# EVQ6634-LTE-00A

## 35V, 2A Peak, 3-Phase, Sensorless BLDC Motor Driver Evaluation Board, AEC-Q100 Qualified

## DESCRIPTION

The EVQ6634-LTE-00A is an evaluation board designed to demonstrate the capabilities of the MPQ6634, a 3-phase, sensorless brushless DC (BLDC) motor driver with integrated power MOSFETs. The MPQ6634 provides sensorless field-oriented control (FOC) to achieve improved efficiency and low vibration with up to 2A of peak current. The input voltage ($V_{IN}$) range is between 4.5V and 35V.

The MPQ6634 controls the motor speed through the pulse-width modulation (PWM) signal with a 50Hz to 20kHz PWM input frequency. The device supports DC input speed control. It also provides closed-/open-loop speed control and a built-in configurable speed curve function.

The MPQ6634 provides rotational speed detection. The rotational speed detector (the FG/RD pin) is an open-drain output. In addition to rotation speed detection, the direction is controlled via the DIR pin input.

Rich protections include input over-voltage protection (OVP), under-voltage lockout (UVLO), locked-rotor protection, phase-loss protection, over-current protection (OCP), and thermal shutdown protection.

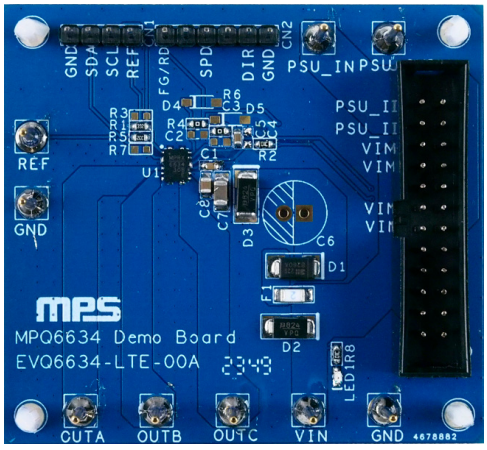
The MPQ6634 is available in a TQFN-12 (3mmx4mm) package with wettable flanks, and it is available in AEC-Q100 Grade 1.

## PERFORMANCE SUMMARY

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

| Parameters | Conditions | Value |
|---|---|---|
| Input voltage ($V_{IN}$) range | | 4.5V to 35V |
| Peak phase current | | Maximum 2A |
| Input PWM frequency | Configured to pulse-width modulation (PWM) mode | 50Hz to 20kHz |
| PWM voltage range | Configured to DC mode | 0V to 3.3V |
| Switching frequency ($f_{SW}$) | | 24kHz |

## EVQ6634-LTE-00A EVALUATION BOARD




**LxWxH (6cmx5.5cmx2.2cm)**

| Board Number | MPS IC Number |
|---|---|
| EVQ6634-LTE-00A | MPQ6634GLTE-0000-AEC1 |

# QUICK START GUIDE

## Quick Start Using the Communication Kit (MPS Fan Driver Communication Kit)

1. Preset the DC power supply, then turn the power supply off.
2. Connect the power supply outputs to PSU_IN and PSU_GND (see Figure 1).
3. Connect the communication kit to the EVQ6634-LTE-00A via CN3.
4. Connect the motor phase terminals to:
   a. Motor phase A: OUTA
   b. Motor phase B: OUTB
   c. Motor phase C: OUTC
5. Connect the communication kit to the computer.
6. Turn the power supply on.
7. Run the MPS BLDC Virtual Bench GUI and select the MPQ6634. (1)
8. Figure 1 shows the equipment set-up with the communication kit.

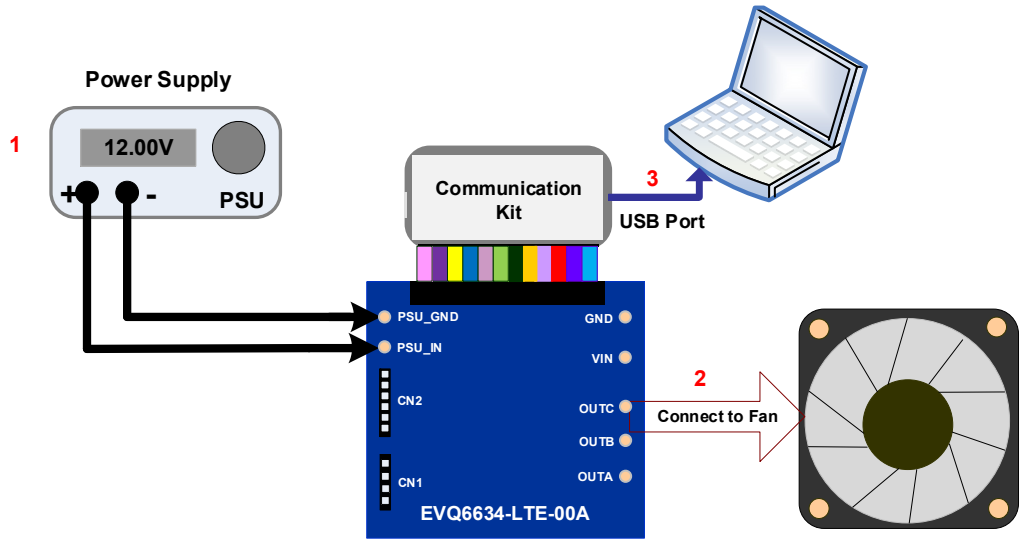



**Figure 1: EVB Connection with the Communication Kit**

**Note:**

1) Contact an MPS FAE to obtain the MPS BLDC Virtual Bench GUI.

## Quick Start without the Communication Kit

1. Ensure that the IC code is the configured code based on the fan to be tested.
2. Connect the power supply's output terminals to VIN and GND.
3. Connect the motor phase terminals to:
   a. Motor phase A: OUTA
   b. Motor phase B: OUTB
   c. Motor phase C: OUTC

4. Turn the power supply on. The motor should begin working.
5. Set the function generator to pulse mode, such that the high level is 3.3V and the low level is 0V. Adjust the pulse duty cycle to control the motor's speed.
6. Figure 2 shows the equipment set-up without the communication kit.

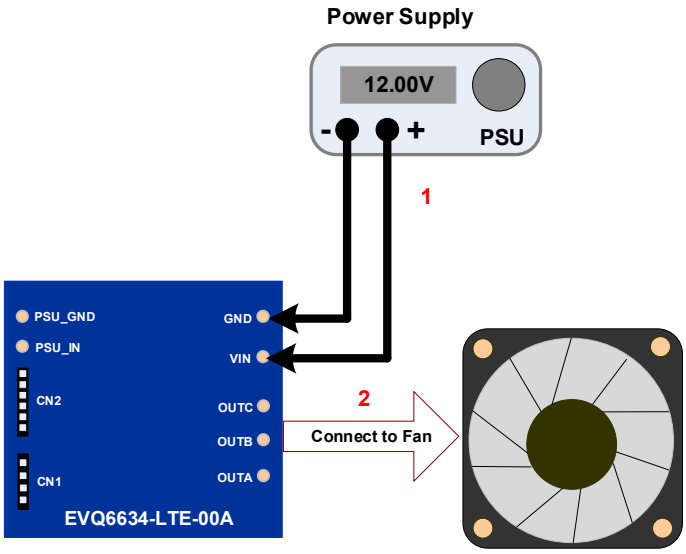



**Figure 2: EVB Connection without the Communication Kit**

## Measurement of Motor Parameters

The motor phase resistance and phase inductance are two important parameters for sensorless field-oriented control (FOC). The motor phase resistance or inductance refers to the resistance or inductance from the phase output to the center tap.

To determine the phase resistance, measure the resistance between the two-phase terminals via the multimeter or LCR meter, then divide the resistance by two.

To determine the phase inductance, measure the inductance between the two-phase terminals via the LCR meter, then divide the inductance by two. The LCR frequency is 1kHz, and the LCR voltage is 1V.

## GUI Operation Guide

1. Install the MPS BLDC Virtual Bench GUI.
2. Start up the GUI software, then click “Select Chip” (see Figure 3).

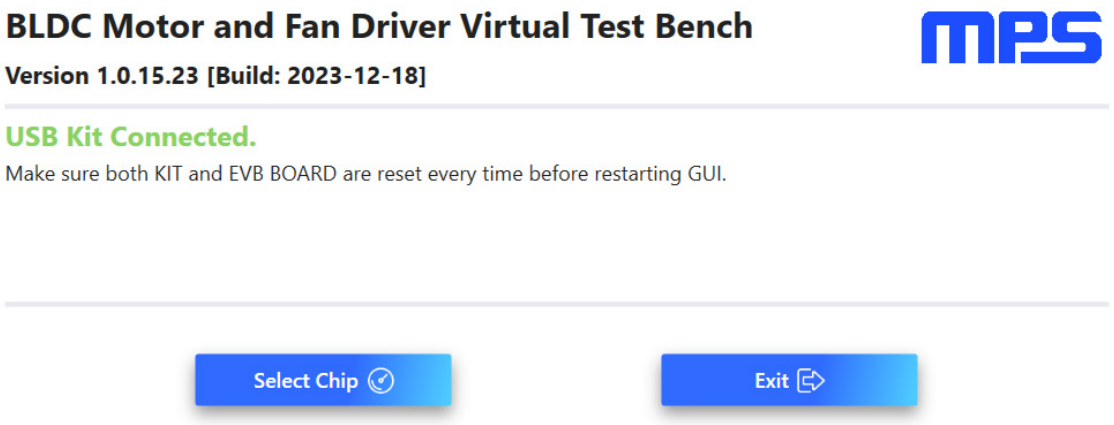



**Figure 3: Select Chip**

3. Click “Details” on the bottom-right corner to enter the test mode (see Figure 4).

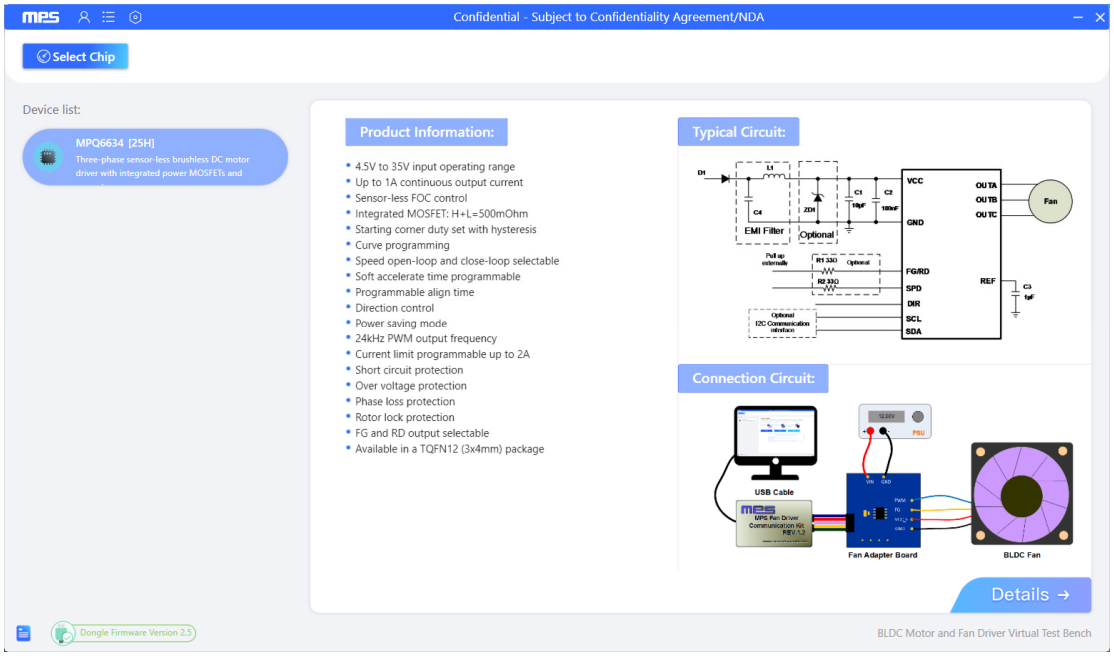



**Figure 4: Enter the Test Mode**

# EVALUATION BOARD SCHEMATIC

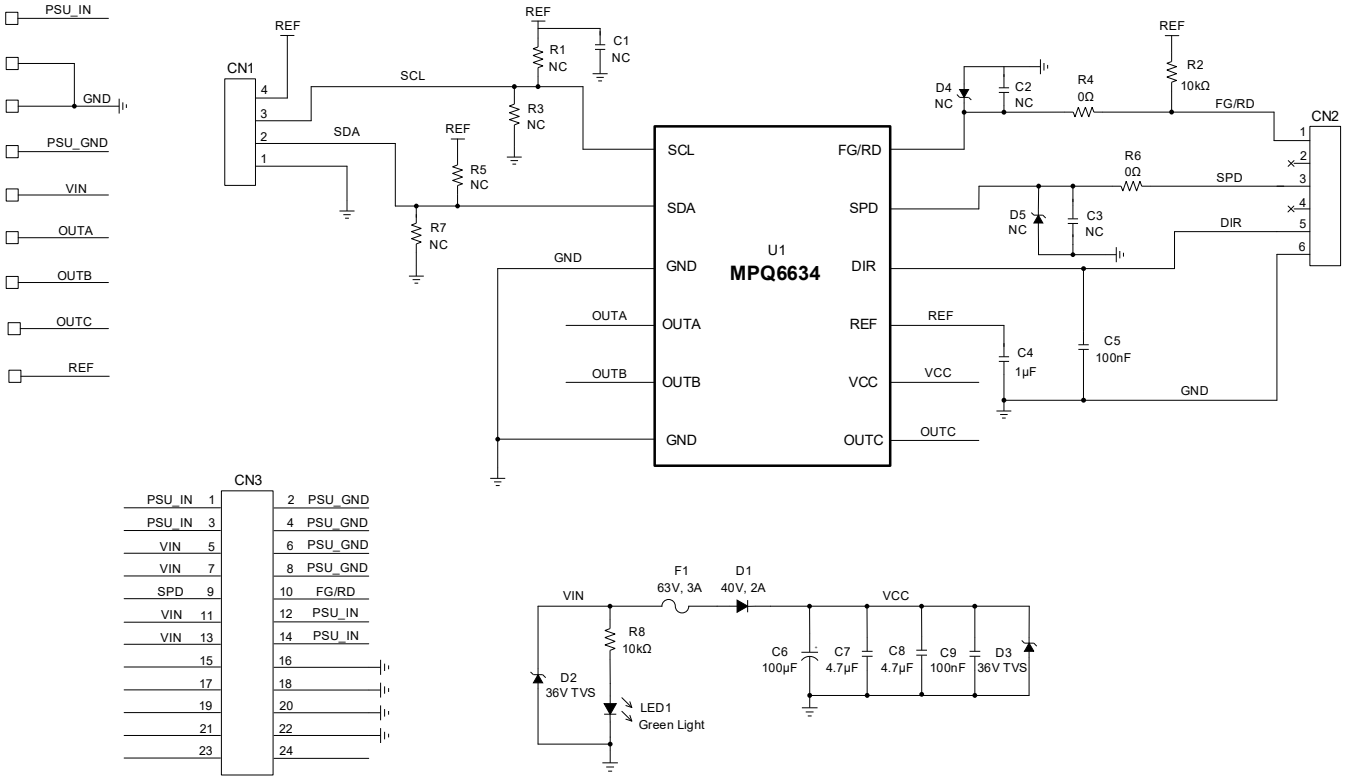



**Figure 5: Evaluation Board Schematic**

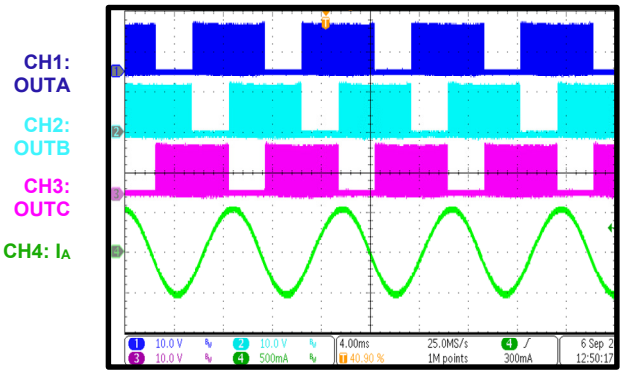
## EVQ6634-LTE-00A BILL OF MATERIALS

| Qty | Ref | Value | Description | Package | Manufacturer | Manufacturer PN |
|---|---|---|---|---|---|---|
| 2 | CN1, CN2 | 2.54mm | Connector, 1 x 40-pin | DIP | Any | |
| 1 | CN3 | 2.54mm | Socket with frame, 180°, 2 x 12-pin | DIP | Any | |
| 1 | C1 | 1μF | Ceramic capacitor, 16V, X7R | 0603 | Wurth | 885012206052 |
| 1 | C5 | 100nF | Ceramic capacitor, 16V, X7R | 0603 | Murata | GRM188R71C104KA01D |
| 1 | C7 | 4.7μF | Ceramic capacitor, 50V, X7R | 1206 | TDK | C3216X7R1H475K |
| 1 | C8 | 4.7μF | Ceramic capacitor, 50V, X5R | 0805 | Murata | GRM21BR61H475KE51L |
| 1 | C9 | 100nF | Ceramic capacitor, 50V, X7R | 0603 | Murata | GRM188R71H104KA93D |
| 1 | D1 | 2A | Schottky diode, 60V | SMA | Diodes, Inc. | B260A-13-F |
| 2 | D2, D3 | 36V | TVS diode | DO-214AC | Bourns | SMAJ36CA-Q |
| 1 | F1 | 2A | Surface-mount fuse, 63V | 1206 | Cooper Bussmann | 3216FF2-R |
| 9 | VIN, REF, PSU_IN, OUTA, OUTB, OUTC, GND1, GND2, PSU_GND | 1mm | Connector | DIP | Any | |
| 1 | LED1 | Green | Green LED | 0603 | Baihong | BL-HGE36A-AV-TRB |
| 2 | R1, R5 | 3.3kΩ | Film resistor, 1% | 0603 | Yageo | RC0603FR-073K3L |
| 2 | R2, R8 | 10kΩ | Film resistor, 1% | 0603 | Yageo | RC0603FR-0710KL |
| 2 | R4, R6 | 0Ω | Film resistor, 1% | 0603 | Yageo | RC0603FR-070RL |
| 1 | U1 | MPQ6634 | 35V, 2A peak, 3-phase sensorless BLDC motor driver, AEC-Q100 qualified | TQFN-12 (3mmx 4mm) | MPS | MPQ6634GLTE-0000-AEC1 |

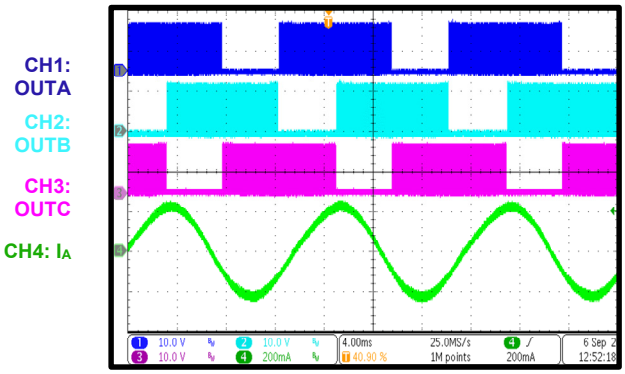
# EVB TEST RESULTS

**Performance waveforms are tested on the evaluation board. $V_{IN}$ = 12V, PWM input frequency = 100Hz, load = seat fan, unless otherwise noted.**

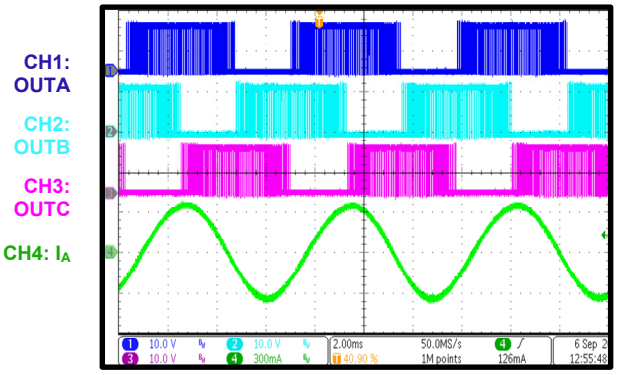
### Steady State
PWM duty = 100%, DIR = low



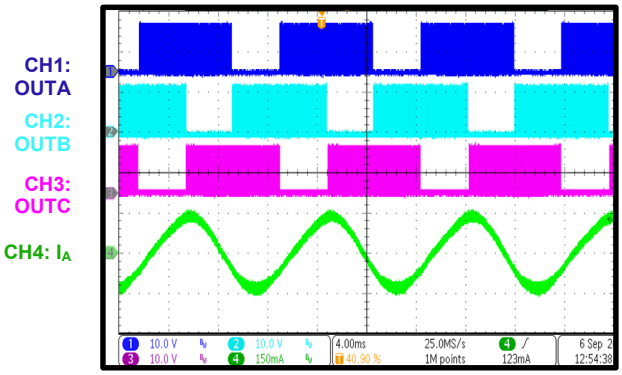

### Steady State
PWM duty = 50%, DIR = low



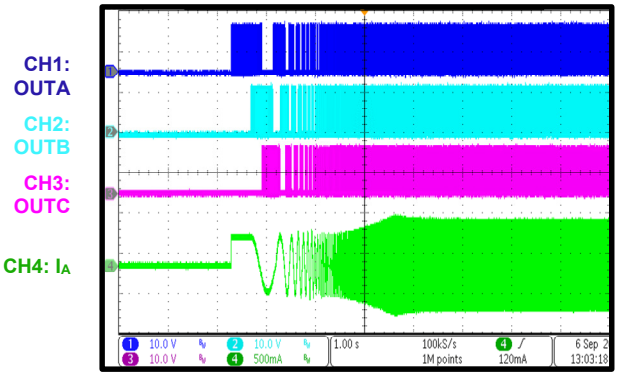

### Steady State
PWM duty = 100%, DIR = high



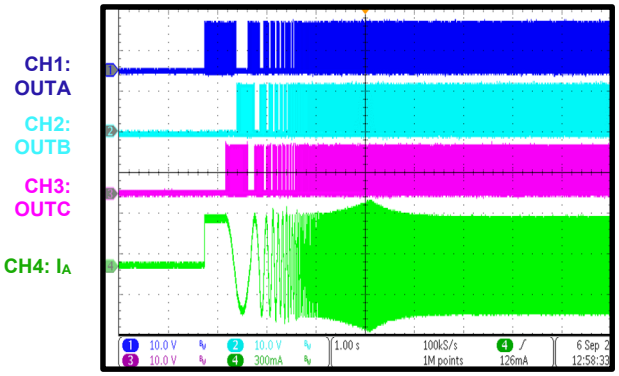

### Steady State
PWM duty = 50%, DIR = high




### PWM On
PWM duty = 0% to 100%, DIR = low




### PWM On
PWM duty = 0% to 100%, DIR = high

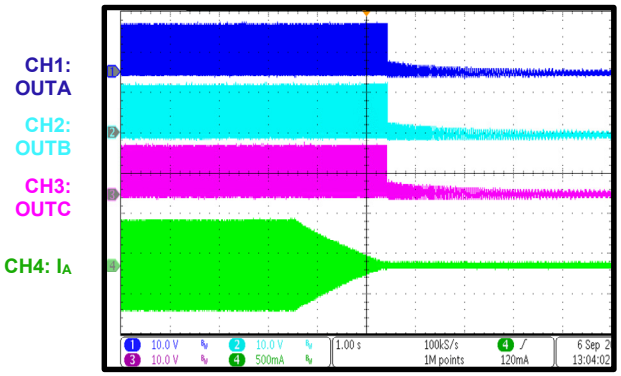


## EVB TEST RESULTS *(continued)*

**Performance waveforms are tested on the evaluation board. $V_{IN}$ = 12V, PWM input frequency = 100Hz, load = seat fan, unless otherwise noted.**

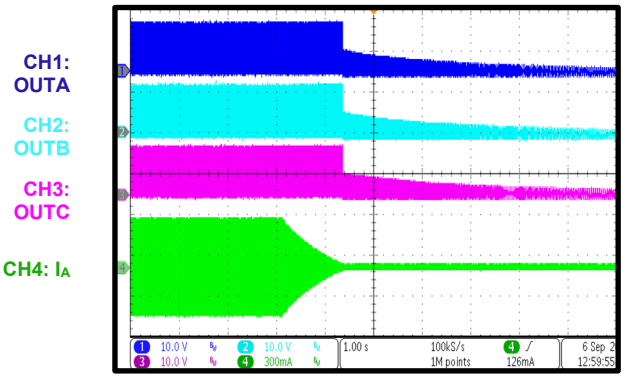
### PWM Off

PWM duty = 100% to 0%, DIR = low



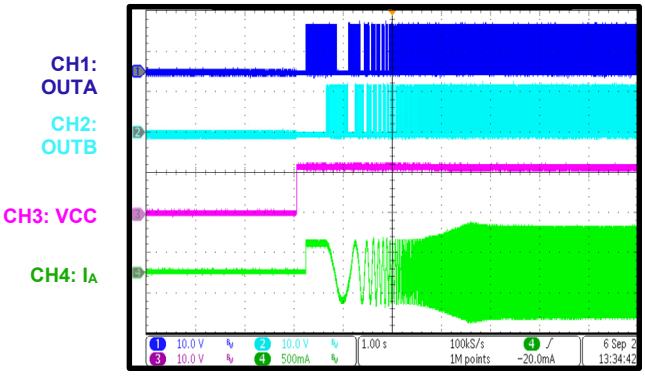

### PWM Off

PWM duty = 100% to 0%, DIR = high



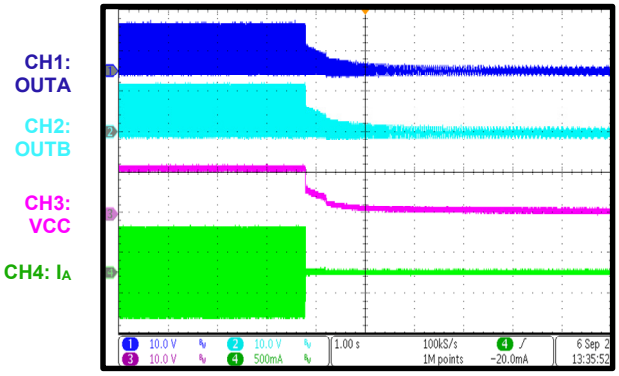

### Start-Up through VCC

VCC = 0V to 12V, PWM duty = 100%, DIR = low



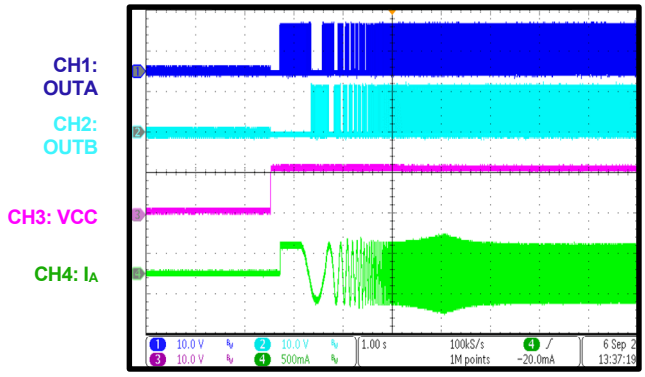

### Shutdown through VCC

VCC = 12V to 0V, PWM duty = 100%, DIR = low



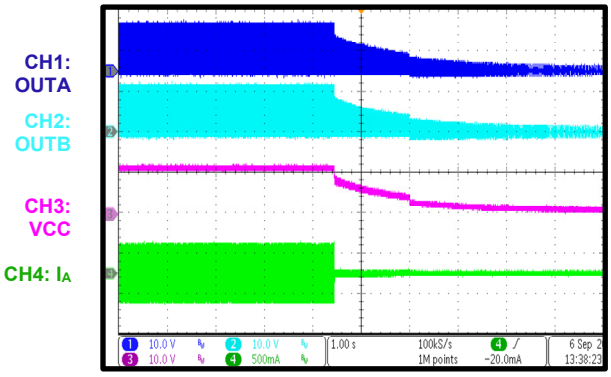

### Start-Up through VCC

VCC = 0V to 12V, PWM duty = 100%, DIR = high




### Shutdown through VCC

VCC = 12V to 0V, PWM duty = 100%, DIR = high

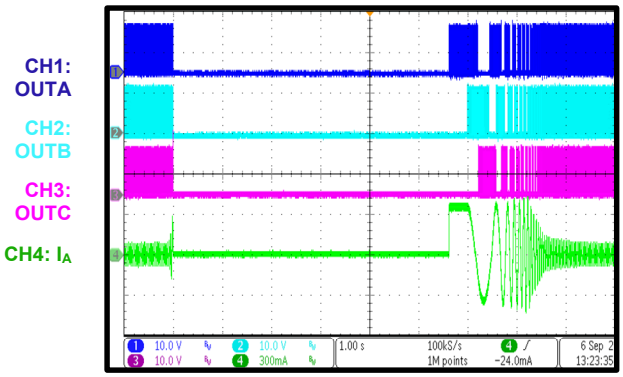


## EVB TEST RESULTS *(continued)*

**Performance waveforms are tested on the evaluation board. $V_{IN}$ = 12V, PWM input frequency = 100Hz, load = seat fan, unless otherwise noted.**

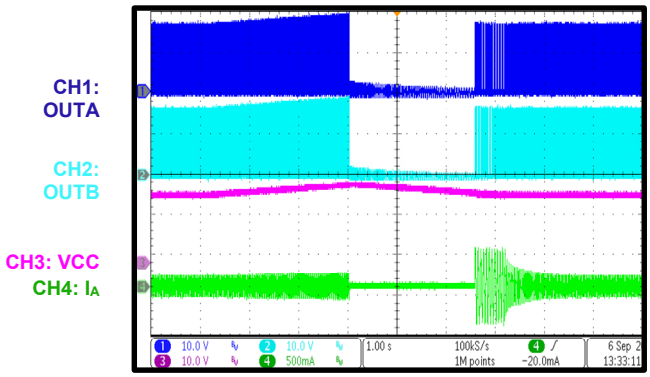
### Rotor Lock and Retry

PWM duty = 20%, enable RD_MODE1 and RD_MODE2



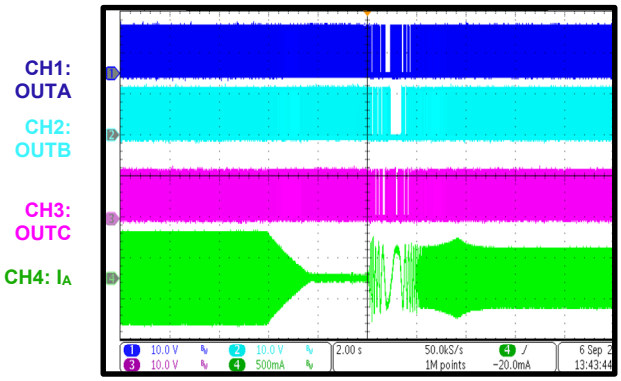

### Over-Voltage Protection

PWM duty = 20%, UIN_SEL = 0




### Direction Change

PWM duty = 100%, enable soft shutdown, DIR = low to high



## PCB LAYOUT

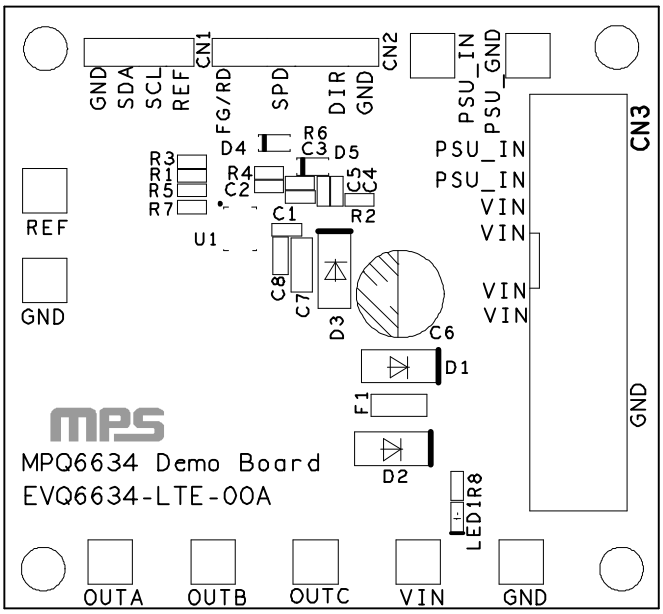



Figure 6: Top Silk

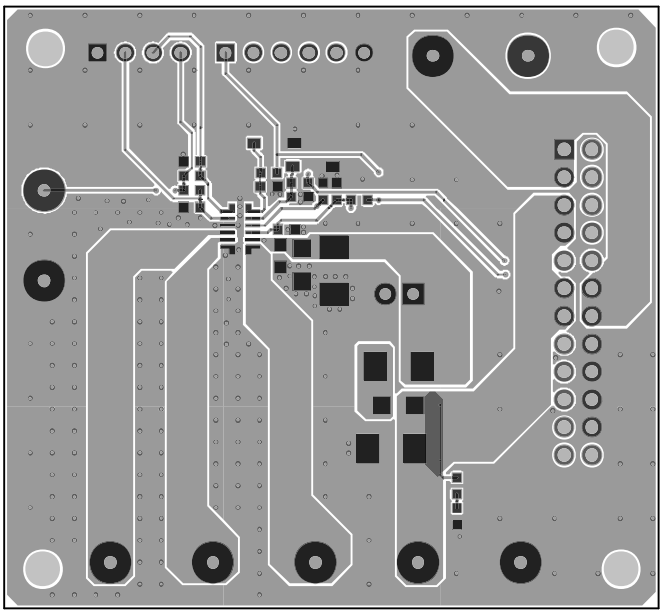


Figure 7: Top Layer

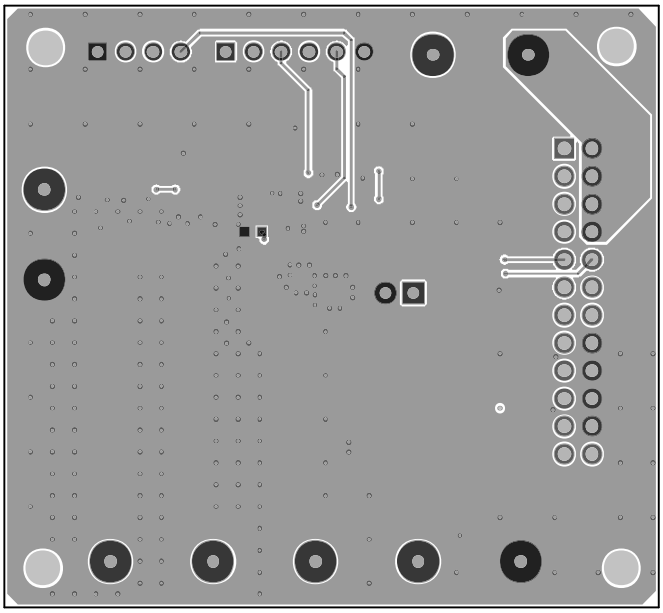


Figure 8: Bottom Layer

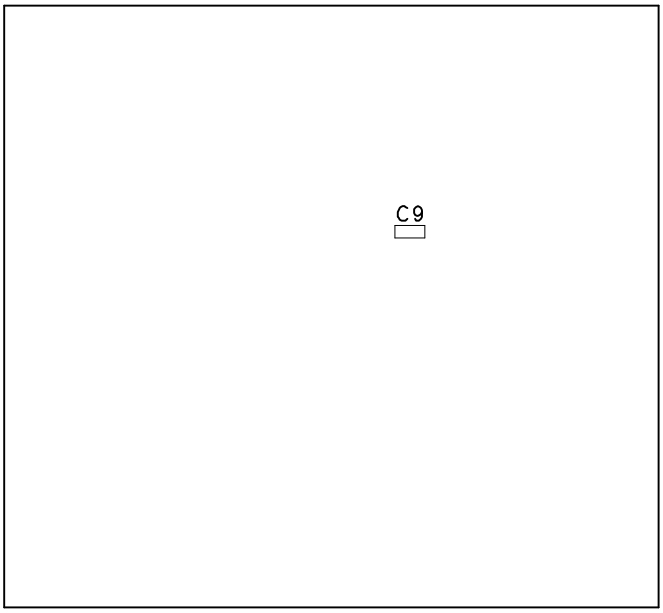



Figure 9: Bottom Silk

## REVISION HISTORY

| Revision # | Revision Date | Description | Pages Updated |
|---|---|---|---|
| 1.0 | 3/19/2024 | Initial Release | - |