EV2169-RH-00A

6V, Dual 3A/1A or 2A/2A Low IQ, Synchronous Buck with PG and SS Evaluation Board

The Future of Analog IC Technology®

DESCRIPTION

The EV2169-RH-00A is an evaluation board for the MPQ2169, an internally compensated, dual, PWM, synchronous, step-down regulator that operates from a 2.7V to 6V input and generates an output voltage as low as 0.6V.

The MPQ2169 can be configured as a 2A/2A or 3A/1A output current regulator and is ideal for powering portable equipment that runs on a single-cell lithium-ion (Li+) battery due to a low 60μA quiescent current.

The MPQ2169 integrates dual, 55mΩ, high-side switches and 20mΩ synchronous rectifiers for high efficiency without an external Schottky diode. The MPQ2169 has peak-current-mode control and internal compensation and is capable of low dropout configurations. Both channels can operate at 100% duty cycle.

Fault condition protections include cycle-by-cycle current limit and thermal shutdown.

The EV2169-RH-00A is assembled and tested with a QFN-18 (2.5mmx3.5mm) package.

ELECTRICAL SPECIFICATIONS

Parameter	Symbol	Value	Units
Input Voltage	V_{IN}	2.7-6	V
Output Voltage	V_{OUT}	1.8/1.2	V
Output Current	I_{OUT}	3/1 or 2/2	A

FEATURES

- 2.7V to 6V Operating Input Range
- 3A/1A or 2A/2A Output Current
- Programmed Frequency up to 3MHz
- External Sync Clock Up to 3MHz
- 180^o Phase Shifted Operation
- PG Indicators
- External SS and Track
- Adjustable Advanced Asynchronous Mode (AAM) or Forced Continuous Conduction Mode (CCM)
- Peak Efficiency >90%
- Output Adjustable from 0.6V to VIN
- 100% Duty Cycle Operation
- Fully Assembled and Tested

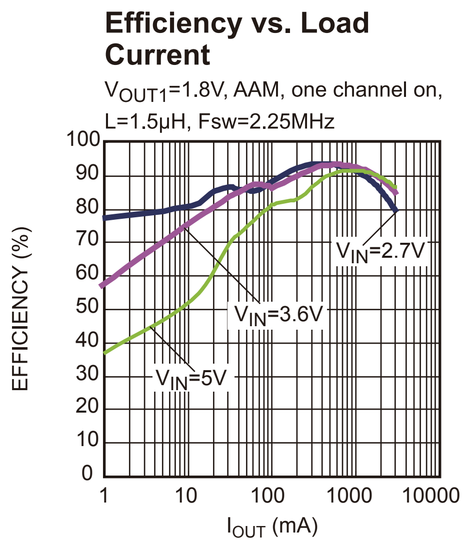
APPLICATIONS

- Small/Handheld Devices
- DVD Drivers
- Smart phones and Feature Phones
- Battery-Powered Devices
- Portable Instruments

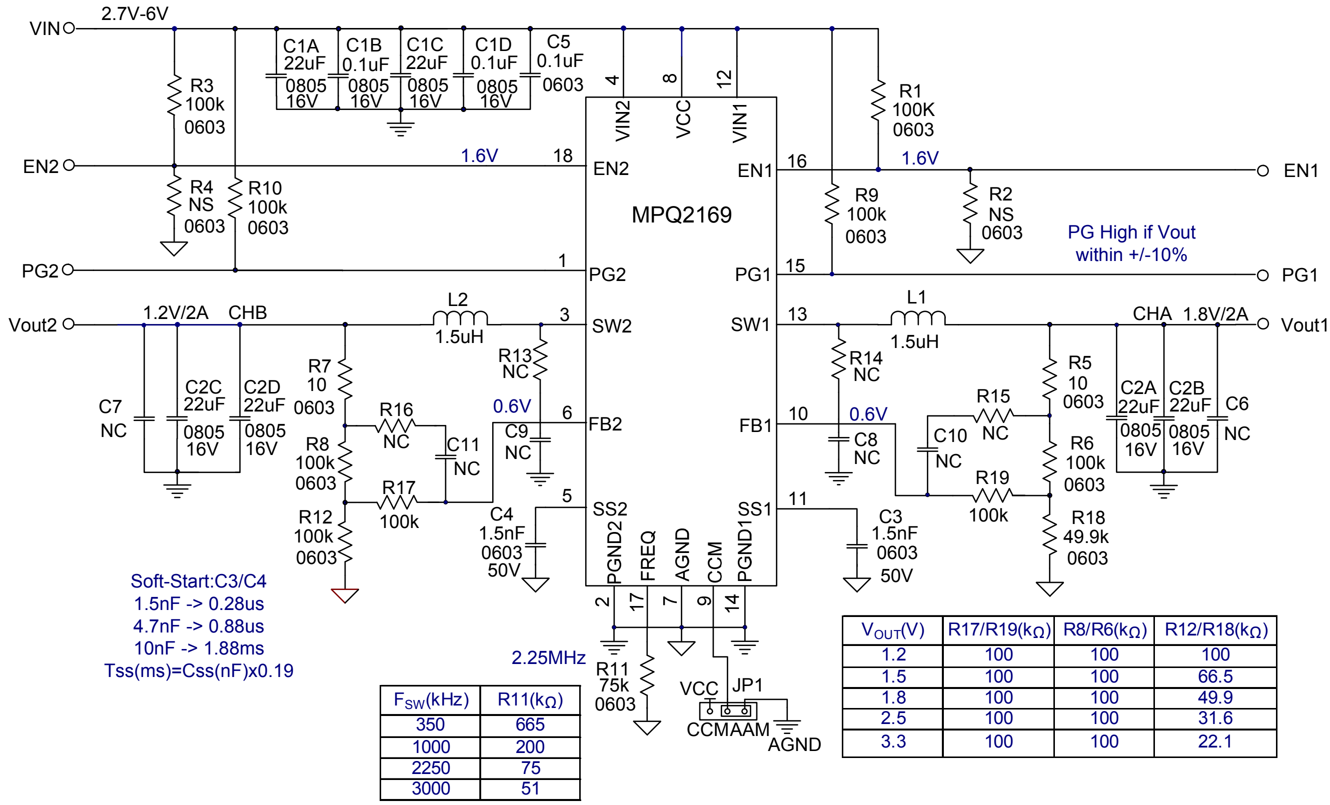
EV2169-RH-00A EVALUATION BOARD

(L x W x H) 2.5” x 2.5” x 0.2”
(6.35cm x 6.35cm x0.5cm)

Board Number	MPS IC Number
EV2169-RH-00A	MPQ2169



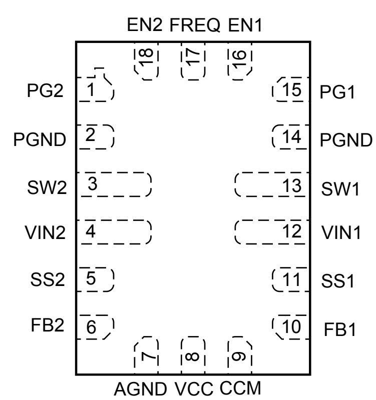
EVALUATION BOARD SCHEMETIC



V_{OUT}(V)	R17/R19(kΩ)	R8/R6(kΩ)	R12/R18(kΩ)
1.2	100	100	100
1.5	100	100	66.5
1.8	100	100	49.9
2.5	100	100	31.6
3.3	100	100	22.1

F_{SW}(kHz)	R11(kΩ)
350	665
1000	200
2250	75
3000	51

PACKAGE REFERENCE



EV2169-RH-00A BILL OF MATERIALS

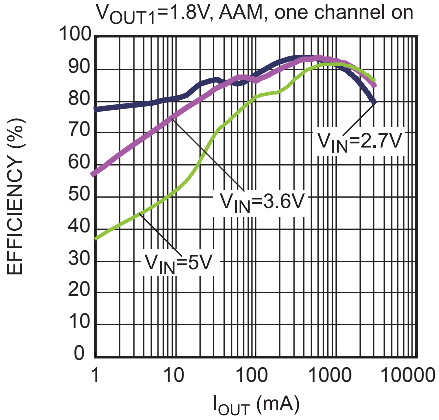
RefDes	Value	Description	Package	Manufacturer	Manufactuer_P/N
C1A, C1C, C2A, C2B C2C, C2D	22μF	Ceramic Cap;16V;X5R	0805	muRata	GRM21BR61C226ME44L
C1B, C1D	0.1μF	Ceramic Cap;16V;X7R	0805	muRata	GRM219R71C104KA01D
C3, C4	1.5nF	Ceramic Cap;50V;X7R	0603	muRata	GRM188R71H153KA01D
C5	0.1μF	Ceramic Cap;16V;X5R	0603	muRata	GRM188R61C104KA01D
C6, C7, C8, C9, C10, C11	NS				
L1, L2	1.5μH	Inductor; 1.5uH; 15.8m; 9.1A	SMD	Coilcraft	XFL4020-152MEB
R1,R3,R6, R8,R9, R10,R12, R17,R19	100K	Film Resistor;1%;	0603	Yageo	RC0603FR-07100KL
R5,R7	10	Film Resistor;1%;	0603	Yageo	RC0603FR-0710RL
R2, R4, R13, R14,R15, R16	NS				
R11	75K	Film Resistor;1%;	0603	Yageo	RC0603FR-0775KL
U1		Step-Down Converter	QFN-18 (2.5x3.5mm)	MPS	MPQ2169GRH
CN1		Connector; 2.54mm;		any	
VIN, VEMI,GND, GND, VOUT1, VOUT2	Test Point	2.0 Golden Pin		HZ	

EVB TEST RESULTS

V_{IN} = 5V, V_{OUT1} = 1.8V, V_{OUT2} = 1.2V, L1 = L2 = 1.5µH, F_{SW} = 2.25MHz, T_A = 25°C, unless otherwise noted.

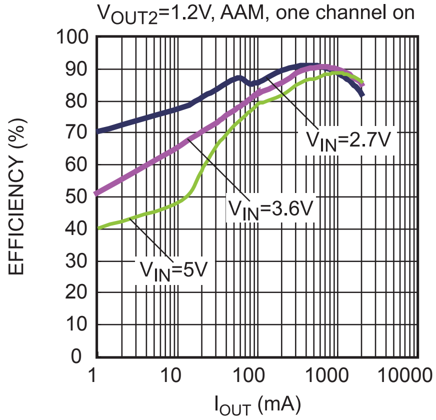
Efficiency vs. Load Current

V_{OUT1}=1.8V, AAM, one channel on



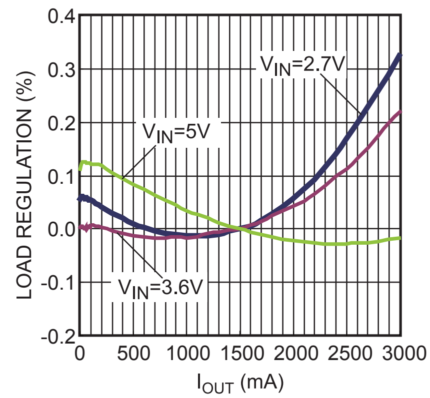
Efficiency vs. Load Current

V_{OUT2}=1.2V, AAM, one channel on



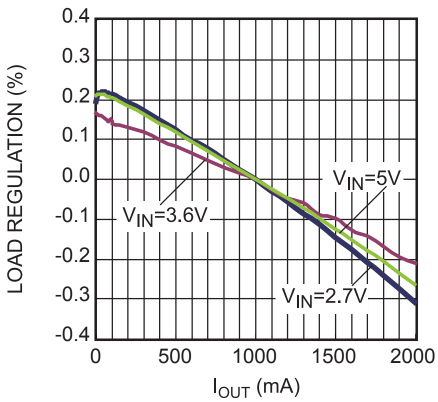
Load Regulation

V_{OUT1}=1.8V, AAM, one channel on



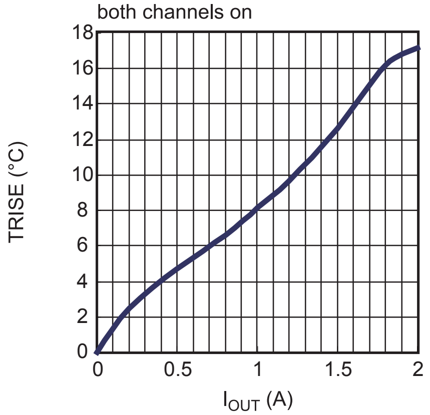
Load Regulation

V_{OUT2}=1.2V, AAM, one channel on



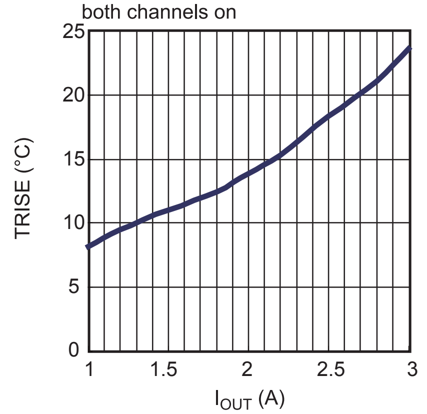
Case Thermal Rise

V_{IN}=5V, I_{OUT1}=I_{OUT2}=2A, AAM, both channels on

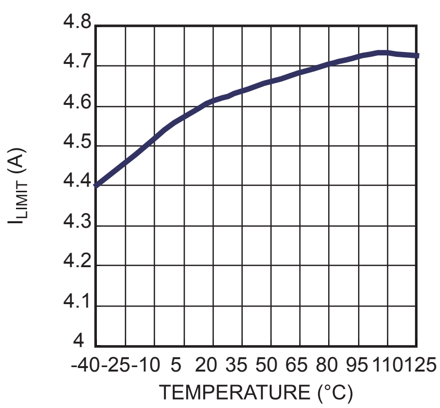


Case Temp Rise

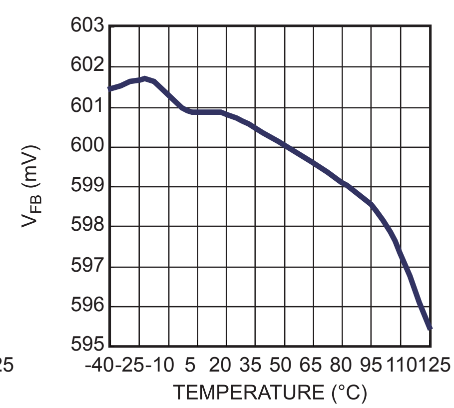
V_{IN}=5V, I_{OUT1}=1A-3A, I_{OUT2}=1A, both channels on



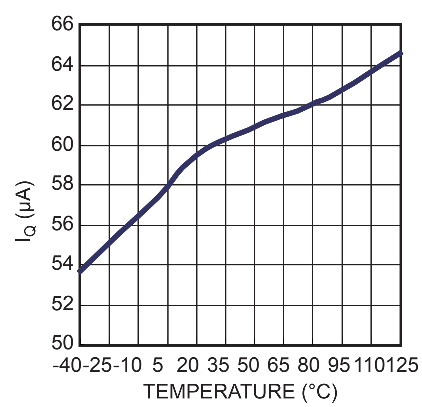
I_{LIMIT} vs. Temperature



V_{FB} vs.Temperature



I_Q vs.Temperature

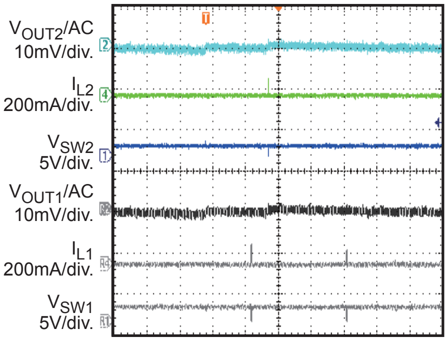


EVB TEST RESULTS

V_{IN} = 5V, V_{OUT1} = 1.8V, V_{OUT2} = 1.2V, L1 = L2 = 1.5µH, F_{SW} = 2.25MHz, T_A = 25°C, unless otherwise noted.

Steady State

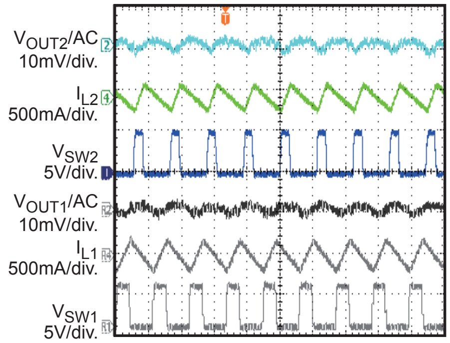
I_{OUT1}=I_{OUT2}=0, AAM Mode



1ms/div.

Steady State

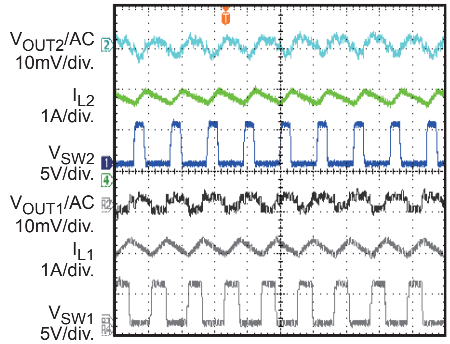
I_{OUT1}=I_{OUT2}=0, Forced CCM Mode



400ns/div.

Steady State

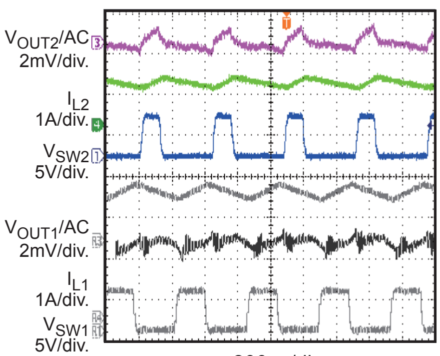
I_{OUT1}=I_{OUT2}=2A



400ns/div.

Steady State

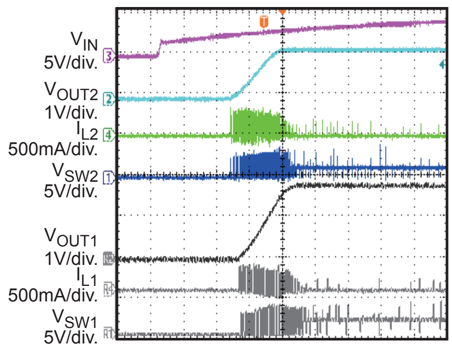
I_{OUT1}=3A, I_{OUT2}=1A



200ns/div

Start-Up through V_{IN}

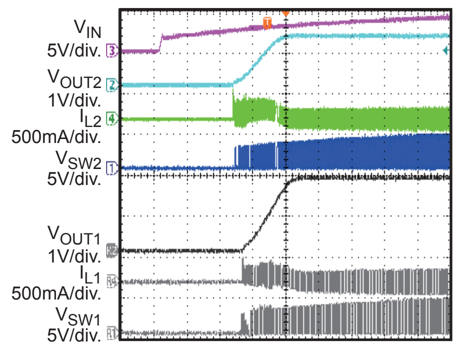
I_{OUT1}=I_{OUT2}=0, AAM Mode



400µs/div

Start-Up through V_{IN}

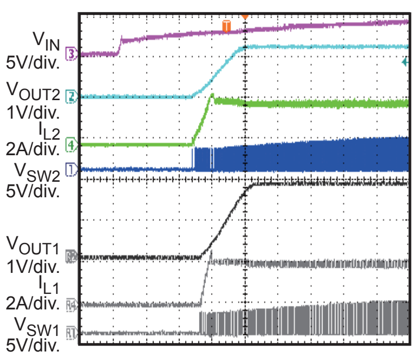
I_{OUT1}=I_{OUT2}=0, Forced CCM Mode



400µs/div

Start-Up through V_{IN}

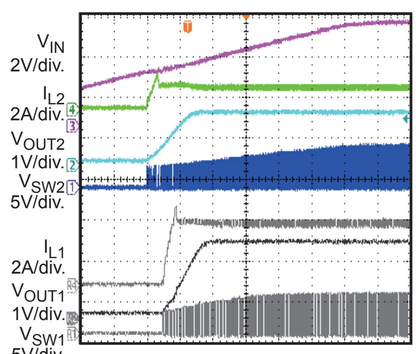
I_{OUT1}=I_{OUT2}=2A



400µs/div

Start-Up through V_{IN}

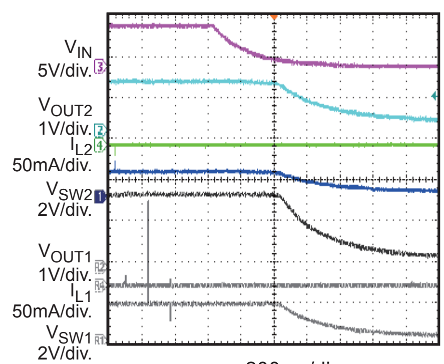
I_{OUT1}=3A, II_{OUT2}=1A



400µs/div

Shutdown through V_{IN}

I_{OUT1}=I_{OUT2}=0, AAM Mode

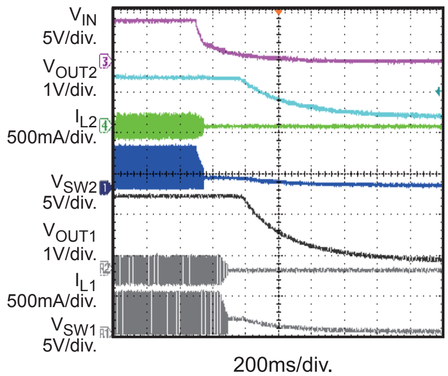


200ms/div

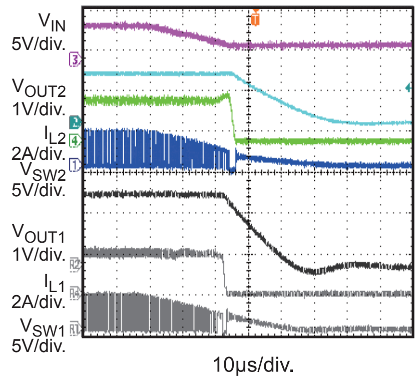
EVB TEST RESULTS

V_{IN} = 5V, V_{OUT1} = 1.8V, V_{OUT2} = 1.2V, L1 = L2 = 1.5µH, F_{SW} = 2.25MHz, T_A = 25°C, unless otherwise noted.

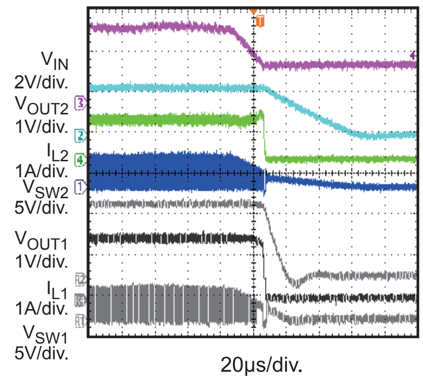
Shutdown through V_{IN}
I_{OUT1}=I_{OUT2}=0, Forced CCM Mode



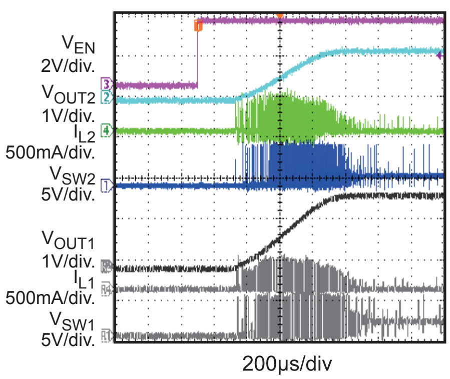
Shutdown through V_{IN}
I_{OUT1}=I_{OUT2}=2A



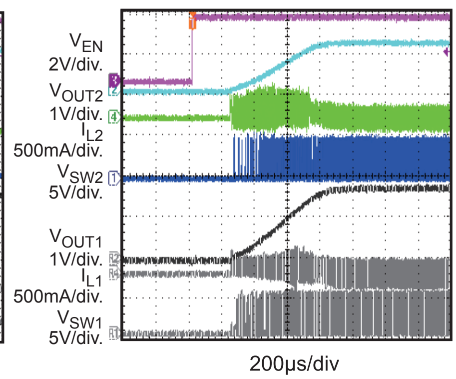
Shutdown through V_{IN}
I_{OUT1}=3A, I_{OUT2}=1A



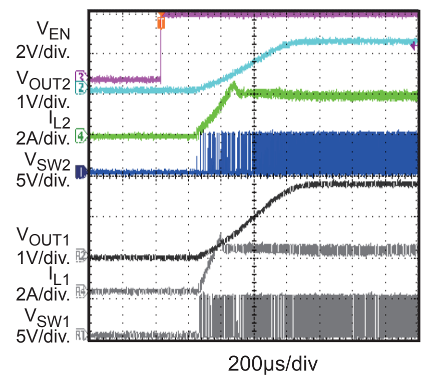
Start-Up through EN
I_{OUT1}=I_{OUT2}=0, AAM Mode



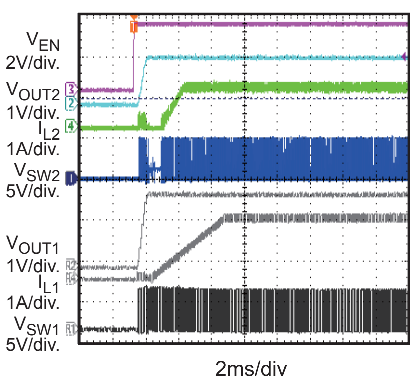
Start-Up through EN
I_{OUT1}=I_{OUT2}=0, Forced CCM Mode



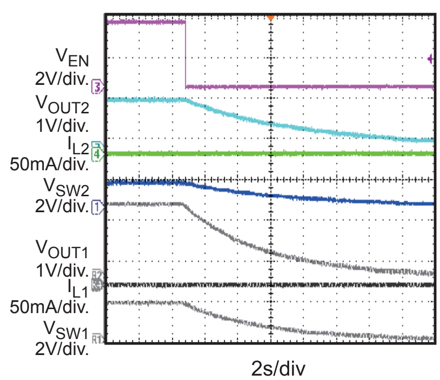
Start-Up through EN
I_{OUT1}=I_{OUT2}=2A



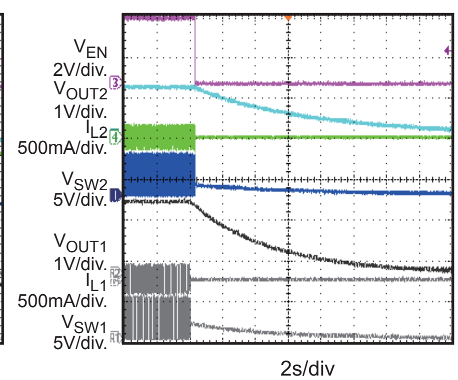
Start-Up through EN
I_{OUT1}=3A, I_{OUT2}=1A



Shutdown through EN
I_{OUT1}=I_{OUT2}=0, AAM Mode



Shutdown through EN
I_{OUT1}=I_{OUT2}=0, Forced CCM Mode

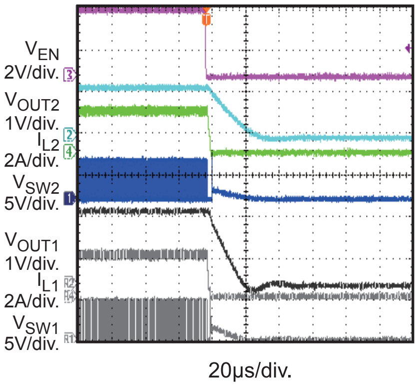


EVB TEST RESULTS

V_{IN} = 5V, V_{OUT1} = 1.8V, V_{OUT2} = 1.2V, L1 = L2 = 1.5µH, F_{SW} = 2.25MHz, T_A = 25°C, unless otherwise noted.

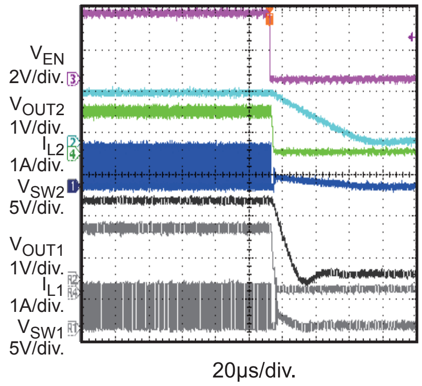
Shutdown through EN

I_{OUT1}=I_{OUT2}=2A



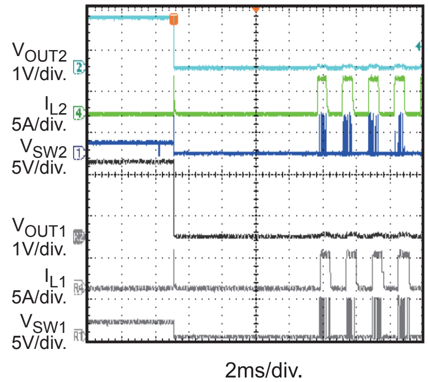
Shutdown through EN

I_{OUT1}=3A, I_{OUT2}=1A



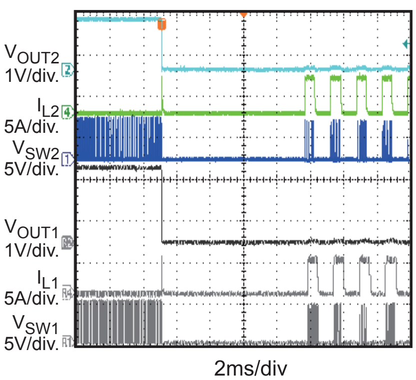
SCP Entry

I_{OUT1}=I_{OUT2}=0, AAM Mode



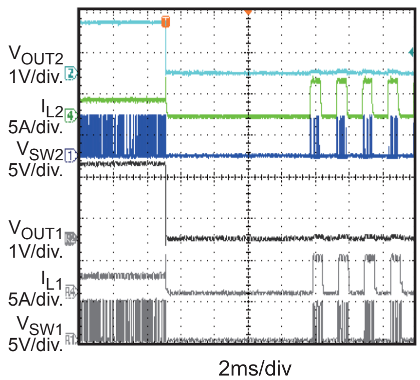
SCP Entry

I_{OUT1}=I_{OUT2}=0, Forced CCM Mode



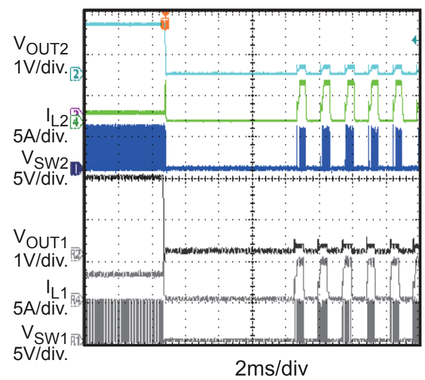
SCP Entry

I_{OUT1}=I_{OUT2}=2A



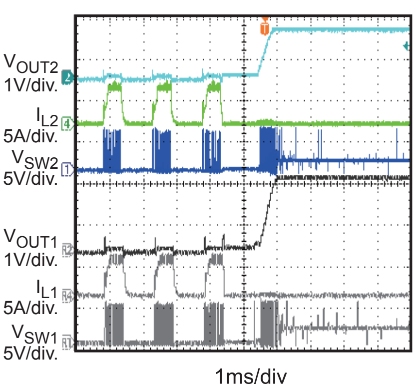
SCP Entry

I_{OUT1}=3A, I_{OUT2}=1A



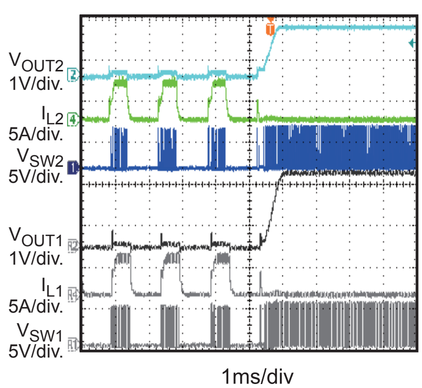
SCP Recovery

I_{OUT1}=I_{OUT2}=0, AAM Mode



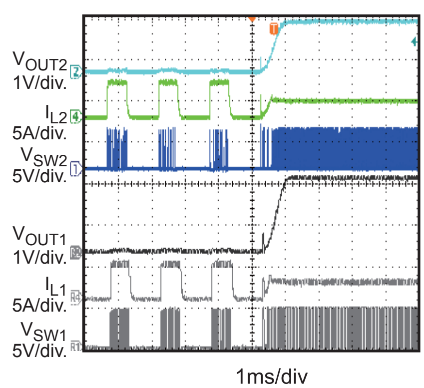
SCP Recovery

I_{OUT1}=I_{OUT2}=0, Forced CCM Mode



SCP Recovery

I_{OUT1}=I_{OUT2}=2A

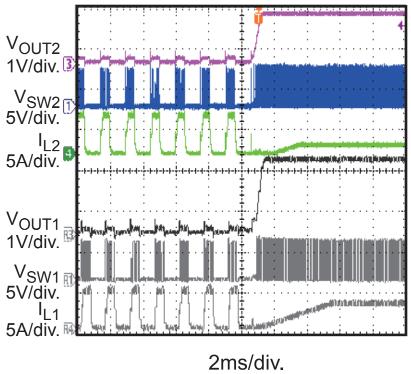


EVB TEST RESULTS

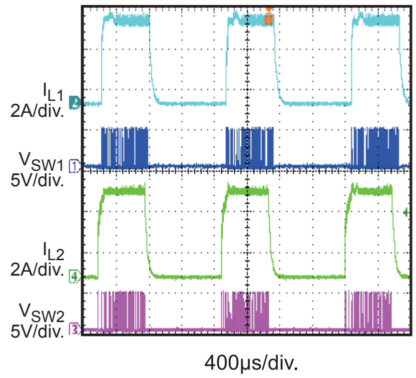
V_{IN} = 5V, V_{OUT1} = 1.8V, V_{OUT2} = 1.2V, L1 = L2 = 1.5µH, F_{SW} = 2.25MHz, T_A = 25°C, unless otherwise noted.

SCP Recovery

I_{OUT1}=3A, I_{OUT2}=1A

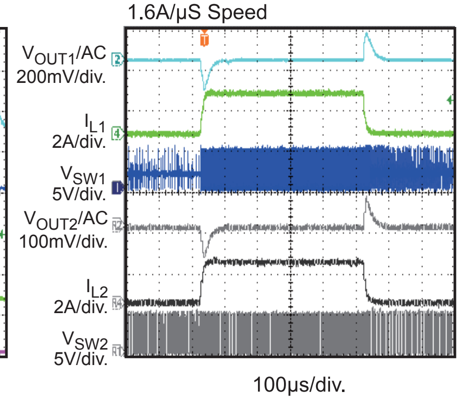


SCP Steady State



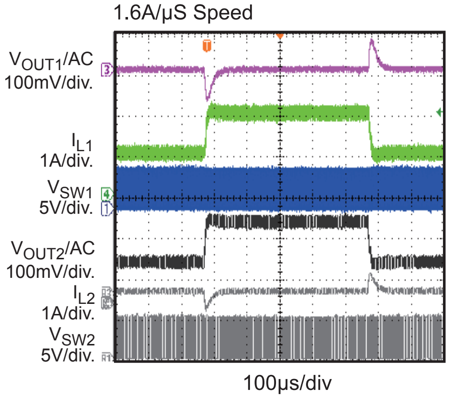
Load Transient

I_{OUT1}=I_{OUT2}=0 to 2A, AAM Mode, 1.6A/µS Speed



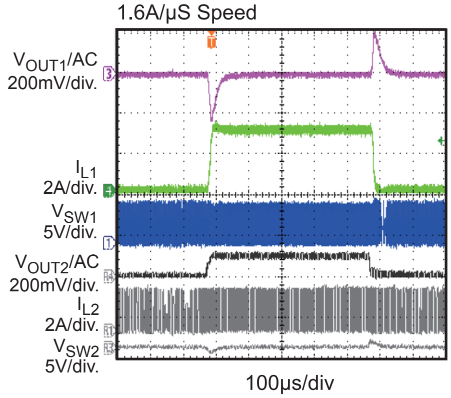
Load Transient

I_{OUT1}=I_{OUT2}=1 to 2A, AAM Mode, 1.6A/µS Speed



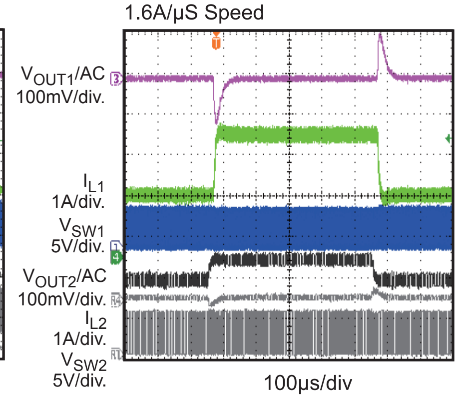
Load Transient

I_{OUT1}=0 to 3A, I_{OUT2}=0 to 1A, 1.6A/µS Speed

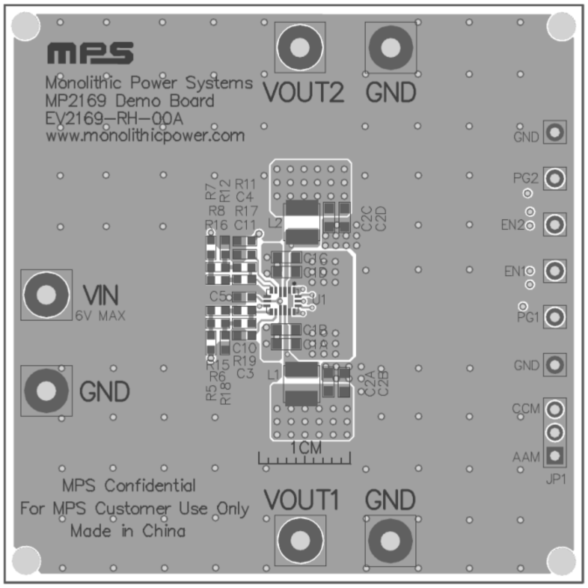


Load Transient

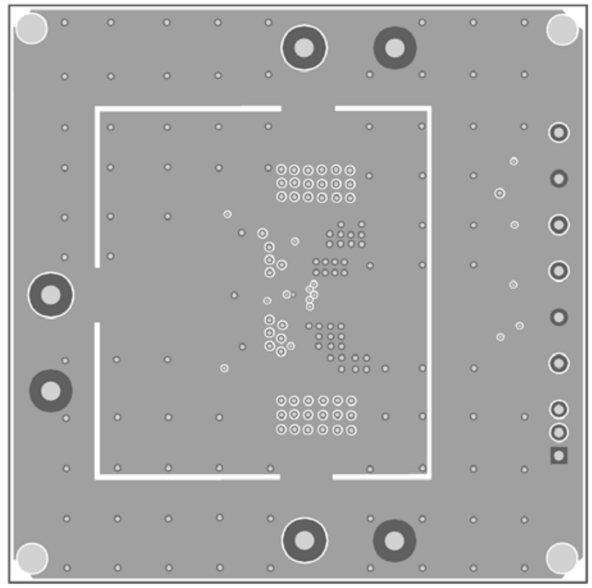
I_{OUT1}=1.5 to 3A, I_{OUT2}=0.5 to 1A, 1.6A/µS Speed



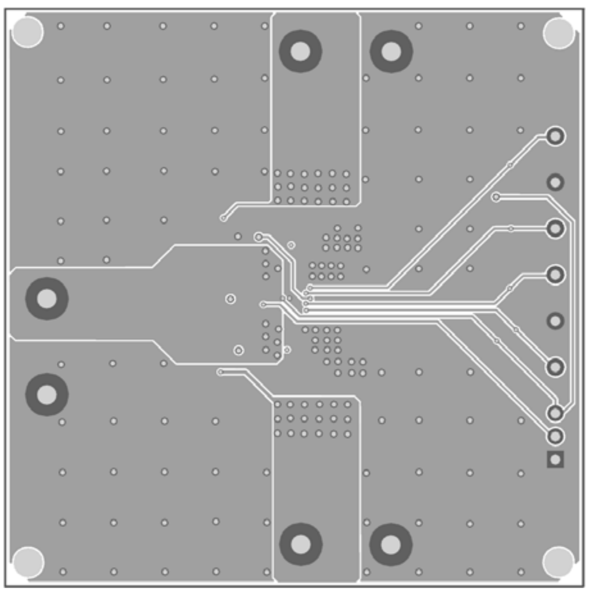
PRINTED CIRCUIT LAYOUT



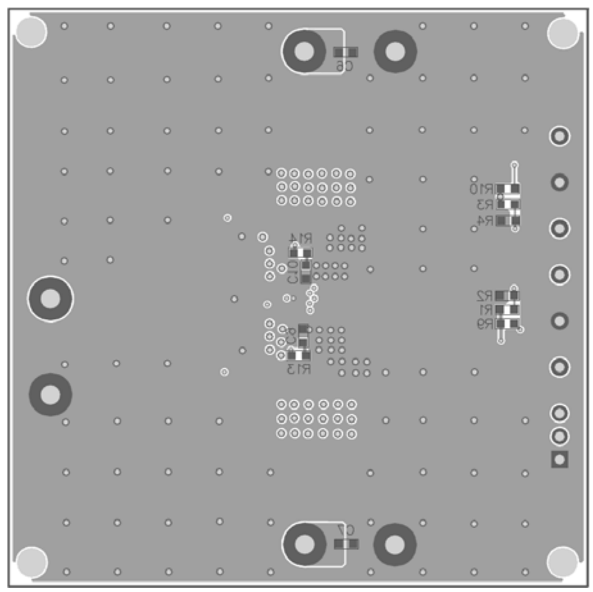
Top Silk & Top Layer



Inner1 Layer



Inner2 Layer

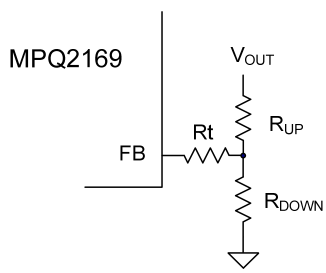


Bottom Silk & Bottom Layer

QUICK START GUIDE

1. Connect the positive and negative terminals of the load to the VOUT and GND pins, respectively. Be aware that electronic load represents negative impedance to the regulator and if set it to a too high current, the SCP protection may be triggered at startup.
2. Preset the power supply output to expected value (2.7V to 6V), and then turn it off.
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 MPQ2169 will automatically startup.
5. To use the Enable function, apply a digital input to the EN pin. Drive EN higher than 1.6V to turn on the regulator, drive EN less than 0.4V to turn it off.
6. The oscillating frequency of MPQ2169 can be programmed by an external frequency resistor R_{FREQ}. The relationship between the oscillator frequency and R_{FREQ} is shown in the schematic.
7. To use the Sync function, apply a 350kHz to 3MHz clock to the FREQ pin to synchronize the internal oscillator frequency to the external clock. The rising edge of the channel 1 clock is synchronized to the external clock rising edge, while the channel 2 clock remains at 180° out-of-phase to channel 1. Considering the parasitic capacitance of the pad, the pulse is recommended to be longer than 100ns.
8. Use JP1 to choose AAM/CCM mode at light load. Connecting the jumper to VCC to set the device to forced CCM mode; while connecting the jumper to GND to the set the device to AAM mode.
9. The output voltage is set by the external resistor divider. Choose 100 kΩ Rt to stable the loop. R_{UP} is estimated to be 100kΩ. R_{DOWN} can then be calculated with equation below:

$$R_{DOWN} = \frac{R_{UP}}{\frac{V_{OUT}}{0.6V} - 1}$$



Below table lists the recommended feedback resistor values for common output voltages.

V_{OUT}(V)	Rt(kΩ)	R_{UP}(kΩ)	R_{DOWN}(kΩ)
1.2	100	100	100
1.5	100	100	66.5
1.8	100	100	49.9
2.5	100	100	31.6
3.3	100	100	22.1