  $V_{OUT2}=3.3V$ ,  $V_{IN}=6V$  to  $18V$

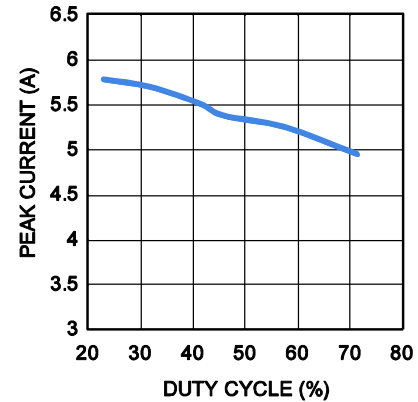


### Case Temp Rise



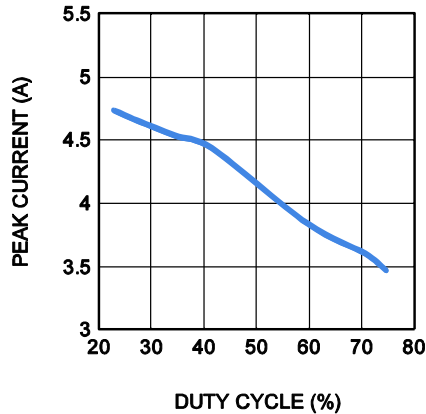
### Peak Current Vs. Duty Cycle

CH1,  $V_{OUT1}=5V$



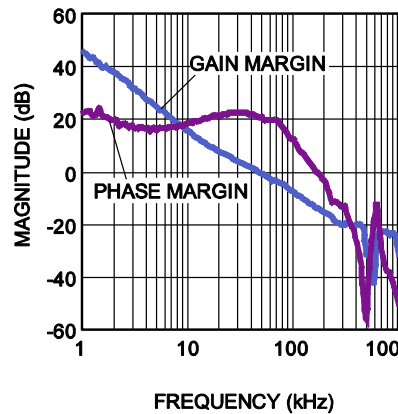
### Peak Current Vs. Duty Cycle

CH2,  $V_{OUT2}=5V$



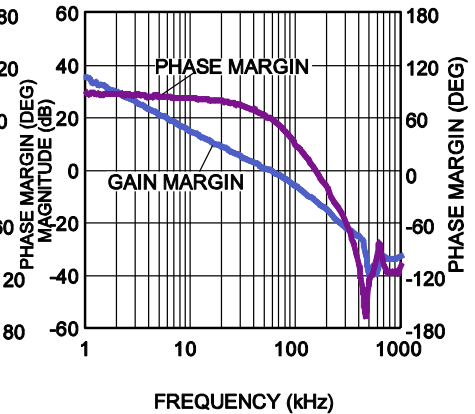
### Bode Plot

CH1,  $V_{OUT1}=1.8V$



### Bode Plot

CH1,  $V_{OUT1}=1.2V$

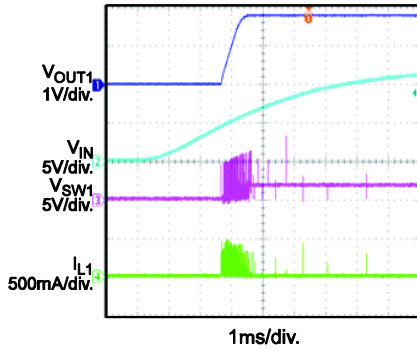


## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$V_{IN} = 12V$ ,  $V_{OUT1} = 1.8V$ ,  $V_{OUT2} = 1.2V$ ,  $L_{OUT1} = 3.3\mu H$ ,  $L_{OUT2} = 1.5\mu H$ ,  $T_A = 25^\circ C$ , unless otherwise noted.

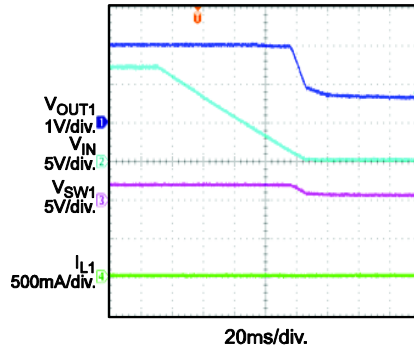
**Startup through Input Voltage (CH1)**

$I_{OUT} = 0A$



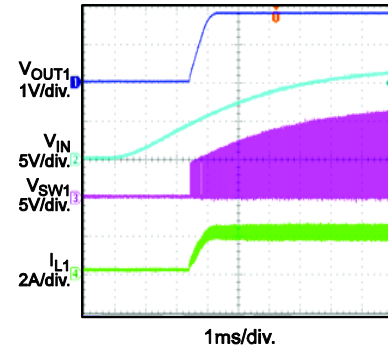
**Shutdown through Input Voltage (CH1)**

$I_{OUT} = 0A$



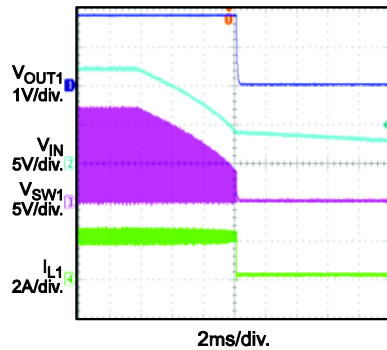
**Startup through Input Voltage (CH1)**

$I_{OUT} = 3A$



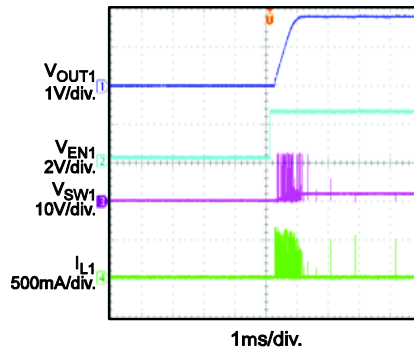
**Shutdown through Input Voltage (CH1)**

$I_{OUT} = 3A$



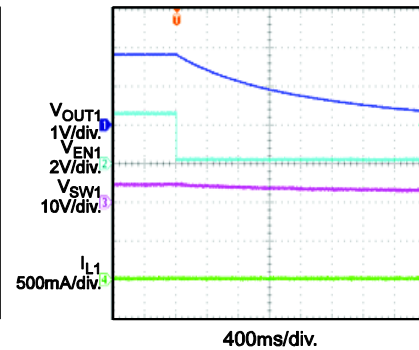
**Startup through Enable (CH1)**

$I_{OUT} = 0A$



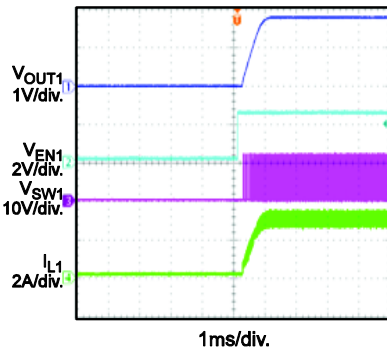
**Shutdown through Enable (CH1)**

$I_{OUT} = 0A$



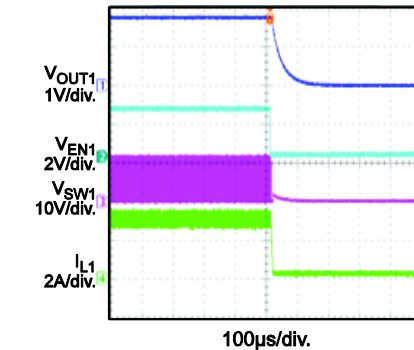
**Startup through Enable (CH1)**

$I_{OUT} = 3A$



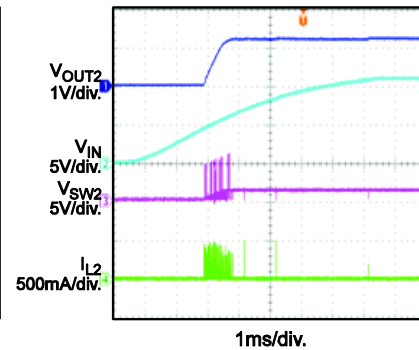
**Shutdown through Enable (CH1)**

$I_{OUT} = 3A$



**Startup through Input Voltage (CH2)**

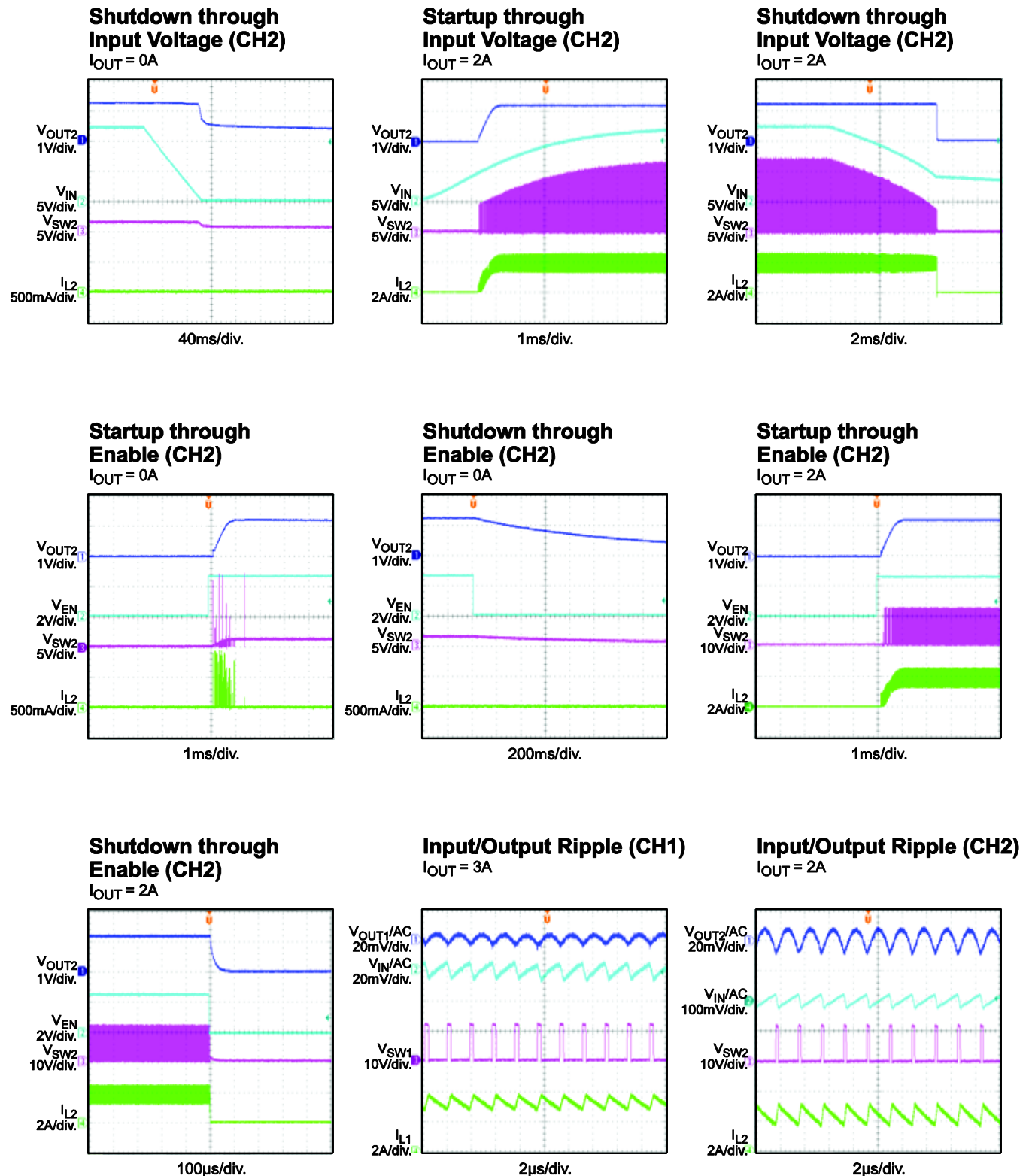
$I_{OUT} = 0A$





# TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$V_{IN} = 12V$ ,  $V_{OUT1} = 1.8V$ ,  $V_{OUT2} = 1.2V$ ,  $L_{OUT1} = 3.3\mu H$ ,  $L_{OUT2} = 1.5\mu H$ ,  $T_A = 25^\circ C$ , unless otherwise noted.



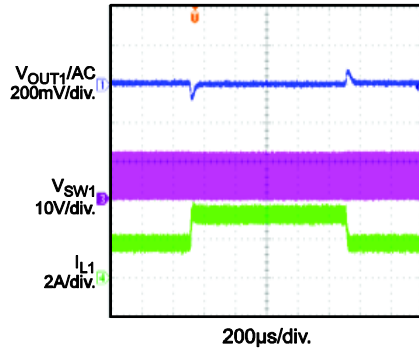


# TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$V_{IN} = 12V$ ,  $V_{OUT1} = 1.8V$ ,  $V_{OUT2} = 1.2V$ ,  $L_{OUT1} = 3.3\mu H$ ,  $L_{OUT2} = 1.5\mu H$ ,  $T_A = 25^\circ C$ , unless otherwise noted.

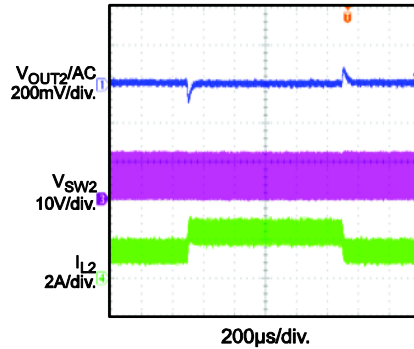
## Transient Response (CH1)

$I_{OUT} = 1.5A$  to  $3A$ ,  $2.5A/\mu s$



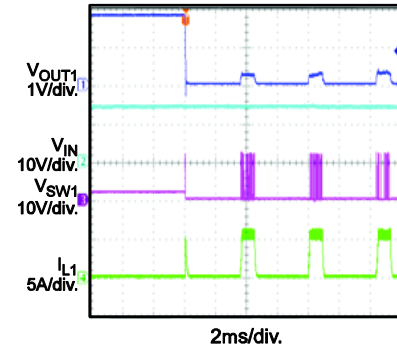
## Transient Response (CH2)

$I_{OUT} = 1A$  to  $2A$ ,  $2.5A/\mu s$



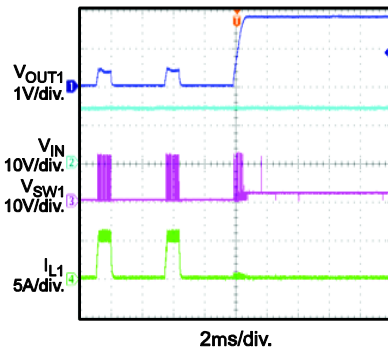
## Short Circuits Entry (CH1)

$I_{OUT} = 0A$



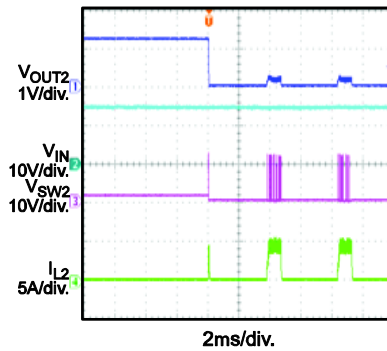
## Short Circuits Recovery (CH1)

$I_{OUT} = 0A$



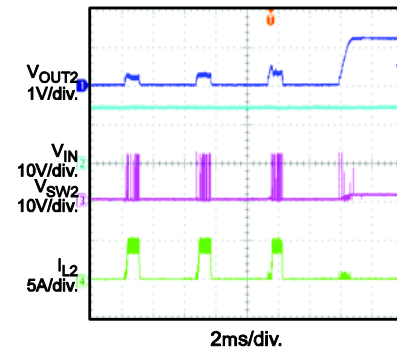
## Short Circuits Entry (CH2)

$I_{OUT} = 0A$



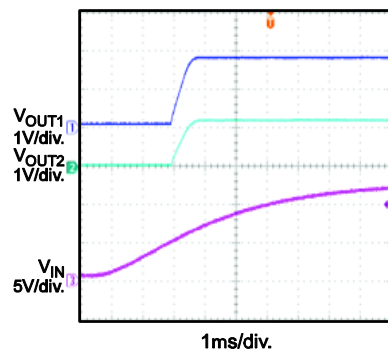
## Short Circuits Recovery (CH2)

$I_{OUT} = 0A$



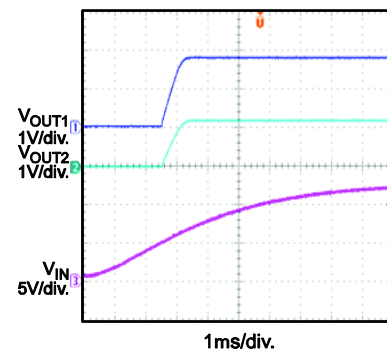
## Startup through Input Voltage (Both CH1 and CH2 On)

$I_{OUT1} = 0A$  and  $I_{OUT2} = 0A$



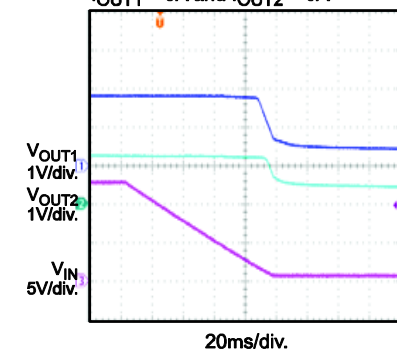
## Startup through Input Voltage (Both CH1 and CH2 On)

$I_{OUT1} = 3A$  and  $I_{OUT2} = 2A$



## Shutdown through Input Voltage (Both CH1 and CH2 On)

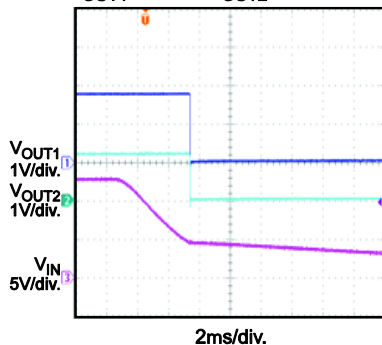
$I_{OUT1} = 0A$  and  $I_{OUT2} = 0A$



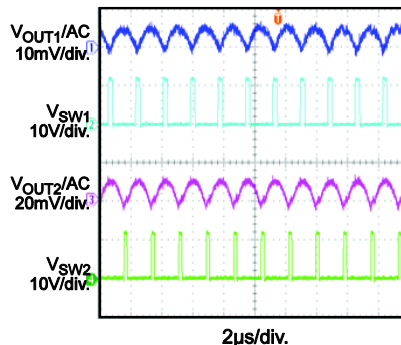
# TYPICAL PERFORMANCE CHARACTERISTICS *(continued)*

$V_{IN} = 12V$ ,  $V_{OUT1} = 1.8V$ ,  $V_{OUT2} = 1.2V$ ,  $L_{OUT1} = 3.3\mu H$ ,  $L_{OUT2} = 1.5\mu H$ ,  $T_A = 25^{\circ}C$ , unless otherwise noted.

**Shutdown through  
Input Voltage  
(Both CH1 and CH2 On)**  
 $I_{OUT1} = 3A$  and  $I_{OUT2} = 2A$



**Input/Output Ripple  
(Both CH1 and CH2 On)**  
 $I_{OUT1} = 3A$  and  $I_{OUT2} = 2A$



## PRINTED CIRCUIT BOARD LAYOUT

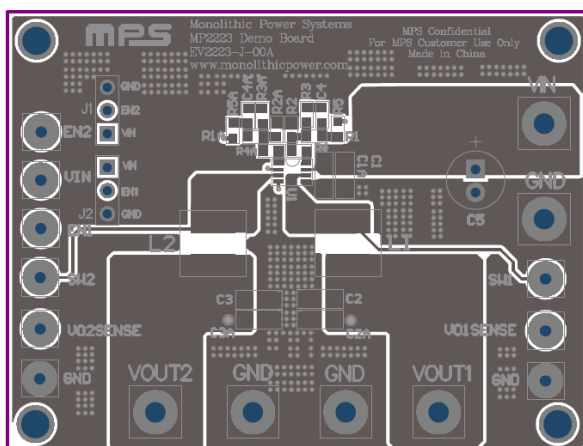


Figure 1—Top Silk

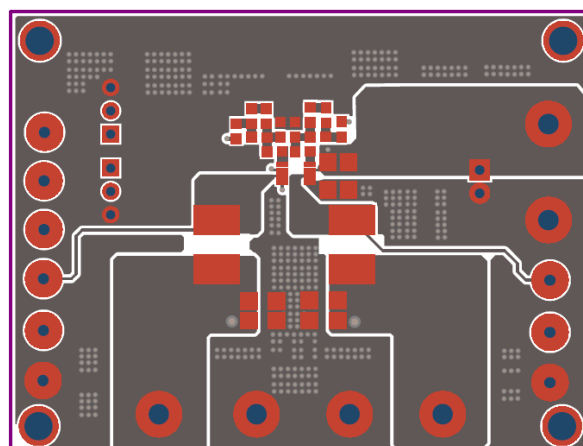


Figure 2—Top Layer

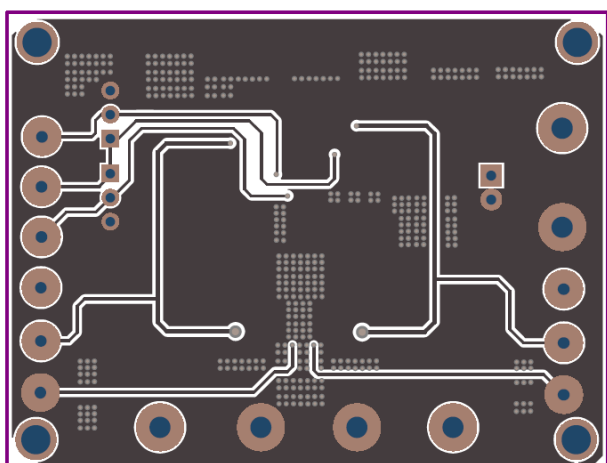


Figure 3—Bottom Layer

## QUICK START GUIDE

1. Preset the input power supply output between 4.5V and 18V.
2. Turn off the input power supply.
3. Connect the positive and negative terminals of the load to the VOUT and GND pins, respectively.
4. Connect the positive and negative terminals of the input power supply output to the VIN and GND pins, respectively.
5. Turn input power supply on after making connections. The board will automatically start up.
6. To use the Enable function, apply a digital input to the EN pin. Drive EN higher than 1.41V to turn on the regulator, or less than 0.95V to turn it off.

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