# EVQ70240FS-RH-00A

## MPSafe™ ASIL-B, 18V, 4-Channel PMIC with 3 Bucks and 1 LDO Evaluation Board, AEC-Q100 Qualified

## DESCRIPTION

The EVQ70240FS-RH-00A is an evaluation board designed to demonstrate the capabilities of the MPQ70240FS, a power management solution that integrates three high-efficiency step-down DC/DC converters and a low-noise, low-dropout (LDO) regulator.

The MPQ70240FS uses a unique, dual-stage, 18V buck architecture that maximizes efficiency for the 1.8V image sensor I/O rail in the complementary metal oxide semiconductor (CMOS) sensor in high-resolution camera modules.

Constant-on-time (COT) control with phase-locked loop (PLL) provides a fast transient response time for the MPQ70240FS. The MPQ70240FS supports a 2.2MHz fixed switching frequency ($f_{SW}$).

The MPQ70240FS supports a PMBus interface, for application flexibility. In addition, fault statuses can be monitored. Fault protections include input under-voltage lockout (UVLO), over-current protection (OCP), over-voltage protection (OVP), under-voltage protection (UVP), and thermal shutdown. The one-time programmable (OTP) memory is provided to preset these functions.

The MPQ70240FS supports applications with a high automotive safety integrity level up to ASIL-B. Functional safety features include analog built-in self-testing (ABIST), diagnostics, and a power good (PG) output pin. The MPQ70240FS is developed under MPS's advanced MPSafe™ functional safety product development process, which has been independently certified to meet ISO26262 guidelines.

The EVQ70240FS-RH-00A is a fully assembled and tested evaluation board. The MPQ70240FS is available in a QFN-15 (2.5mmx3.5mm) package with wettable flanks. It is available in AEC-Q100 Grade 1.


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## PERFORMANCE SUMMARY

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

| Parameters | Conditions | Value |
|---|---|---|
| Input voltage ($V_{IN}$) range | | 3.5V to 18V |
| Buck 1 output voltage ($V_{OUT1}$) | $V_{IN}$ = 3.5V to 18V, $I_{OUT1}$ = 0A to 0.6A, $I_{OUT3}$ = $I_{LDO}$ = 0A | 3V |
| Buck 1 maximum output current ($I_{OUT1}$) | $V_{IN}$ = 3.5V to 18V, $V_{OUT1}$ = 3V, $I_{OUT3}$ = $I_{LDO}$ = 0A | 0.6A |
| Buck 2 output voltage ($V_{OUT2}$) | $V_{IN}$ = 3.5V to 18V, $I_{OUT2}$ = 0A to 0.6A | 1.8V |
| Buck 2 maximum output current ($I_{OUT2}$) | $V_{IN}$ = 3.5V to 18V, $V_{OUT2}$ = 1.8V | 0.6A |
| Buck 3 output voltage ($V_{OUT3}$) | $V_{IN}$ = 3.5V to 18V, $V_{OUT1}$ = 3V, $I_{OUT3}$ = 0A to 1A, $I_{OUT1}$ = 0A | 1.2V |
| Buck 3 maximum output current ($I_{OUT3}$) | $V_{IN}$ = 3.5V to 18V, $V_{OUT1}$ = 3V, $V_{OUT3}$ = 1.2V, $I_{OUT1}$ = 0A | 1A |
| LDO output voltage ($V_{LDO}$) | $V_{IN}$ = 3.5V to 18V, $V_{OUT1}$ = 3V, $I_{LDO}$ = 0A to 0.2A, $I_{OUT1}$ = 0A | 2.5V |
| LDO maximum output current ($I_{LDO}$) | $V_{IN}$ = 3.5V to 18V, $V_{OUT1}$ = 3V, $V_{LDO}$ = 2.5V, $I_{OUT1}$ = 0A | 0.2A |
| Typical efficiency of buck 1 | $V_{IN}$ = 8V, $V_{OUT1}$ = 3V, $I_{OUT1}$ = 0.6A, other rails are disabled | 90.1% |
| Peak efficiency of buck 1 | $V_{IN}$ = 4V, $V_{OUT1}$ = 3V, $I_{OUT1}$ = 0.2A, other rails are disabled | 93.9% |
| Typical efficiency of buck 2 | $V_{IN}$ = 8V, $V_{OUT2}$ = 1.8V, $I_{OUT2}$ = 0.6A, other rails are disabled | 82.4% |
| Peak efficiency of buck 2 | $V_{IN}$ = 4V, $V_{OUT2}$ = 1.8V, $I_{OUT2}$ = 0.25A, other rails are disabled | 90.2% |
| Typical efficiency of buck 3 | $V_{IN3}$ = $V_{OUT1}$ = 3V, $V_{OUT3}$ = 1.2V, $I_{OUT3}$ = 1A, LDO is disabled | 81.9% |
| Peak efficiency of buck 3 | $V_{IN3}$ = $V_{OUT1}$ = 2.5V, $V_{OUT3}$ = 1.2V, $I_{OUT3}$ = 0.3A, LDO is disabled | 89.3% |
| Switching frequency ($f_{SW}$) | | 2.2MHz |


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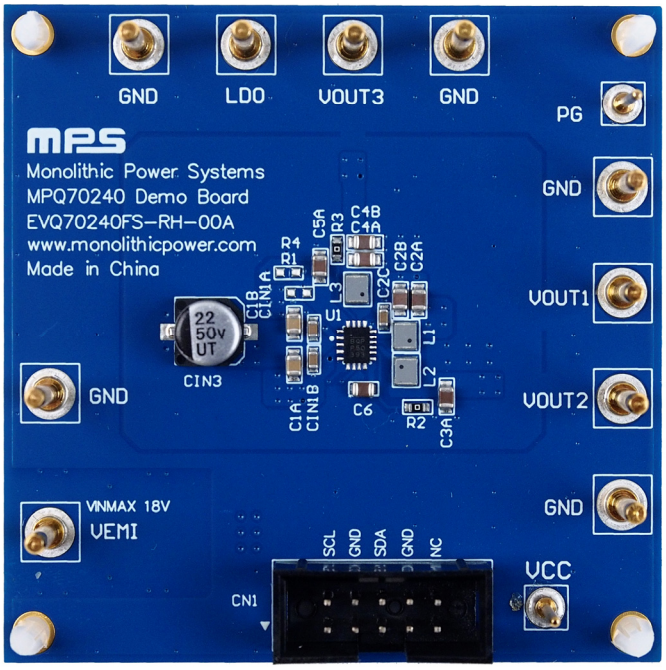
# EVQ70240FS-RH-00A EVALUATION BOARD




**LxWxH (6.35cmx6.35cmx1cm)**

| Board Number | MPS IC Number |
|---|---|
| EVQ70240FS-RH-00A | MPQ70240FSGRHE-0000AEC1 |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## QUICK START GUIDE

The EVQ70240FS-RH-00A evaluation board is easy to set up and use to evaluate the MPQ70240FS's performance. For the proper measurement equipment set-up, refer to Figure 2 on page 4 and follow the steps below:

1. Preset the power supply ($V_{IN}$) between 3.5V and 18V, then turn off the power supply.
2. Set the load current for each channel ($I_{OUT2}$ = 0A to 0.6A, $I_{OUT3}$ = 0A to 1A, and $I_{LDO}$ = 0A to 0.2A). (1) Electronic loads represent a negative impedance to the converter, and setting a current too high can trigger hiccup mode.
3. If longer cables (>0.5m total) are used between the source and the evaluation board, place a damping capacitor at the input terminals.
4. Connect the power supply terminals to:
   a. Positive (+): VEMI
   b. Negative (-): GND
5. Connect the load terminals to:
   a. Positive (+) channel: VOUT2, VOUT3, or LDO
   b. Negative (-) channel: GND
6. After making the connections, turn on the power supply. The MPQ70240FS should automatically start up.
7. Evaluate with the I²C digital interface by following the steps below:
   a. Download and install the software Virtual Bench Pro 4.0 (VBP 4.0) from the MPS website. The MPQ70240FS GUI is embedded in VBP 4.0.
   b. Connect the EVKT-USBI2C-02 to CN1 with a ribbon cable, then connect the EVKT-USBI2C-02 to the computer with a USB cable.
   c. Using the MPQ70240FS GUI, scan for the evaluation board address, which is 03h by default.
   d. Start to evaluate the device with the MPQ70240FS GUI, such as the turn-on delay time and soft-start time. Figure 1 shows the I²C evaluation kit set-up.

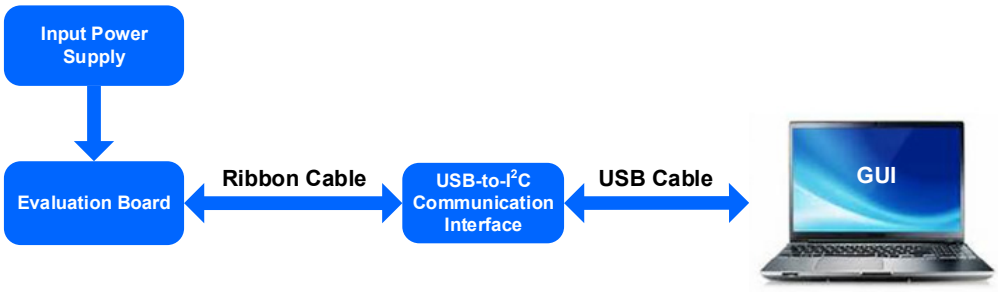


**Figure 1: I²C Evaluation Kit Set-Up**

**Note:**

1) Buck 1's output is the input for buck 3 and the LDO. Do not let the total load current of buck 1 to exceed 600mA to avoid triggering buck 1's over-current protection (OCP).


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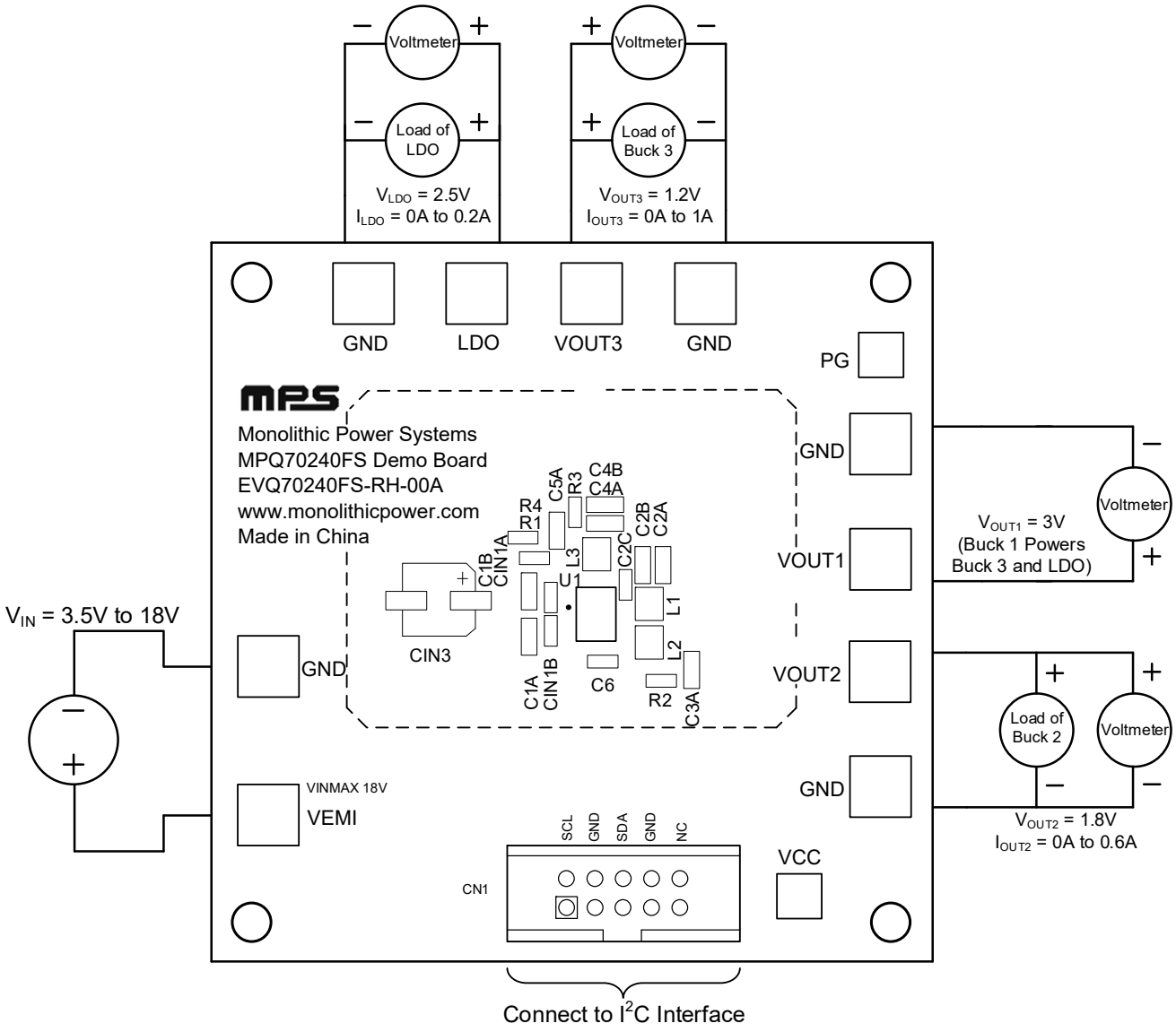


**Figure 2: Measurement Equipment Set-Up**


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## MPQ70240FS-0000 DEFAULT REGISTER VALUES

| Register Number | Page | Register Name | Register Value | Description |
|---|---|---|---|---|
| 01h | 0 | OPERATION | 80h | Buck 1 is enabled |
| 10h | 0 | WRITE_PROTECT | 00h | Enable writes to all registers |
| 21h | 0 | VOUT_COMMAND | 05h | $V_{OUT1}$ = 3V |
| 61h | 0 | TON_RISE | 00h | Buck 1's soft-start time = 0.5ms |
| C4h | 0 | FREQ_DITHER | 11h | Frequency spread spectrum (FSS) is disabled |
| C5h | 0 | PG_MAPPING | 00h | Communication failure/ CRC failure / reference failure / BIST failure causes PG to go low and register assertion |
| CBh | 0 | PROTECTION_CONFIG | 1Ch | • $V_{OUT}$ OVP / UVP enabled<br>• Built-in self-testing (BIST) enabled<br>• PG_REACTION = 0, PG low fault doesn't cause a safe state<br>• Packet error checking (PEC) is disabled |
| CCh | 0 | PG_CONFIG | 03h | • $V_{PGOUT}$ = 1.8V<br>• PG de-assertion time = 2ms<br>• PG threshold = ±6% |
| CDh | 0 | GATE_DRIVE_STRENGTH | 03h | High gate drive strength is selected |
| CEh | 0 | LIGHT_LOAD | 02h | • Output discharge is enabled<br>• Continuous conduction mode (CCM) is selected as the light-load mode |
| CFh | 0 | TON_OFF_DELAY | 00h | • Buck 1's turn-on delay time = 0ms<br>• Buck 1's turn-off delay time = 0ms |
| D0h | 0 | TON_OFF_SCALE | 00h | Turn-on/turn-off delay scale = 0.25ms |
| D1h | 0 | FREQUENCY_ILIM_SCALE | 00h | • $f_{SW1}$ = $f_{SW2}$ = $f_{SW3}$ = 2.2MHz<br>• Current limit scale = 100% |
| D2h | 0 | VIN_START_STOP | 00h | • $V_{IN_START}$ = UVLO threshold<br>• $V_{IN_STOP}$ = UVLO threshold |
| D3h | 0 | ADDRESS | 03h | The chip's PMBus communication address is 03h |
| 01h | 1 | OPERATION | 80h | Buck 2 is enabled |
| 21h | 1 | VOUT_COMMAND | 18h | $V_{OUT2}$ = 1.8V |
| 61h | 1 | TON_RISE | 00h | Buck 2's soft-start time = 0.5ms |
| CFh | 1 | TON_OFF_DELAY | 00h | • Buck 2's turn-on delay time = 0ms<br>• Buck 2's turn-off delay time = 0ms |
| 01h | 2 | OPERATION | 80h | Buck 3 is enabled |
| 21h | 2 | VOUT_COMMAND | 0Ch | $V_{OUT3}$ = 1.2V |
| 61h | 2 | TON_RISE | 00h | Buck 3's soft-start time = 0.5ms |
| CFh | 2 | TON_OFF_DELAY | 00h | • Buck 3's turn-on delay time = 0ms<br>• Buck 3's turn-off delay time = 0ms |
| 01h | 3 | OPERATION | 80h | LDO is enabled |
| 21h | 3 | VOUT_COMMAND | 26h | $V_{LDO}$ = 2.5V |
| CFh | 3 | TON_OFF_DELAY | 00h | • LDO's turn-on delay time = 0ms<br>• LDO's turn-off delay time = 0ms |


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# EVALUATION BOARD SCHEMATIC

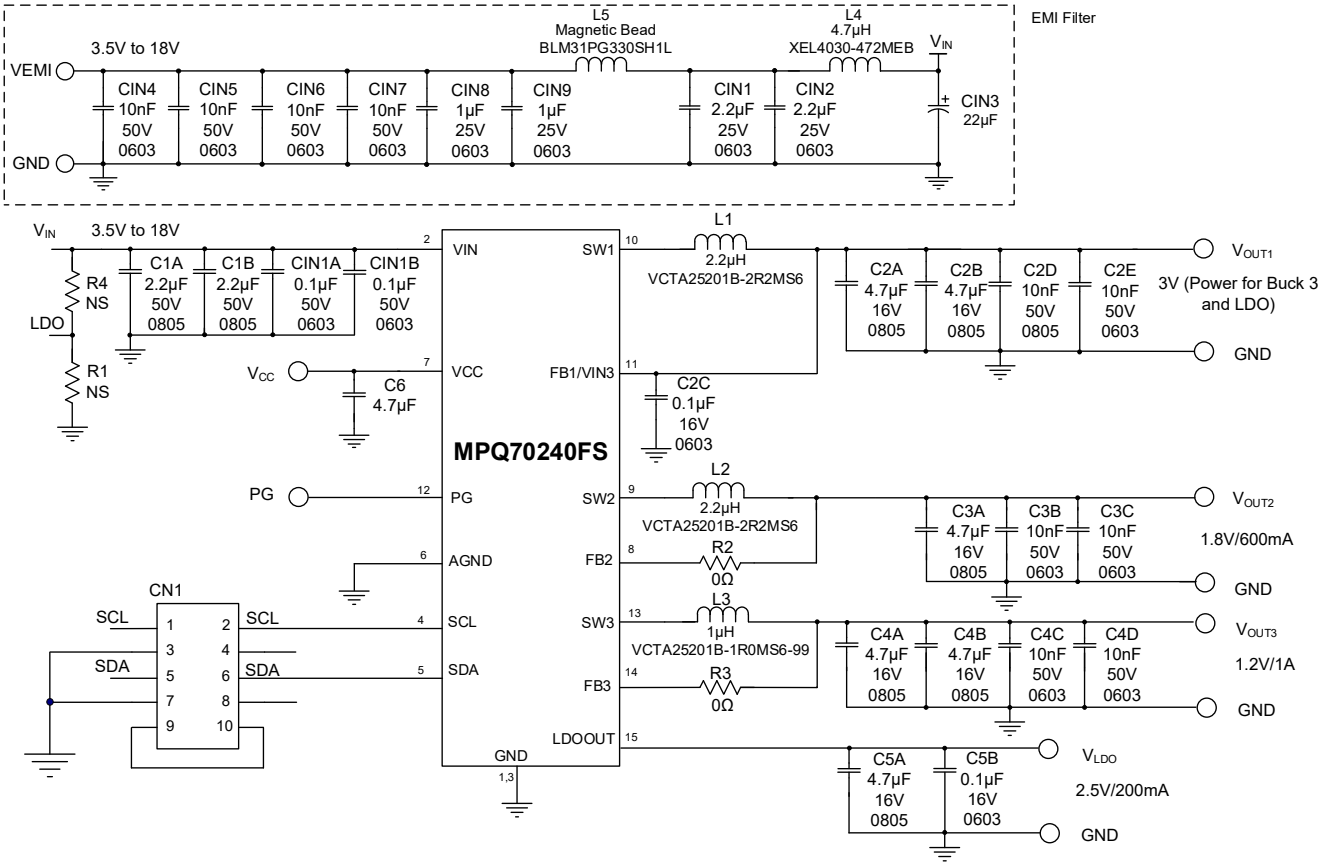
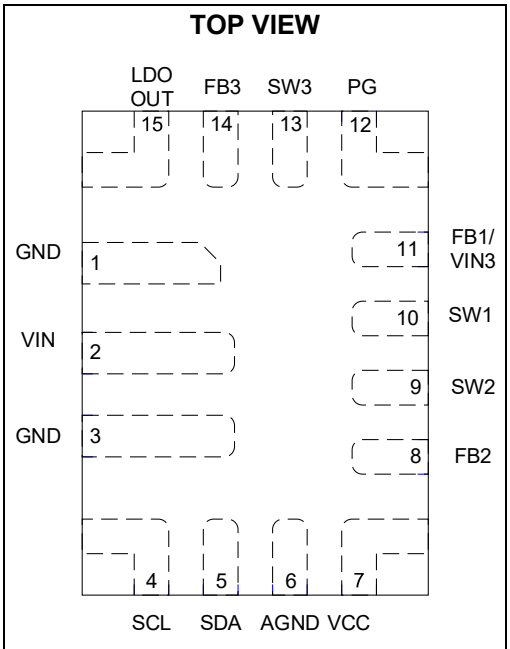



**Figure 3: Evaluation Board Schematic**

# PACKAGE REFERENCE




**QFN-15 (2.5mmx3.5mm)**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## EVQ70240FS-RH-00A BILL OF MATERIALS

| Qty | Ref | Value | Description | Package | Manufacturer | Manufacturer PN |
|---|---|---|---|---|---|---|
| 2 | C1A, C1B | 2.2μF | Ceramic capacitor, 50V, X7R | 0805 | TDK | CGA4J3X7R1H225K125 AB |
| 2 | CIN1A, CIN1B | 0.1μF | Ceramic capacitor, 50V, X7R | 0603 | Murata | GRM188R71H104KA93D |
| 2 | CIN1, CIN2 | 2.2μF | Ceramic capacitor, 25V, X7S | 0603 | Murata | GRM188C71E225KE11D |
| 1 | CIN3 | 22μF | Electrolytic capacitor, 50V | SMD | Cotronic | UT1H220M0605VG |
| 7 | C2A, C2B, C3A, C4A, C4B, C5A, C6 | 4.7μF | Ceramic capacitor, 16V, X7R | 0805 | Murata | GCM21BR71C475KA73L |
| 2 | C2C, C5B | 0.1μF | Ceramic capacitor, 16V, X7R | 0805 | Murata | GRM188R71C104KA01D |
| 10 | C2D, C2E, C3B, C3C, C4C, C4D, CIN4, CIN5, CIN6, CIN7 | 10nF | Ceramic capacitor, 50V, X7R | 0603 | Murata | GRM188R71H103KA01D |
| 2 | CIN8, CIN9 | 1μF | Ceramic capacitor, 25V, X7R | 0603 | Murata | GCM188R71E105KA64D |
| 2 | L1, L2 | 2.2μH | Inductor, 70mΩ DCR, 3.5A | 0603 | Murata | VCTA25201B-2R2MS6 |
| 1 | L3 | 1μH | Inductor, 35mΩ DCR, 3.8A | SMD | Cyntec | VCTA25201B-1R0MS6-99 |
| 1 | L4 | 4.7μH | Inductor, 44.1mΩ DCR, 5.1A | SMD | Cyntec | XEL4030-472MEB |
| 1 | L5 | 33Ω, 6A | Magnetic bead | SMD | Coilcraft | BLM31PG330SH1L |
| 2 | R2, R3 | 0Ω | Film resistor, 1% | 1206 | Yageo | RC0603FR-070RL |
| 1 | CN1 | 2.54mm | 180° pin header, 2x5 pin, 2.54mm | DIP | Wurth | 61201021621 |
| 10 | VEMI, GND*5, VOUT1, VOUT2, VOUT3, LDO | 2mm | 2.0 golden pin | DIP | Custom (2) | |
| 2 | PG, VCC | 1mm | 1.0 golden pin | DIP | Custom (2) | |
| 2 | R1, R4 | NS | | | | |
| 1 | U1 | MPQ70240FS | Power management IC | QFN-15 (2.5mmx 3.5mm) | MPS | MPQ70240FSGRHE-0000-AEC1 |

**Note:**

2) MPS custom-produces these pins. Contact an MPS FAE for more information.


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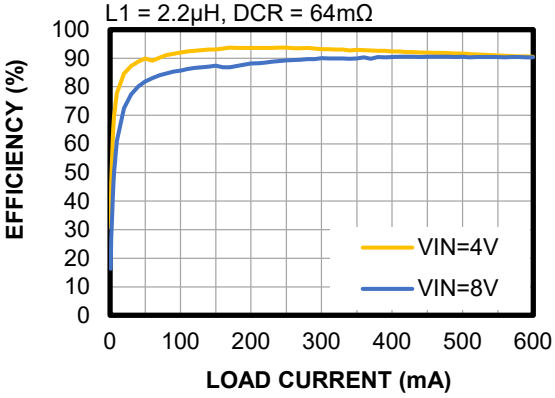
## EVB TEST RESULTS

**Performance curves and waveforms are tested on the evaluation board. $V_{IN}$ = 8V, $V_{OUT1}$ = 3V, $V_{OUT2}$ = 1.8V, $V_{OUT3}$ = 1.2V, $V_{LDO}$ = 2.5V, $L_1$ = $L_2$ = 2.2µH, $L_3$ = 1µH, $f_{SW1}$ = $f_{SW2}$ = $f_{SW3}$ = 2.2MHz, FCCM, $T_A$ = 25°C, unless otherwise noted.**

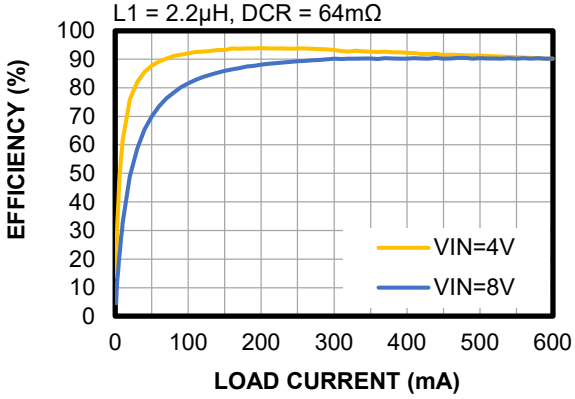
### Efficiency vs. Load Current (Buck 1)

$V_{OUT1}$ = 3V, $f_{SW1}$ = 2.2MHz, DCM, other channels are disabled, L1 = 2.2µH, DCR = 64mΩ



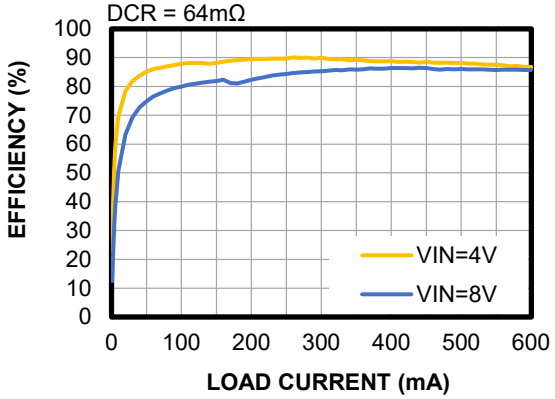

### Efficiency vs. Load Current (Buck 1)

$V_{OUT1}$ = 3V, $f_{SW1}$ = 2.2MHz, FCCM, other channels are disabled, L1 = 2.2µH, DCR = 64mΩ



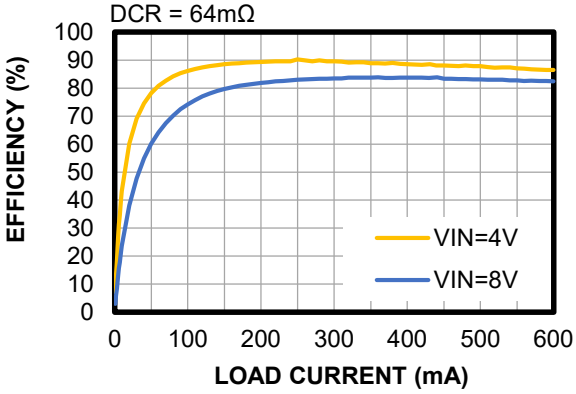

### Efficiency vs. Load Current (Buck 2)

$V_{OUT2}$ = 1.8V, $f_{SW2}$ = 2.2MHz, DCM, other channels are disabled, L2 = 2.2µH, DCR = 64mΩ



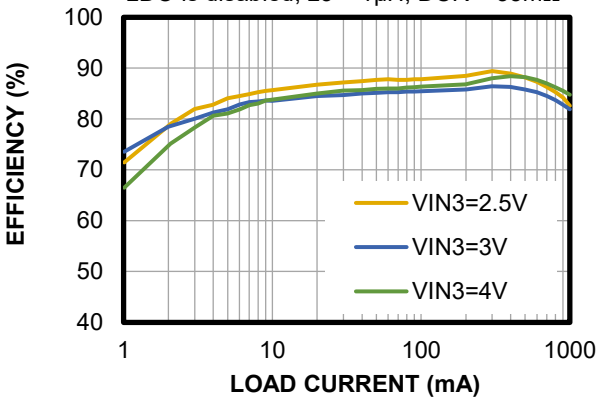

### Efficiency vs. Load Current (Buck 2)

$V_{OUT2}$ = 1.8V, $f_{SW2}$ = 2.2MHz, FCCM, other channels are disabled, L2 = 2.2µH, DCR = 64mΩ



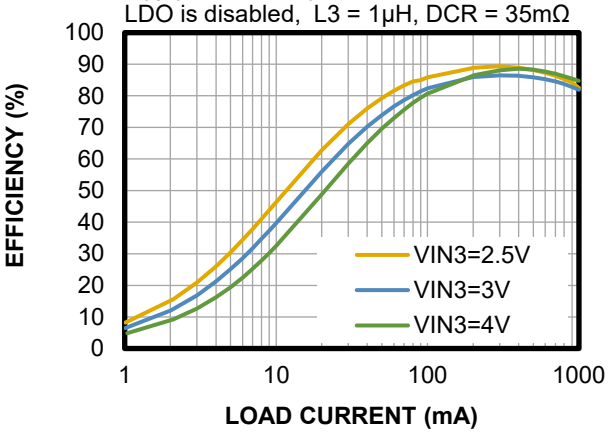

### Efficiency vs. Load Current (Buck 3)

$V_{OUT3}$ = 1.2V, $f_{SW3}$ = 2.2MHz, DCM, LDO is disabled, L3 = 1µH, DCR = 35mΩ




### Efficiency vs. Load Current (Buck 3)

$V_{OUT3}$ = 1.2V, $f_{SW3}$ = 2.2MHz, FCCM, LDO is disabled, L3 = 1µH, DCR = 35mΩ





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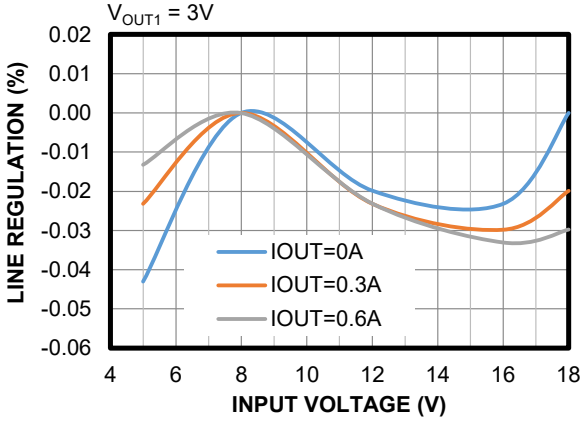
## EVB TEST RESULTS *(continued)*

**Performance curves and waveforms are tested on the evaluation board. $V_{IN}$ = 8V, $V_{OUT1}$ = 3V, $V_{OUT2}$ = 1.8V, $V_{OUT3}$ = 1.2V, $V_{LDO}$ = 2.5V, $L_1$ = $L_2$ = 2.2µH, $L_3$ = 1µH, $f_{SW1}$ = $f_{SW2}$ = $f_{SW3}$ = 2.2MHz, FCCM, $T_A$ = 25°C, unless otherwise noted.**

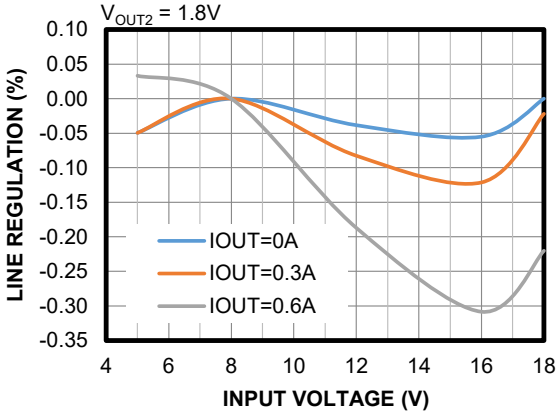
**Line Regulation (Buck 1)**

$V_{OUT1}$ = 3V



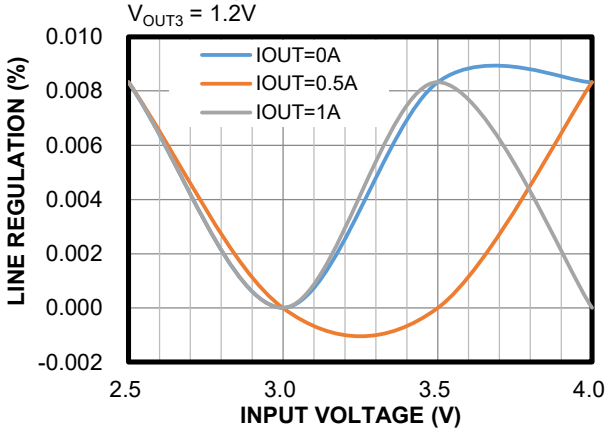

**Line Regulation (Buck 2)**

$V_{OUT2}$ = 1.8V



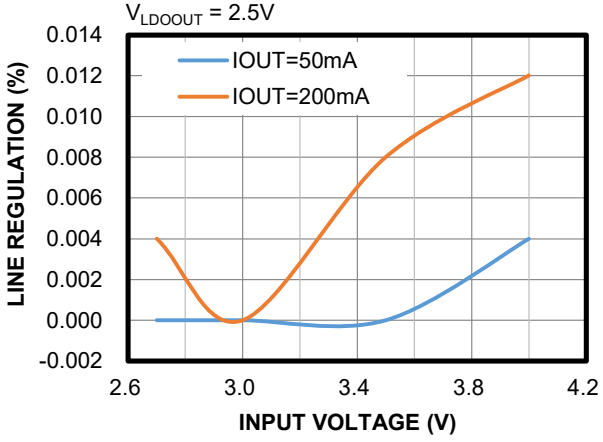

**Line Regulation (Buck 3)**

$V_{OUT3}$ = 1.2V



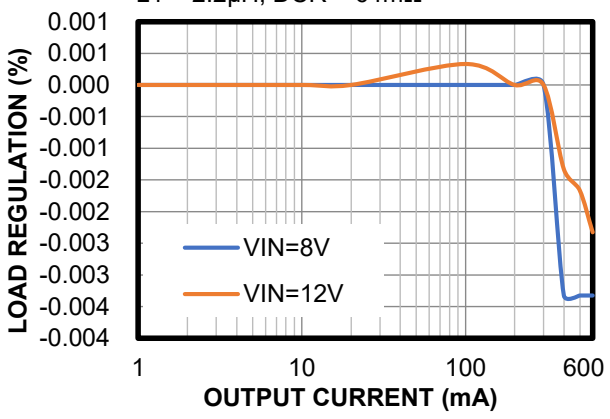

**Line Regulation (LDO)**

$V_{LDOOUT}$ = 2.5V



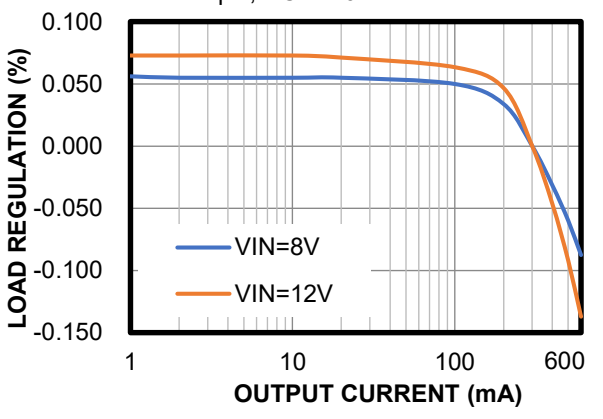

**Load Regulation (Buck 1)**

$V_{OUT1}$ = 3.0V, $f_{SW1}$ = 2.2MHz, FCCM,
L1 = 2.2µH, DCR = 64mΩ




**Load Regulation (Buck 2)**

$V_{OUT2}$ = 1.8V, $f_{SW2}$ = 2.2MHz, FCCM,
L2 = 2.2µH, DCR =64mΩ





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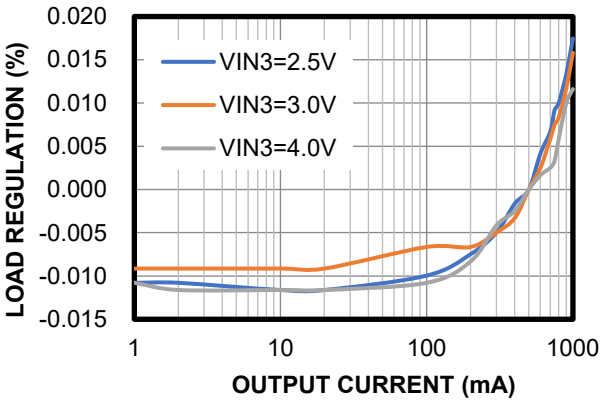
## EVB TEST RESULTS *(continued)*

**Performance curves and waveforms are tested on the evaluation board. $V_{IN}$ = 8V, $V_{OUT1}$ = 3V, $V_{OUT2}$ = 1.8V, $V_{OUT3}$ = 1.2V, $V_{LDO}$ = 2.5V, $L_1$ = $L_2$ = 2.2µH, $L_3$ = 1µH, $f_{SW1}$ = $f_{SW2}$ = $f_{SW3}$ = 2.2MHz, FCCM, $T_A$ = 25°C, unless otherwise noted.**

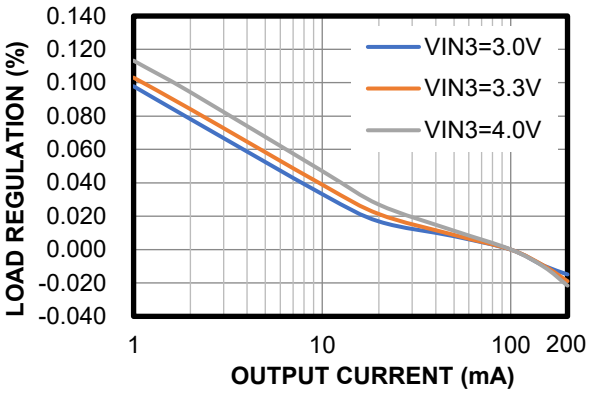
### Load Regulation (Buck 3)

$V_{OUT3}$ = 1.2V, $f_{SW3}$ = 2.2MHz, FCCM, L3 = 1µH, DCR = 35mΩ



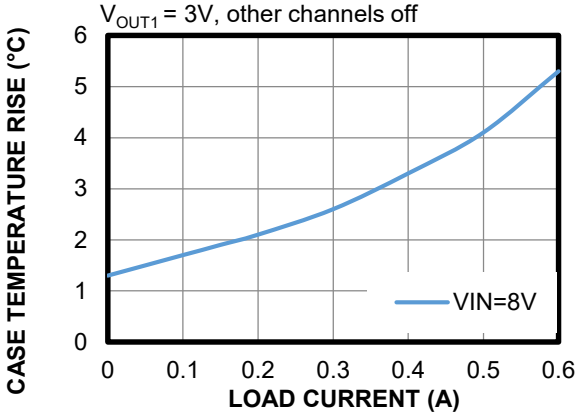

### Load Regulation (LDO)

$V_{LDO}$ = 2.5V, FCCM



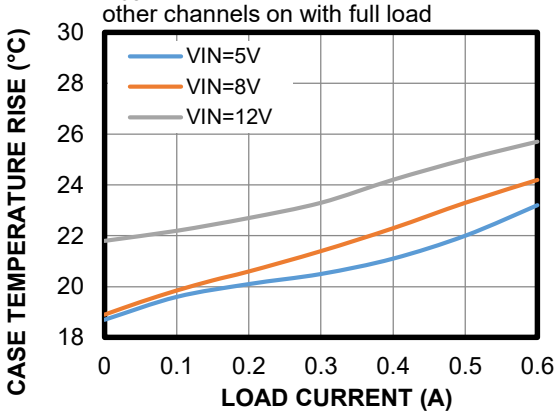

### Case Temperature Rise (Buck 1)

$V_{OUT1}$ = 3V, other channels off



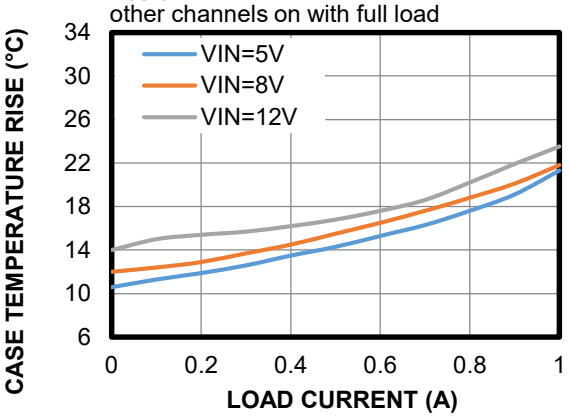

### Case Temperature Rise (Buck 2)

$V_{OUT2}$ = 1.8V, channel 1 on with no load, other channels on with full load



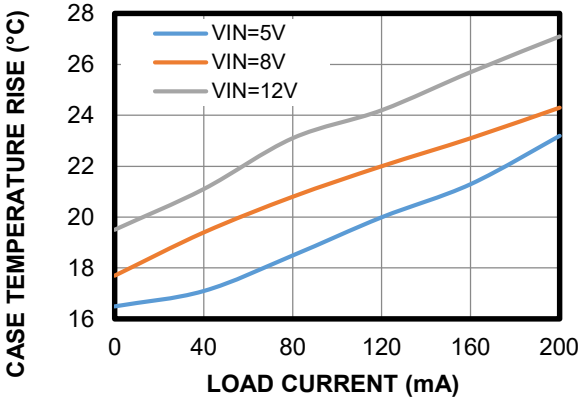

### Case Temperature Rise (Buck 3)

$V_{OUT3}$ = 1.2V, channel 1 on with no load, other channels on with full load




### Case Temperature Rise (LDO)

$V_{LDOOUT}$ = 2.5V, channel 1 on with no load, other channels on with full load





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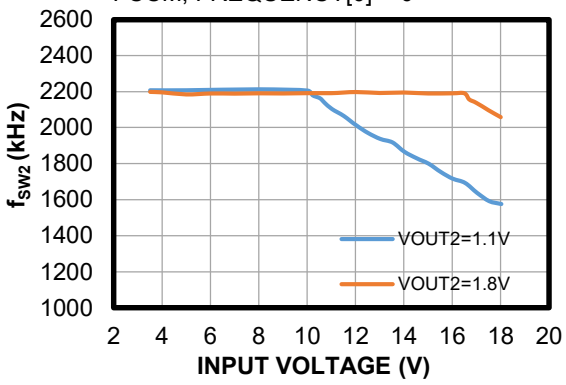
## EVB TEST RESULTS *(continued)*

**Performance curves and waveforms are tested on the evaluation board. $V_{IN}$ = 8V, $V_{OUT1}$ = 3V, $V_{OUT2}$ = 1.8V, $V_{OUT3}$ = 1.2V, $V_{LDO}$ = 2.5V, $L_1$ = $L_2$ = 2.2µH, $L_3$ = 1µH, $f_{SW1}$ = $f_{SW2}$ = $f_{SW3}$ = 2.2MHz, FCCM, $T_A$ = 25°C, unless otherwise noted.**

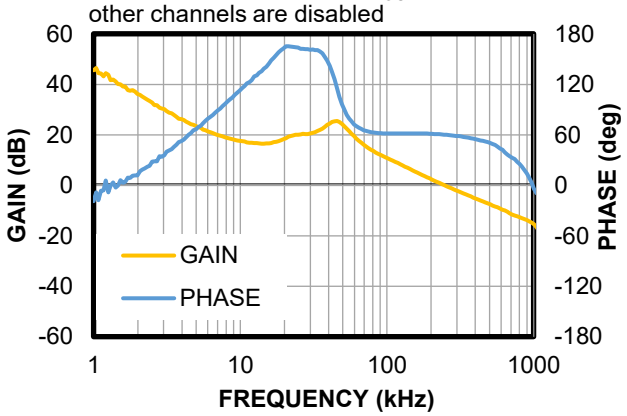
### $f_{SW2}$ vs. $V_{IN}$

FCCM, FREQUENCY[0] = 0



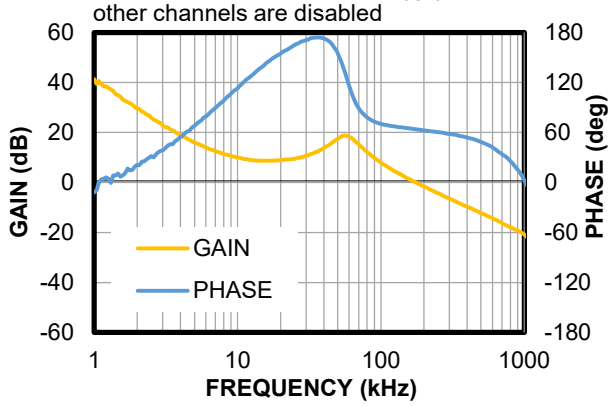

### Bode Plot vs. Frequency (Buck 1)

$V_{IN}$ = 8V, $V_{OUT1}$ = 3V, $I_{OUT1}$ = 0.6A, CCM, $f_{SW1}$ = 2.2MHz, L1 = 1µH, $C_{OUT1}$ = 2 x 4.7µF, other channels are disabled



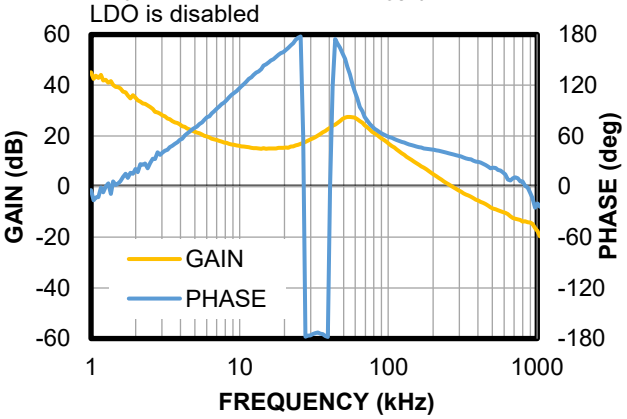

### Bode Plot vs. Frequency (Buck 2)

$V_{IN}$ = 8V, $V_{OUT2}$ = 1.8V, $I_{OUT2}$ = 0.6A, CCM, $f_{SW2}$ = 2.2MHz, L2 = 2.2µH, $C_{OUT3}$ = 4.7µF, other channels are disabled



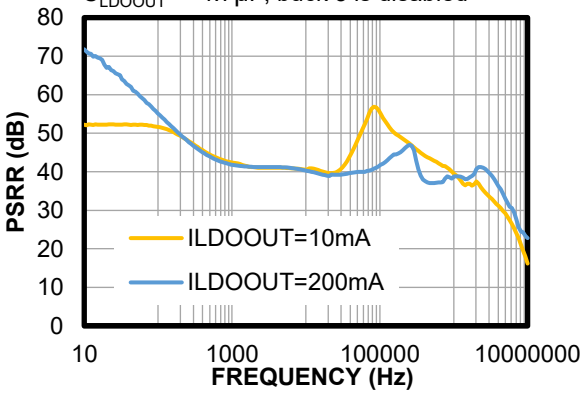

### Bode Plot vs. Frequency (Buck 3)

$V_{IN3}$ = 3V, $V_{OUT3}$ = 1.2V, $I_{OUT3}$ = 1A, CCM, $f_{SW3}$ = 2.2MHz, L3 = 1µH, $C_{OUT3}$ = 2 x 4.7µF, LDO is disabled



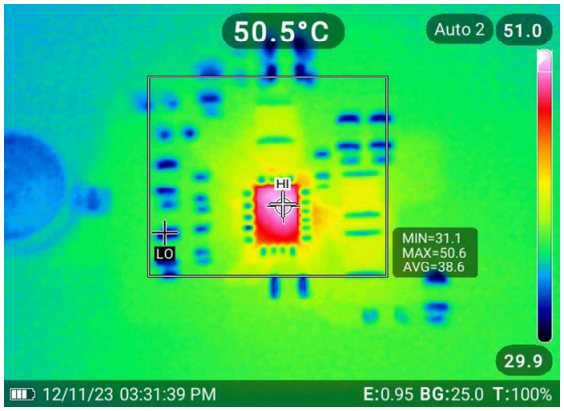

### PSRR vs. Frequncy (LDO)

$V_{IN3}$ = 4V, $V_{LDOOUT}$ = 2.5V, $C_{IN3}$ = 100nF, $C_{LDOOUT}$ = 4.7µF, buck 3 is disabled




### Thermal Performance

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA, no forced airflow, $T_A$ = 25°C





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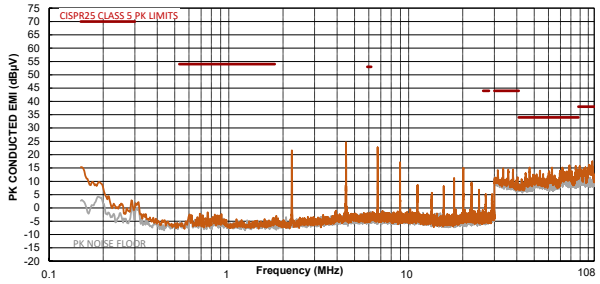
## EVB TEST RESULTS *(continued)*

**Performance curves and waveforms are tested on the evaluation board. $V_{IN}$ = 8V, $V_{OUT1}$ = 3V, $V_{OUT2}$ = 1.8V, $V_{OUT3}$ = 1.2V, $V_{LDO}$ = 2.5V, $L_1$ = $L_2$ = 2.2µH, $L_3$ = 1µH, $f_{SW1}$ = $f_{SW2}$ = $f_{SW3}$ = 2.2MHz, FCCM, $T_A$ = 25°C, unless otherwise noted.** (3)

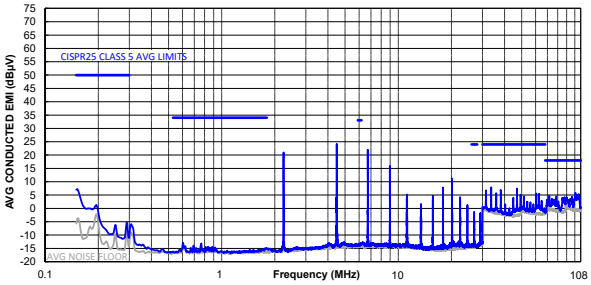
### CISPR25 Class 5 Peak Conducted Emissions

150kHz to 108MHz



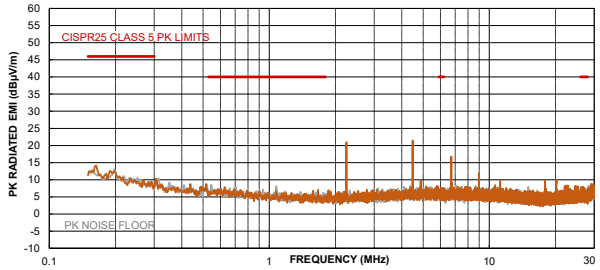

### CISPR25 Class 5 Average Conducted Emissions

150kHz to 108MHz



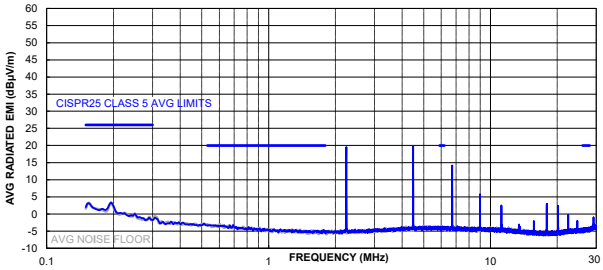

### CISPR25 Class 5 Peak Radiated Emissions

150kHz to 30MHz



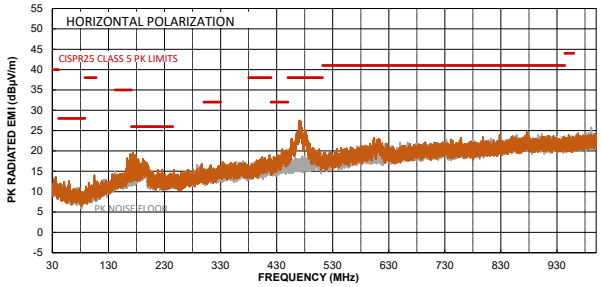

### CISPR25 Class 5 Average Radiated Emissions

150kHz to 30MHz



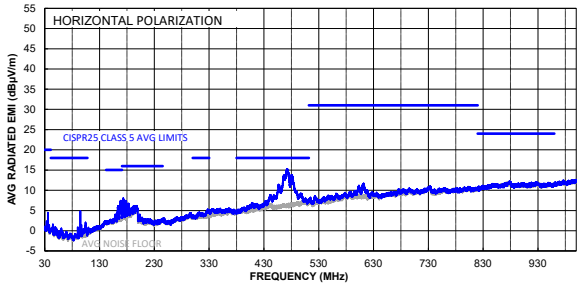

### CISPR25 Class 5 Peak Radiated Emissions

Horizontal, 30MHz to 1GHz




### CISPR25 Class 5 Average Radiated Emissions

Horizontal, 30MHz to 1GHz





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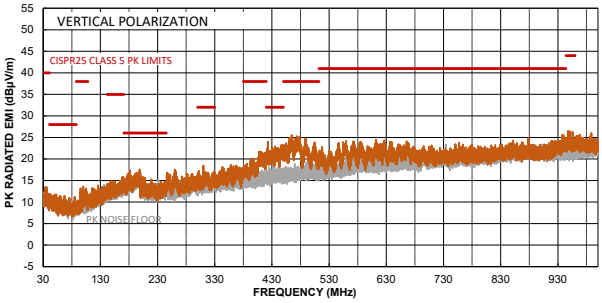
## EVB TEST RESULTS *(continued)*

**Performance curves and waveforms are tested on the evaluation board. $V_{IN}$ = 8V, $V_{OUT1}$ = 3V, $V_{OUT2}$ = 1.8V, $V_{OUT3}$ = 1.2V, $V_{LDO}$ = 2.5V, $L_1$ = $L_2$ = 2.2µH, $L_3$ = 1µH, $f_{SW1}$ = $f_{SW2}$ = $f_{SW3}$ = 2.2MHz, FCCM, $T_A$ = 25°C, unless otherwise noted.** (3)

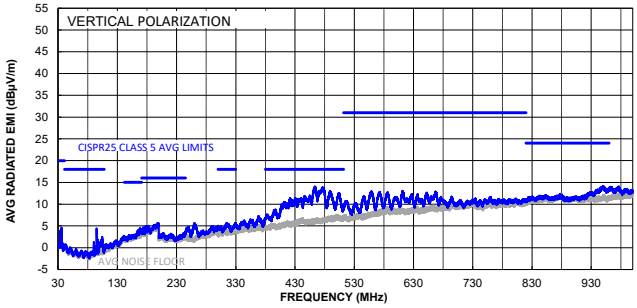
### CISPR25 Class 5 Peak Radiated Emissions

Vertical, 30MHz to 1GHz




### CISPR25 Class 5 Average Radiated Emissions

Vertical, 30MHz to 1GHz




**Note:**

3) All EMC test results are based on the evaluation board schematic with EMI filters (see Figure 2 on page 7).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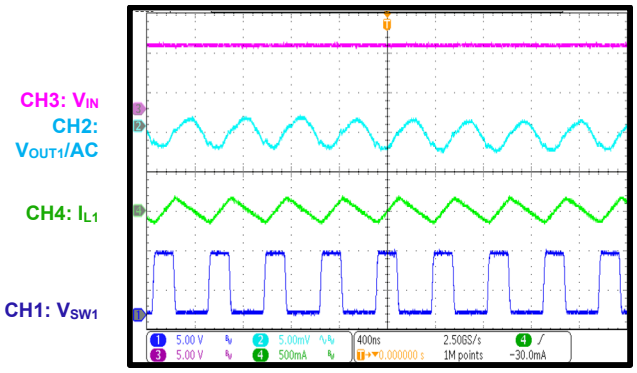
## EVB TEST RESULTS *(continued)*

**Performance curves and waveforms are tested on the evaluation board. $V_{IN}$ = 8V, $V_{OUT1}$ = 3V, $V_{OUT2}$ = 1.8V, $V_{OUT3}$ = 1.2V, $V_{LDO}$ = 2.5V, $L_1$ = $L_2$ = 2.2µH, $L_3$ = 1µH, $f_{SW1}$ = $f_{SW2}$ = $f_{SW3}$ = 2.2MHz, FCCM, $T_A$ = 25°C, unless otherwise noted.**

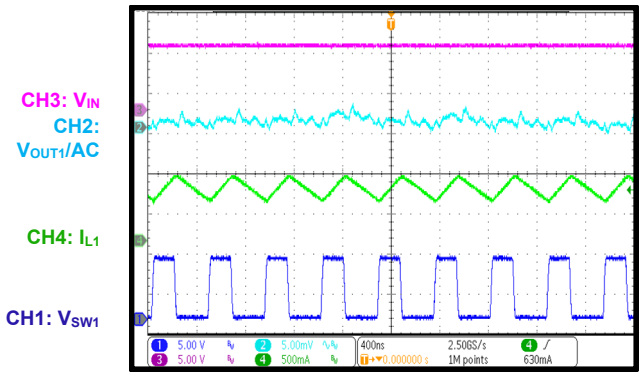
### Steady State (Buck 1)

$I_{OUT1}$ = $I_{OUT2}$ = $I_{OUT3}$ = $I_{LDO}$ = 0A



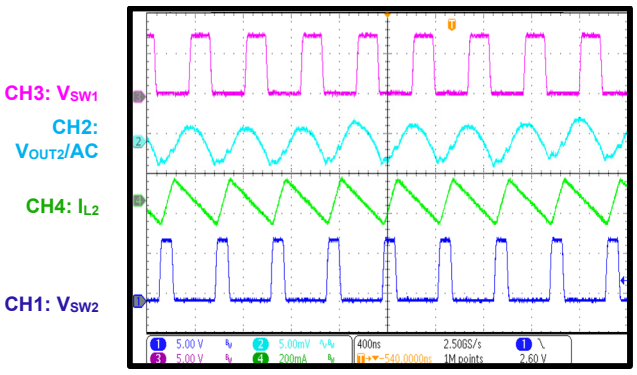

### Steady State (Buck 1)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA



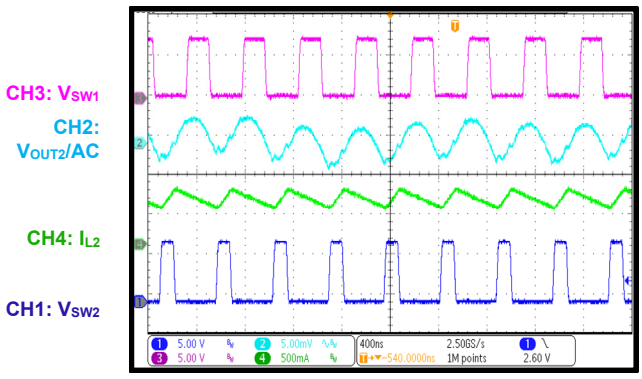

### Steady State (Buck 2)

$I_{OUT1}$ = $I_{OUT2}$ = $I_{OUT3}$ = $I_{LDO}$ = 0A



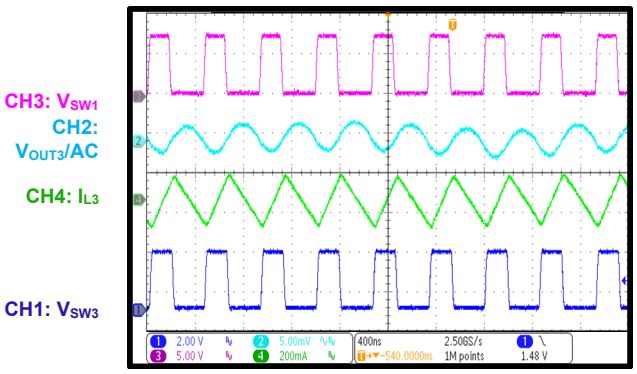

### Steady State (Buck 2)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA



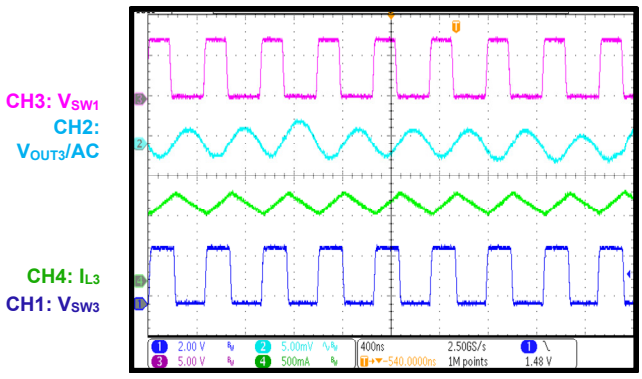

### Steady State (Buck 3)

$I_{OUT1}$ = $I_{OUT2}$ = $I_{OUT3}$ = $I_{LDO}$ = 0A




### Steady State (Buck 3)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA





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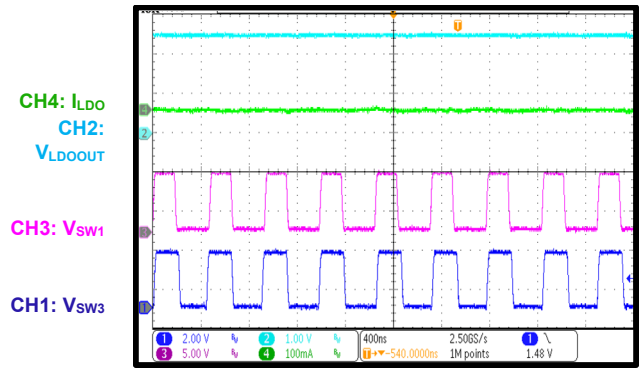
## EVB TEST RESULTS *(continued)*

**Performance curves and waveforms are tested on the evaluation board. $V_{IN}$ = 8V, $V_{OUT1}$ = 3V, $V_{OUT2}$ = 1.8V, $V_{OUT3}$ = 1.2V, $V_{LDO}$ = 2.5V, $L_1$ = $L_2$ = 2.2µH, $L_3$ = 1µH, $f_{SW1}$ = $f_{SW2}$ = $f_{SW3}$ = 2.2MHz, FCCM, $T_A$ = 25°C, unless otherwise noted.**

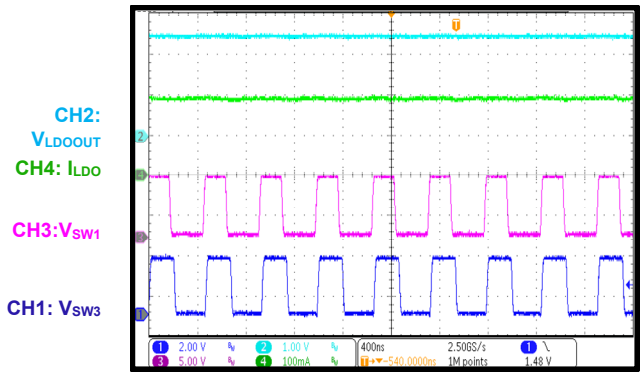
### Steady State (LDO)

$I_{OUT1}$ = $I_{OUT2}$ = $I_{OUT3}$ = $I_{LDO}$ = 0A



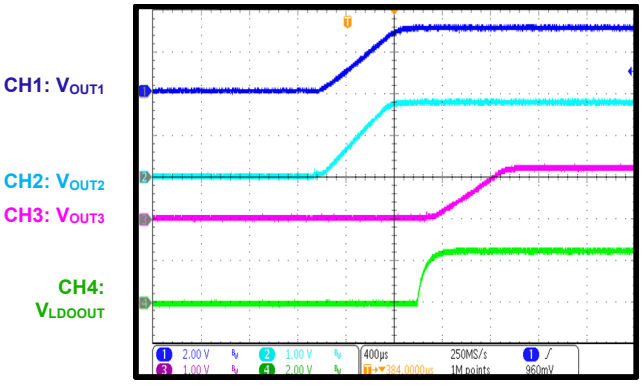

### Steady State (LDO)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA



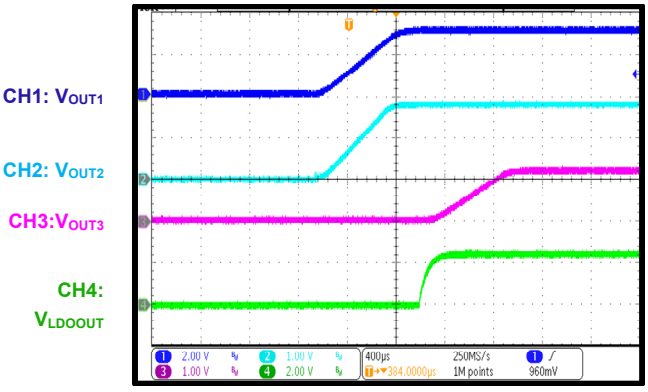

### Start-Up through VIN (Start-Up Sequence)

$I_{OUT1}$ = $I_{OUT2}$ = $I_{OUT3}$ = $I_{LDO}$ = 0A



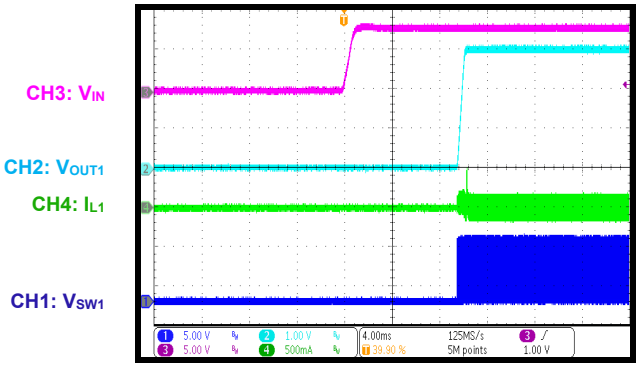

### Start-Up through VIN (Start-Up Sequence)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA



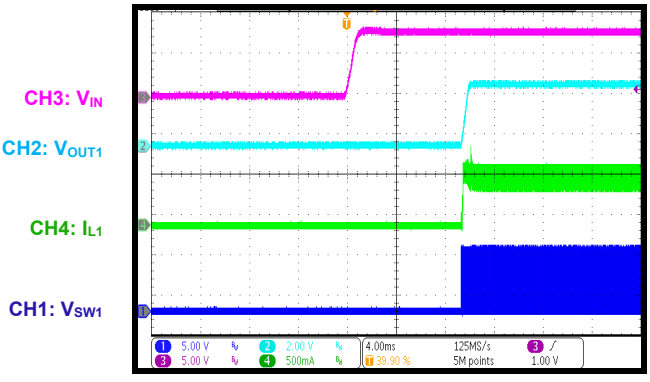

### Start-Up through VIN (Buck 1)

$I_{OUT1}$ = $I_{OUT2}$ = $I_{OUT3}$ = $I_{LDO}$ = 0A




### Start-Up through VIN (Buck 1)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA





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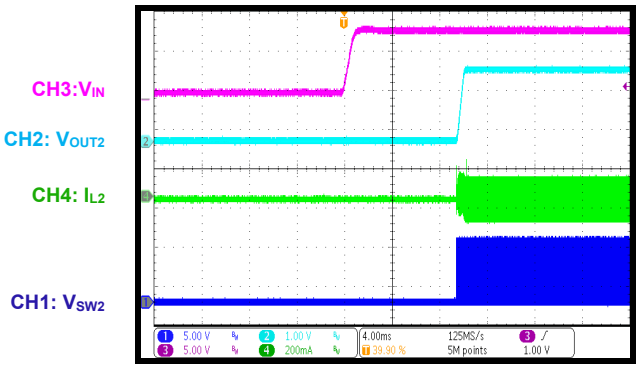
## EVB TEST RESULTS *(continued)*

**Performance curves and waveforms are tested on the evaluation board. $V_{IN}$ = 8V, $V_{OUT1}$ = 3V, $V_{OUT2}$ = 1.8V, $V_{OUT3}$ = 1.2V, $V_{LDO}$ = 2.5V, $L_1$ = $L_2$ = 2.2µH, $L_3$ = 1µH, $f_{SW1}$ = $f_{SW2}$ = $f_{SW3}$ = 2.2MHz, FCCM, $T_A$ = 25°C, unless otherwise noted.**

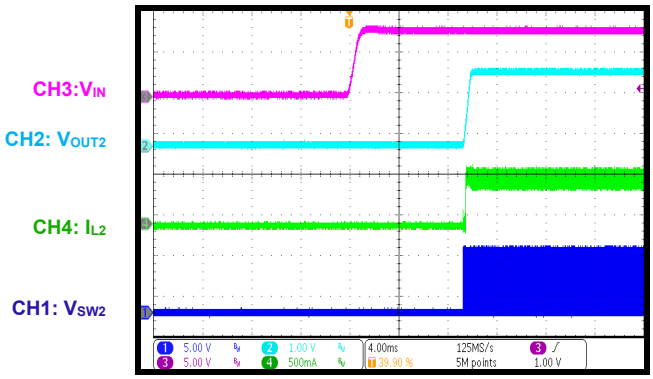
### Start-Up through VIN (Buck 2)

$I_{OUT1}$ = $I_{OUT2}$ = $I_{OUT3}$ = $I_{LDO}$ = 0A



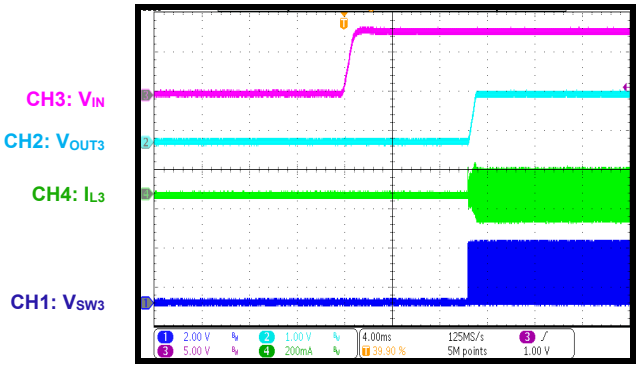

### Start-Up through VIN (Buck 2)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA



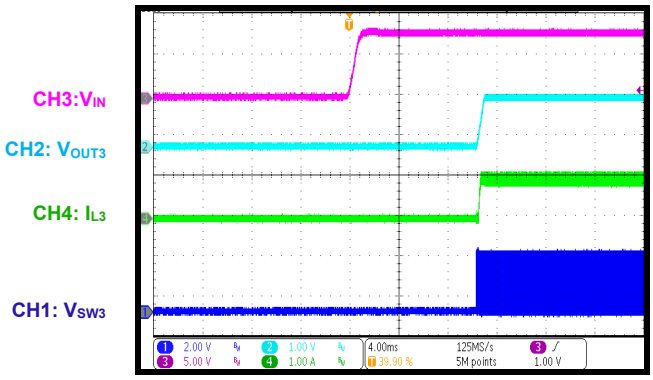

### Start-Up through VIN (Buck 3)

$I_{OUT1}$ = $I_{OUT2}$ = $I_{OUT3}$ = $I_{LDO}$ = 0A



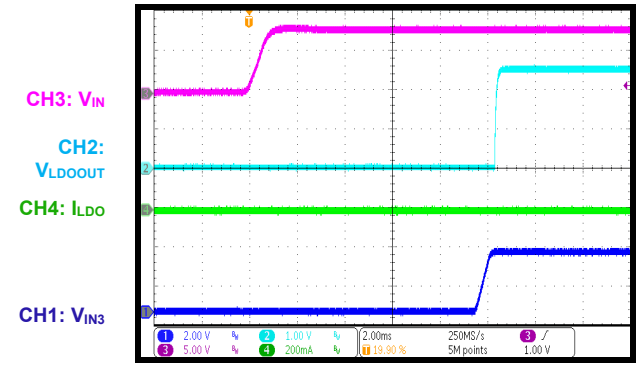

### Start-Up through VIN (Buck 3)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA



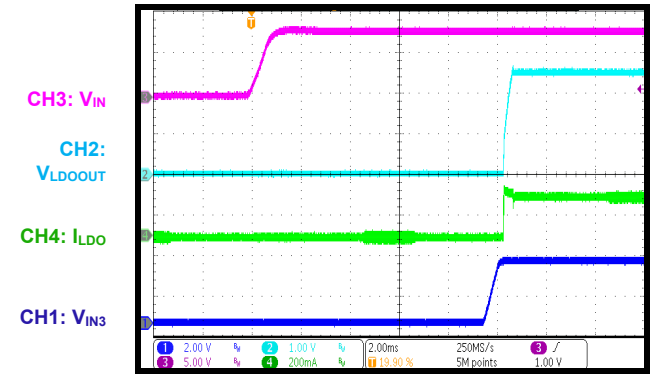

### Start-Up through VIN (LDO)

$I_{OUT1}$ = $I_{OUT2}$ = $I_{OUT3}$ = $I_{LDO}$ = 0A




### Start-Up through VIN (LDO)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA





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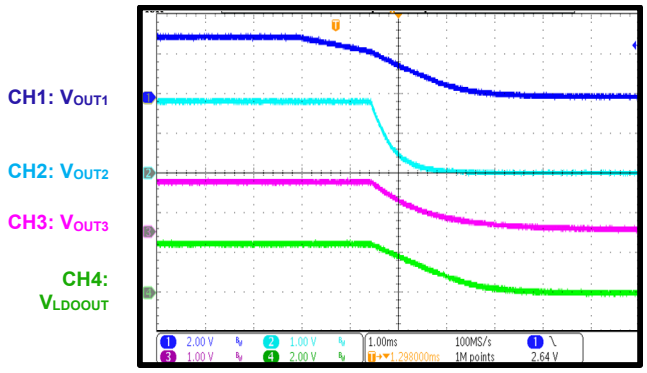
## EVB TEST RESULTS *(continued)*

**Performance curves and waveforms are tested on the evaluation board. $V_{IN}$ = 8V, $V_{OUT1}$ = 3V, $V_{OUT2}$ = 1.8V, $V_{OUT3}$ = 1.2V, $V_{LDO}$ = 2.5V, $L_1$ = $L_2$ = 2.2µH, $L_3$ = 1µH, $f_{SW1}$ = $f_{SW2}$ = $f_{SW3}$ = 2.2MHz, FCCM, $T_A$ = 25°C, unless otherwise noted.**

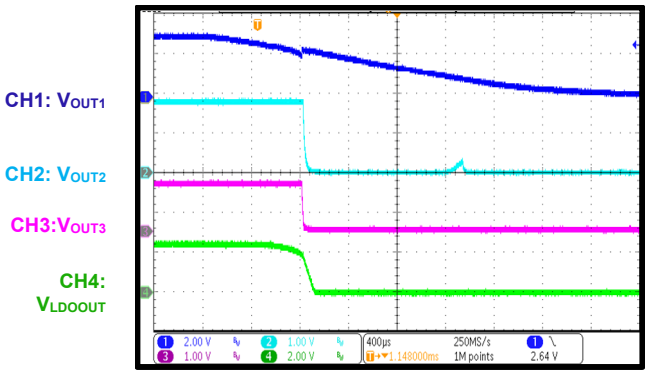
### Shutdown through VIN

$I_{OUT1}$ = $I_{OUT2}$ = $I_{OUT3}$ = $I_{LDO}$ = 0A



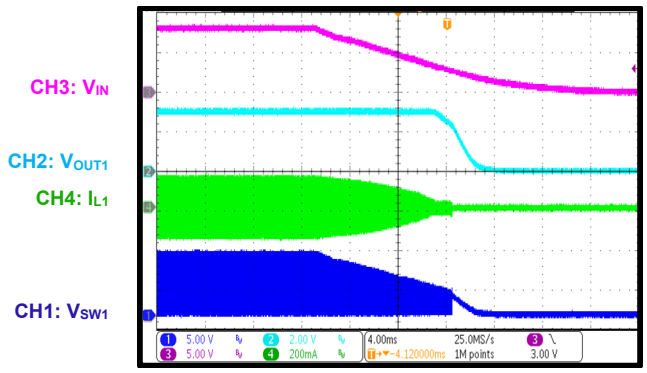

### Shutdown through VIN

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA



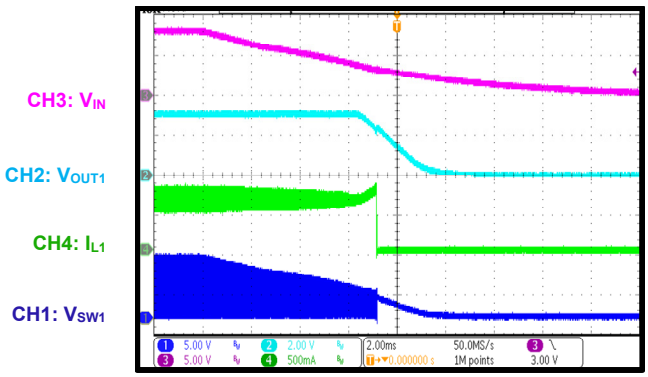

### Shutdown through VIN (Buck1)

$I_{OUT1}$ = $I_{OUT2}$ = $I_{OUT3}$ = $I_{LDO}$ = 0A



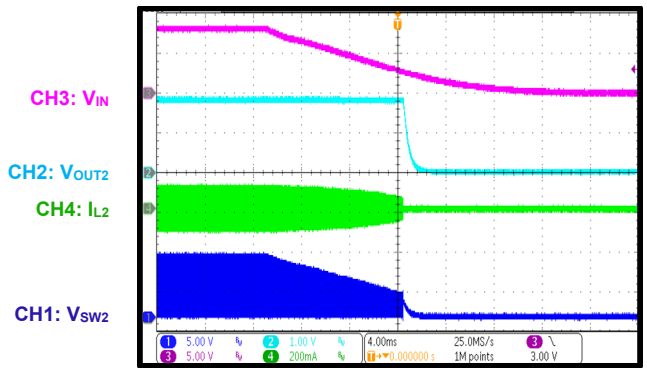

### Shutdown through VIN (Buck1)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA



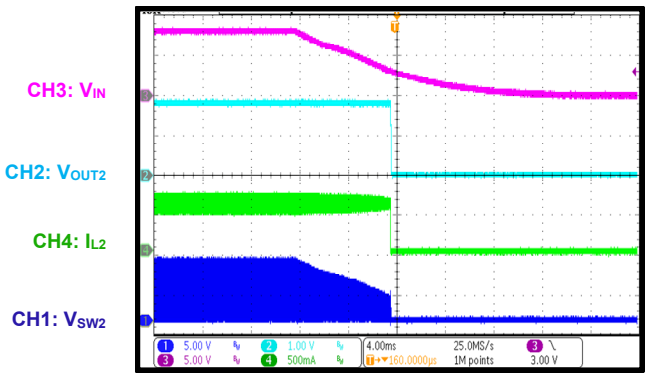

### Shutdown through VIN (Buck 2)

$I_{OUT1}$ = $I_{OUT2}$ = $I_{OUT3}$ = $I_{LDO}$ = 0A




### Shutdown through VIN (Buck 2)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA





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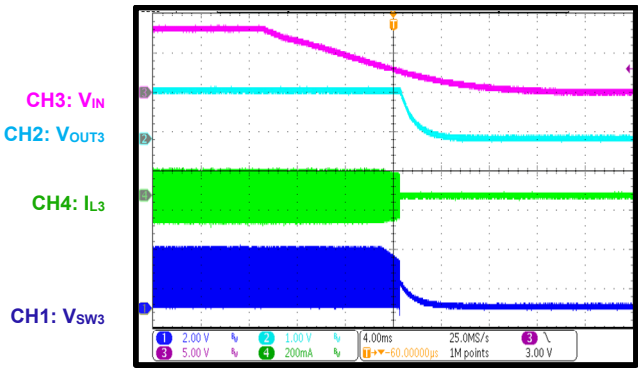
## EVB TEST RESULTS *(continued)*

**Performance curves and waveforms are tested on the evaluation board. $V_{IN}$ = 8V, $V_{OUT1}$ = 3V, $V_{OUT2}$ = 1.8V, $V_{OUT3}$ = 1.2V, $V_{LDO}$ = 2.5V, $L_1$ = $L_2$ = 2.2µH, $L_3$ = 1µH, $f_{SW1}$ = $f_{SW2}$ = $f_{SW3}$ = 2.2MHz, FCCM, $T_A$ = 25°C, unless otherwise noted.**

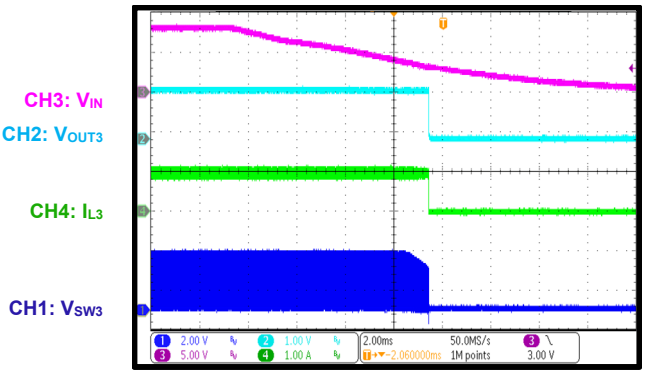
### Shutdown through VIN (Buck 3)

$I_{OUT1}$ = $I_{OUT2}$ = $I_{OUT3}$ = $I_{LDO}$ = 0A



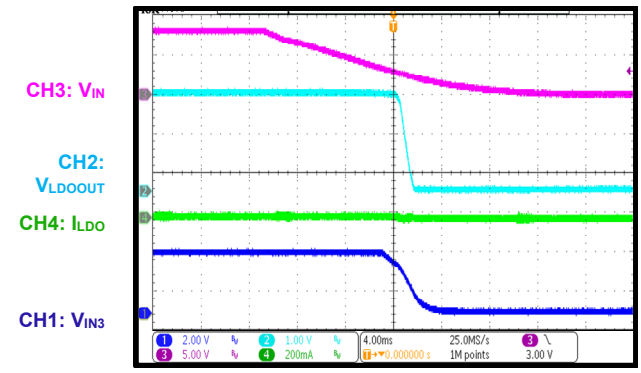

### Shutdown through VIN (Buck 3)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA



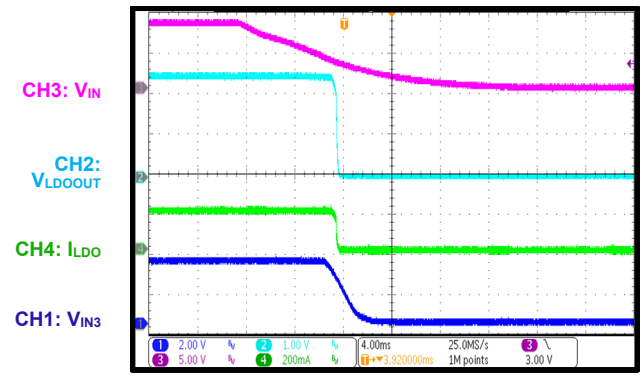

### Shutdown through VIN (LDO)

$I_{OUT1}$ = $I_{OUT2}$ = $I_{OUT3}$ = $I_{LDO}$ = 0A

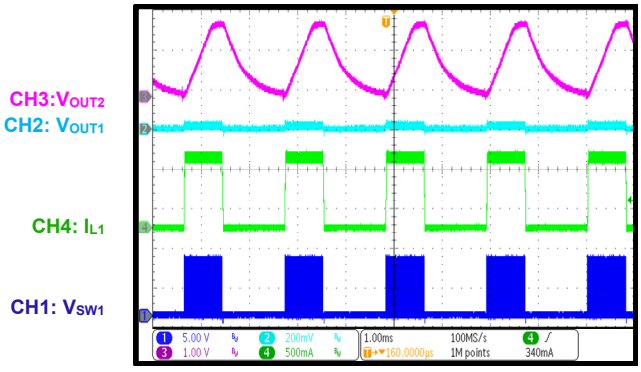



### Shutdown through VIN (LDO)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA

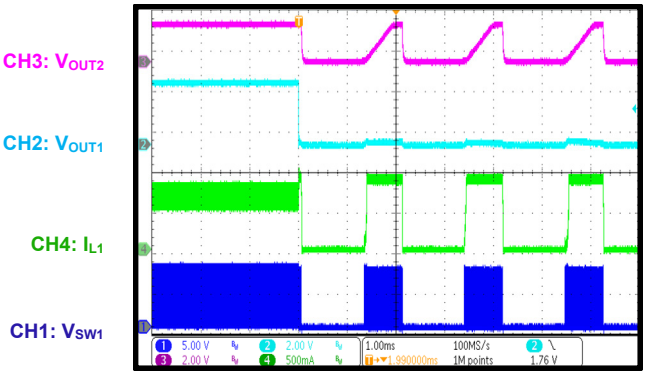



### SCP Steady State (Buck 1)




### SCP Entry (Buck 1)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA





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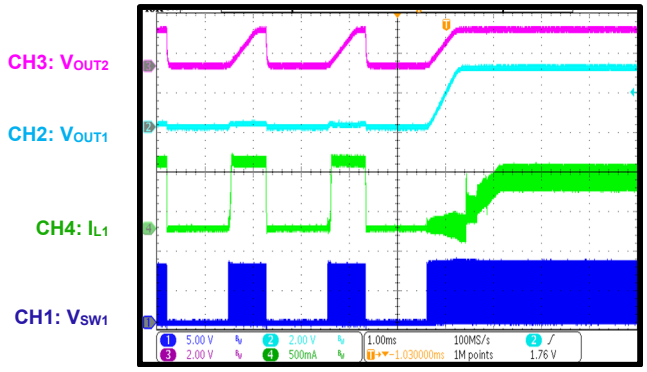
## EVB TEST RESULTS *(continued)*

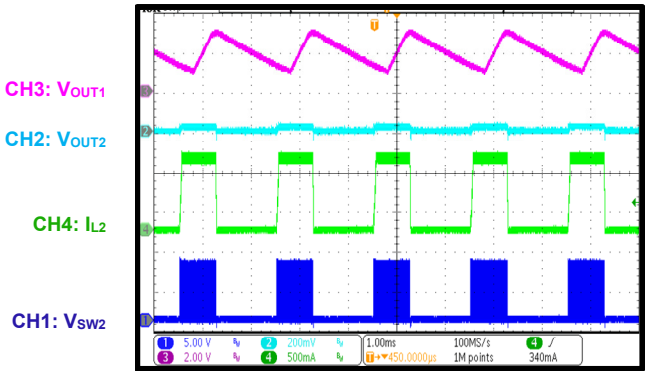
**Performance curves and waveforms are tested on the evaluation board. $V_{IN}$ = 8V, $V_{OUT1}$ = 3V, $V_{OUT2}$ = 1.8V, $V_{OUT3}$ = 1.2V, $V_{LDO}$ = 2.5V, $L_1$ = $L_2$ = 2.2µH, $L_3$ = 1µH, $f_{SW1}$ = $f_{SW2}$ = $f_{SW3}$ = 2.2MHz, FCCM, $T_A$ = 25°C, unless otherwise noted.**

### SCP Recovery (Buck 1)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA

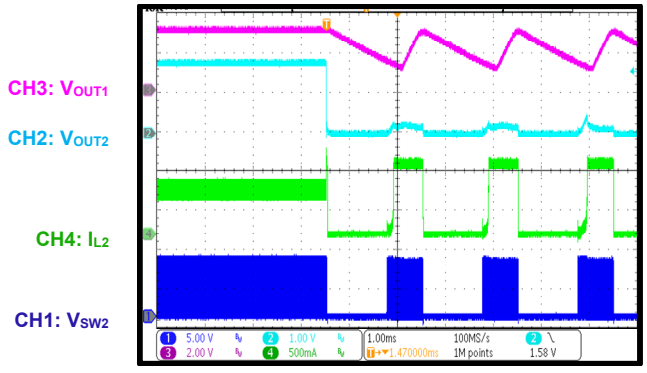



### SCP Steady State (Buck 2)



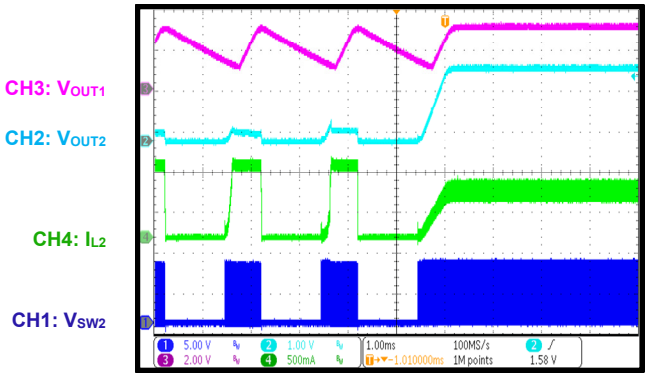

### SCP Entry (Buck 2)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA

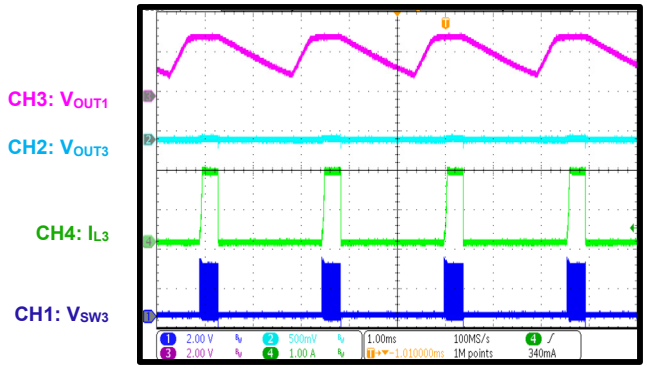



### SCP Recovery (Buck 2)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA

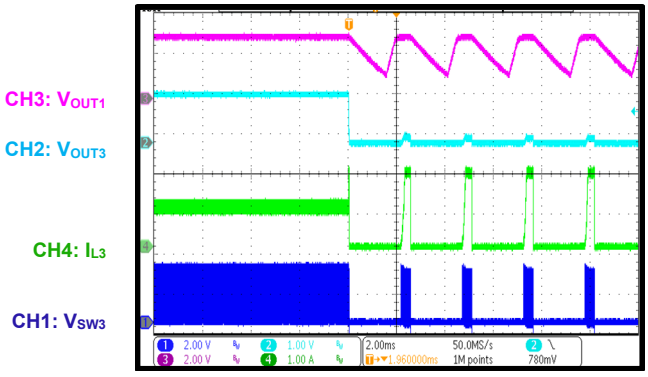



### SCP Steady State (Buck 3)




### SCP Entry (Buck 3)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA





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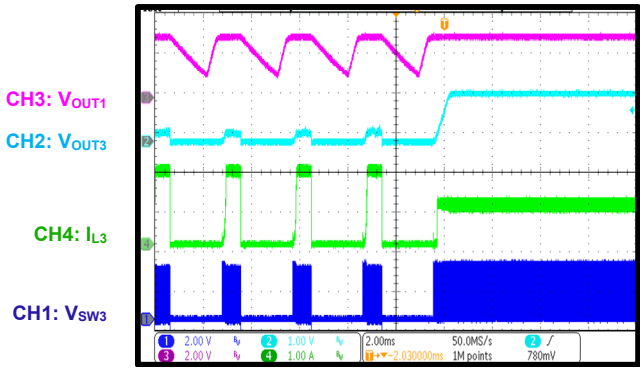
## EVB TEST RESULTS *(continued)*

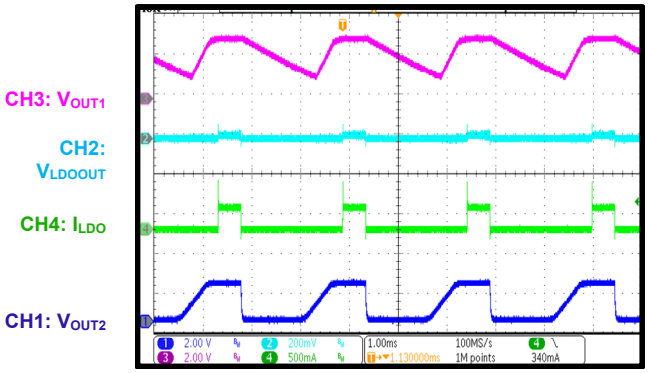
**Performance curves and waveforms are tested on the evaluation board. $V_{IN}$ = 8V, $V_{OUT1}$ = 3V, $V_{OUT2}$ = 1.8V, $V_{OUT3}$ = 1.2V, $V_{LDO}$ = 2.5V, $L_1$ = $L_2$ = 2.2µH, $L_3$ = 1µH, $f_{SW1}$ = $f_{SW2}$ = $f_{SW3}$ = 2.2MHz, FCCM, $T_A$ = 25°C, unless otherwise noted.**

### SCP Recovery (Buck 3)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA

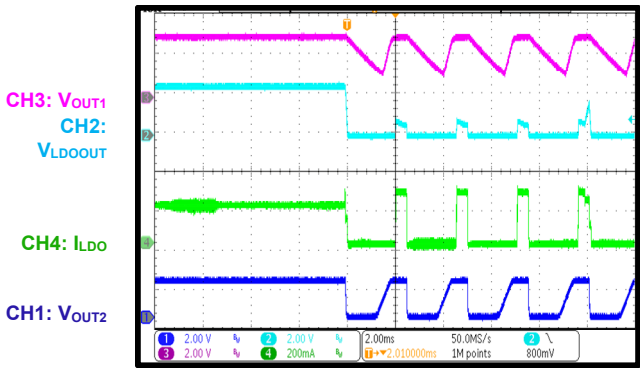



### SCP Steady State (LDO)



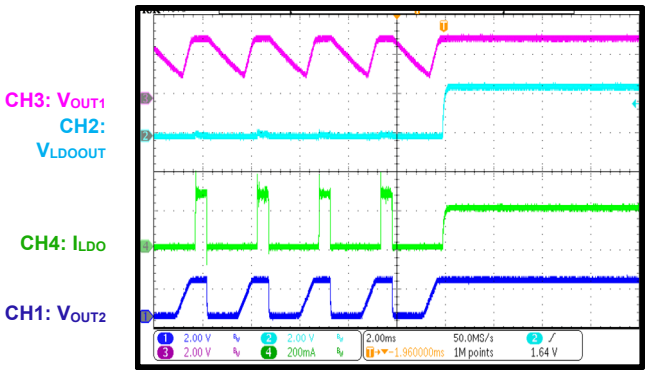

### SCP Entry (LDO)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA



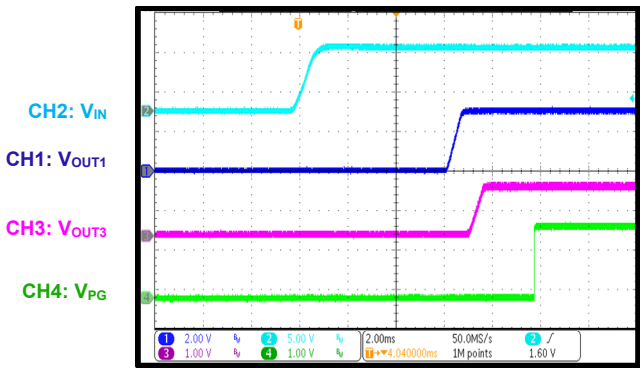

### SCP Recovery (LDO)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA



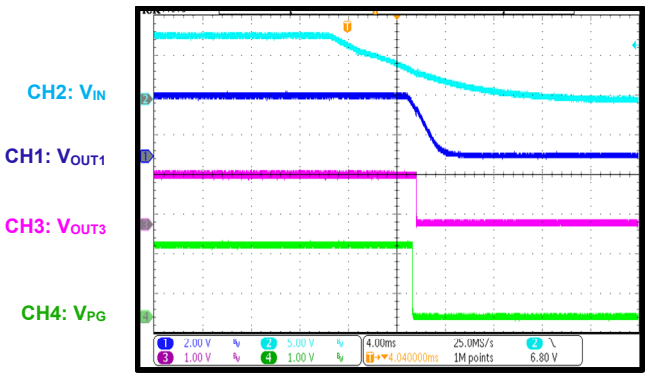

### PG Start-Up through VIN

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA




### PG Shutdown through VIN

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA





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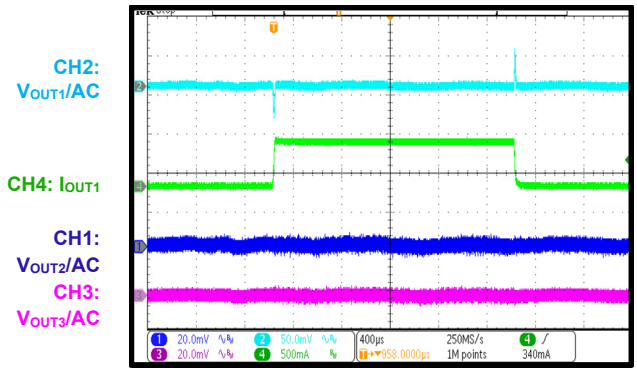
## EVB TEST RESULTS *(continued)*

**Performance curves and waveforms are tested on the evaluation board. $V_{IN}$ = 8V, $V_{OUT1}$ = 3V, $V_{OUT2}$ = 1.8V, $V_{OUT3}$ = 1.2V, $V_{LDO}$ = 2.5V, $L_1$ = $L_2$ = 2.2µH, $L_3$ = 1µH, $f_{SW1}$ = $f_{SW2}$ = $f_{SW3}$ = 2.2MHz, FCCM, $T_A$ = 25°C, unless otherwise noted.**

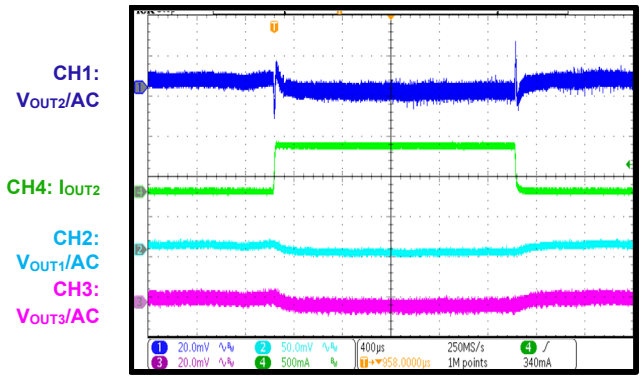
### Load Transient Response (Buck 1)

$I_{OUT1}$ = 0A to 600mA, $I_{OUT2}$ = $I_{OUT3}$ = $I_{LDO}$ = 0A



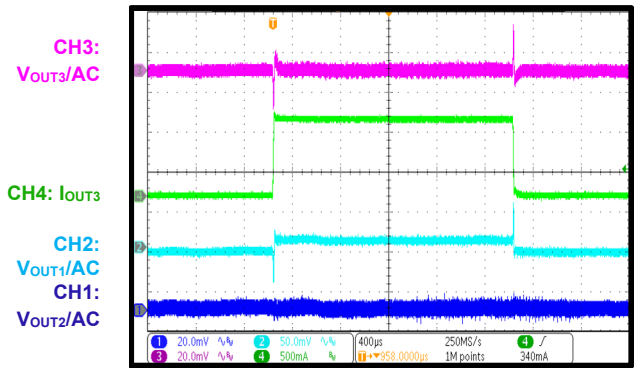

### Load Transient Response (Buck 2)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 0A to 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 200mA



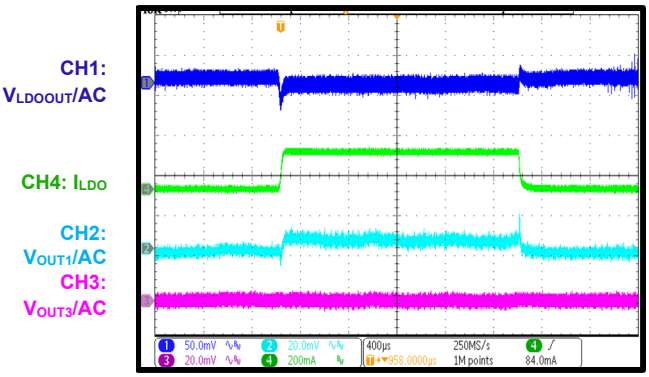

### Load Transient Response (Buck 3)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 0A to 1A, $I_{LDO}$ = 200mA




### Load Transient Response (LDO)

$I_{OUT1}$ = 0A, $I_{OUT2}$ = 600mA, $I_{OUT3}$ = 1A, $I_{LDO}$ = 0A to 200mA





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## PCB LAYOUT (4)

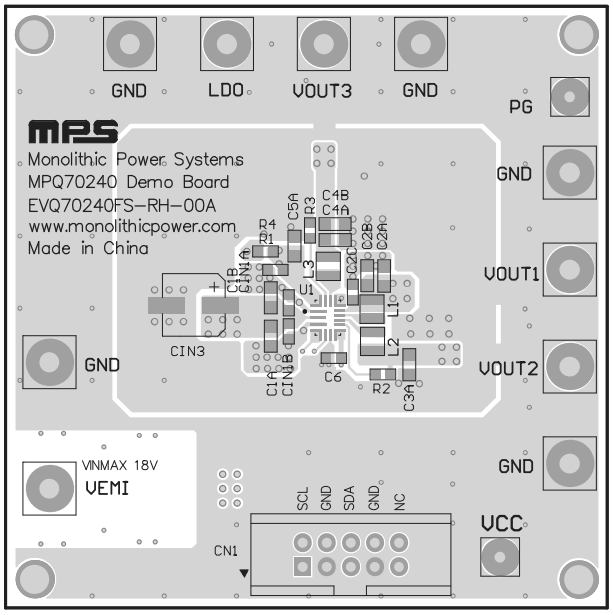


**Figure 4: Top Silk and Top Layer**

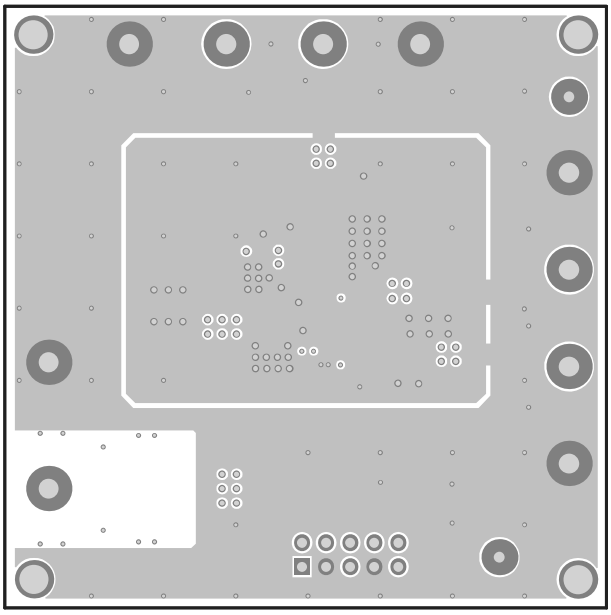

**Figure 5: Mid-Layer 1**

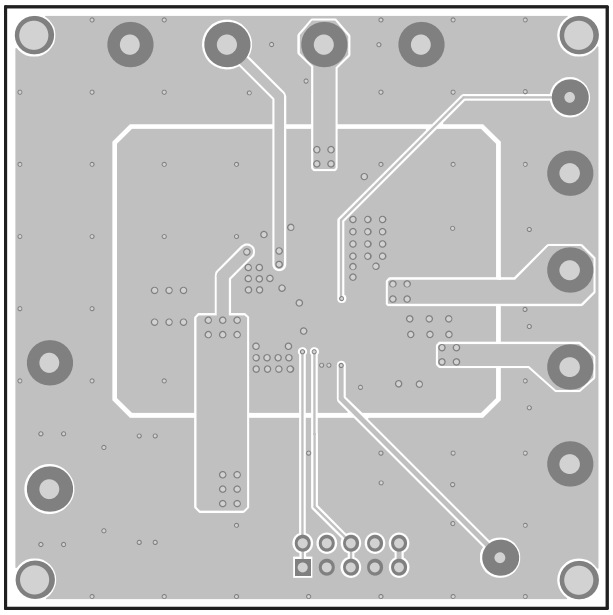

**Figure 6: Mid-Layer 2**

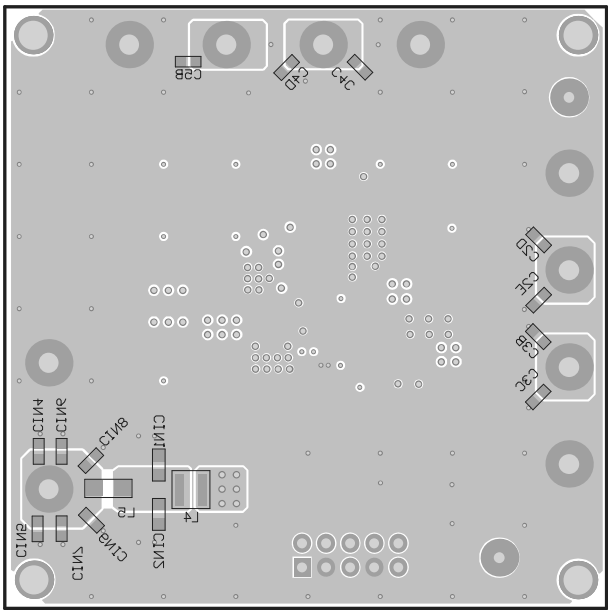

**Figure 7: Bottom Layer and Bottom Silk**

**Note:**

4) The EVQ70240FS-RH-00A is a 4-layer PCB with a 2oz copper thickness PCB (6.35cmx6.35cm).


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## REVISION HISTORY

| Revision # | Revision Date | Description | Pages Updated |
|---|---|---|---|
| 1.0 | 1/31/2024 | Initial Release | - |

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